

Follow-up opinion of the Specialist Forum on Annexure F

Annexure G

15th October, 2014

Contact person	Dr. Johan van der Waals
Tel:	082 570 1297
E-mail:	johan@terrasoil.co.za

To: Lizelle Gregory and Anè Agenbach
Bokamoso Landscape Architects & Environmental Consultants

SUMMARY OF FINDINGS: CONFIRMATORY INVESTIGATION – GRAVE SITES AND GRAVE DISTRIBUTION, LINKSFIELD SITE, GAUTENG PROVINCE

A dedicated report, dated 6th February 2014, was prepared by myself regarding the distribution of graves on the Linksfield site. The main findings were:

1. The occurrence of the graves were verified through the following procedures:
 - a. Interpretation of various historical aerial photographs.
 - b. Interpretation of the past decade's Google Earth images.
 - c. Dedicated consultation with a range of people that know the area and that pointed out the graves on the site.
 - d. Dedicated field investigation into the distribution of the graves.
 - e. Dedicated sampling and analysis of soils within and outside of the graveyards.
2. The graves on the site were situated in three dedicated gravesites namely two along Club Road and one on the banks and within the floodplain of the Jukskei River.
3. No signs were found of additional graves on the site and there was also no evidence found for an animal carcass disposal site.

Subsequent to the submission of the report I was presented with a rough map (**Figure 1**) indicating many additional potential grave areas. One of the potential gravesites was "confirmed" by a small business owner on the site. The new information prompted a revisiting of the site, re-interpretation of aerial photographs and the re-assessment of the above-mentioned report.

During the new and intensive investigation no additional sites were identified (other than those already reported upon in the above-mentioned report) as there is a distinct lack of empirical evidence in the form of gravestones, grave related soil disturbance or even signs on historical aerial photographs. The results of the interpretation of the aerial photograph are provided in **Figure 2**.

Additionally, during a site visit on the 14th of October 2014 it was evident that a large section along Club Road that had been indicated as a gravesite was actually a Rand Water pipeline servitude. This was evident in the clearing of rubble that had taken place on said date (**Figures 3 and 4**) with a dedicated soil investigation yielding only disturbances related to the original pipeline burial footprint.

624 Whippet Street
Garsfontein
Pretoria

P.O. Box 40568
Garsfontein
0060

Tel: (012) 993 0969
Fax: 086 274 6653



Figure 1 Anecdotal information provided to JH van der Waals regarding distribution of grave sites

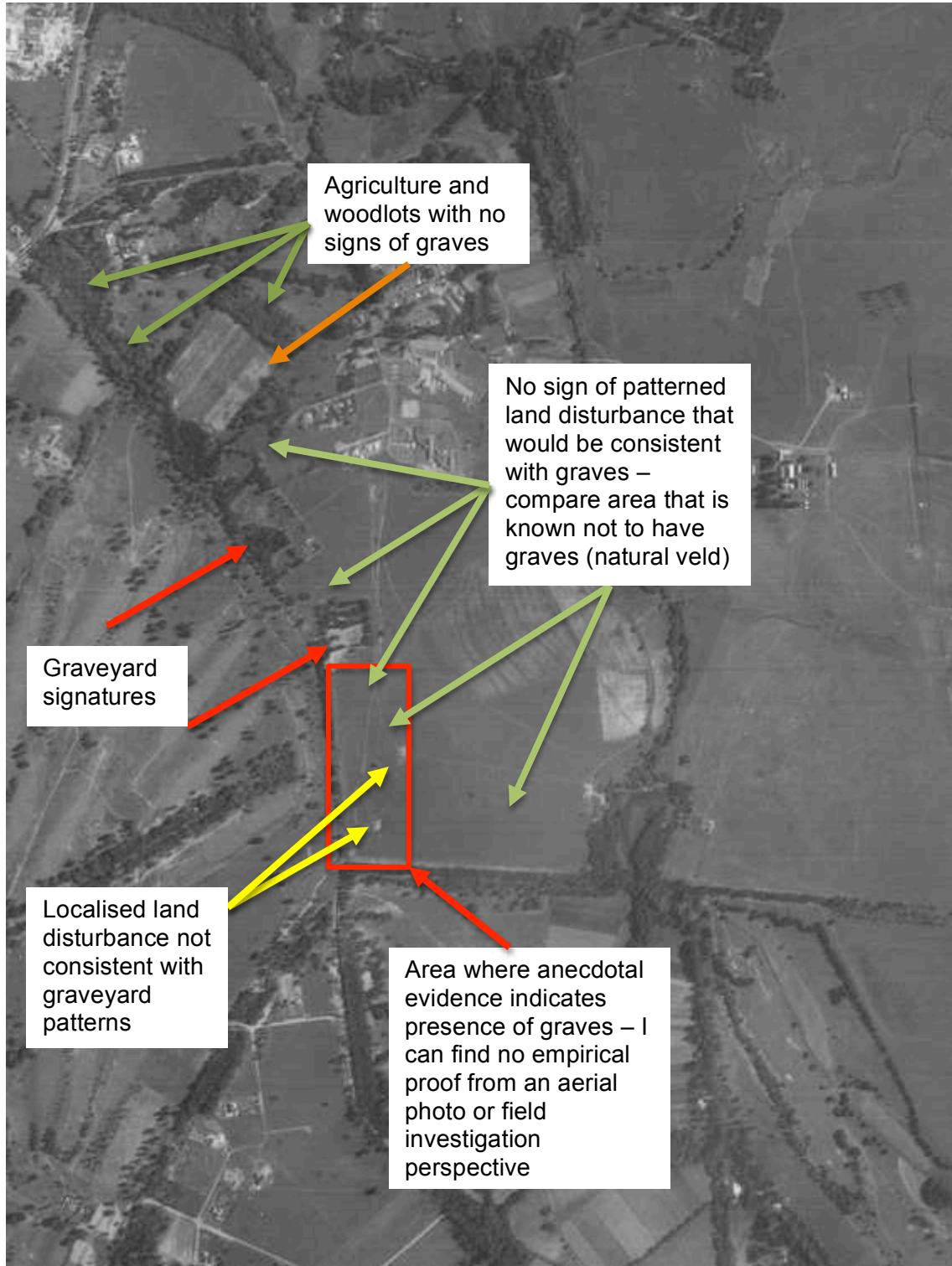


Figure 2 Aerial photograph from 1952

624 Whippet Street
Garsfontein
Pretoria

P.O. Box 40568
Garsfontein
0060

Tel: (012) 993 0969
Fax: 086 274 6653



Figure 3 Cleared ground (rubble) with Rand Water pipeline markers



Figure 4 Cleared ground (rubble) with a TLB in the foreground

624 Whippet Street
Garsfontein
Pretoria

P.O. Box 40568
Garsfontein
0060

Tel: (012) 993 0969
Fax: 086 274 6653



The additional investigations did not yield any new information regarding additional graves and from an empirical evidence perspective I have no grounds for expanding the grave areas indicated in the report dated 6th February 2014. I am willing however to consider additional new information that may surface but it will have to be based on empirical evidence before I can amend the above-mentioned report to include such information.

I trust that the above provides a clear statement regarding the proof that currently exists for the identified grave areas as well as those areas that are considered to be devoid of graves.

Yours sincerely,

A handwritten signature in black ink, appearing to read "J.H. VAN DER WAALS".

(Signed electronically)
DR. J.H. VAN DER WAALS
Pr.Sci.Nat. (Soil Science)

J LOUIS VAN ROOY

Pr.Sci.Nat. PhD(Pret) FSAIEG MGSSA
Engineering Geologist

Report 1339/add/2

P O Box 36786

MENLOPARK
PRETORIA
SOUTH AFRICA
0102

 C - 083 2910938

louisvanrooy@mweb.co.za

BOKAMOSO
P O Box 11375
Maroelana
0161

9 October 2014

Att: A Agenbacht

ENGINEERING GEOLOGICAL INPUT INTO THE LINKSFIELD DEVELOPMENT

The Phase I Geotechnical Report (Report 1339 Van Rooy, 2014) on the proposed Linksfield Development in Johannesburg refers.

The geotechnical site investigation is undertaken to determine the:

1. Geological conditions;
2. Outcrop and soil cover;
3. Presence of groundwater, perched water tables, seepage areas

The guideline and specification documents by the SANS 643:2009, South African Institute of Engineering and Environmental Geologists and South African Institution for Civil Engineers (1997), the National Department of Housing (2002) and National Home Builders Registration Council (1999) are used during these investigations.

The results from the trial pits, soil profiles and soil laboratory testing indicate the following expected geotechnical constraints for this site:

- Collapsible soil
- Seasonal shallow groundwater: perched groundwater and surface seepage near the floodplain,
- Moderate erodability of surficial soils, and
- Localised difficulty of excavation to 1,5 m below surface.

General findings can be summarised as follows:

- General topography is dominated by the river and a small tributary flowing from the south-eastern corner joining the river in the central eastern part. The slopes are towards the river channel with slopes from 1 600 m in the south and north sloping down to 1540 m at stream level. Locally in the southeast the slopes are towards the smaller drainage channel.
- The north and north-eastern portion showed slightly voided profiles of transported and residual soils. Intermediate excavation is expected due to the refusal of the TLB within the upper 1.5 m of the profile, on weathered greenstone bedrock.

- The central portion of the site up to the river and its surrounding floodplain (including the hospital site) also had voided and pinholed residual greenstone profiles. Shallow perched groundwater levels are expected.
- The southern and south-western portion of the site adjacent to the site boundary is underlain by granitic bedrock. Closer to the floodplain boundary and drainage channels, seepage conditions with perched water tables of less than 1,5 m below ground surface is expected. These soils are also erodible.
- Localised portions in the north are covered by thick uncontrolled dumped materials of various origin. The underlying soils could not be investigated in this area.

The main objective of the geotechnical investigation was to determine the soil mechanical properties. During this investigation some of the 39 test pits were shared with the soil science specialist Dr Johan van der Waals. No evidence of any specific graves or other human or animal remains were found in any of the soil profiles described in the test pits.

The soil tests were executed to determine the soil mechanical properties and no biological or chemical tests were included in the geotechnical investigation. The greenstone bedrock area, making up the largest part of the site, is typically covered by greenstone rock boulders and most of the test pits refused within the upper 1,5 m or shallower. This is therefore not the best area to locate a cemetery. The deeper profiles on the granite bedrock zones to the south and west, that are already developed, may in general be more suitable as burial sites than the greenstone bedrock area.



J.L. van Rooy
Pr.Sci.Nat.

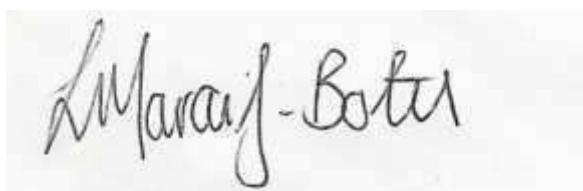
*Leonie Marais-Botes
868 Endeman Street
Wonderboom South
Pretoria
0084
Mobile: 082 576 6253
E-mail: leoniembotes@gmail.com*

BA (Cultural History and Archaeology) (UP), BA (Hons) Cultural History (UP), Post Grad Dip Museology (UP), Cert Conservation of Traditional Buildings (Univ of Canberra) Post Grad Dip: Heritage (Wits)

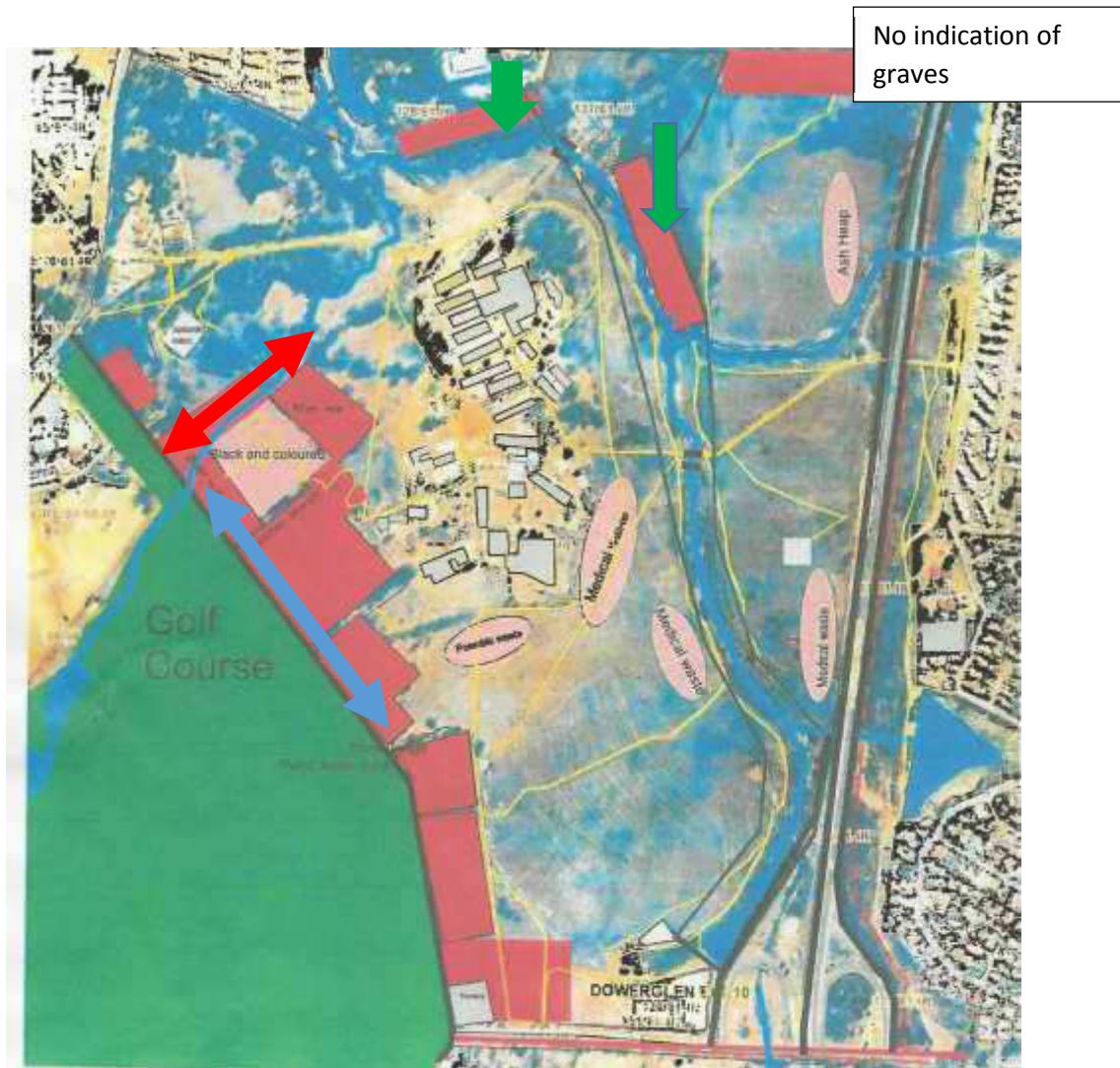
Professional member: SA Society for Cultural History (CH 0002)

POSSIBLE GRAVE SITES AS IDENTIFIED BY NAOMI DINUR

1. The writer was requested to investigate possible grave sites indicated on a map provided by an Interested and Affected Party, Naomi Dinur.
2. A site visit was conducted by myself on 12 September 2014. During this site visit I also met with the owner of the nursery, Mr Eben de Villiers.
3. I have found the following;
 - Along Club Road a linear excavation (ditch) was found. I investigated the material in the said excavation and could not find any evidence of skeletal material.
 - In the area indicated west of the stream an ESKOM power line runs, again if any skeletal material was imbedded here it would have been found during excavations for the pylons.
4. Mr Eben de Villiers indicated some areas next to the nursery as possible grave sites. It was very difficult to investigate the area as it was covered with rubble. The areas in which I could investigate the possible graves seem to be soil disturbances rather than graves.
5. Most of the "new"areas indicated on the map can be described as wetland areas and will not have been utilised for burials.
6. No indication of graves at site called "possible jewish section" or the most northern red block (near Edenvale Hospital)
7. The only grave sites I can confirm are those I indicated in my Phase 1 Heritage Impact Assessment (HIA) for the site.
8. Heritage Practitioners never rule out sub-surface discoveries. The procedure for sub-surface discoveries is set out in my Phase 1 Heritage Impact Assessment (HIA) Report.



Leonie Marais-Botes
2014-09-23



Red arrow: Eskom power

Blue arrow: Existing excavation (ditch)

Green arrows: Wetland areas

Correspondence: The Adler Museum

Annexure H

29/08/2008

Loura

To: Dept-AdlerMuseum-Curator@wits.ac.za
Cc: user1@bokamoso.net
Subject: THE OLD RIETFONTEIN HOSPITAL NOW KNOWN AS THE SIZWE HOSPITAL

Good day, *Poetelle Keens (Kurator)*
011 717 2067 ext 81

A few months ago our Company spoke to someone at the museum in connection with the above mentioned Hospital, its origin, history and especially the gravesites. Unfortunately we could obtain no information related to the above from your side at that time.

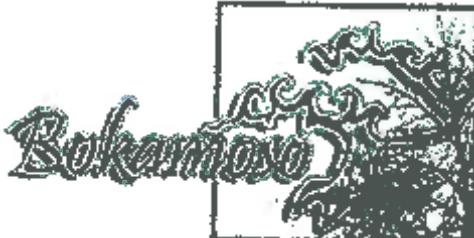
Could you maybe provide us with any information with the above mentioned Hospital and especially any information regarding to the gravesites and the Jewish gravesite. We are Independent Environmental Consultants appointed to do all the investigations related to the environmental issues.

It would be much appreciated if you could confirm your willingness regarding this information and receipt of this e-mail as well.

Kind regards,

*Loura du Toit (on behalf of Anè Agenbach - Senior Editor/ Manager)
Personal Assistant to Anè Agenbach*

THE AD
MUSE



09/05/2014
User1

Mrs Rochelle Kee ne

From: Bokamoso <lizelleg@mweb.co.za>
Sent: Friday, May 09, 2014 9:54 AM
To: user1@bokamoso.net
Subject: FW: RE: Rietfontein records

From: Henriette VanHeerden [mailto:Henriette.VanHeerden@up.ac.za]
Sent: 09 May 2014 09:49 AM
To: leoniembotes@gmail.com; lizelleg@mweb.co.za
Cc: Johan van der Waals
Subject: Fwd: RE: Rietfontein records

Goeie dag

Ek het Adler Museum weer gekontak en die kurator het vir iemand gevra by NICD vir rekord en sy sal dit opvolg. Sal haar weer volgende week weer email as sy nie terugkom na my toe nie

Groete
Henriette

Henriette van Heerden (Ph.D)
University of Pretoria
Faculty of Veterinary Science
Paraclinical Building Room 2-11
Onderstepoort Campus
Private Bag X04
Onderstepoort 0110
South Africa
Tel +27 12 5298265
Fax + 27 12 5298312
Fax 086 6590239
Cell 072 0193868
Email: Henriette.vanheerden@up.ac.za

>>> #Dept-Adler Museum-Curator <Dept-AdlerMuseum-Curator@wits.ac.za> 2014/05/08 06:10 PM >>>

Mrs Rochelle Kee ne
011 717 2067(8)

Dear Henriette

I do remember responding to your email and forwarding it to relevant people who may be able to assist you. I will look through my emails tomorrow to see if I have kept my response and referrals. If I recall correctly this was quite a while ago. If I do not find it, I will put you in touch with people at the NICD Rietfontein who may be able to assist. The Adler Museum does not have records about the graves.

Loura

Rietfontein Jan m,
1895 600 Ha / Mr Dicsey

From: Bokamoso <lizelleg@mweb.co.za>
Sent: Tuesday, September 02, 2014 11:16 AM
To: user9@bokamoso.net
Cc: user1@bokamoso.net
Subject: FW: LINKSFIELD:

From: #Dept-Adler Museum-Curator [mailto:Dept-AdlerMuseum-Curator@wits.ac.za]
Sent: 02 September 2014 10:51 AM
To: Bokamoso
Subject: RE: LINKSFIELD:

Dear Loura

I am afraid we do not have the contact details for Ms van Staden. We do not have any further information regarding the gravesites at Rietfontein Hospital other than what I sent you.

Perhaps contact Naomi Dinur on mobile: 082496111 and Henriette van Heerden 012 5298265 who are also both doing research on this particular site.

I hope that this information helps.

Kind regards
Cheryl

Adler Museum of Medicine:
7 York Road
Parktown 2193
Telephone: 011 717-2067/81
Fax: 086 5532483
www.wits.ac.za/health/adlermuseum



From: Bokamoso [mailto:lizelleg@mweb.co.za]
Sent: 02 September 2014 10:38 AM
To: #Dept-Adler Museum-Curator
Cc: user1@bokamoso.net
Subject: LINKSFIELD:

RE: THE OLD RIETFONTEIN HOSPITAL NOW KNOWN AS THE SIZWE HOSPITAL:

Good day MS Keene,

Our previous e-mail of the 29th August refers. We are independent Environmental Consultants appointed to do all the investigations related to the environmental issues regarding this site.

Could you maybe provide us with the contact details of MS Elizma van Staden the previous ECO of the Sizwe Hospital, the old Rietfontein Hospital? It would also be much appreciated if you can provide us with any information related to the gravesites and especially the Jewish gravesite.

Kindly confirm your willingness regarding this information and receipt of this e-mail.

Kind regards,

Loura du Toit (on behalf of Ané Agenbach - Senior ECO/ Manager)
Personal Assistant to Ané Agenbach



T: (+27)12 346 3810 | F: (+27) 86 570 5659 | E: lizelleg@mweb.co.za | www.bokamoso.biz
36 Lebombo Street, Ashlea Gardens, Pretoria | P.O. Box 11375 Maroelaana 0161

This communication is intended for the addressee only. It is confidential. If you have received this communication in error, please notify us immediately and destroy the original message. You may not copy or disseminate this communication without the permission of the University. Only authorised signatories are competent to enter into agreements on behalf of the University and recipients are thus advised that the content of this message may not be legally binding on the University and may contain the personal views and opinions of the author, which are not necessarily the views and opinions of The University of the Witwatersrand, Johannesburg. All agreements between the University and outside parties are subject to South African Law unless the University agrees in writing to the contrary.

From: Bokamoso <ilzelleg@mweb.co.za>
Sent: Tuesday, September 02, 2014 11:39 AM
To: user9@bokamoso.net
Cc: user1@bokamoso.net
Subject: Fw: newspaper article 2010

From: #Dept-Adler Museum-Curator [mailto:Dept-AdlerMuseum-Curator@wits.ac.za]
Sent: 02 September 2014 11:13 AM
To: ilzelleg@mweb.co.za
Subject: newspaper article 2010

26 Aug. 2010

Sizwe Hospital Cemetery - Bedfordview & Edenvale News article

August 26, 2010 at 8:59am

Below is the article which appeared in the NEWS yesterday. Any further information on the history of the cemetery would be great. I think it is incredibly interesting.

ARTICLE

A few broken graves is all that remains of the Sizwe Hospital Cemetery. There is thought to be some 7 000 people buried in the cemetery but after years of neglect, a handful of broken graves is all that is left. The area holds more than 100 years of Edenvale's rich and diverse history. Sizwe Hospital, formerly known as Rietfontein Hospital, has been treating the ill of Johannesburg for the past 115 years. Sizwe Hospital was established to treat diseases such as the plague, smallpox, leprosy and TB. After having treated its last smallpox case in 1965, Sizwe Hospital was treating tropical diseases and in 1995 the hospital's name was changed to the Sizwe Tropical Disease Hospital. Sizwe is the only tropical disease hospital south of the Sahara. Mrs Dianne Rodrigues and her mother, Elma Rohlandt, first noticed the graves along Club Street after the long grass in the area was burnt about three months ago. "At first we only saw one grave, but after driving past the area several times we started to see more and more of the graves," Mrs Rodrigues said. The NEWS joined Mrs Rodrigues on Tuesday last week on a visit to the area. Crossing over piles of building rubble which has been left at the side of Club Street lies around 1km of open land scattered with broken headstones and unmarked mounds of stones. Only a small number of the grave sites are still in good condition while others have deteriorated after years of exposure to the elements. Over much of the land there is no evidence of the graves which once could have covered the entire area. "It feels like going back to the stone age, there are possibly hundreds of graves we cannot see," Mrs Rodrigues said. Ms Nomasa Vilikazi, who was walking through the area, told the NEWS that she was once told that the graves belonged to patients of the hospital. "This is sad and scary. Where are the families of these people?" Mrs Rodrigues asked. "It was only when the grass had burnt that we noticed the graves," she added. Around 2 200 patients placed into three camps in Johannesburg were treated for smallpox in 1893. The residents of Johannesburg at that stage were unhappy about the close proximity of the camps to the growing city. Transvaal Republican Government bought the farm Rietfontein, of 750 morgen (around 700 hectares) in 1895 from a Mr Keiser. The farm was considered sufficiently far away from the centre of the town, around 30km from the CBD. Today only 320 hectares of the original farm remains. N3 in the East, now containing

Marais Steyn Park and Dowerglen, is one of the boundaries of the farm while Modderfontein Road marks another boundary. The first superintendent of the hospital, Dr John Max Mehliss, was appointed to the hospital in 1895. Dr Mehliss was at the hospital until his death in 1927, at the age of 59. His tombstone, originally in the hospital's large unkempt cemetery, was moved, together with those of Matron Mary Middler and nurse Emily Blake to the front of the administration block. Nurse Blake contracted the plague after kissing a child good night and died at the age of 27. It is believed that some 7 000 victims of smallpox, leprosy, plague and syphilis were buried in the cemetery, divided into black, white and Jewish sections. In 1897 a leper asylum was built in the top Northeast corner of the farm, consisting of wood and iron structures, surrounded by a 12-foot iron fence, and patrolled by armed guards. In 1900 the patients were moved to Westfort Hospital in Pretoria. In 1904 the plague broke out in Johannesburg and more than 1 000 patients were treated at Sizwe Hospital. Those who died were buried in a separate plague cemetery in the grounds, in graves demarcated only by numbers. In 1939 another outbreak of smallpox hit Johannesburg. Patients were dying at the rate of 20-30 a day. As a precaution against the disease lingering, quick lime was poured into the graves. Today the large cemetery is in a state of disrepair, with gravestones toppled or removed and metal numbers scattered or stolen. The leprosy and Jewish cemeteries have not been located and the hospital's burial register has been missing for years. Mr Peter Moss, from the Genealogical Society of South Africa's (GSSA) Cemetery Recording Project, told the NEWS that the main cemetery at Sizwe was recorded in 1990 by the South East Wits Family History Society, and updated in 1998. "There are 33 headstones, one of which is for Nurse Blake who died after contracting a dreaded disease from one of her patients. "This headstone is not in the main cemetery, but as we understand placed in a position of honour in front of the main offices," Mr Moss said. "We have not located the Plague Cemetery," he added. "We did try to locate the burial register, but were told that it had been lost in a fire," Moss said. He added that the society is concerned about the poor condition of cemeteries throughout South Africa. "We can unfortunately not do much about the physical care, but do at least aim to record the data for posterity," he said. Residents who may have more information on the hospital's history or the history of the cemetery can contact Charmaine Slator on 011 453-2220 or via e-mail at cslater@caxton.co.za

Adler Museum of Medicine
7 York Road
Parktown 2193
Telephone: 011 717-2067/81
Fax: 086 5532483
www.wits.ac.za/health/adlermuseum



Adler Museum of Medicine
Faculty of Health Sciences
University of the Witwatersrand
Johannesburg

From: Bokamoso [<mailto:lizelleg@mweb.co.za>]
Sent: 02 September 2014 10:38 AM
To: #Dept-Adler Museum-Curator
Cc: user1@bokamoso.net
Subject: LINKSFIELD:

RE: THE OLD RIETFONTEIN HOSPITAL NOW KNOWN AS THE SIZWE HOSPITAL:

Good day MS Keene,

Our previous e-mail of the 29th August refers. We are independent Environmental Consultants appointed to do all the investigations related to the environmental issues regarding this site.

Could you maybe provide us with the contact details of MS Elizma van Staden the previous ECO of the Sizwe Hospital, the old Rietfontein Hospital? It would also be much appreciated if you can provide us with any information related to the gravesites and especially the Jewish gravesite.

Rietfontein Hospital

Cyril Adler
Director: Afrikaans Museum

Rietfontein Hospital was originally established in 1893 as a Lazaretto for the increasing number of smallpox cases occurring in Johannesburg and on the Reef.

A history of its existence indicates that it was not built as a general isolation hospital and the treatment of infectious diseases such as measles, scarlet fever and diphtheria was never included. The story goes that in 1893, a man called Hunter, the valet of an English nobleman, who was staying at a local hotel contracted smallpox, the first victim of the subsequent epidemic. As no other accommodation was available at that time he was placed in a tent in Hospital Hill where the Fort now stands. More cases of smallpox developed and a camp, under the charge of a medical man, consisting of tents and wood and iron houses, was provided. A Sanitary Board responsible for its management was constituted under the name of "Kinder-pokken Komitee".

Apart from the camp, or lazaretto, in Hospital Hill there existed two other lazarettos in the vicinity of Johannesburg — in the Grootvlei Estate and in Lindeparkvallei. These lazarettos handled 2215 patients in 1893. Following protests lodged against the proximity of the smallpox camp to the town and continuous demands from the town for a properly designed institution, all the lazarettos were moved to the farm, Rietfontein.

Rietfontein, 600 Ha in extent, was bought by the Transvaal Republican Government in 1895 from a Mr Kleser. It was chosen because it was "a day's march" from the centre of Johannesburg which was considered a safe distance for the isolation of smallpox. After the epidemic had abated the medical man was discharged from the Rietfontein Lazaretto and Mr Hunter, who had recovered from smallpox, remained in charge. This lazaretto was still being run by the exiled "Kinder-pokken Komitee".

In 1895 the government decided to take over the smallpox lazaretto in Rietfontein and appointed a new committee, responsible to the government directly, to deal with infectious diseases such as smallpox, leprosy and syphilis. This committee was called the "Spesiale Komitee van Gezondheid" and its first duty was to appoint a qualified medical man instead of a lay-man to be in charge of the hospital. More sanitary and comfortable buildings were erected to replace the old structures which had been of a temporary nature. The oldest buildings, constructed of wood and iron, were reputedly used as barracks for British troops during the Anglo-Boer War.

In 1898 additional accommodation was provided at Rietfontein for patients suffering from venereal diseases and, as Johannesburg grew in population, it became necessary to isolate infectious diseases such as measles and scarlet fever. No other facilities being available it was decided to use Rietfontein for this purpose and what started as a lazaretto now became known as Rietfontein Hospital, for blacks as well as whites. All mine workers were examined regularly by their medical officers to detect leprosy or syphilis as were the inhabitants of the Chinese and Indian "locations". In addition the "Komitee van Gezondheid" successfully fought the epidemics of smallpox and revaccinated the whole of the Witwatersrand population, both white and black, free of charge. At one time the whole population of Johannesburg was vaccinated within four days; every available medical man was engaged by the committee for that purpose.



Fig. 1 Dr. J. M. Mehlliss in medical regalia

DR. JOHN MAX MEHLISS (Fig. 1)

Dr. John Max Mehlliss was appointed in charge when the Riefontein Lazaretto, at that time a collection of ten shanties, was opened in 1895. The following year he became the first full-time medical superintendent, journeying to Riefontein daily until 1900, when he became resident in a spacious house situated about one kilometre west of the lazaretto. During his long term at what subsequently became known as Riefontein Hospital after additional accommodation for other diseases was provided, Dr. Mehlliss gained unique experience in smallpox, plague and venereal illnesses and was considered the leading authority on these diseases in the country (Fig. 2).

John Max Mehlliss was born in Grahamstown in 1866 and was educated in King William's Town where he proved to be an outstanding athlete. He matriculated at the age of fifteen years and was then sent to study at the Universities of Munich and Göttingen in Germany. He graduated top of the whole country and was personally congratulated by Bismarck, the Iron Chancellor, who was a third cousin to Otto Mehlliss, father of Dr. John Max Mehlliss.

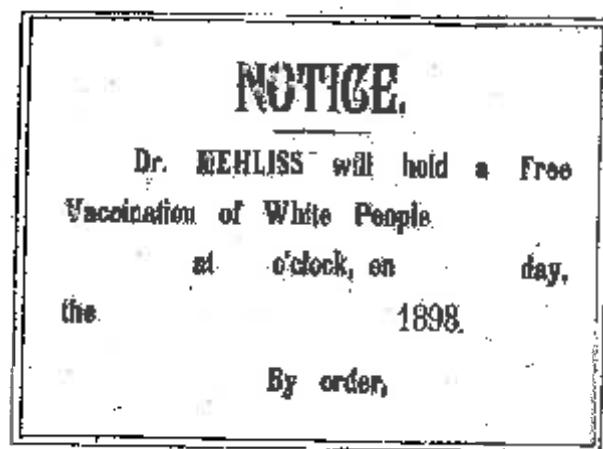


Fig. 2

Dr Mehliss returned to Johannesburg in 1893 and it is believed that he was in private practice on the Witwatersrand. His first official appointment, until he was put in charge of Rietfontein Hospital, was as District Surgeon in Krugersdorp. As a student in Germany, Mehliss had worked with Paul Ehrlich on the development of Salvarsan or "606", considered to be the wonder drug in the treatment of syphilis. When venereal diseases were added to the list of diseases being treated at Rietfontein Hospital, Mehliss applied for a licence to import Salvarsan. Actually this drug was being supplied by Ehrlich for experimental purposes and was used by Mehliss in 1905 before it was publicised. With Salvarsan the fame of Rietfontein Hospital spread and queues at the clinic increased. The hospital became known as "Meylie's", a mispronounced tribute to a great doctor.

Dr Mehliss died in 1927 at the age of 59 years in the Johannesburg General Hospital after suffering a stroke which left him partially paralysed. He was buried at his own request in a simple coffin in one of the hospital cemeteries in Rietfontein (Fig. 3). At his simple funeral the plain coffin was draped with the Union Jack and the Vandaag. His battle against smallpox and venereal diseases earned for him a name of international significance.

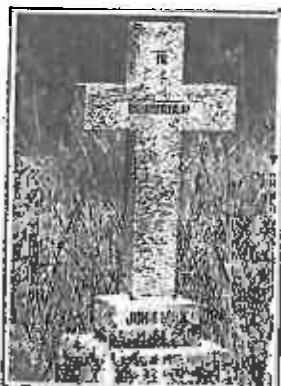


Fig. 3 Grave of Dr Mehliss, half covered in grass and weeds in the forgotten graveyard in the hospital grounds.

In 1904 plague broke out in Johannesburg and a camp was established at Rietfontein where more than 1000 patients were treated. Those who died were buried in a separate plague cemetery. One of the tragic victims was nurse Emily Blake who cared for plague patients and succumbed to the disease on 30 March 1904. She was buried in grave number 218 at the Rietfontein plague camp. Yet another forgotten grave in Rietfontein is that of Matron Mary Middler who gave devoted service to the Rietfontein Hospital for nineteen years (Fig. 4).



Fig. 4 Grave of Matron Mary Middler

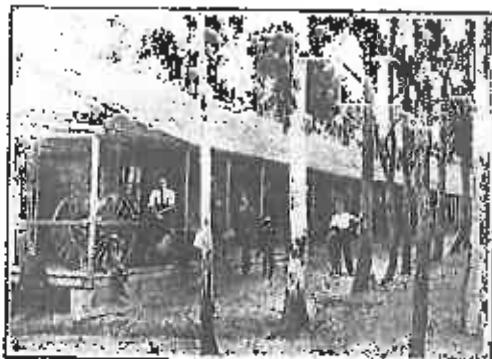


Fig. 3 Part of Rietfontein Hospital in 1911

RIEFONTEN HOSPITAL, 1905 ONWARDS (Fig. 5)

Conditions which existed at Rietfontein Hospital, despite its very real service to the community, were far from satisfactory and serious complaints were made concerning the inadequate accommodation, the structurally defective buildings and the lack of electric lights.

In 1909 questions were raised in parliament on the fire hazard which existed because of the use of paraffin lamps instead of electric lighting. The Colonial Secretary indicated that the question of installing electric lights had received careful consideration but the expense would be greater than the value of the existing buildings and the government had decided to postpone the expenditure on electric lighting until it could see its way clear to erect new buildings for the hospital.²⁴

However, the protests gained momentum and the newspapers began to give the Rietfontein institution negative publicity. The *Pretoria News*, 24 June 1911, stated that Rietfontein hospital was becoming known as "the hell on earth". It further continued: "Besides the hundreds of persons who are treated there for venereal diseases of the worst kind, there are in the institution about 100 whites of all nationalities who with the motto 'all hope abandon ye that enter here', have been carried inside. Their diseases are incurable, they are confined to their beds or to their chairs until their bodies are carried to the grave. Most of them cannot move... their treatment is excellent... but their lodgings — galvanised iron shanties — are shocking compared with the aristocratic housing of Dr Theiler's horses and mules in Onderstepoort. There prevails a worse state of affairs still. The buildings, in which those helpless human wrecks are lying, are lighted by paraffin lamps. Three times already has there been an outbreak of fire which luckily was checked in the beginning, otherwise those patients would have been burnt alive. Several times has the Transvaal Government been asked for an electric installation costing a few hundred pounds — without success, however. Dr Theiler's horses and mules, again, have electric lights in their 'rooms'. Can the Administration deny that such conditions rightly deserve the adjective 'shocking'?"²⁵

The Reverent Bustace Hill, English Church Priest, visited Rietfontein as the English Church Chaplain and his views were expressed fervently in a letter published in the *Draeveld Leader*, dated 20 September 1911. The letter had the desired effect and apart from an article in the newspaper which accompanied the published letter, an independent inspection of Rietfontein Hospital by a representative of *The Leader* was undertaken. His report was published under the heading "Disgraceful state of affairs and a new Scandal found" (*The Leader* 20 October 1911). In it he stated that he was received most courteously by the staff who placed the fullest facilities for seeing the building and general arrangements at his disposal. Everything and every place were thrown open to his inspection. His opinion was that if Mr Hill, in his letter, called the lazaretto a public disgrace it was too mild a phrase. "It is a gross and intolerable scandal, a disgrace to the Government, and a reproach to the town. The buildings, generally speaking, have been said to be unsuitable. 'Unsuitable' isn't the word; they are outrageous."

The reporter mentioned the objectionable proximity both of the white male and female venereal wards and of the black male and female wards. According to him this posed a danger not only to the spread of infection but also to morals. While he praised the work of Dr Mehlike and his dedicated staff he was appalled at the conditions in which they worked. "The need for improvement is crying", he concluded, "...whatever the cost, the present state of affairs should not be allowed to continue." (Fig. 6).

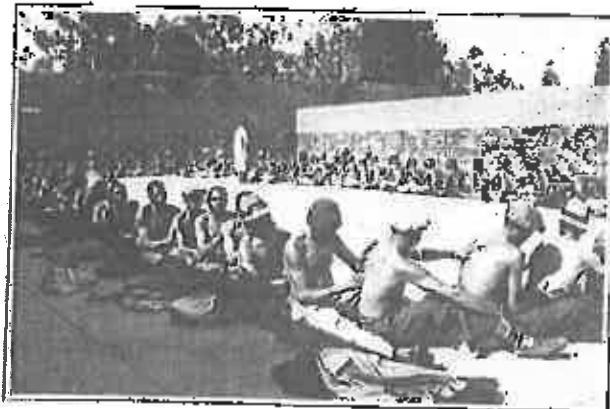


Fig. 6 Treatment of patients by naked application of mercury

The storm of criticism was brought to a head following the sad death of a little boy who had been taken to the institution with measles and then contracted scarlet fever from which he died. As a result the mayor of Johannesburg was requested to summon a public meeting in order that the prevailing conditions at the lazaretto and the urgent need for radical reform might be discussed. (Fig. 7).

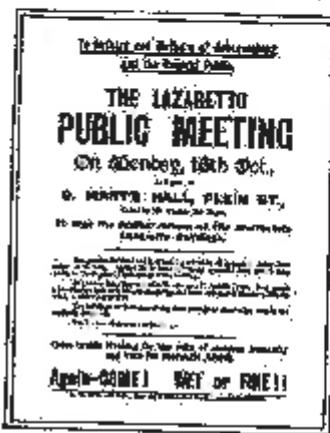


Fig. 7 Notice advertising meeting, started on 12 October 1911

The meeting was held on 16 October 1911 and the resolution taken read as follows:

"This meeting of the citizens of Johannesburg strongly condemns the conditions of the Lazaretto and calls upon the Government to take immediate steps to remedy the present state of affairs."

In all the criticism levelled at the lazaretto no reflection was ever cast upon the work of Dr Mehlike and his helpers. Everybody was full of praise for the work of the staff. This was the case amongst the patients as well and *The Leader* man reported that one of the patients had asked him to mention that the patients one and all wished to express their gratitude to Dr Mehlike and his assistants for their unceasing attention and kindness towards their charges (Fig. 8).



Fig. 8 Dr John Max Mehliss (centre) and staff

After continuous agitation for over six years by Dr Mehliss and the public of Johannesburg, the government agreed to install electric lighting of a permanent nature. This was completed in 1914 but it was not until 1921 that additional accommodation was provided and a complete new lay-out decided upon.

Further extensions to the Rietfontein Hospital came about when a hospital for formidable epidemic diseases was built in 1923, including an infectious disease section for blacks, which was opened in 1926, and the sprawling complex of buildings now included an operating theatre and an X-ray department.

In 1939 there was a major epidemic of smallpox and two wards were added and enclosed from the rest of the complex. These still proved inadequate and tents were erected. Patients were dying at the rate of 20 to 30 a day and eight grave diggers were kept fully employed. One day during the epidemic Jan Christiaan Steyn's role in nocking on his bicycle through the hospital gates and past the yellow flag, intent on collecting botanical specimens. He was arrested by the gate keeper, Mr Matthysen, and taken to be forcibly vaccinated.

Over the years a portion of the Rietfontein farm on which the hospital was originally situated, was excised for the building of the present Edenvale Hospital. Later further tracts of ground were made available for the Poliomyelitis Research Foundation (now the National Institute for Virology), and adjacent to the town of Edenvale a hostel and school for the care of juvenile delinquents, Norman House. In 1981 a further portion of the grounds was excised for the building of an institution for the rehabilitation of alcoholics. Future plans include a large psychiatric institution in the south-western area, near Bedfordview, and the rebuilding of Rietfontein Hospital itself.

After the Johannesburg Fever Hospital was closed at the end of 1978 Rietfontein Hospital provided facilities for all infectious diseases in whites and, at the same time, high-security isolation facilities were provided for highly infectious haemorrhagic virus diseases such as Congo-Crimerian Haemorrhagic Fever, Marburg Virus Disease, Bola Virus Disease and Lassa Fever.

The hospital has approximately 600 beds and serves as a referral centre for the Transvaal and further afield for suspected cases of pulmonary tuberculosis in whom the diagnosis of the disease has not been confirmed by bacteriological examination of sputum, and undertakes further investigations such as bronchoscopy and bronchography, lung, pleural and mediastinal lymph biopsies and serological and bacteriological diagnosis of other infections. Resection of lobes and lungs damaged by tuberculosis is also regularly performed. As a consequence of the diagnostic facilities provided a wide spectrum of interesting non-tuberculous pulmonary conditions is seen by the hospital.

From its small and primitive beginnings in 1895 this unit has grown to become the only one of its kind in Africa and one of the very few in the world which provides specialised diagnostic and treatment facilities, and it now enjoys a recognised international reputation.

The following persons have been Medical Superintendents of Rietfontein Hospital:

Dr J M Mehliss (1896-1927)	Dr F J Bozman (1968-1974)
Dr J Dened (1927-1944)	Dr J M Tobias (1974-1977)
Dr J Loots (1944-1956)	Dr T P B Collins (1977-1981)
Dr F J Wilks (1956-1961)	Dr G B Miller (1982-)
Dr P H Pieterse (1962-1967)	

362.19691(68225)
Sizwe Tropical Disease
Hospital

Forgotten history

Sandy Sher

THE controversy surrounding the ground around Sizwe Tropical Diseases Hospital (previously Rietfontein) continues unabated with residents in the area greatly concerned about the appalling state of the land. The leased area surrounding the hospital belongs to the Gauteng Health Department.

Although Sizwe was named as a tropical diseases hospital, its profile has changed dramatically and it is now designated for the treatment of TB with complications - many of them being HIV/AIDS related. According to Chief Executive Officer of Sizwe, Elizma van Staden, for the past 20 to 25 years no anthrax, Ebola fever etc has been treated at Sizwe. Hantorrhagia fevers are treated at Johannesburg Hospital, said Van Staden.

The neglect of the grave sites on the land has been ongoing for many years and is certainly not looking any better than it did when many decades ago people started questioning the existence of the graves. According to history, five grave sites are in existence on the land, but only three have been identified. It is believed about 7000 people have been buried at Sizwe, the last one apparently in 1952.

The incredibly sad thing is that there are no registers to confirm the bodies. Most of the graves can't even be identified as such and there is only a small percentage of tombstones still standing, many of them badly damaged.

Van Staden said: "There were never hundreds of tombstones, and to my knowledge, and what I have personally observed, tombstones have not been removed to recent times. I have been involved with Sizwe since 1978 and although I don't visit the cemetery on a frequent basis, the only obvious thing I have noted is the existing tombstones are badly cracked and damaged. I think this has occurred through normal wear and tear

1 Oct 2004 NEL TRIO



1 Oct 2004

Elizma van Staden, CEO of Sizwe Tropical Disease Hospital standing next to the grave of nurse Emily Blaauw (27) who died of bubonic plague in 1904.

and lack of maintenance - not through vandalism."

Van Staden said she has repeatedly requested maintenance of the property, but had been told there was no money or manpower available.

She emphatically stated borders needed to be fenced and permanent manpower established on the land. She was adamant building on the land could not be contemplated due to lack of knowledge on the location of graves.

Other problems regarding the land have cropped up. Burnt grass due to veld fires, dumping of rubble by the public and trees being chopped down.

Van Staden said the

trees were taken down by the Department of Water Affairs in line with their project of removing invader trees, such as bloukrans and black wattle.

Most of the trees have yet to be removed by the department.

The Tribune has experienced enormous difficulty in getting hold of anyone in provincial government for comment. However, we will continue the investigation in an attempt to obtain answers to our questions.

DWA

Correspondence Letters from GDARD

Annexure I



GAUTENG PROVINCE

AGRICULTURE AND RURAL DEVELOPMENT
REPUBLIC OF SOUTH AFRICA

FAX COVER

TO:	FROM:
Ms. Lizelle Gregory	Marc Leroy
COMPANY:	DATE:
Bokamoso Landscape Architects and Environmental Consultants cc	
FAX NUMBER:	TOTAL NO. OF PAGES, INCLUDING COVER:
(086) 570 - 5659	03
PHONE NUMBER:	TEL:
(011) 346 - 3810	(011) 240 - 3398
RE:	YOUR REFERENCE NUMBER:
RE LETTER PROPOSING AMENDMENTS TO THE SCOPING ACCEPTANCE: THE PROPOSED MIXED USE DEVELOPMENT SITUATED ON PORTIONS 87, 148, 149 AND THE REMAINDER OF PORTION 1 OF THE FARM RIETFONTEIN 61 IR, CITY OF JOHANNESBURG METROPOLITAN MUNICIPALITY	GAUT: 002/13-14 E0153

URGENT FOR REVIEW PLEASE COMMENT PLEASE REPLY PLEASE RECYCLE

CC: Gauteng Department of Local Government and Housing

Attn: Ms. Rethabile Nkosi

Tel: (011) 355 - 4205

Fax: (011) 355 - 4000

Impact Management - Johannesburg

Attn: Mr Marc Leroy

City of Johannesburg Metropolitan Municipality

Fax: (086) 620 7364

Attn: Ms. Lebo Molefe

Fax: (086) 627 7516



GAUTENG PROVINCE
AGRICULTURE AND RURAL DEVELOPMENT
REPUBLIC OF SOUTH AFRICA

Reference: Gaut 002/13-14/E0153
Enquiries: Marc Leroy
Telephone: (011) 240 - 3396
Email: Marc.Leroy@gauteng.gov.za

Bokamoso Landscape Architects & Environmental Consultants CC
P.O. Box 11375
Maroelana
0161

Attn: Lizelle Gregory
Fax no: (086) 570 - 5659
Tel no: (012) 346 - 3810

PER FACSIMILE / REGISTERED MAIL

Dear Madam,

RE: RESPONSE TO THE LETTER REQUESTING CHANGEE TO THE ACCEPTANCE OF THE SCOPING REPORT DATED 24 MAY 2014 FOR THE PROPOSED MIXED USE DEVELOPMENT SITUATED ON PORTIONS 87, 148, 149 AND THE REMAINDER OF PORTION 1 OF THE FARM RIETFONTEIN 61 IR, CITY OF JOHANNESBURG METROPOLITAN MUNICIPALITY

With regards to your letter received by the Department on 28 May 2014, the Department was asked to:

1. Approve the Peer Review team, and
2. Forgo the requirement of a Specialist Socio-economic Study as detailed in point 3.a. of the acceptance of the Scoping Report dated 24 April 2014.

The Department with respect to the above issues raised has decided on the following:

1. With regard to the peer review, the Department does not accept the proposal. The point of peer review is to get an independent assessment of the scientific validity of the studies being undertaken. Thus the medical/health specialist report must be sent for independent review by another BUT independent specialist. This therefore means that a member of your team who has conducted the specialist study cannot undertake the peer review. It is therefore recommended that experts within the field, but not on the team studying the impacts peer review the specialist reports.
2. The removal of the Socio-economic impact study is not supported as the study should not only be limited to health issues but must take into consideration all socio-economic impacts i.e. social, economic and environmental. Bokamoso may incorporate any existing information from other specialist reports into the study.

*Linksfield mixed use development: Portions 87, 148, 149 and the remainder of Portion 1 of Rietfontein
61IR, City of Johannesburg Metropolitan Municipality*

If you have any queries regarding the above, please do not hesitate to contact the official above.

Yours faithfully



Mr Loyiso Mkwana
Chief Director: Sustainable Use of Environment
Date: 07/07/2014

CC: Gauteng Department of Local Government and Housing

Attn: Ms. Rethabile Nkosi
Tel: (011) 355 - 4205
Fax: (011) 355 - 4000

GDARD Impact Management

Attn: Mr Marc Leroy
Fax: (086) 620 7364

City of Johannesburg Metropolitan Municipality

Attn: Ms. Lebo Molefe
Fax: (086) 627 7516

24/05/2014

User1

From: User1 <user1@bokamoso.net>
Sent: Saturday, May 24, 2014 2:20 PM
To: marc.leroy@gauteng.gov.za
Subject: Linksfield - 002/13-14/E0153
Attachments: SKMBT_C36014052414240.pdf

**RE: SCOPING REPORT ACCEPTED: THE PROPOSED MIXED USE DEVELOPMENT SITUATED ON PORTIONS 87, 148, 149 AND THE REMAINDER OF PORTION 1 OF THE FARM RIETFONTEIN 61 IR, CITY OF JOHANNESBURG METROPOLITAN MUNICIPALITY
GAUT REF NR. 002/13-14/E0153**

Dear Mark

Attached please find a letter for your attention.

Please do not hesitate to contact me or alternatively Mrs. Lizelle Gregory, the Owner of Bokamoso, should you have any other questions in this regard.

Kind regards,

Anè Agenbach

Senior Environmental Assessment Practitioner / Manager

Tel: 012-346 3810

Cell: 083 533 0420

Email: lizelleg@mweb.co.za (Attention: Anè)



Landscape Architects &
Environmental Consultants

T: (+27)12 346 3810 | F: (+27) 86 570 5659 | E: lizelleg@mweb.co.za | www.bokamoso.biz
36 Lebombo Street, Ashlea Gardens, Pretoria | P.O. Box 11375 Maroelana 0161

LEBOMBO GARDENS
BUILDING
36 LEBOMBO ROAD
ASHLEA GARDENS
P.O. BOX 11375
MAROELANA
0181

Tel: (012) 346 3810
Fax: 086 570 5659
E-mail: lizeleg@mweb.co.za
Website: www.Bokamoso.biz



**Gauteng Department of Agriculture
and Rural Development**

SUE Admin
Diamond Building
11 Diagonal Street
Johannesburg
2000

Tel: 011-240 3396

Email: marc.leroy@gauteng.gov.za

Attention: Mr. Marc Le Roy

24 May 2014

**LINKSFIELD PROPOSED MIXED USE DEVELOPMENT SITUATED ON PORTIONS 87, 148,
149, AND THE REMAINDER OF PORTION 1 OF THE FARM RIETFONTEIN 61 IR
GAUT REF NR. 002/13-14/E0153**

Your letter of approval dated (24 April 2014) for the Environmental Scoping Report Refers.

In Item/point 4 on pages 2 of 3 and 3 of 3 GDARD requests that the EIA compiled for the proposed mixed use development also be submitted to suitably qualified experts for a specialist review. Apparently the Anthrax issue raised concerns at the Department and GDARD requires specialist inputs in order to make an informed and responsible decision.

As Environmental consultants with many years experience in the conducting of Environmental Impact Assessments we had the same concerns and we therefore established (already early in

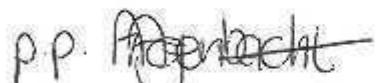
REG NO: CK 2010/087490/23
VAT REG NO: 4080260872

BOKAMOSO LANDSCAPE ARCHITECTS AND ENVIRONMENTAL CONSULTING CC

MEMBER: Lizelle Gregory

Please do not hesitate to contact Bokamoso should you have any further queries in this regard.

Kind regards,



Lizelle Gregory

Bokamoso Landscape Architects
and Environmental Consultants CC



GAUTENG PROVINCE
AGRICULTURE AND RURAL DEVELOPMENT
REPUBLIC OF SOUTH AFRICA

24/04/2014

FAX COVER

TO:	FROM:
Ms. Lizelle Gregory	Marc Leroy
COMPANY:	DATE:
Bokamoso Landscape Architects and Environmental Consultants cc.	
FAX NUMBER:	TOTAL NO. OF PAGES, INCLUDING COVER:
(086) 570 - 5659	04
PHONE NUMBER:	TEL:
(011) 346 - 3810	(011) 240 - 3396
RE:	YOUR REFERENCE NUMBER:
SCOPING REPORT ACCEPTED: THE PROPOSED MIXED USE DEVELOPMENT SITUATED ON PORTIONS 87, 148, 149 AND THE REMAINDER OF PORTION 1 OF THE FARM RIETFONTEIN 61 IR, CITY OF JOHANNESBURG METROPOLITAN MUNICIPALITY	GAUT: 002-13-14-E0153

URGENT FOR REVIEW PLEASE COMMENT PLEASE REPLY PLEASE RECYCLE

CC: Gauteng Department of Local Government and Housing

Impact Management – Johannesburg

City of Johannesburg Metropolitan Municipality

Attn: Ms. Rethabile Nkosi

Tel: (011) 355 - 4205

Fax: (011) 355 - 4000

Attn: Mr Marc Leroy

Fax: (086) 620 7364

Attn: Ms. Lebo Malefe

Fax: (086) 627 7516



Reference: Gaut 002/13-14/E0153
Enquiries: Marc Leroy
Telephone: (011) 240 - 3396
Email: Marc.Leroy@gauteng.gov.za

Bokamoso Landscape Architects & Environmental Consultants CC
P.O. Box 11375
Maroelana
0161

Attn: Lizelle Gregory
Fax no: (086) 570 - 5659
Tel no: (012) 346 - 3810

PER FACSIMILE / REGISTERED MAIL

Dear Madam,

SCOPING REPORT ACCEPTED: THE PROPOSED MIXED USE DEVELOPMENT SITUATED ON PORTIONS 87, 148, 149 AND THE REMAINDER OF PORTION 1 OF THE FARM RIETFONTEIN 61 IR, CITY OF JOHANNESBURG METROPOLITAN MUNICIPALITY

The scoping report and plan of study for environmental impact assessment which was submitted in respect of the above-mentioned application and received by the Department on 17 February 2014 has been accepted. You may accordingly proceed with undertaking the environmental impact assessment (EIA) in accordance with the tasks that are outlined in the plan of study for environmental impact assessment.

Notwithstanding the above, your attention is drawn to the requirements that must be addressed in the EIA Report which are not limited to the following:

1. General:

- a. Include information on past development applications for the property and provide adequate motivation on how the current proposal addresses the issues differently to the previous ones.
- b. Indicate what past activities that have been exercised on the land; in particular the contoured land in the southern open grassland of the site.
- c. Clearly indicate the types of activities planned for the commercial area of the proposed development and the environmental implications thereof (e.g. listing notice triggers).

- d. Fully investigate alternatives (including the no-go alternative, which is not shown in the Scoping Report) to the preferred alternative in terms of size, density and technology.
- e. Fully discuss the proposed development's compatibility with the local authorities' regional spatial development plan for the area.
- f. The methodology used for the impact assessment (Table 10 - page 76) needs to be clarified in the EIA. This table points to positive impacts on the Economic impact of Interested and Affected Parties (I&APs), yet the bulk of the I&APs economic concerns are around negative economic impacts (e.g. house prices). Please explain this.
- g. Append a feasibility study for the relocation of Sizwe Tropical Disease hospital.
- h. Append a detailed layout plan showing the different development areas taking into consideration existing sensitivities on the property (for example grasslands, listed plants etc).
- i. Append detailed drawings of proposed river crossings.
- j. Include delineation of a 1:100 year flood line and the relevant buffer zone where the flood line is unknown along the Perennial River and wetlands on the layout plan.

2. Public Participation Process:

Expand public participation process to include the following identified stakeholders:

- a. City of Johannesburg Metropolitan Municipality (inclusive of Environment, Town Planning and Health Sections).
- b. National Institute of Communicable Diseases.
- c. Sizwe Hospital Management.
- d. Department of Water Affairs.
- e. Gauteng Department of Health.
- f. Authorities/owners in charge of any servitude affecting the property.
- g. Authority in charge of providing required services to the proposed development including an indication that there is enough capacity to cater for the development including, but not limited to; Sewage treatment, electricity, refuse removal, water and road capacity.
- h. Include all I&AP comments submitted to the Department and forwarded to the applicant/EAP in terms of S57 of the regulations

3. Specialist Studies

- a. A socio-economic study, (with emphasis on adverse health impacts) that fully assesses the social consequences for the surrounding area must form part of the EIR investigations. The study must investigate; but not limited to the following:
 - i. Programs to minimize the possible negative health impacts of the proposed development to the immediate community during both construction and operational phases.
 - ii. The feasibility of the proposed development from a health impact perspective. This feasibility must include an investigation on potential and significant adverse microbiological impacts of the proposed activity.
- b. The specialist study for the identification of cemeteries must reconcile with the all records for graves on site, including those held by Sizwe-about 6000 patients reportedly buried on the site.

4. Appointment of an external specialist to review the assessment

- a. Having due regard to the provisions of section 24I of the NEMA, the Department has exercised its right to appoint external specialist reviewer(s) as the Department may not have the

- technical/specialist knowledge available to review the health/medical specialist reports to be submitted in this application. External specialist reviewer(s) will be appointed by the Department to undertake the review of health/medical specialist reports (not the entire EIR) at cost to the applicant.
- b. The applicant must within 14 days of receipt of the approval of SR indicate in writing and furnish to the Department commitment to pay invoices submitted to the applicant by the Department within 30 days of receipt of invoice.

5. Environmental Management Program

- a. A storm water management plan detailing the management of all surface runoff generated as a result of the development.
- b. Details of the intended sewerage treatment system which should include but not limited to the following: capacity (including of the receiving sewerage treatment plant), flow diagram, methods of handling sewage sludge, positioning, etc.
- c. A Waste Management Plan that includes the hierarchy of waste reduction, reuse, recovery and final disposal during construction and operational phase.
- d. The EMPr must include an operational risk plan for the potential need for disease management including during construction phase of the proposed development.
- e. Rehabilitation plan for wetland and river areas.

Please note that all specialist studies must comply with GDARD requirements for Biodiversity Assessments and Departmental Policies and Guidelines. A copy of this document can be obtained by e-mailing EIAADMIN@gauteng.gov.za

Notwithstanding the above, your attention is drawn to the fact that, due to the history of the development property, the Department will refer the EIA report to an external specialist reviewer (at your cost) in order to ascertain whether the information contained in the report is adequate for decision-making.

In addition to the above, your attention is drawn to the fact that the success of the application may be prejudiced by the potential impact of diseases on site and level of concern from the public.

Yours faithfully,

Mr. L. Mkwana

Acting Chief Director: Sustainable Use of Environment

Date: 24/04/2014

CC: Gauteng Department of Local Government and Housing

Attn: Ms. Rethabile Nkosi

Tel: (011) 355 - 4205

Fax: (011) 355 - 4000

Attn: Mr Marc Leroy

Fax: (086) 620 7364

Attn: Ms. Lebo Molefe

Fax: (086) 627 7516

GDARD Impact Management

City of Johannesburg Metropolitan Municipality

05/02/2014



agriculture and rural development

Department: Agriculture and Rural Development
GAUTENG PROVINCE

Diamond Building, 11 Diagonal Street, Johannesburg
P O Box 8769, Johannesburg, 2000

Telephone: (011) 240 2500
Fax: (011) 240 2700
Website: <http://www.gard.gpg.gov.za>

Reference:	Gaut 002/13-14/E0153
Enquiries:	Justine Chan
Telephone:	(011) 240 3048
Email:	Justine.Chan@gauteng.gov.za

Bokamoso Landscape Architects and Environmental

Email/Fax: lizelleg@mweb.co.za

Dear Sir / Madam

Draft Scoping Report : Linksfield Mixed Use Development

The Department acknowledges having received of the Draft Scoping Report for environmental authorisation of the above-mentioned project on 09/12/2013.

You are required to submit five (5) copies (3 full colour hard copies and 2 CDs-PDF) of the Final Scoping Report.

Please draw the applicant's attention to the fact that the activity may not commence prior to an environmental authorisation being granted by the Department.

Yours faithfully

ubent

Boniswa Belot

Deputy Director: Strategic Administration Support

Date: 05/02/2014

CC: Gauteng Department of Local Att: L Gregory
Government & Housing Email/Fax: 011 355 4000



agriculture and rural development

Department: Agriculture and Rural Development
GAUTENG PROVINCE

Diamond Corner Building, 68 Eloff & Market Street, Johannesburg
P O Box 8769, Johannesburg, 2000

Telephone: (011) 355-1900

Fax: (011) 355-1000

Website: <http://www.gard.gpg.gov.za>

Reference:	Gaut: 002/13-14/E0153
Enquiries:	Faith Mlambo
Telephone:	(011) 355-1974
Email:	Faith.mlambo@gauteng.gov.za

Bokamoso Landscape Architects & Environmental

Email/Fax, 011 355 4000

Dear Sir / Madam

Application for Environmental Authorisation: Linksfield Mixed Use Development

The Department acknowledges having received the application form for environmental authorisation of the above-mentioned project on 06/09/2013, but final amendments were made on 26/09/2013.

The application has been assigned the reference number Gaut: 002/13-14/E0153. Kindly quote this reference number in any future correspondence in respect of the application.

Please circulate the draft report to any state department that administers a law relating to a matter affecting the environment to comment.

You are required to submit two (2) copies (full colour CDs-PDF) of the Draft Scoping Report as well as proof of submission to state departments referred to above.

In order to determine whether a biodiversity assessment is required and, if so, which specialist studies are required, please send a shapefile (WGS84 datum; geographic co-ordinate system) of the application site to our biodiversity information service (GDACE_BiodiversityInfo@gauteng.gov.za), the e-mail clearly indicating the project reference number. Where biodiversity assessment is required, please ensure that it is

conducted consistent with the *GDACE Requirements for Biodiversity Assessments*. A copy of this document can be obtained by e-mailing GDACE_BiodiversityInfo@gauteng.gov.za

In terms of Regulation 67(1) (2) of the NEMA EIA Regulations 2010, this application will lapse should you fail to submit the requested information within 6 months of the date of signature of this letter, except in the case where the Department has received and accepted written explanation for failure to submit such information.

Please draw the applicant's attention to the fact that the activity may not commence prior to an environmental authorisation being granted by the Department.

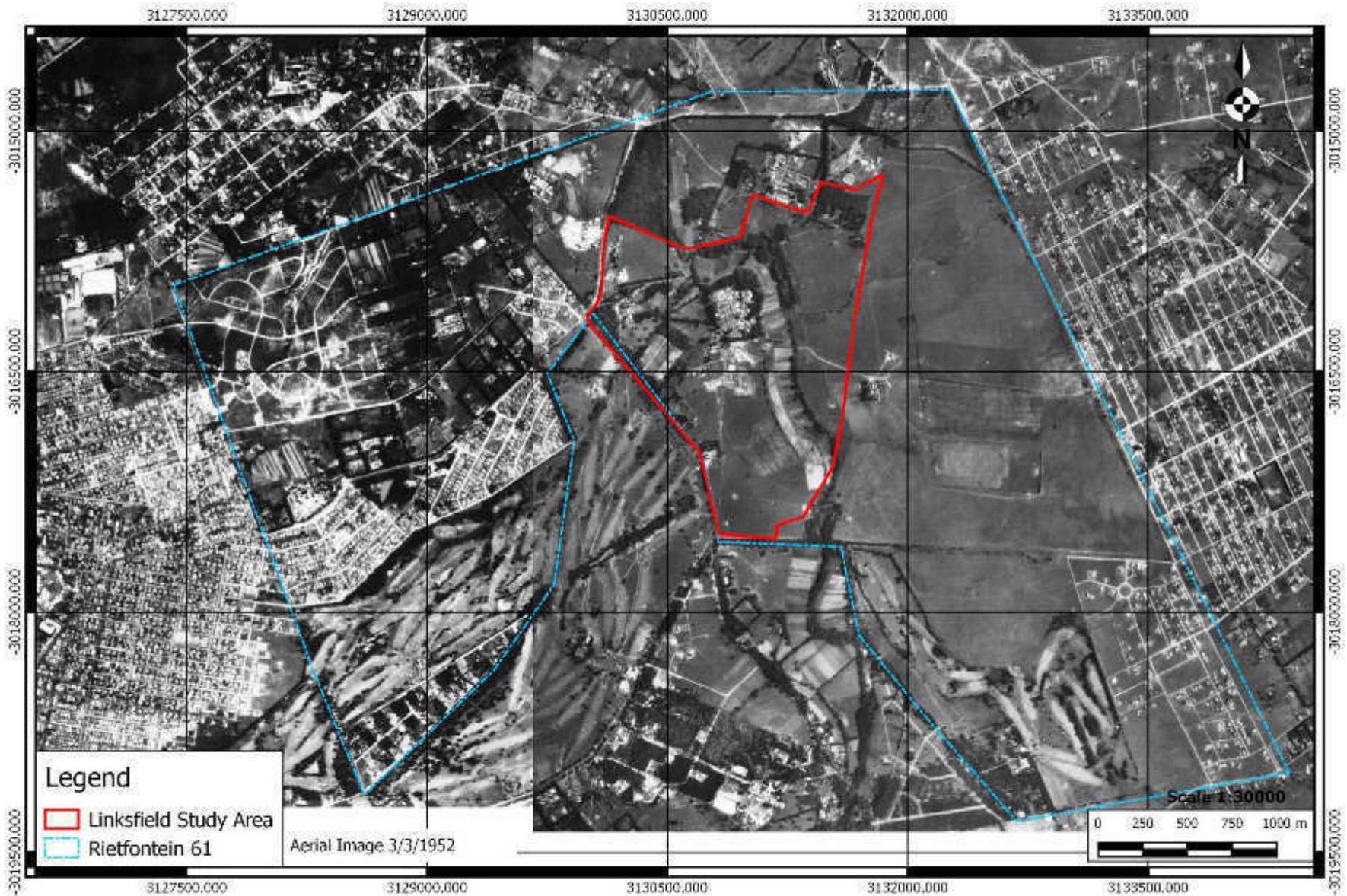
Yours faithfully

ubent
Boniswa Belot
Deputy Director: Strategic Administration Support
Date: 02/10/2013

CC: Gauteng Department of Local Government & Housing Att: L Gregory
Email/Fax: lizelleg@mweb.co.za

Historical Aerial Photo of the Larger Farm

Annexure J



Newspaper Advertisement to public to come forward with information

Annexure K

MIDDLE-AGED WITH A NOSTALGIA FOR YOUTH



GRAPHIC: FVINI NTI ONONDA

QUESTION: I've always regarded myself as sensible, grateful for a full life and family I love. But as I approach 50, I find myself suddenly drawn to younger men.

I'll write my garden and get crushed on my son's 20-something friends.

We're no intention of acting on such impulses, but it makes me feel unattractive.

Is this just a symptom of the menopause?

ANSWER: When Germaine Greer's *The Boys* was published a decade ago, there were some raised eyebrows that a feminist writer, then in her mid-60s, should glorify the impact of young male beauty in our culture.

Women are usually more sensible than men about actively pursuing far younger conquests, but that doesn't mean they don't feel a similar nostalgia for smooth skin and uncrossed optimism.

It's certainly true that acute wristiness can accompany the loss of fertility.

Many 50-something women fear becoming invisible to junior generations and therefore a spot of light flirtation is incredibly bolstering.

Momma's Bosom



It can feel like the last-chance saloon: flirt now, while hormones allow.

You don't have to be lecherous to appreciate having young men in your kitchen.

Not it's criminally flirtatious to respond to gallantries with appreciation and a spot of light joshing.

You only lose dignity when you read more into this exchange of pleasantries than is warranted, or become overly familiar.

It's fine to make your children's friends feel

■ People in crisis should call LifeLine on 011-728-1347.

■ Children in crisis should call the Child Protection Unit on 08 000 555 55.

■ For sexual wellbeing, phone the South African Sexual Health Association on 086-010-0262.

567 To Let Flats

Close to shops

BEDFORD GARDENS

1.5 bedroom apartment to let
R6200 plus elec
Close to schools and pool in complex
Close to town centre
With secure parking
Available immediately.
Fully curtained.

■ Marcus
083 653 7533

BELLEVUE East: 1 bedrm
R3200, backrm R1200,
ex w/e 082 330 2689

670 To Let Simplex/Duplex

24 HOUR SECURITY

RIVER CLUB SANDTON

Sunny penthouse
apartment, 2 bedrooms, 2
bathrooms, lounge, dining
room, open plan on to balcony
with views, 2 secure under cover parking
Available immediately.
Fully curtained.

R12 500 (lev included)
■ 082 604 5600

571 To Let Townhouses

RADIOKOP

Opposite Eagle Canyon Estate
2 bed, 1 bath, lounge/dinner
room, 2 bedrooms, garage, private
garden, Close to town centre
Avail 1st July

R6500
■ Masaccha
083 295 56804

24 HOUR SECURITY

Close to shops

BRAMFONTEIN BREA / CITY (Johannesburg)

Bachelors and 1 Bedroom flats

Available for Immediate Occupation.

Call Clinton
(011) 024-3170
(011) 024-9786

BRAMLEY NORTH

Bachelor apartment 5 minutes from Melrose Arch and Sandton City

Suits single person Available 1 July

R3500 + 1 month Dep. Rent incl 1/w.

John ■ 082 467 0343

Close to shops

RANDBURG OPPOSITE BRIGHTWATER COMMONS

1bedroom, 1 bath, spacious kitchen/living room

Ground floor unit facing dam with water birds

In security complex & under cover parking

R6000pm excl 1/w.
■ 083 267 8234.

WINDSOR WEST 3 bed, garden, occ 1 July
R2400pm ■ 082 2540062

581 To Let

Accommodation TO LET FLORIDA • WEST RAND

• Bach, 2 bed, 2 bed
• Rent from R2850 pm

• Deposit payable over 2 months

• Private bathrooms

• No admin fee

• 1st Month rental free

Call now!
011 472 9205
082 784 4009

Ts & Cs apply

591 Court Orders

CASE NO: 644/2013

IN THE HIGH COURT OF SOUTH AFRICA

LOCAL DIVISION, JOHANNESBURG

In the matter between:

MAKANJE, MAYA (PLATIFF) and

KESHOR JIKISON, AJAYKUMAR (DEFENDANT)

NOTICE OF SALE IN EXECUTION

In pursuance of the judgment of the Honourable Court of the 12th March

2013 and a Warrant of Sale dated the 04th April 2014 the Vehicle listed below will be sold in execution to the highest bidder on the 30 June 2014 at the following address:

James Crescent, Midrand, 16111
VEHICLE TO BE SOLD:
black, 2010 Mercedes-Benz C-Class

Dated at JOHANNESBURG on this 17th day of JUNE 2014

LESLIE COHEN ASSOCIATES
Debtors & Attorneys
P O Box 8034
011 461 2000
Fax: (011) 447-7747
Tel: Mr Cohen/M520
(STAR 9690182)

601 To Let

Garden Cottages PRETORIA VILLA FERNE

Singles or Couples

Holiday lets, 1 bed flat

Garden setting on Graham Road

No pets

R5000pm All Inclusive

Carole ■ 082-787-7755
www.villaferne.co.za

611 To Let

Rooms to Let PRETORIA CBD

1 bedroom flat, 1st flt,

1 bath, 1 kitchen.

Secure complex. R22000 negotiable

■ Gabriel
078 0163 946/
072 521 4485

621 To Let

Furnished Property

622 For Sale Flats PRETORIA CBD

1 bedroom flat, 1st flt,

1 bath, 1 kitchen.

Secure complex. R22000 negotiable

■ Gabriel
078 0163 946/
072 521 4485

623 To Let

Rooms to Let PRETORIA CBD

1 bedroom flat, 1st flt,

1 bath, 1 kitchen.

Secure complex. R22000 negotiable

■ Gabriel
078 0163 946/
072 521 4485

624 To Let

Rooms to Let PRETORIA CBD

1 bedroom flat, 1st flt,

1 bath, 1 kitchen.

Secure complex. R22000 negotiable

■ Gabriel
078 0163 946/
072 521 4485

625 To Let

Rooms to Let PRETORIA CBD

1 bedroom flat, 1st flt,

1 bath, 1 kitchen.

Secure complex. R22000 negotiable

■ Gabriel
078 0163 946/
072 521 4485

626 To Let

Rooms to Let PRETORIA CBD

1 bedroom flat, 1st flt,

1 bath, 1 kitchen.

Secure complex. R22000 negotiable

■ Gabriel
078 0163 946/
072 521 4485

627 To Let

Rooms to Let PRETORIA CBD

1 bedroom flat, 1st flt,

1 bath, 1 kitchen.

Secure complex. R22000 negotiable

■ Gabriel
078 0163 946/
072 521 4485

628 To Let

Rooms to Let PRETORIA CBD

1 bedroom flat, 1st flt,

1 bath, 1 kitchen.

Secure complex. R22000 negotiable

■ Gabriel
078 0163 946/
072 521 4485

629 To Let

Rooms to Let PRETORIA CBD

1 bedroom flat, 1st flt,

1 bath, 1 kitchen.

Secure complex. R22000 negotiable

■ Gabriel
078 0163 946/
072 521 4485

630 To Let

Rooms to Let PRETORIA CBD

1 bedroom flat, 1st flt,

1 bath, 1 kitchen.

Secure complex. R22000 negotiable

■ Gabriel
078 0163 946/
072 521 4485

631 To Let

Rooms to Let PRETORIA CBD

1 bedroom flat, 1st flt,

1 bath, 1 kitchen.

Secure complex. R22000 negotiable

■ Gabriel
078 0163 946/
072 521 4485

632 To Let

Rooms to Let PRETORIA CBD

1 bedroom flat, 1st flt,

1 bath, 1 kitchen.

Secure complex. R22000 negotiable

■ Gabriel
078 0163 946/
072 521

ALL APPLIANCE REPAIRS

- W/machines
- Fridges, regasing @ R350
- T/Driers
- Stoves
- D/washers
- Aircons

Donnie
078 861 3004
084 462 4931
SD007556

ALL APPLIANCE REPAIRS ON SITE

Stoves, W/Machines,
T/Dryers, D/Washers
Fridges Free quotes !

Call Jason
082 401 8239
076 210 6532
SD007556

Appliance and Plumbing repairs

Fridges, Stoves, C/Rooms
M/waves, D/washers,
T/Dryers, W/Machines,
Geysers, Electrical Wiring & Plumbing Maintenance.

Contact Stanley
011 039 1869 / 073 754 2974
078 472 6362

stanleyruuben@yahoo.com 20 years
of experience, available on Public Holidays!!

**personal services**

- beauty & health
- bridal
- catering
- child care
- computer repairs / installations
- driving schools
- entertainment
- for hire
- furniture restoration
- home industry / dressmaking
- limousines for hire
- miscellaneous services
- personal services
- pest control
- pet services / accommodation
- professional & business
- photographic
- removals & storage
- security
- transport
- tuition / education
- upholstery

0224 DRIVING SCHOOLS

ACT NOW ON K53 WITH ZEBRA DRIVING SCHOOL IN ORANGE GROVE

Pick up + drop off.
Codes: 01;08;10;14.
Male + female
Instructors.

**Office 011 728 8229
074 354 9298**
CL003318

0288 REMOVALS & STORAGE

A2B FURNITURE REMOVALS
www.a2bremovals.co.za
011 886 2328
083 304 2579
info@a2bremovals.co.za
CL003529

MAN & HIS VAN'S

REMOVALS- HOME-OFFICE-COMMERCIAL
071 444 8998
hotair@icon.co.za
Dave
LD004551

PETER`S REMOVALS AND STORAGE!

p.remove
@mweb.co.za
(011) 683-2227
(011) 683-5121

TY007703

0292 SECURITY**AZTECH ENGINEERING**

Gates & automation.
Fencing & burglar proofing.
Carports. Service & repairs.
Centurion Motors R3850
inst.

Moh
084-595-8122
LD004322

GATE AUTOMATION ELECTRIC FENCING

Sales and Repairs.
Hansa, Centurion.

Pierre
082 788 3368
SD007318

0296 TUITION / EDUCATION

ALL GRADES
Science/Maths to Matric by
Exp.qual.patient teacher
011-786 4089
SD007570

MATHS SPEECH TRAINING HOME SCHOOLING TUTOR TRAVELS
082 851 1328
011 786 9259 (messages)
CL003306

for sale

- arms & ammunition
- baby & children's corner
- carpets / furniture / appliances
- clothing
- computers
- collectables / antiques
- jewellery
- miscellaneous
- musical
- office furniture & equipment
- pets & livestock
- plant & machinery
- sports & leisure
- under R200
- wanted to buy
- for kids - to swap / for sale

0342 JEWELLERY**BEST CASH PRICES!**

We sell / buy Diamond and Gold Jewellery for cash.
Tel: (011) 787-0814
Randburg Diamond Co.
LD004344

0396 WANTED TO BUY

AA AUCTIONS
Barry pays best cash prices for all good, used furniture, appliances, antiques, pianos, etc. 079 819 7935
011 793 4668 / 4478
CL003293

AABER BUYS

Antiques, Collectables, Porcelain, Ornaments, Silver, Paintings, etc.

011 442 9039
0823329254
LD004549

ALL CASH PAID FOR SA ART, ANTIQUES & JEWELLERY
Tel 082-657-2610
7 Days a week
SD007332

BARNEY'S ANTIQUES

Top CASH paid for gold & silver jewellery, art, antiques, etc.

072 358 9404
LD004557

property to let

- accommodation to share / rooms to let
- domestic accommodation
- factories / industrial / workshops
- flats
- farms & plots
- garden flats / cottages
- houses
- offices / shops / business premises
- retirement villages
- storage / parking facilities
- timeshare to let
- townhouses / simplexes / clusters / duplexes
- wanted to rent

0442 GARDEN FLATS / COTTAGES**LYNDHURST**

Furnished garden cottage with undercover parking. Suitable for 1 person only. R3800 pm excluding electricity.

083-300-1511
TY007709

MELROSE

Secure cluster style double storey 2 bed cottage. Private entrance. 2 off street parkings. 1 ½ km's from Rosebank Gautrain. 4 km's from Sandton. 3 km's from Melrose arch. R12000.00 incl w/l. Viewing on Thursday between 16h30 and 18h30.

Contact Shelley on
082-589-5445
LD004546

SYDENHAM DOUBLE STOREY

1 bed, security, parking R5300 pm.

011-485-1677
SD007575

WE WANT U FOR TV COMMERCIALS**vacancies**

- business
- computers
- general
- hairdressing & beauty
- management
- medical
- legal
- part time / temps
- personnel agencies
- professional
- sales / marketing
- security
- senior citizens
- technical
- trade

0820 GENERAL

Looking for a hard working receptionist, that is quick on their feet and able to handle emergency situations. Must stay around the Sandringham area. Own transport essential. Hours: 8am to 4pm Mon to Fri. Starting salary at R8 500.00.

Please email us on
sandringhamvetacc
@gmail.com.
No phone calls
please.

LD004575

0840 PART TIME / TEMPS

WE WANT U FOR TV COMMERCIALS
Earn extra cash.
Call
011 704 4293
T & C apply
= Facebook
DJ's Models
SD007555

0855 SALES / MARKETING**SALES PERSON STUDENT**

For Wesley's
Tobacconist
Rosebank Mall.

MUST BE 18 years or older.

Most Saturdays,
Sundays and Public
Holidays.

Remuneration:
Sat: R28. per hour.
Sun / Holidays:
R41. per hour.

Interesting work and pleasant working conditions.

Should be careful, caring and enjoy interacting with people.

Must want to work and be committed.

Fax brief CV to:
011 440 1292 or
011 880 1150

Attention Mr Wesley
Please do not telephone the shop

CL003522

20 SALES REPS

Company Expansion
No exp nec. Imm start
MUST HAVE OWN CAR
Target based package
R12000 to start/Com
Bonus/Incentive/Med
Call/ 1 SMS Full Name/Age
Area to 072-186-6918
(Normal VAS Rates apply)

LW030463

employment

- general employment wanted
- domestic employment wanted
- gardener employment wanted
- domestic employment available

0895 DOMESTIC EMPLOYMENT WANTED**ACCREDITED DOMESTIC WORKER TRAINING**

Domestic Bliss
011 447 5517
083 525 4992

STAFF PLACEMENTS

011 880 4647
076 683 4100
235 Jan Smuts Ave
Parktown North
SD007320

For Referenced Maids/
Gardeners contact St. Pauls
Church.
58 - 12th Street Parkhurst.
Open Wednesday
afternoons.

Phone
(011) 447-3148
anytime and leave a
message.

SD007414

MEMORY hardworker,
honest, reliable lady
requires domestic work
full-time.

Ref 082 770 9011.
Ph 061 827 4654
SI030627

NOSAKHE Sa,seeks F
/time, Domestic,
Childminding work, Have
Ref and speak Eng. 072
397 4767
RO000053

0899 DOMESTIC EMPLOYMENT AVAILABLE**ABIGAIL'S DOMESTICS EST 1996**

Fully Screened
H/keepers, Cooks, Nannies,
Caregivers, Nurses,
Housemen, Gardeners,
Drivers.

(011) 483-1234
071-425-3491
abigailsdom@
mweb.co.za
CL003530

We need experienced
housekeepers, cooks,
nannies, gardeners and
drivers with references.
Fulltime/ part time positions
available.

TT DOMESTICS
011 435 6797 /
078 893 1115
LD004571

legals

- auctioneers
- legal notices

0950 LEGAL NOTICES

INFORMATION URGENTLY REQUIRED REGARDING ALLEGED ANIMAL AND HUMAN BURIAL SITES ON PORTIONS 87, 148,149 AND THE REMAINDER OF PORTION 1 OF THE FARM RIETFONTEIN 61 IR (SIZWE TROPICAL DISEASE HOSPITAL SITE)

We hereby invite any members of the public/ institutions, organisations/ government bodies etc. to come forward and supply any information regarding the alleged animal and human graves on the Sizwe / Rietfontein Hospital site, which is located on the above mentioned property.

The property is situated in Modderfontein Road, Edenvale. According to information supplied from various sources the following burial sites occur on the open areas that surround the hospital: 1) Carcasses of animals that were infected by the Anthrax bacteria; 2) The bodies of humans that were infected by various tropical diseases and that were most probably treated in the Sizwe Hospital; and 3) a Jewish Cemetery.

Apparently all the patient records kept in the archives of the Sizwe Hospital were destroyed by a fire and therefore it was not possible for the management of the hospital to supply any records of patients that were buried on the property. The project team furthermore tried (for more than 6 months) to obtain concrete evidence regarding the existence and locality of the alleged Jewish and animal graves on the property, but nobody could supply any useful or specific information in that regard.

At this stage the preliminary soil surveys, cultural and historical surveys and other relevant specialist surveys (such surveys will be made available as part of the EIA Report to be compiled), identified only three small burial sites on the property and at this stage we are of the opinion that the three sites identified incorporates the only graves present on the property. The shallow soil conditions of the site furthermore supports the project team's preliminary finding that there are only three burial sites on the property.

The purpose of this open invitation is thus to determine the following:

- Whether there are any parties that have more information regarding the history of the Sizwe / Rietfontein Hospital and the associated burial activities,

- Whether anybody can identify any of the patients/deceased that were buried in any of the three existing graveyards,

- Whether anybody can provide any proof/information regarding the alleged animal and Jewish Graves, and

- Whether anybody can assist with the identification with other burial sites on the property.

Please contact Juanita De Beer of Bokamoso Environmental Consultants at (012) 346-3810 (Pretoria) or send an E-Mail to lizelleg@mweb.co.za if you require more information/ if you have concrete evidence to provide that will assist with the Environmental Impact Assessment currently in process.

SD007514



Contact us to place your classified advert today!

Geklassifiseerd

T: 086 063 8237 | F: 012 485 9067 | E: olx@beeld.com

Geklassifiseerd

Beeld

FAMILIEKENNISGEWINGS

1001 Geborente
1005 Sterfies
1006 Sterfies (laat)
1015 Ter nagedienis
1020 Dankbetuigings
1023 Graafkundige
1033 Graduerings
1040 Verloofings
1045 Herdenkings
1050 Huwelike
1055 Algemeen

ALGEMENE KENNISGEWINGS

1201 Diers-aanmeldings
1205 Kennerskennings
1210 Gemeenskapskennings
1215 Gevind
1220 Gratis advertenties
1225 Verlore/weg

PERSONLEKE DIENSTE

1401 Spysenering & lokale
1402 Aanmeldings
1405 Kindervernaak
1410 Mens en creches
1415 Speurders
1420 Finansiële
1425 Funkies & konferensies
1430 Gesondheid & skoonheid
1435 Kruidekoker
1440 Regadsview
1441 Saamrygleeënthe
1445 Lenings
1450 Medies
1455 Verpleging
1460 Persoonlike
1465 Fotografie & video's
1470 Reünies
1475 Sosiale & ontpspanning
1480 Opleiding & onderrig
1485 Gevra
1490 Huwelike

TE KOOP

1605 Antiekware & kuns
1607 Boek
1610 Boumateriaal
1615 Klere
1620 Elektriese toebehoeve
1625 Elektronics & digitaal
1630 Snuffels
1635 Meubels
1636 Rommelverkopung
1640 Tuinmaak
1642 Huisdouchedelik
1645 Juwels & tyeboere
1650 Masjinerie & toerusting
1655 Tellefoni
1660 Tellefoni
1665 Fotografie
1670 Ruitjhooke
1675 Te koop gevra
1677 Wendy-huise

ALGEMENE & HUISDIENSTE

1801 Bouwers & Konstruksie
1802 Bouplande
1805 Skoonmaakdiens
1807 DSTV-TV-DWB dienste

1810 Elektries
1815 Elektronies & digitale dienste

1820 Tuin & besproeling

1825 Glas & vensters

1830 Huisverbetorings binne

1835 Huisverbetorings buite

1840 Masjinerie

1845 Verskeidenheid

1850 Plaasbestryding

1855 Loodgieters

1860 Alvalverwerking

1865 Veiligheid

1868 Swembaddens

1870 Vervoer & berging

1875 Bome

1880 Verwerk

1885 Plaveisel

1890 Houtwerk

VOLWASSENES

2000 Klietlyne

2005 Klubs & vermaak

2010 Massering

2015 Privaat

2020 Betrekings

2200 Landbou

2201 Bye & byboerdery

2202 Boorgate

2205 Implement, masjinerie

2210 Vee & vluimvee

2215 Organies

2220 Andere diere

2225 Produsente

2230 Tenks & damme

SAKE

2400

2401 Te huur

2405 Te koop

2410 Beleggings

2415 Geleenheidte

2420 Dienste

2425 Gevra

VAKANSIE & REISE

2600 Toere & aktiwiteite

2605 Reisagents

2610 Geleenthede

2615 Voertuigverhuurings

2620 Builtegoerungs

2625 Gasteblou & B/O / hotelle

2630 Tyddee

2635 Akkommodasie

2640 Fees-verbyl

2645 Woonwparke

2650 Sport-verbyl

2655 4x4-roetes

2660 Plaasvakansies

2700 Bestemmings

2701 Sudelike Afrika

2705 Namibië

2710 Bululent

2715 Mosambiek

2720 Ander

2725 Bosveld

2730 Botswana

2735 Krugerpark

2740 Suid-Kaap

2745 Suid-Kaap

2750 Weskus

2755 Tuinrette

2760 Noordkus

2800 Provinsies

2801 Wes-Kaap

2805 Oos-Kaap

2810 Vrystaat

WERK

3600

ALGEMEEN

3600

Vakature beskikbaar in die **BALFOUR/GROOTVLEI**

omgewing vir die volgende poste:

1. HPCSA-registreerde ANA (Ambulans Nood Assistent) met brandwerkvalifikasies en/of ondervinding.

2. Sekuriteitsbeampte met Graad B SIRA-registrasie.

Faks CV na 086 618 0329

REGSKENNISGEWINGS & TENDERS

4000

4001 Epskediens/- huveliks-kontrakte/-iensaeks-

4005 Hoofbelle & sekwestrasies / likwidasiés

4010 Algemene kennissgewings

4015 Sakelisiese

4020 AJV-vergaderings

4025 Dorpsbestryding

4030 Dorpsverdigting-stigting

4035 Dranklisiese

4040 Verlore dokumente

4045 OOS (omgewingsimpak-studies)

4050 Profesionele / bestuur

4055 Personele / menslike

4060 Regsbestryding

4065 Profesionele / bestuur

4070 Geleenheidte

4075 Stapping

4080 Tenders

4085 Heregistrasies

BOEDELKENNSIEWINGS

4200

4201 Boedels: Kredieture en debiteure

4202 Boedels: Likwidiese

4205 Invalente boedels

4210 Goege van boedel

4215 Geleenheidte

4220 Goege van boedel

4225 Rehabilitasies

VEILINGS

4400 Openbare veilinge

GXEKUSIEVERKOPENING

4500 Geregtige verkoping

GROOT GELEENTHEID!

4600

VERKOPE & BEMARKING

3760

REGSKENNISGEWINGS & TENDERS

4000

4001 Epskediens/- huveliks-kontrakte/-iensaeks-

4005 Hoofbelle & sekwestrasies / likwidasiés

4010 Algemene kennissgewings

4015 Sakelisiese

4020 AJV-vergaderings

4025 Dorpsbestryding

4030 Dorpsverdigting-stigting

4035 Dranklisiese

4040 Verlore dokumente

4045 OOS (omgewingsimpak-studies)

4050 Profesionele / bestuur

4055 Personele / menslike

4060 Regsbestryding

4065 Profesionele / bestuur

4070 Geleenheidte

4075 Stapping

4080 Tenders

4085 Heregistrasies

BOEDELKENNSIEWINGS

4200

4201 Boedels: Kredieture en debiteure

4202 Boedels: Likwidiese

4205 Invalente boedels

4210 Goege van boedel

4215 Geleenheidte

4220 Goege van boedel

4225 Rehabilitasies

VEILING

Inputs from NICD

Annexure L



REPORT

BASELINE FORENSIC SOIL INVESTIGATION INTO POTENTIAL PATHOLOGICAL RISKS ASSOCIATED WITH DEVELOPMENT OF THE LINKSFIELD SITE, GAUTENG PROVINCE

6th February, 2014

Compiled by:
J.H. van der Waals
(PhD Soil Science, Pr.Sci.Nat)
Member of:
Soil Science Society of South Africa (SSSSA)

Accredited member of:
South African Soil Surveyors Organisation (SASSO)

Registered with:
The South African Council for Natural Scientific Professions
Registration number: 400106/08

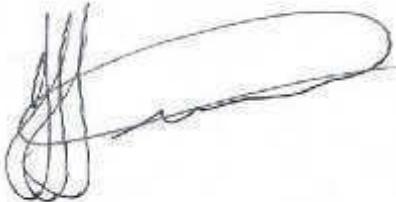
H. van Heerden
(PhD Plant Pathology)

A. Hassim
(MSc Veterinary Science)

Declaration

I, Johan Hilgard van der Waals, declare that I –

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



**J.H. VAN DER WAALS
TERRA SOIL SCIENCE**

EXECUTIVE SUMMARY

The Linksfield site was assessed regarding grave site distribution, pathogen presence in soils and selected chemical parameters of the soils.

The distribution of the graves was established through the interpretation of historical aerial photographs and satellite images. These were found to be concentrated in three distinct areas. The two sites located along Club Road are associated with the Rietfontein Hospital. The site located on the banks of the Jukskei River appears to pre-date the hospitals main burial activities. No sites could be identified that gave the impression of haphazard burying or animal carcass burying.

During the literature survey regarding persistence of pathogens in soil all the pathogens, except for anthrax, were ruled out as risks due to poor or non-survival for prolonged periods in soil. The emphasis on anthrax was due to the reported persistence of the pathogen in soils with neutral to alkaline pH as well as elevated Ca levels and the anecdotal evidence that indicted the burial of animal carcasses of animals that died due to an anthrax outbreak. These indications informed the approach followed during the analysis phase of the investigation.

None of the human diseases identified during the literature survey could be identified in the soils. This includes anthrax. The only human pathogen in the same genus as anthrax (*Bacillus cereus*) was cultured from the soils along the Club Road graveyard soils. The pathogenicity of this organism is limited to two kinds of foodborne infections, an emetic (vomiting) intoxication due to the ingestion of a toxin (cereulide) pre-formed in the food and a diarrhoeal infection due to the ingestion of bacterial cells/spores which produce enterotoxins in the small intestine (Arnesen et al., 2008). *Bacillus cereus* is ubiquitous and its spores will not be eliminated from food materials by heat treatment, apart from canning. Spores are present in almost all categories of foods before storage, generally in numbers too low to cause foodborne poisoning (Opinion of the Scientific Panel on Biological Hazards, 2005). It therefore poses a negligible risk.

The chemical analysis data of the soils was inconclusive regarding differences between control plots outside the graveyards and the graveyard soils. This was especially so for pH, calcium (Ca) and magnesium (Mg) levels. Potassium and phosphorus levels showed a significant difference between the two soil sample zones with higher levels in the graveyard soils. From the data it therefore appears that only K and P levels were influenced by the presence of the graveyard. The reason for these increased values falls outside of the scope of this study.

The absolute values of the pH and Ca levels indicate that none of the soils can be considered conducive for the survival of anthrax, rather, the levels are low enough to confidently indicate a very low risk of anthrax survival. However, as there is a potential risk that localised infected remains may still be encountered during earthwork activity, workers will have to be given a standard operating procedure upon uncovering graves. Workers will have to be properly informed

Summary of comments: Linksfield Baseline Forensic Soil Gravesite Report JF comments.pdf

Page:3

 **Number: 1 Author: johnf Subject: Comment on Text Date: 2014-03-28 07:12:31**

This suggests strongly that human graves pose an anthrax transmission risk. There is no suggestion that human anthrax victims are buried on the site. Your recommendations are therefore misleading. Discovery of animal bones outside the cemeteries is clearly a different issue in relation to anthrax, but there is also no credible evidence that anthrax animal burial sites are present.

 **Number: 2 Author: johnf Subject: Highlight Date: 2014-03-28 07:08:46**

about the disease and the risks and they will have to adhere to a "biosecurity" protocol that has to [1] be set up with linked safety measures. Workers and general public will have to be informed of anthrax and the symptoms. If grave sites are uncovered the bones / grave site must be covered with soil, excavation must be stopped and experts must be called in to identify the origin of the bones. Samples should be taken to confirm the absence/presence of *Bacillus anthracis*. Should any sample be positive for anthrax all workers will have to receive medical care and a treatment protocol using penicillin or a cephalosporin (for penicillin susceptible individuals).

TABLE OF CONTENTS

1.	INTRODUCTION.....	1
1.1	Terms of Reference	1
1.2	Background	1
1.3	Aim of the Investigation.....	1
1.4	Structure of the Report.....	1
2.	BRIEF DESCRIPTION OF THE SURVEY AREA	2
2.1	Survey Area Boundary.....	2
2.2	Survey Area Physical Features.....	2
3.	LITERATURE REVIEW.....	2
3.1	Methodology	2
3.2	Results	2
3.2.1	Rietfontein Hospital and Graves	2
3.2.2	Pathogens	4
3.2.3	Distribution of Graves/Sites	6
4.	INTERPRETATION OF HISTORICAL AND RECENT AERIAL PHOTOGRAPHS	6
5.	SOIL SAMPLING	13
5.1	Microbial Analysis Sampling	13
5.2	Soil Chemical Analysis Sampling	13
5.3	Soil Sampling Results / Observations	18
6.	MICROBIOLOGY / PATHOLOGY ANALYSIS	22
6.1	Material and Methods	22
6.1.1	Culturing of Bacteria	22
6.1.2	PCR.....	23
6.2	Results	23
6.2.1	Culturing of <i>Bacillus anthracis</i>	23
6.2.2	Culturing of <i>Clostridium</i>	26
6.2.3	PCR.....	26
6.3	Discussion	30
7.	SOIL ANALYSIS RESULTS	32
7.1	Soil Physical Analysis.....	32
7.2	Soil Chemical Analysis	33
7.2.1	Soil pH.....	33
7.2.2	Exchangeable Cations	35
7.2.3	Phosphorus	35
8.	SUMMARY AND CONCLUSIONS	37
	REFERENCES	38

DEFINITIONS:

Diseases

A condition of the living animal or plant body or of one of its parts that impairs normal functioning and is typically manifested by distinguishing signs and symptoms

Endophytes

An **endophyte** is an endosymbiont, often a bacterium or fungus, that lives within a plant for at least part of its life without causing apparent disease

Fomites

Objects or materials which are likely to carry infection, such as clothes, utensils, and furniture

Infectious diseases

Infectious diseases are caused by pathogenic microorganisms, such as bacteria, viruses, parasites or fungi; the diseases can be spread, directly or indirectly, from one person to another

Microorganisms

A microscopic organism, especially a bacterium, virus, or fungus

Pathogen

A bacterium, virus, or other microorganism that can cause disease

Zoonotic diseases

Infectious diseases of animals that can cause disease when transmitted to humans, such as anthrax (*Bacillus anthracis*, *Mycobacterium tuberculosis* and *M. bovis*)

BASELINE FORENSIC SOIL INVESTIGATION INTO POTENTIAL PATHOLOGICAL RISKS ASSOCIATED WITH DEVELOPMENT OF THE LINKSFIELD SITE, GAUTENG PROVINCE

1. INTRODUCTION

1.1 TERMS OF REFERENCE

Terra Soil Science was appointed by **Bokamoso** to conduct a baseline forensic soil investigation into potential human pathological risks associated with the development of the Linksfield site in the Gauteng Province.

1.2 BACKGROUND

The Rietfontein Hospital was originally established in 1895 as a **Lazaretto** (quarantine house) for increasing numbers of smallpox cases in the Johannesburg area (Adler, 1985). Although not built as a general isolation hospital and for treatment of infectious diseases it became necessary to isolate infectious diseases such as measles, scarlet fever, smallpox, plague, leprosy, syphilis, etc. There is a long history associated with Rietfontein/Sizwe Hospital as it progressed to being a tropical / infectious disease hospital, the various people who dedicated their lives to saving infectious diseases victims as well as the victims that did not survive. This is especially evident when walking around the hospital and associated cemeteries.

The site on which the hospital is situated (as well as the surrounding open area) is earmarked for urban development.

1.3 AIM OF THE INVESTIGATION

The aims of this investigation are to: 1) collect all available information regarding diseases that led to the deaths of the patients at Rietfontein Hospital as well as references to the position of the graveyards; 2) determine the distribution of the graves and extent of the gravesites; 3) report on the results of a dedicated field soil sampling exercise; 4) determine the presence of human pathogens in the soils of the site; 5) determine specific soil chemical properties linked to pathogen persistence; and 6) determine whether these infectious diseases pose a risk during the development of the surrounding sites or the graveyards.

1.4 STRUCTURE OF THE REPORT

The report was generated through:

1. The conducting of a dedicated literature search regarding the history of the hospital, fatal diseases and grave site distribution on the site;
2. The detailed assessment of historical aerial photographs and satellite images;

3. The sampling and analysis of soils for microbial / pathogen and selected chemical parameters
4. Presentation of the findings of the various components of the investigation.

2. BRIEF DESCRIPTION OF THE SURVEY AREA

2.1 SURVEY AREA BOUNDARY

The site lies between 26° 07' 46" and 26° 08' 59" south and 28° 07' 05" and 28° 08' 04" east in Linksfield in Johannesburg (**Figure 1**). The survey site is bordered by various urban developments to the north, south and west, by golf courses on the south-west and the N3 highway to the east.

2.2 SURVEY AREA PHYSICAL FEATURES

The altitude above mean sea level varies from 1540 in the north to 1610 in the south-west. The geology of the area is dominated by granite and serpentinite – leading to the dominance of beached sandy topsoil horizons overlying red and yellow coloured weathered rock subsoils.

3. LITERATURE REVIEW

3.1 METHODOLOGY

A review was conducted of the limited formal information available for the Rietfontein hospital and its associated grave sites. From the literature several diseases were identified and these were investigated in detail regarding the available information on persistence in soils. An attempt was also made to identify the grave sites from available literature.

3.2 RESULTS

3.2.1 Rietfontein Hospital and Graves

The only published report that was found is a historical article by Cyril Adler in the Adler Museum Bulletin in 1985 about Rietfontein Hospital and the diseases associated with the hospital (Adler, 1985). No records are available from the Rietfontein / Siswe Hospital. The other information consist of blog sites (<http://gravehunter-drw.blogspot.com/2013/07/rietfontein-just-wont-go-away.html>; <http://gravehunter-drw.blogspot.com/2012/11/graves-in-veld-rietfontein-hospital.html>), with a link to a newspaper report that is based on speculation and poorly verifiable facts. Adler (1985) indicated that people died of diseases like measles, scarlet fever, smallpox, plague, leprosy, tuberculosis, lassa fever, Ebola haemorrhagic fever, Marburg haemorrhagic fever², syphilis and Congo-Crimean haemorrhagic fever. This article indicates that Rietfontein / Siswe Hospital consisted of several cemeteries and that a plague camp was established at Rietfontein in 1904 where plague victims were buried (Adler, 1985).

Page:8

 **Number: 1 Author: johnf Subject: Sticky Note Date: 2014-03-28 07:14:24**

No Ebola cases were ever treated here. The only Marburg patients were treated in the old Fever Hospital in Braamfontein in 1975. It is misleading to associate them with the Sizwe site.

 **Number: 2 Author: johnf Subject: Highlight Date: 2014-03-28 07:12:30**

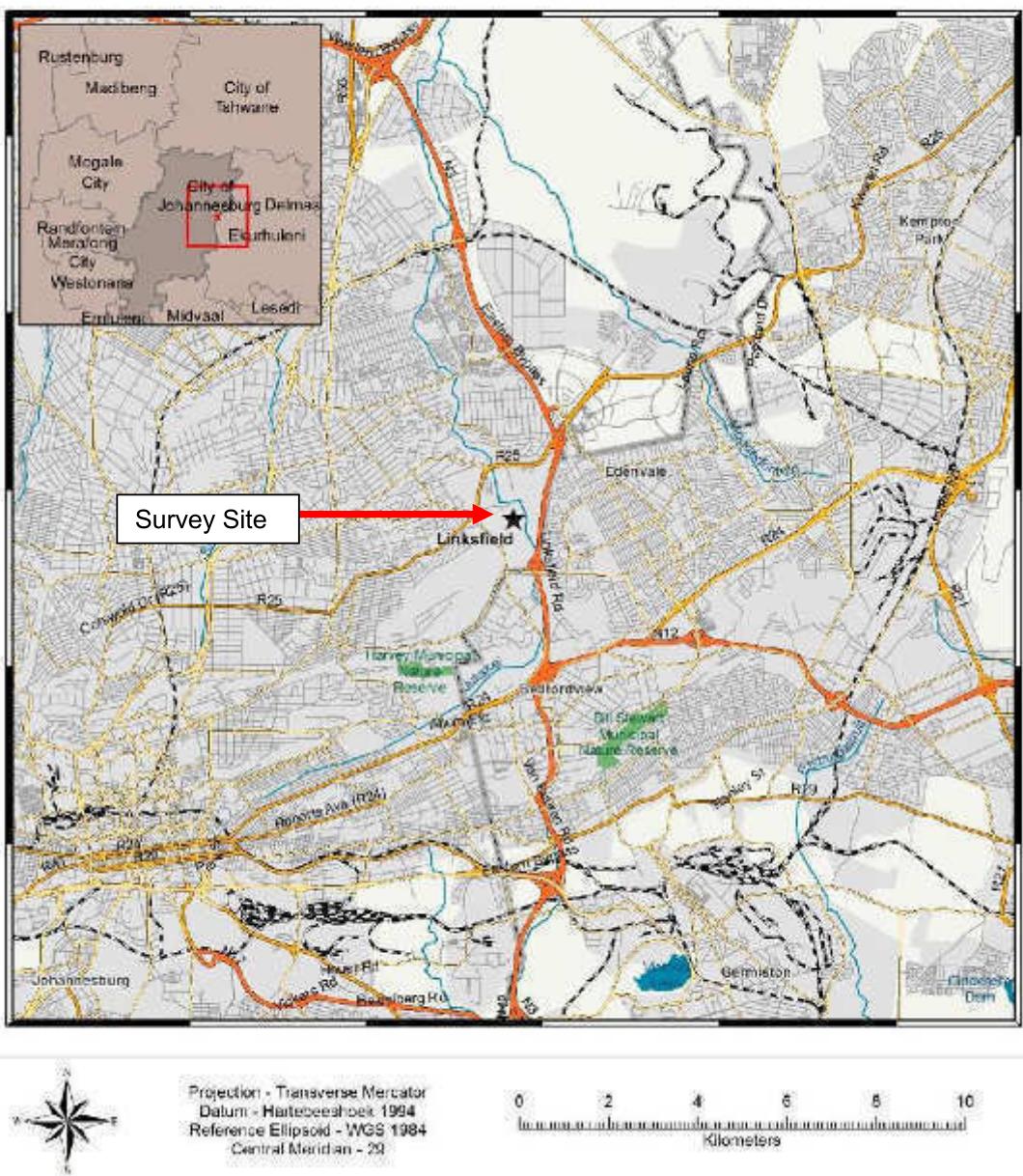


Figure 1 Location of the survey site

Anecdotal evidence (newspaper articles and word-of-mouth) suggest the existence of four cemeteries at the Rietfontein / Sizwe Hospital namely: 1) white; 2) black; 3) Jewish; and 4) leper. In addition, this evidence suggest that animals that died due to an anthrax outbreak were also buried in the area of the hospital.

3.2.2 Pathogens

The relevant diseases identified on the site from literature would have to survive in soil, water and human remains for decades to pose a risk during development. From anecdotal evidence it appears that the last persons were buried at Rietfontein [n] the late 1960's (although the "youngest" grave stone found by us on site dated from 1949). [2] important diseases of humans, which include Category A agents inclusive of potential biological terrorism agents identified by the Centres for Disease Control (CDC), were identified. Sinclair *et al.* (2008) reviewed selected Category A microorganisms and their ability to persist in the environment. These microorganisms / infectious diseases included:

- Variola major virus (smallpox; vaccinia virus)
- *Bacillus anthracis* (anthrax)
- *Yersinia pestis* (plague)
- *Clostridium botulinum* toxin (botulism)
- *Francisella tularensis* (tularemia)
- Viral haemorrhagic fever agents:
 - *Arenaviridae* (Lassa fever, Junin-Argentine haemorrhagic fever, and Venezuelan haemorrhagic fever)
 - *Bunyaviridae* (hantavirus)
 - *Filoviridae* (Ebola haemorrhagic fever and Marburg haemorrhagic fever)
 - *Flaviviridae* (St. Louis encephalitis and Japanese B encephalitis)



These category A agents include [most of the pathogens that killed people at Rietfontein Hospital] [4]. In the natural environment [these pathogens are primarily transmitted by insect vectors, through animal contact or material contaminated by infected animals. The latter refers to the risk at Rietfontein / Sizwe Hospital cemeteries as the pathogens are released in the bodily fluids of infected humans and animals and persist with the remains when buried. The maintenance of the infectivity by any pathogen outside the host (in this case the soil at Linksfield site around Rietfontein / Sizwe Hospital) is dependent on a number of factors including temperature, relative humidity, desiccation and UV light. Temperature has the most significant effect on persistence of all the factors mentioned. Sinclair *et al.* (2008) investigated the persistence of anthrax (*B. anthracis*), plague (*Y. pestis*), smallpox (Vaccinia virus), tularemia (*F. tularensis*), haemorrhagic fever agents (including *Arenaviridae*, *Bunyaviridae*, *Filoviridae* and *Flaviviridae*) and found smallpox and anthrax to be the most persistent. Anthrax could survive 146 years in water and more than 60 years in soils (Wilson and Russel, 1964; De Vos, 1990; Sinclair *et al.*, 2008) and smallpox could survive 8 years on fomites. Therefore, anthrax would be the agent of concern, not smallpox, as it will persist in the soil for more than 50 years.] [5]

Page:10

 **Number: 1 Author: johnf Subject: Sticky Note Date: 2014-03-28 07:17:51**

There is a recent newspaper article with a picture showing a 1950 gravestone.

 **Number: 2 Author: johnf Subject: Highlight Date: 2014-03-28 07:15:48**

 **Number: 3 Author: johnf Subject: Sticky Note Date: 2014-03-28 07:34:19**

This is not true. None of these viral haemorrhagic fevers were treated here, nor were there human anthrax victims. There is no tularaemia in SA. There are no reports of botulism cases at Rietfontein that I am aware of. Most deaths were not from this group of pathogens.

 **Number: 4 Author: johnf Subject: Highlight Date: 2014-03-28 07:19:49**

 **Number: 5 Author: johnf Subject: Sticky Note Date: 2014-03-28 07:27:38**

Only plague, tularaemia, and the flaviviruses are normally vector-borne

 **Number: 6 Author: johnf Subject: Highlight Date: 2014-03-28 07:24:48**

 **Number: 7 Author: johnf Subject: Sticky Note Date: 2014-03-28 07:28:47**

Sizwe

 **Number: 8 Author: johnf Subject: Highlight Date: 2014-03-28 07:28:39**

In this study the occurrence of anthrax as well as *Clostridium* species is investigated. The latter [2] includes *C. botulinum* (botulism) and *Mycobacterium tuberculosis* (tuberculosis). [3, TB] [4] These were included in the investigation as *C. botulinum* (botulism) can persist in soil [5] (Gressel and Bohnel, 2006) and TB can occur in the environment with Siswe [6] Hospital being an HIV and TB Hospital. It is not clear though whether these will be able to persist for more than 50 years in soil.

3.2.2.1 Anthrax (*Bacillus anthracis*)

Bacillus anthracis is a Gram-positive, spore-forming bacterium that consists of a chromosome and the virulent factors occur on two plasmids (extra-chromosomal DNA) namely pXO1, that contain toxins, and pXO2, that contain capsule (WHO, 2008). Three components are found on pXO1 namely lethal factor, oedema factor and protective antigen which are not toxic individually (Okinaka *et al.*, 1999; Read *et al.*, 2003). The lethal factor combines with protective antigen to form lethal toxin whereas oedema factor combines with protective antigen to form oedema toxin. The capsule gene on pXO2 consists of a five gene operon (*capABCDE*) that interact at the bacterial cell membrane to produce a poly-gamma-D- glutamic acid which helps the vegetative cells from phagocytic killing during infection. The capsule therefore protects the anthrax organism against the host (Read *et al.*, 2003). *Bacillus anthracis* is the causative agent of anthrax, a serious and often fatal disease of wild and domestic animals, especially herbivores. It can also infect humans. The disease occurs primarily as a cutaneous (skin), pulmonary (respiratory / lungs), or gastrointestinal (ingestion / eating) infection, depending on the route of entry of the *B. anthracis* spores. Upon entry into the host, the spores germinate and the resultant vegetative cells replicate rapidly, enter the bloodstream, and result in death or septicaemia.

The remains of animals that have died of anthrax usually discharge large amount of anthrax bacilli, returning the organism to the soil. If opened, endospores / spores will be formed due to exposure to oxygen. Thus carcasses of animals where anthrax is suspected should not be opened in order to avoid the formation of spores (OIE, 2008). *Bacillus anthracis* is able to form spores that are highly resistant to harsh conditions like chemical disinfection, heat, cold, etc. These have the ability to survive in the soil for a long period. The spores are present in abundance in soil at sites where infected animals had died or been buried (Leppla *et al.*, 2002). This is especially so in soils with elevated calcium levels and pH neutral-to-alkaline soils (Dragon and Rennie, 1995; Smith *et al.*, 2000). De Vos (1990) isolated *B. anthracis* spores from bones retrieved at an archaeological site in Kruger National Park, estimated to be 200 ±50 years old.

3.2.2.2 *Clostridium botulinum* (Botulism)

Botulism is a severe flaccid paralytic disease caused by seven different neuroparalytic toxin subtypes (A to G). The botulinum neurotoxins (BoNTs) are produced by the anaerobic Gram-positive bacterium, *Clostridium botulinum* (BoNT A to F). BoNT types A, B, E, and F are mainly responsible for human botulism, whereas toxin types C and D are involved in animal botulism (Woudstra *et al.*, 2012). The most common sources of animal botulism are contaminated poultry litter, soil or carcasses. Human botulism consists of food-borne botulism caused by the toxin pre-

Page:11

 **Number: 1 Author: johnf Subject: Sticky Note Date: 2014-03-28 07:38:44**

M.tb is not a Clostridium species, which is how this reads.

 **Number: 2 Author: johnf Subject: Highlight Date: 2014-03-28 07:38:54**

 **Number: 3 Author: johnf Subject: Sticky Note Date: 2014-03-28 07:33:12**

The natural habitat of C. botulinum is soil. Botulism is typically caused by the toxin in food, rather than the organism itself. Botulism really isn't relevant to this investigation

 **Number: 4 Author: johnf Subject: Highlight Date: 2014-03-28 07:37:10**

 **Number: 5 Author: johnf Subject: Highlight Date: 2014-03-28 07:30:23**

 **Number: 6 Author: johnf Subject: Sticky Note Date: 2014-03-28 07:39:21**

Sizwe

 **Number: 7 Author: johnf Subject: Highlight Date: 2014-03-28 07:39:10**

formed in foods as well as infant botulism caused by toxin produced in the intestine after ingestion of spores (Aranda *et al.*, 1997). *Clostridium botulinum* are found world-wide, but with limited prevalence. In areas where the bacteria are detected in soil there is potentially an increased risk for the disease; as from the soil *C. botulinum* may enter the food chain contaminating food or feed (Gressel and Bohnel, 2006).

3.2.2.3 *Mycobacterium tuberculosis*

The Mycobacterium tuberculosis complex (MTBC) is composed of closely related bacterial subspecies that have plagued human and animal populations for thousands of years. The most famous member of the MTBC is *M. tuberculosis*, the causal agent of tuberculosis in humans (Wirth *et al.*, 2008). *Mycobacterium bovis* the causal agent of bovine tuberculosis is also a member of MTBC. A study on the persistence of *M. bovis* in the environment indicated that it can remain in the soil for up to 88 days (Fine *et al.*, 2011).

3.2.3 Distribution of Graves/Sites

The literature search was inconclusive regarding the distribution and extent of graves / graveyards on the Linksfield site.

4. INTERPRETATION OF HISTORICAL AND RECENT AERIAL PHOTOGRAPHS

Due to the difficulty in identifying the exact boundary of the grave sites in the field a dedicated search for and interpretation of historical aerial photographs and satellite images was conducted. From the images three grave sites were identified.

The determination of the boundaries of the graveyards as well as the possible sites that were included from anecdotal evidence was challenging. As will be explained in the soil survey results most of the markers in the graveyards have been stolen or removed and only a few gravestones were evident on the site – occurring sporadically throughout. From the outset it was intended to identify the formal graveyards as well as any potential area that was used for the disposal of animal carcasses (having died from anthrax). Due to the dearth of information available from formal sources/records the only option was to obtain high resolution historical aerial photographs from Chief Directorate National Geospatial Information (CDNGI) in Mowbray, Cape Town. These images were obtained from CDNGI through the conducting of a dedicated search on their database as well as the high resolution scanning of the said images.

For the site images dating from 1937 (**Figure 2**) and 1948 (**Figure 3**) were used for the purposes of identifying the graveyard boundaries. In the 1937 image (**Figure 2**) the original boundaries of the graveyards along Club Road are clearly discernable. The older graveyard on the banks of the Jukskei River could not be identified from the image, neither could any other indication of burial activities. Significant extension of the Rietfontein Hospital buildings and developments is evident in

the 1948 (Figure 3) image. The graveyard signatures remain the same and again there are no indications of any other burial activities.

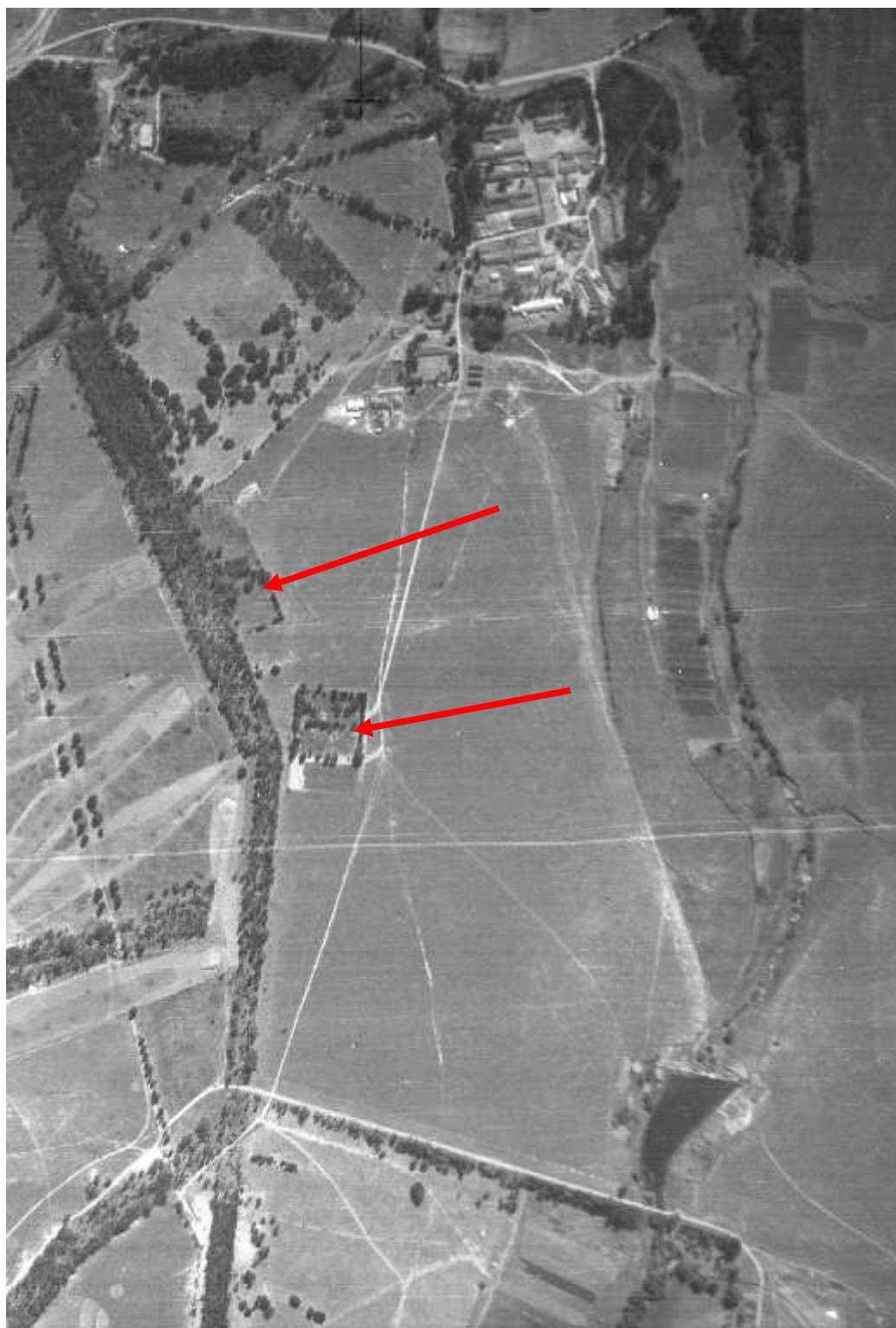


Figure 2 Extract from an aerial photograph dated 1937 indicating the original graveyard areas



Figure 3 Extract from an aerial photograph dated 1948 indicating the original graveyard areas

The graveyards identified above are the only ones indicated on the 1:50 000 topographic map for the area dating from 1954 (**Figure 4**).

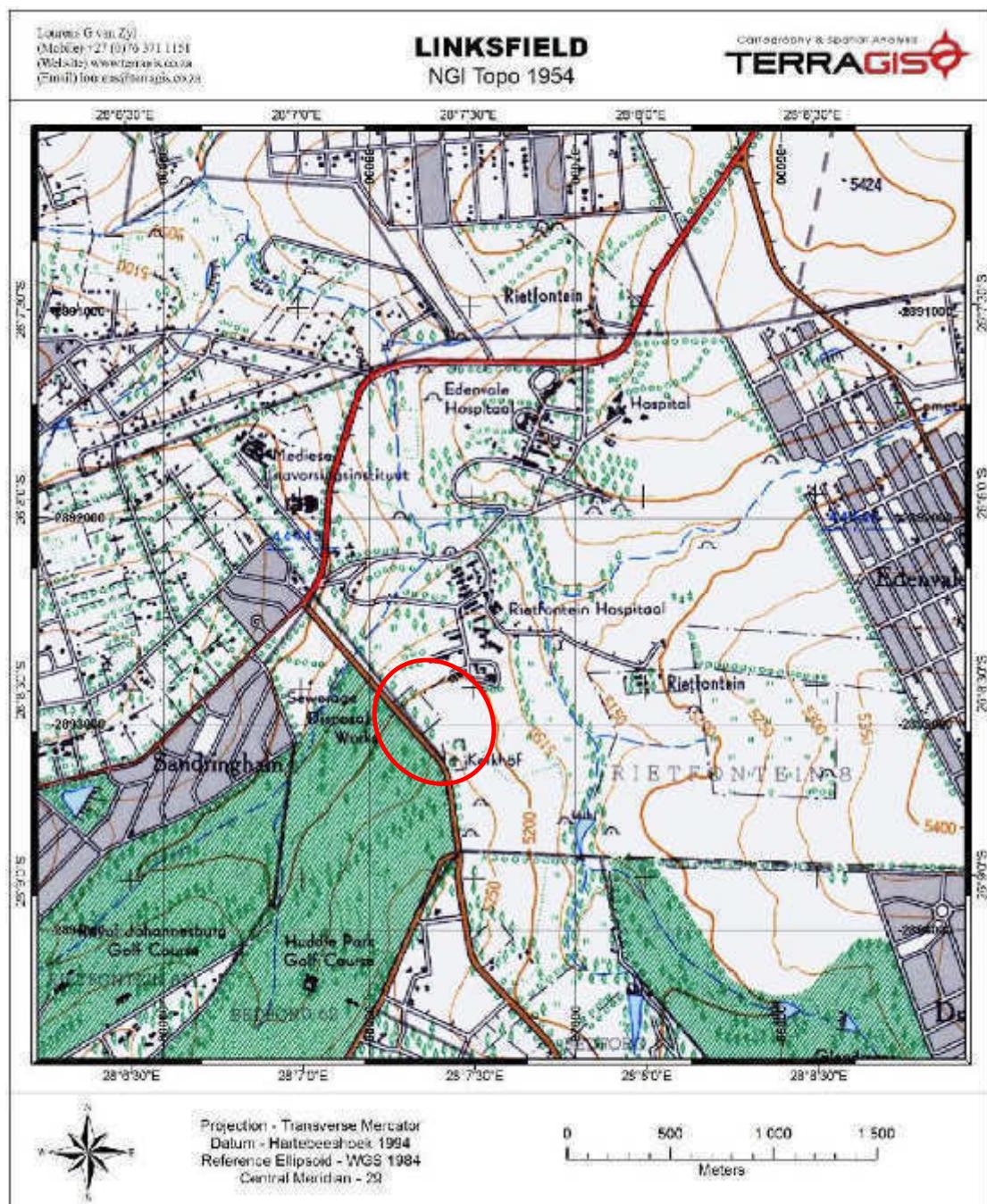


Figure 4 Extract from the 1:50 000 topographic map for the area, dating from 1954, indicating the two graveyards

Google Earth images from 2001 to 2012 (**Figures 5 to 10**) indicate the presence of the graveyards as well as the land use/cover changes on the site. This is especially evident in the removal of trees from the graveyards and the larger site as well as the significant increase in rubble around and in the graveyards along Club Road.

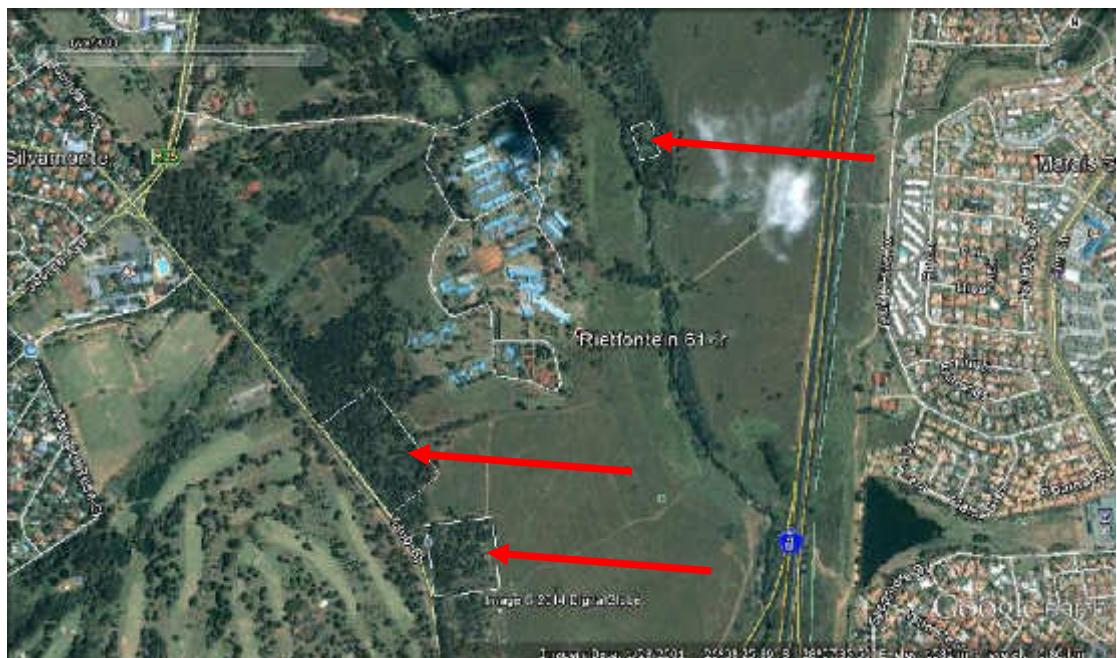


Figure 5 Google Earth image dated 2001/01/28 indicating the graveyards (note the presence of trees)



Figure 6 Google Earth image dated 2004/03/26 indicating the graveyards (note the cleared trees in all three the graveyards)



Figure 7 Google Earth image dated 2005/11/17 indicating the graveyards (note the cleared trees on the rest of the site)



Figure 8 Google Earth image dated 2008/09/07 indicating the graveyards (note the cleared trees on the rest of the site)



Figure 9 Google Earth image dated 2012/07/03 indicating the graveyards (note the increasing amount of rubble between and around the two main graveyards)

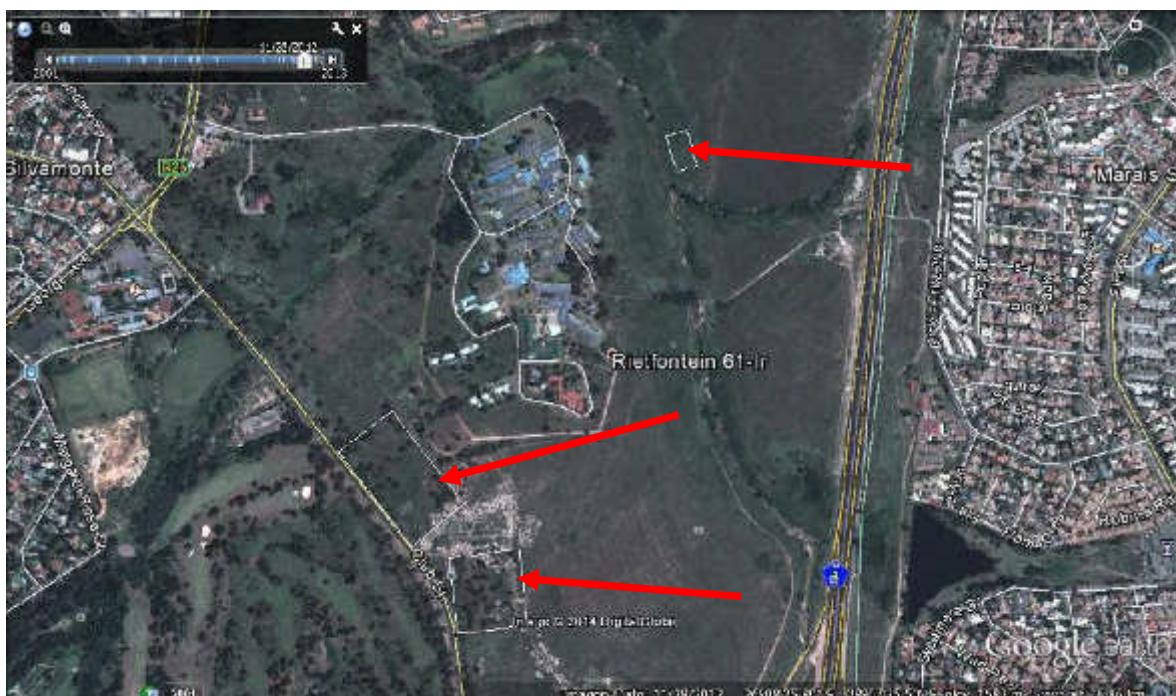


Figure 10 Google Earth image dated 2012/11/28 indicating the graveyards (note the increasing amount of rubble between and around the two main graveyards)

From the images there are no signs of other graveyards or burial sites. The dates and types of graveyards will be discussed with the results of the soil sampling exercise later in this report.

5. SOIL SAMPLING

Due to the sensitive nature of graves only the surface soil material could be sampled within the graveyards. On the outside perimeter of the graveyards, in undisturbed soils, profiles were dug for the geotechnical survey (report as produced by J Louis van Rooy, 2014). These profiles were sampled as well as described and classified according to the Taxonomic System (The Soil Classification Working Group, 1991). Two sets of soils samples were collected namely 1) small volume samples for microbial analysis and 2) larger volume samples, of a larger number, for basic soil chemical analysis.

5.1 MICROBIAL ANALYSIS SAMPLING

For the purpose of the microbial analysis samples were collected mainly from top part of soil (first 5 cm) but some samples included collection from greater depths (>5 – 60 cm) using a soil auger at different positions (outside of the graveyards) on the proposed development site (indicated by L# in **Table 1**). Soil samples were taken from mole hills in cemetery areas as this allowed for non-invasive sample collection in the cemeteries (in theory allowing sampling of soil brought from subsoil horizons to the surface by moles). In addition, as will be discussed in the results, snails were found to be associated with the mole hills in the graveyards. A live snail was collected and also subjected to analysis. Refer to **Table 1** for the listing, description and position of soil samples taken at Linksfield site. **Figure 11** provides the positions of the sample points.

5.2 SOIL CHEMICAL ANALYSIS SAMPLING

Samples were collected for the chemical analysis of the soils. The motivation being to determine 1) whether the bones had contributed to increased Ca levels in the graveyard soils; 2) whether the mole activity had brought Ca rich soil material to the surface; and 3) whether the soil chemical conditions were conducive for the survival of anthrax in the graveyard soils. For this purpose five profile pits, that were dug on the perimeter of the graveyards for the geotechnical survey, were sampled at different depths corresponding to diagnostic horizons or specific materials. These are indicated by the code LP# in **Table 2** and **Figure 12**. In the graveyard areas surface samples were taken from mole heaps only. These are indicated by the code LPG# in **Table 2** and **Figure 3**.

Table 1 Information of microbial analysis soil samples collected at Linksfield site

Sample number	Sample depth	Comments	Coordinates
L1-1	5 cm	High in organic matter	S26° 08' 19.7" E28° 07' 15.1"
L1-2	30 cm		
L1-3	60 cm	Mottled soil	
L2	Mole hill	High in organic matter	S26° 08' 28.3" E28° 07' 21.5"
L3-1	5 cm	Moist and include root matter	S26° 08' 29.4" E28° 07' 19.8"
L3-2	20 cm		
L4-1	5 cm	Depression	S26° 08' 31.1" E28° 07' 18.8"
L4-2	Mole hill	Clay	
L5	Mole hill	Near grave	S26° 08' 34.3" E28° 07' 24.6"
L6	Mole hill	Near grave of Mariahā	S26° 08' 40.2" E28° 07' 27.5"
L7	Mole hill	Near grave of Sidney James	S26° 08' 40.9" E28° 07' 27.9"
L8	Mole hill		S26° 08' 42.9" E28° 07' 27.4"
L9	Mole hill	Floodplain; structured soil	S26° 08' 10.3" E28° 07' 42.1"
L10	Mole hill	Floodplain: structured soil	S26° 08' 08.9" E28° 07' 41.9"
BIO-1 (snail)		Organic matter on snail	
BIO-2 (snail)		Shell of snail	

LINKSFIELD
Pathology Sample Points

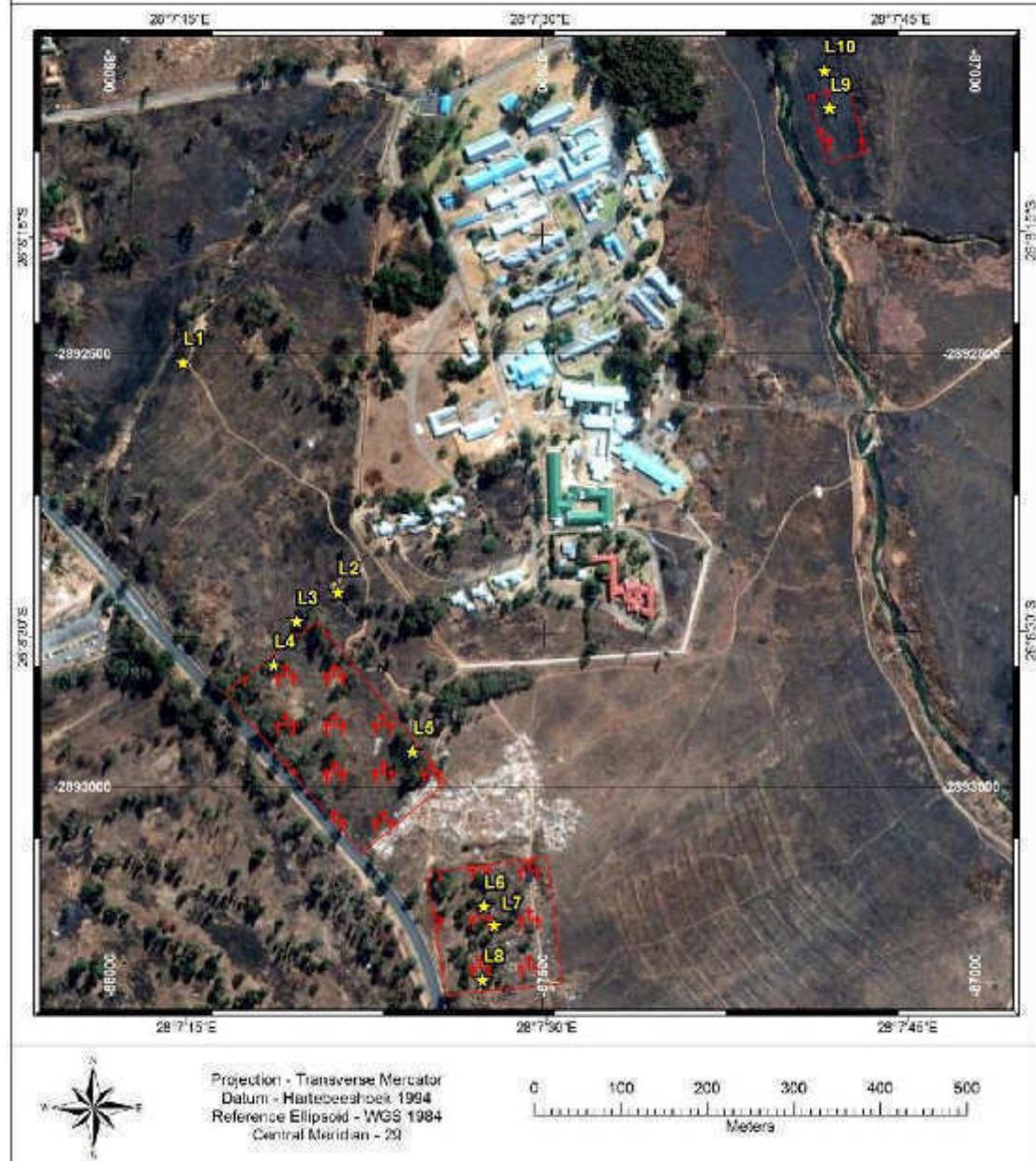


Figure 11 Location of the microbial sample collection points on the Linksfield site

Table 2 Information of chemical analysis soil samples collected at Linksfield site

Sample number	Sample Depth (cm)	Coordinates
LP1	0-10, 10-40, 40-60	S26° 08' 41.6" E28° 07' 29.9"
LP2	0-30, 30-60	S26° 08' 43.1" E28° 07' 27.5"
LP3	0-30, 30-60	S26° 08' 36.8" E28° 07' 24.5"
LP4	0-30, 30-60	S26° 08' 33.1" E28° 07' 24.3"
LP5	0-20, 20-40, 40-60	S26° 08' 29.6" E28° 07' 19.0"
LPG1	0-10	S26° 08' 33.7" E28° 07' 23.6"
LPG2	0-10	S26° 08' 34.9" E28° 07' 22.2"
LPG3	0-10	S26° 08' 35.0" E28° 07' 21.4"
LPG4	0-10	S26° 08' 31.8" E28° 07' 23.0"
LPG5	0-10	S26° 08' 29.9" E28° 07' 18.9"
LPG6	0-10	S26° 08' 31.3" E28° 07' 22.1"
LPG7	0-10	S26° 08' 31.7" E28° 07' 21.6"
LPG8	0-10	S26° 08' 32.2" E28° 07' 19.8"
LPG9	0-10	S26° 08' 40.1" E28° 07' 28.3"
LPG10	0-10	S26° 08' 40.6" E28° 07' 27.1"
LPG11	0-10	S26° 08' 41.1" E28° 07' 26.4"

LINKSFIELD
Chemical Analysis Sample Points

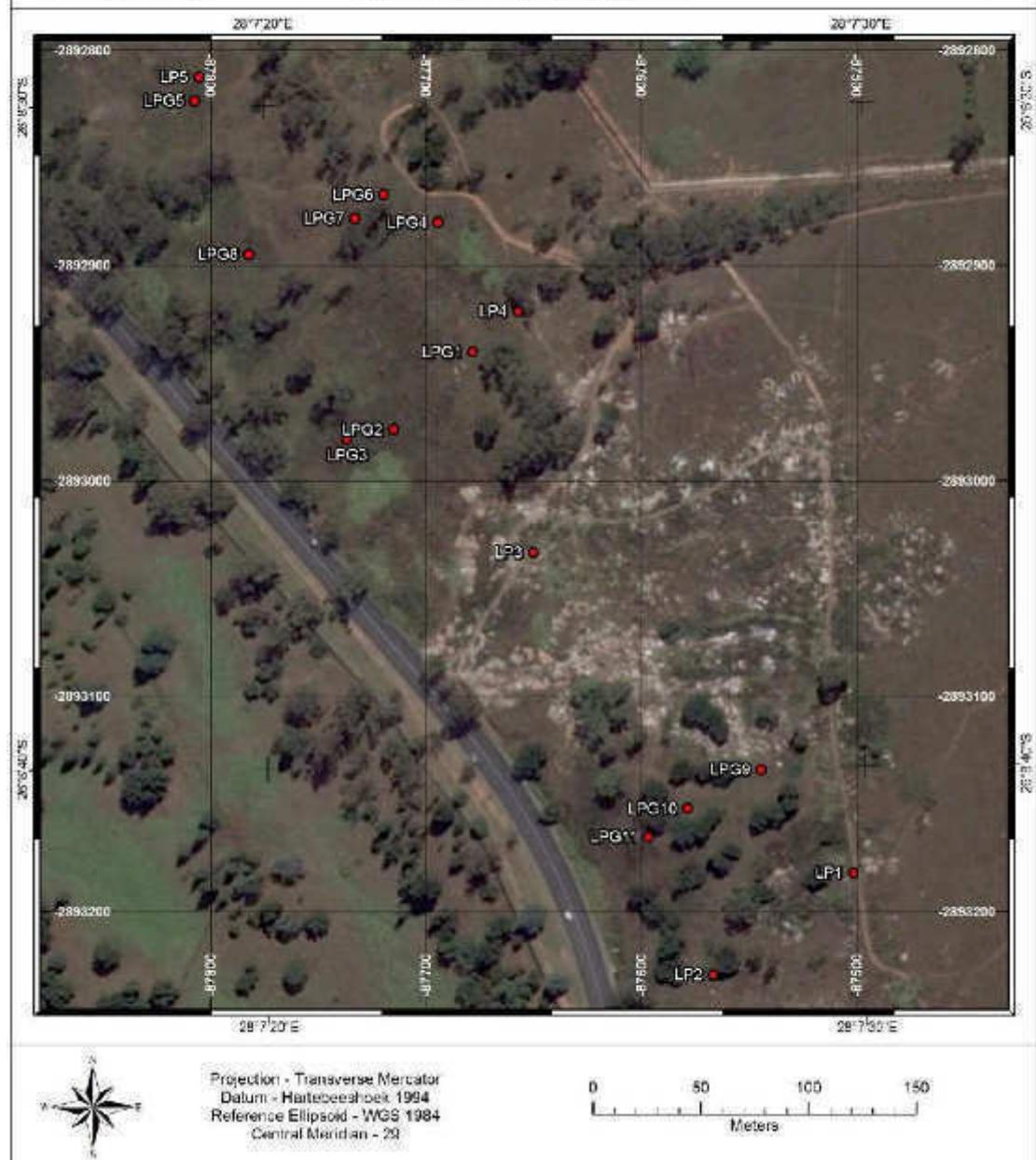


Figure 12 Location of the chemical sample collection points on the Linksfield site

5.3 SOIL SAMPLING RESULTS / OBSERVATIONS

The sampling process in the graveyard areas was restricted due to different sets of legislation (such as the National Heritage Resources Act – Act No. 25 of 1999) that govern the disturbance of such sites that precluded unauthorised digging and auguring. During the site visit it was observed that there was very intensive mole activity among the graves (**Figures 13 and 14**). Upon closer inspection it was evident that the soils in the graveyard areas have been disturbed drastically through the digging of the graves as well as the subsequent mole activity. It was postulated that the moles had mixed the soil material as well as brought decaying bone remains to the surface. This postulation became more credible as large numbers of snails were encountered among the graves (**Figures 15 to 17**). It is well known that snails can only develop and multiply in soils with enough Ca for shell formation.

The soils in the graveyard area are predominantly of the Glenrosa form. These soils have a sandy orthic A horizon (bleached in the lower slope areas of the site) overlying a varyingly weathered serpentine/greenstone rock subsoil (lithocutanic B horizon) that is often red in colour. The interface between the topsoil horizon and the weathered rock subsoil is often characterised by a distinct quartz pebble marker. This marker is found in undisturbed soil profiles outside of the graveyard at a depth of 30 to 50 cm (**Figures 18 and 19**). These pebbles are encountered at the soil surface in the graveyard due to the mixing of material during grave digging as well as due to mole activity. Mole hills contain both coarse (including pebbles) and fine soil material when fresh. The latter is removed with rainfall events and the result is that the pebbles are distinctly visible on the soil surface (**Figure 13**). The presence of the pebbles on the surface is considered to be a good indication of the degree of mixing that the soils have been subjected to.

The depth of the weathered rock profile leads to an additional postulation that the graves were not 1.8 m deep (as is convention). This postulation is confirmed by the lack of weathering greenstone-serpentine rock material on the surface amongst the quartz pebble marker material. We postulate therefore that the graves are at best 0.6 to 0.7 m deep. Under these conditions it is entirely plausible that human remains (and the weathering products of bone material – Ca rich soil) would have been brought to the soils surface by mole activity. The presence of copious amounts of snails in the graveyard areas provides further credibility to this postulation.

Under the conditions as described above it was considered entirely adequate to collect soil material from mole hills for further analysis. The sample points indicated in **Figures 2 and 3** and **Tables 1 and 2** relate predominantly to such material. Outside of the graveyards the conventional manner of auguring was used to collect the relevant samples. In the latter areas the presence of the stone marker at depth inhibited further auguring.



Figure set 13 Mole activity in the graveyard area



Figure set 14 Mole activity among the graves in the graveyard area



Figure 15 Snail shell found among the graves

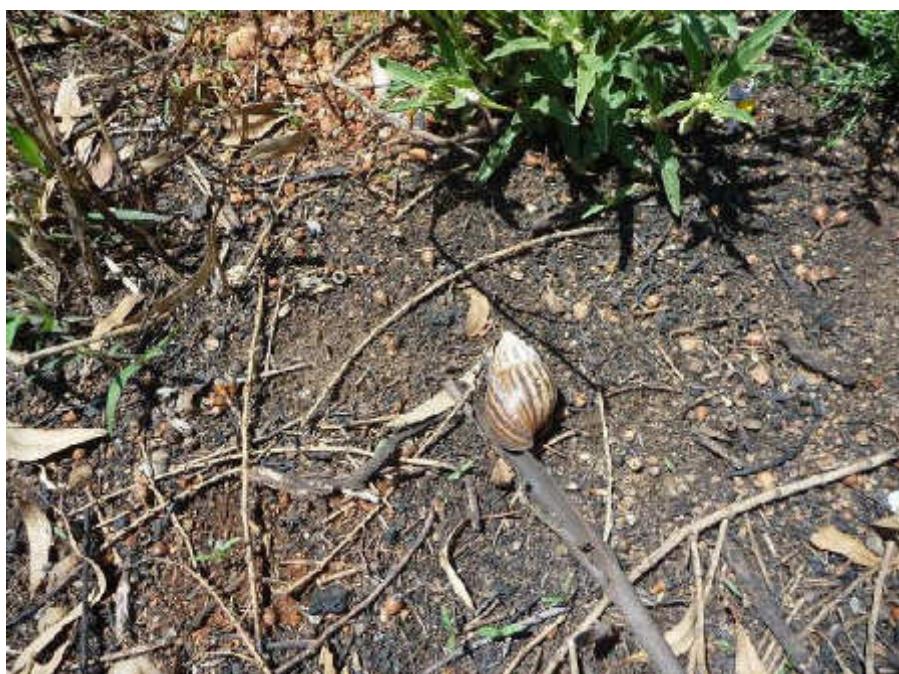


Figure 16 Snail shell found among the graves



Figure 17 Live snails found among the graves



Figure 18 Profile next to the graveyard with distinct pebble marker (yellow arrow)



Figure 19 Profile next to the graveyard with distinct pebble marker (yellow arrow)

6. MICROBIOLOGY / PATHOLOGY ANALYSIS

6.1 MATERIAL AND METHODS

6.1.1 Culturing of Bacteria

Soil samples were processed to allow culturing of *Bacillus anthracis* (causal agent of anthrax) and *Clostridium* species. Soil (1 g) was aliquoted into 9 ml of phosphate buffered saline (PBS) in duplicate for each sample. The samples were shaken for 3 hours and one was plated directly onto nutrient agar while the second sample was heat treated. Heat shock treatment kills off all vegetative bacterial cells and is a means of selecting for the more resistant spore-forming bacteria (*Bacillus* and *Clostridium* species). The 3-hour samples plated onto nutrient agar were pooled for anaerobic culturing of *Clostridium* species by the Bacteriology Laboratory, Department of Veterinary Tropical Diseases, Onderstepoort. *Bacillus anthracis* strains were confirmed using real time PCR as describe by Ellerbrok *et al.* (2002) that detect *B. anthracis* chromosomal region (SASP), protective antigen (pXO1 target BAPA) and capsule (pXO2 target capC) regions.

The heat treated set of samples were plated out onto selective media (PLET) and incubated at 37°C for 8 hours to select for *Bacillus* spp. Both the untreated and heat treated nutrient agar plates were incubated in 5% CO₂ at 37°C overnight to select for other bacteria. The bacterial

lawns were harvested in 1 ml PBS after incubation and split into 2 samples; one for crude boiling DNA extraction and the other for further culturing after serial dilution up to 10^{-8} . The raw soil and PBS solution were also crude boiled at a 110°C for 20 min and the supernatants collected for PCR.

6.1.2 PCR

6.1.2.1 *Bacillus anthracis* Real Time PCR

Bacillus anthracis consists of a chromosome (target SASP) and the virulent factors occurring on two plasmids namely pXO1 (target BAPA) that contain toxins and pXO2 that contain capsule (target CapC). Real time PCR was done as described by Ellerbrok *et al.* (2002).

6.1.2.2 *Clostridium* Conventional PCR

Universal *Clostridium* primers (Chis150/Clostir primers) as described by Hung *et al.* (2008) amplify all *Clostridium* species, which include both pathogenic and environmental strains. The *Clostridium* PCR reaction and condition used by Hung *et al.* (2008) were used in this study.

6.1.2.3 *Mycobacterium* PCR

The *Mycobacterium* PCR targets the RD4 and RD9 regions that identified *B. tuberculosis* and *B. bovis* (Warren *et al.*, 2006). The RD4 region produces a PCR product of 268 bp (size of PCR target in base pairs) for *M. bovis* and 172 bp (base pairs) for *M. tuberculosis*, whereas RD9 region produces 108 bp for *M. bovis* and 235 bp for *M. tuberculosis*.

6.2 RESULTS

6.2.1 Culturing of *Bacillus anthracis*

Soil depth plays a role in the isolation of pathogens and presence of soil endophytes (**Figure 20**). There is a logarithmic decrease in spore counts the deeper the soil is collected. The deeper soil fractions are more representative of typical soil endophytes such as *Bacillus subtilis*, *B. megaterium* and *B. endophyticus*.

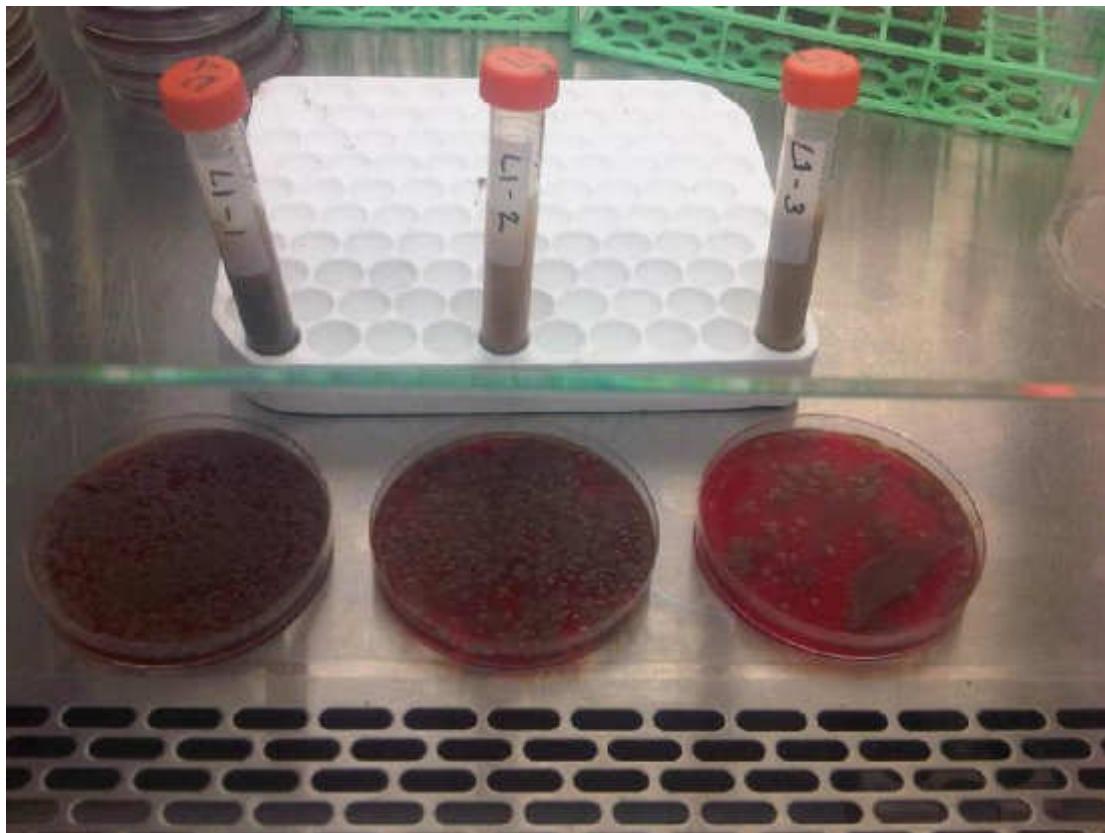


Figure 20 Growth of spore-forming bacteria on blood agar plates from different soil depths at the same site after incubation at 37°C for 8 hours. L1-1 (left) is from the top 5 cm of soil. L1-2 (middle) shows growth from a soil depth of 30 cm and L1-3 (right) is from a depth of 60cm. The decreasing spore-forming bacteria counts are evidenced in the deeper soil fractions.

The bacterial growths observed on blood agar plates were typical for the usual soil endophytes. *Bacillus cereus* was present on all the plates as *B. cereus* circular colonies appear granular being haemolytic (clear zones) (**Figure 21**). *Bacillus cereus* is the most abundant spore former in the area especially in the surface soil fraction. This is not surprising because of the organic/plant root matter present in the topsoil to which *B. cereus* is generally associated.

Soil samples L9 and L10 demonstrated a different assemblage of bacterial populations to the other plates. Colonies on blood agar plates (undiluted) for L1-L8 were all haemolytic while L9 and L10 had haemolytic and non-haemolytic colonies (**Figure 22**). These non-haemolytic colonies were sub-cultured and purified and appear to be *Bacillus thuringiensis* which is a typical soil borne insect pathogen.



Figure 21 Image with typical *Bacillus cereus* colonies on blood agar plates (samples L1-L8 at a dilution of 10^{-6}) from soils at Linksfield site.

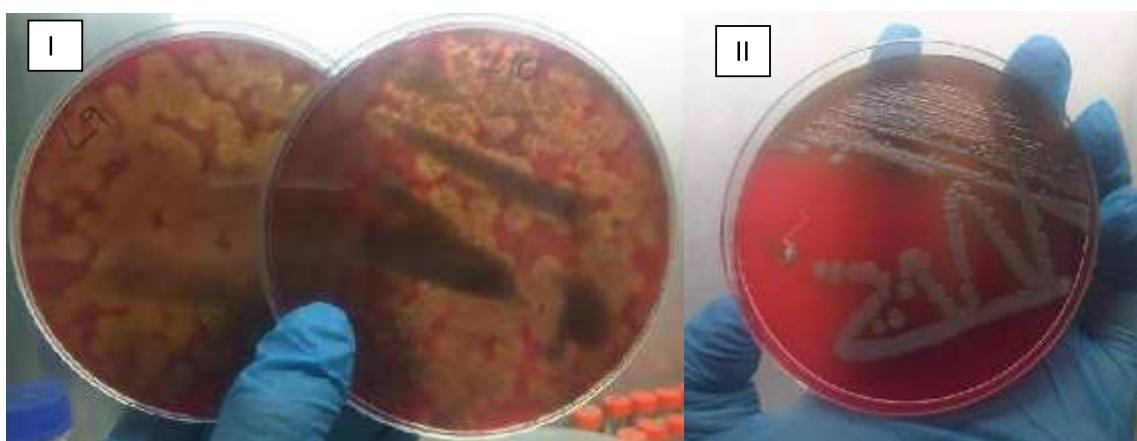


Figure 22 (I) Haemolytic colonies (yellow blotches) and non-haemolytic colonies (red) from samples L9 and L10. Colonies were purified by streaking on blood agar plates and (II) indicate a purified non-haemolytic *B. thuringiensis* culture.

6.2.2 Culturing of *Clostridium*

Refer to the attached report of the Bacteriology Laboratory indicating that pooled soil sample was negative for *Clostridium*.

6.2.3 PCR

6.2.3.1 Real Time PCR for *Bacillus anthracis*

Refer to attached *Bacillus anthracis* Real time PCR report 1 and 2:

Report 1 indicates the real time PCR targeting the toxin plasmid (pXO1, BAPA target). Positive real time PCR results for BAPA (target pXO1 region; page 2 of 4 (Report 1) indicated by samples with CP value and amplification curves (page 3 of 4)). The positive control *B. anthracis* Vollum and Sterne strains were positive as well as samples L1-1, L2, L3-1, L3-2, L4-2, L5 and L6.

Report 2 indicates the real time PCR results for *B. anthracis* chromosome (SAPA) and capsule plasmid, pXO2 (capC). The report shows positive PCR results for only positive *B. anthracis* Ames strain on page 2-3 of 5 (see CP values and amplification peak). *Bacillus anthracis* real time PCR products must be positive for all three targets as virulent *B. cereus* (a close relative to *B. anthracis*) is known from literature to contain similar BAPA (pXO1) (Okinaka *et al.*, 1999, Rasko *et al.*, 2004; Okinaka *et al.*, 2006) region. *Bacillus anthracis* is therefore not present in any of the samples as the chromosomal (SAPA) and pOX2 (capC) real time PCR target regions are absent.

6.2.3.2 *Clostridium* PCR

The presence of spore-forming bacterium *Clostridium* was tested using universal Chis150/Clostr primers (Hung *et al.* 2008) for *Clostridium* cluster I species that include both pathogenic (such as *C. botulinum*) and environmental strains. Ten (L1-1, L2, L3-2, L4-1, L4-2, L6-10) of the enriched bacterial lawns (sample number indicated in red in **Figure 23**) showed positive amplification for *Clostridium* spp. However it is interesting to note that from the crude boiled soil lysate, only L9 showed faint amplification (sample numbers in blue) (**Figure 23**).

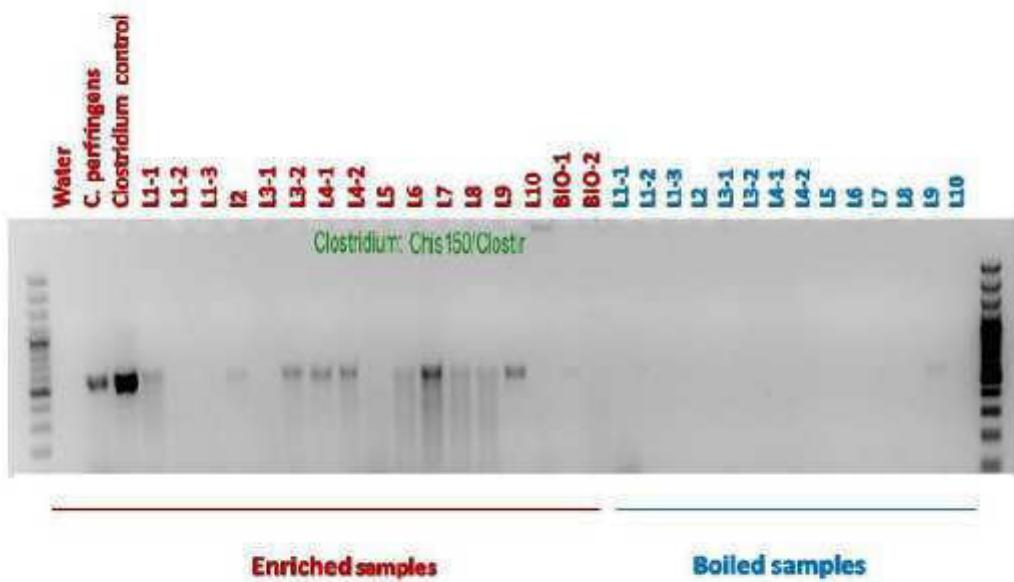


Figure 23 PCR gel image showing PCR products (amplification) for the 2 positive *Clostridium perfringens* and unidentified *Clostridium* species as well as some enriched soil samples (indicated in red) and faint positive PCR product (L9 in blue for crude boiled soil lysate).

6.2.3.3 *Mycobacterium* PCR

The *Mycobacterium* PCR targets the RD4 and RD9 regions that differentiate species within the *Mycobacterium* complex (Warren *et al.* 2006). With the RD4 PCR region, none of the samples were positive for either *Mycobacterium tuberculosis* or *M. bovis*. The RD9 PCR region indicated non-specific PCR products (not the right size; indicated in green in **Figure 24**) due to the presence of non-tuberculosis *Mycobacteria* (NTM's) and faint PCR products for *M. tuberculosis* in sample L9 and L10 (**Figure 24**).

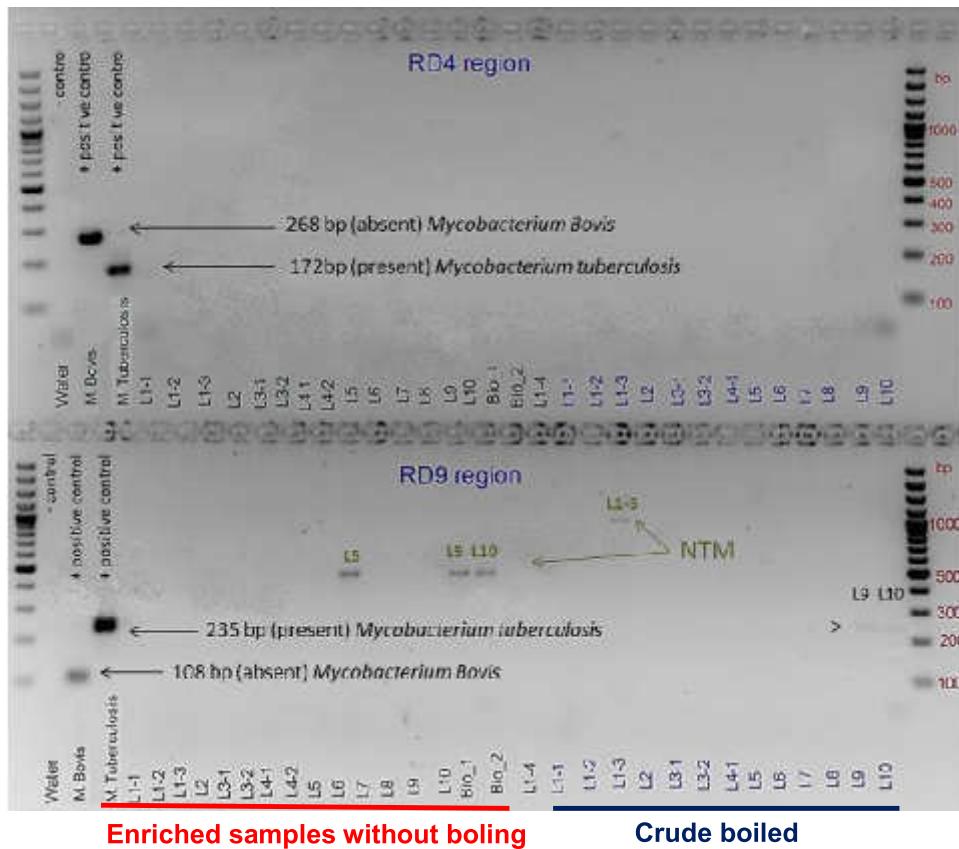


Figure 24 PCR gel image of RD4 and RD9 *Mycobacterium* PCR of enriched samples (in red) and crude boiled samples (in blue). No amplification where obtained in samples collected from Linksfield site for *M. tuberculosis* and *M. bovis* RD4 PCR. With *M. tuberculosis* and *M. bovis* RDp PCR amplification of 235 bp products were obtain with sample L9 and 10. Non-specific PCR products of 500 bp and larger where obtained for L5, L9, L10 (enriched samples) and L1-3 (crude boiled sample).

6.2.3.4 Results summary

Table 2 provides a summary of the results in terms of positive findings.

Table 2 Summary of positive results

Sample	Depth	Comment	Clostridium	Mycobacterium	Bacillus	
L1	1 5cm	high in organic matter	+		+	L1
	2 30cm					L2
	3 60cm	mottled soil				L3
L2	mole hill	high in organic matter	+		+	L4
L3	1 5 cm	moist + includes root matter			+	L5
	2 20cm				+	L6
L4	1 5cm	depression: possible cattle burial site?	+			L7
	2 30cm	clay	+		+	L8
L5	mole hill	near Human grave	+		+	L9
L6	mole hill	near grave of Mariaha			+	L10
L7	mole hill	near grave of Sidney James	+			
L8	mole hill		+			
L9	mole hill	floodplane: well structured soil	+	+		
L10	mole hill	floodplane: well structured soil	+	+		
Bio	1 snail	organic	+			L6
	2 snail	shell				

6.3 DISCUSSION

Bacillus anthracis (causal agent of anthrax) was not found at the site but the unconfirmed / undocumented reports of anthrax cases buried at the site poses a possible health risk as *B. anthracis* can survive for extended periods in the soil. From the literature investigating the persistence of bacteria and viruses it was clear that anthrax (approximately 200 years) and smallpox (8 years) persist for extended periods (Pirtle and Beran, 1991; Gressel and Bohnel, 2006; Fine *et al.*, 2011; Sinclair *et al.*, 2008). De Vos (1990) isolated *B. anthracis* spores from bones retrieved at an archaeological site in Kruger National Park, estimated to be 200 ±50 years old. *Bacillus anthracis* can remain in the soil for decades and humans could contract it through skin lesions or through inhalation from breathing in airborne anthrax spores. This will only occur if buried carcasses are uncovered during development. However the soil composition lowers the health risk anthrax poses since the soils in the black and white cemeteries are mildly acidic unlike the soils associated with endemic anthrax with elevated calcium and neutral-to-alkaline soils (Dragon and Rennie, 1995; Smith *et al.*, 2000).

Humans occasionally become infected by coming into direct contact with blood, excreta, wool, skin or meat of infected animals. Drum makers have contracted the diseases working with infected hides over an extended period (Marston *et al.*, 2011). The health risk will be associated with exposure of anthrax infected carcass. Persons can develop lesions only at the site of a skin wound. This condition is treatable with antibiotics. Note that humans are usually highly resistant to this disease. However, as there is a potential risk, workers will have to be given a standard operating procedure upon uncovering graves. Workers will have to be properly informed about the disease and the risks. Workers will have to adhere to a "biosecurity" protocol that will be set up and safety measures will have to be in place. Workers and general public will have to be informed of anthrax and the symptoms. If grave sites are uncovered the bones / grave site must be covered with soil, excavation must be stopped and experts must be called in to identify the origin of the bones. Samples should be taken to confirm the absence/presence of *Bacillus anthracis*. Should any sample be positive for anthrax all workers will have to receive medical care and a treatment protocol using penicillin or a cephalosporin (penicillin susceptible individuals).

The cost will be difficult to determine since there might be unknown grave sites exposed during excavation. However the presence or absence of anthrax must be confirmed in exposed graves. If anthrax is found, that specific grave site will have to be decontaminated using a prescribed protocol. However most of the prescribe protocols are for laboratories and for solid surfaces. Chemical are used for cleaning anthrax-contaminated sites or materials. Mainly oxidizing agents such as peroxides, ethylene oxide, chlorine dioxide, peracetic acid, hypochlorous acid and liquid bleach containing hypochlorite. Many of the anthrax decontamination technologies have been demonstrated to be effective in laboratory tests (Heninger *et al.*, 2009). Clean up of anthrax-contaminated areas on ranches and in the wild is much more problematic. Carcasses have been soaked in formaldehyde to kill spores, though this has environmental contamination issues. Therefore research will have to be done on the effect of the agents on the spores and the environment. The use of different chemical agents can be viewed at the following websites:

<http://www.epa.gov/pesticides/factsheets/chemicals/chlorinedioxidefactsheet.htm>

http://www.epa.gov/pesticides/factsheets/chemicals/hydrogenperoxide_peroxyaceticacid_factsheet.htm

<http://www.epa.gov/pesticides/factsheets/chemicals/etofactsheet.htm>

Clostridium species (including pathogenic and non-pathogenic) DNA was detected using conventional PCR but no *Clostridium* could be cultured. The presence of *Clostridium* DNA means that the organism was present at some stage but not currently as we could not isolate *Clostridium* from the samples. *Clostridium* DNA poses no health risk. *Clostridium* botulism is a Category A agent but the botulinum neurotoxins types A, B, E, and F are responsible for human botulism, whereas toxin types C and D are involved in animal botulism. There is no record of any human death due to botulism and if animals were buried that died of animal botulism the toxin (types C and D) pose no threat to humans (Woudstra *et al.* 2012).

Mycobacterium tuberculosis, the causal agent of human tuberculosis, is a slow growing organism and culturing will take up to 3 months. PCR was used to detect whether *M. tuberculosis* is present on the site. *Mycobacterium tuberculosis* DNA was present in 'floodplain' sites (L9 and 10). However it is possible that the DNA was present due to the presence of hospital effluent from the HIV and tuberculosis hospital (although this is just one of many possibilities). It is important to note that presence of DNA does not pose a health risk, but is merely used as a guide or diagnostic for bacterial isolation. *Mycobacterium tuberculosis* poses a very low risk as it requires a host and does not survive in soil. However it might pose a higher risk to people living currently on the site. The effluent and waste disposal of Siswe Hospital will have to be investigated to ensure it poses no health risk to people currently living in the area or people living on the site in future. We could not confirm the presence of *M. leprae* DNA (agent of leprosy) at all through the molecular tests available to us.

With the culture and real time PCR no anthrax (*B. anthracis*) was detected. Only pathogenic *B. cereus* was cultured. *Bacillus cereus* is the cause of two kinds of foodborne diseases, an emetic (vomiting) intoxication due to the ingestion of a toxin (cereulide) pre-formed in the food and a diarrhoeal infection due to the ingestion of bacterial cells/spores which produce enterotoxins in the small intestine (Arnesen *et al.*, 2008). *Bacillus cereus* is ubiquitous and its spores will not be eliminated from food materials by heat treatment, apart from canning. Spores are present in almost all categories of foods before storage, generally in numbers too low to cause foodborne poisoning (Opinion of the Scientific Panel on Biological Hazards, 2005). It therefore poses a negligible risk.

7. SOIL ANALYSIS RESULTS

7.1 Soil Physical Analysis

During the sampling and field survey it was observed that a large fraction of the soil consisted of material coarser than 2 mm. Soil is defined as the fraction smaller than 2 mm. The samples that were collected were sieved through a 2 mm sieve for preparation for chemical analysis. The coarse fraction was retained and weighed as was the fraction smaller than 2 mm. The results of this determination are presented in **Table 3**. The samples collected from profile pits showed a general increase in coarse fraction from the surface downwards, although this was not observed in all profiles. The coarse fractions varied significantly from 27 to 77 %. In the graveyard soils (only surface material) the variation was significantly less viz. 26 to 48 %. Although this data is of very little significance it is interesting to note that the graveyard soils could exhibit the smaller variation due to the mixing of materials due to grave excavation and subsequent mole activity leading to more homogenised profiles.

Table 3 Percentage coarse fraction (> 2 mm) in the samples

Sample	Depth	> 2 mm (g)	< 2mm (g)	Total	% coarse
LP1	0-10	233.5	621.0	854.5	27.3
LP1	10-40	604.8	514.6	1119.4	54.0
LP1	40-60	429.5	181.4	610.9	70.3
LP2	0-30	405.3	525.9	931.2	43.5
LP2	30-60	1033.8	353.1	1386.9	74.5
LP3	0-30	1794.8	713.0	2507.8	71.6
LP3	30-60	592.5	506.3	1098.8	53.9
LP4	0-30	570.5	1027.8	1598.3	35.7
LP4	30-60	708.8	1350.0	2058.8	34.4
LP5	0-20	726.6	1168.1	1894.7	38.3
LP5	20-40	1478.4	635.8	2114.2	69.9
LP5	40-60	1322.0	396.0	1718.0	76.9
LPg1	0-10	460.5	1298.7	1759.2	26.2
LPg2	0-10	742.6	966.0	1708.6	43.5
LPg3	0-10	882.7	949.2	1831.9	48.2
LPg4	0-10	451.4	916.4	1367.8	33.0
LPg5	0-10	854.4	1100.6	1955.0	43.7
LPg6	0-10	641.5	953.9	1595.4	40.2
LPg7	0-10	597.8	810.6	1408.4	42.4
LPg8	0-10	788.2	1138.9	1927.1	40.9
LPg9	0-10	527.1	933.8	1460.9	36.1
LPg10	0-10	733.6	1003.7	1737.3	42.2
LPg11	0-10	697.2	1147.6	1844.8	37.8

7.2 Soil Chemical Analysis

The results of the chemical analysis of the samples are provided in **Table 4**. The data set was split for control soils outside of the graveyard areas and graveyard soils. For each set a standard set of statistical parameters were calculated. These include: average (or mean), standard deviation, coefficient of variation, and minimum and maximum values indicating the range.

7.2.1 Soil pH

The pH values for the control plots as well as the graveyard ranged roughly between 4.5 and 6.3 (**Figure 25**). Although there was a slightly larger variation in the graveyard plots the averages were similar and in the range of 5.1 to 5.3. These two values are not considered to be significantly different and the fact that the ranges overlap distinctly indicate that there is no significant difference between the control and graveyard soils. These pH values are not conducive to the survival of anthrax (*B. anthracis*) in soil as its survival requires much higher pH values.

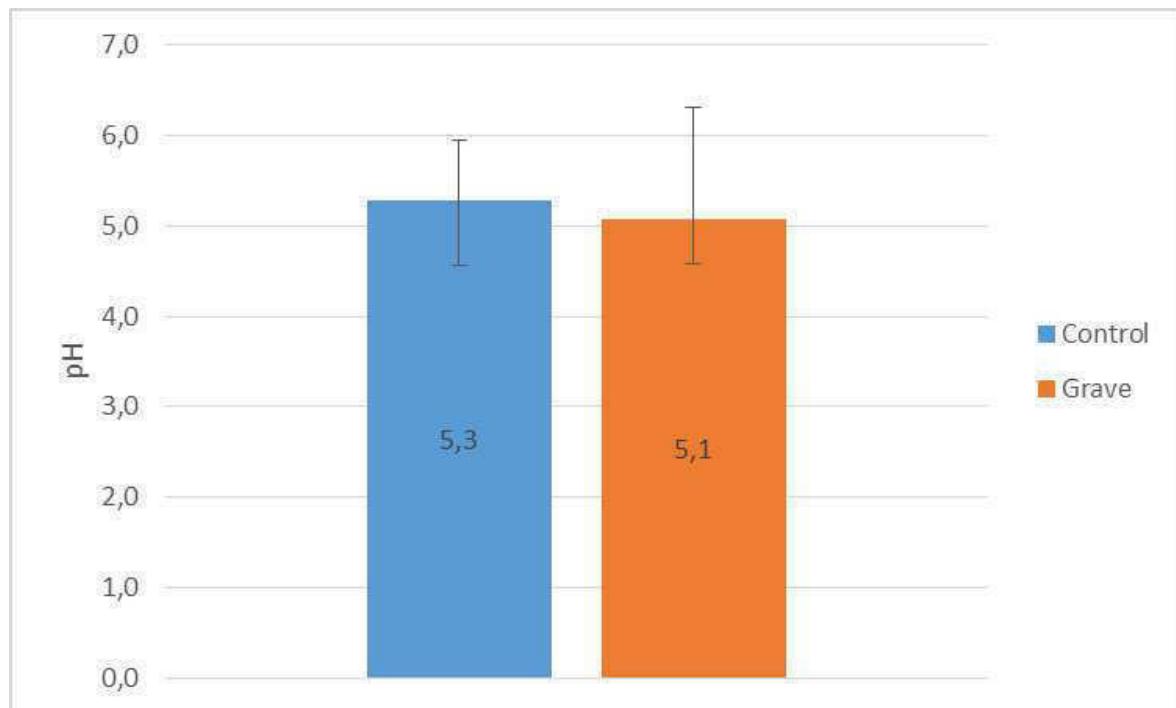


Figure 25 Average soil pH values for the two areas (error bars indicate the data range)

Table 4 Selected chemical parameters of the sampled soils

Sample	Depth	pH (water)	Exchangeable Cations (ammonium acetate)				Bray 1
			K (mg/kg)	Mg (mg/kg)	Ca (mg/kg)	Na (mg/kg)	
Control pits / outside of graveyards							
LP1	0-10	5.6	159.9	188.4	1840.7	6.5	15.7
LP1	10-40	5.7	69.2	172.8	1237.7	6.5	9.0
LP1	40-60	6.0	79.1	462.4	1453.7	11.2	5.5
LP2	0-30	5.9	82.0	83.2	1766.7	6.7	10.1
LP2	30-60	5.2	50.4	65.1	521.2	6.2	11.9
LP3	0-30	5.6	99.1	104.9	1218.7	6.0	14.6
LP3	30-60	5.0	97.3	95.5	573.9	7.0	7.8
LP4	0-30	4.9	116.9	55.2	475.2	6.1	14.5
LP4	30-60	4.6	70.1	82.0	276.3	6.6	11.8
LP5	0-20	5.1	94.3	70.4	896.2	5.0	45.3
LP5	20-40	5.0	81.7	53.8	476.6	4.4	23.8
LP5	40-60	5.1	63.1	80.6	618.7	4.4	12.3
Average		5.3	88.6	126.2	946.3	6.4	15.2
Standard deviation		0.4	28.8	114.2	540.2	1.8	10.6
Coefficient of variation		8.3	32.5	90.5	57.1	27.5	69.5
Minimum value		4.6	50.4	53.8	276.3	4.4	5.5
Maximum value		6.0	159.9	462.4	1840.7	11.2	45.3
Graveyards							
LPg1	0-10	4.9	84.1	38.5	394.0	6.3	23.2
LPg2	0-10	4.8	114.2	63.9	489.2	3.9	24.5
LPg3	0-10	5.2	232.0	98.8	1407.7	8.1	21.8
LPg4	0-10	4.8	130.9	46.8	567.6	7.3	23.8
LPg5	0-10	5.4	203.7	121.1	1682.7	9.9	67.6
LPg6	0-10	5.1	127.2	41.4	697.7	4.3	30.2
LPg7	0-10	5.2	151.7	64.9	982.7	13.0	23.8
LPg8	0-10	4.6	168.6	98.3	1119.7	8.1	31.3
LPg9	0-10	6.3	269.9	196.5	1007.7	5.3	14.6
LPg10	0-10	4.7	109.5	93.9	994.7	6.7	32.1
LPg11	0-10	4.9	135.1	221.9	1516.7	7.5	32.1
Average		5.1	157.0	98.7	987.3	7.3	29.5
Standard deviation		0.5	56.7	61.0	426.5	2.6	13.7
Coefficient of variation		9.6	36.1	61.8	43.2	35.7	46.4
Minimum value		4.6	84.1	38.5	394.0	3.9	14.6
Maximum value		6.3	269.9	221.9	1682.7	13.0	67.6

7.2.2 Exchangeable Cations

The exchangeable cations Ca, Mg and Na showed the same extent of variation as the pH values with no significant difference between the control and the graveyard areas. The results for Ca are indicated in **Figure 26**. Even though the range is slightly larger in the control soils the data overlaps significantly and it is therefore considered not to be significantly different.

The similarity in Ca levels is significant in that it negates any deductions on the degree of bone degradation and dissolution in the soils as well as mixing of soil material by moles. The Ca data is therefore inconclusive regarding such deductions.

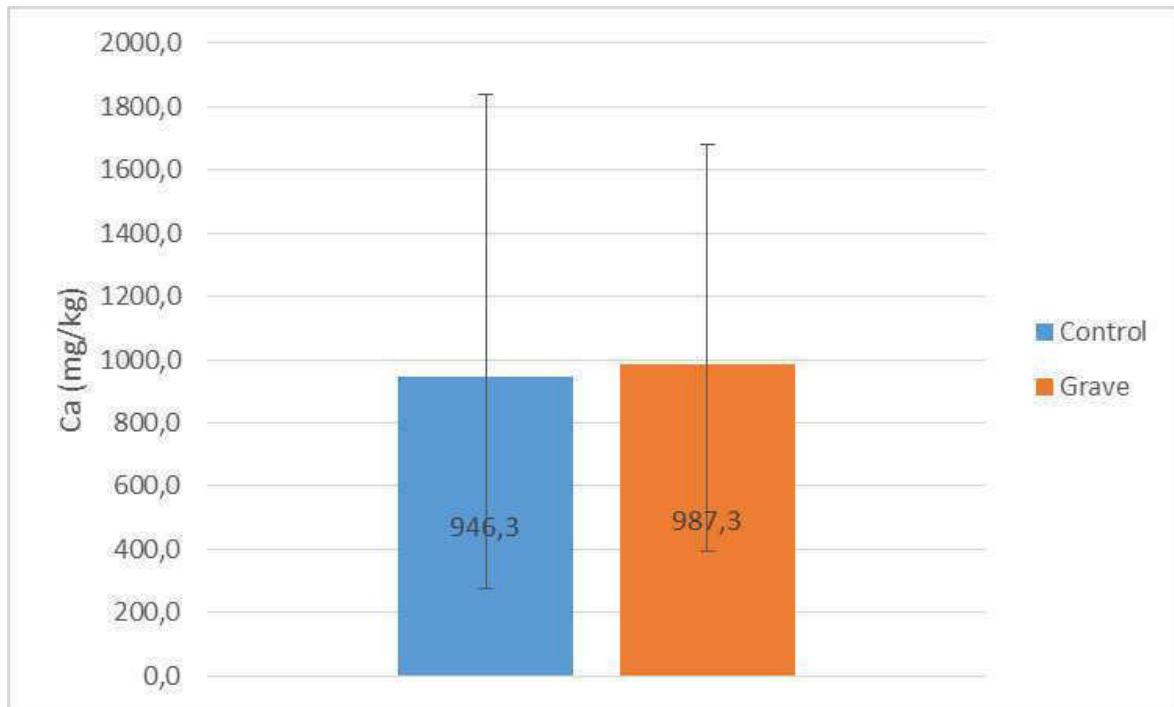


Figure 26 Average soil Ca values for the two areas (error bars indicate the data range)

The K values did indicate a large degree of difference in that the graveyards soils exhibited significantly higher levels compared to the control soils (**Figure 27**). This phenomenon could be ascribed to a range of factors other than graves so there is not much significance assigned to it. It is possible that the decaying bodies in the graveyard contributed to the higher K levels in these soils but this aspect is outside of the scope and interest of this study.

7.2.3 Phosphorus

Phosphorus exhibits a similar trend to K in the graveyard soils (**Figure 28**) and the conclusions reached for the K data apply to the P data as well.

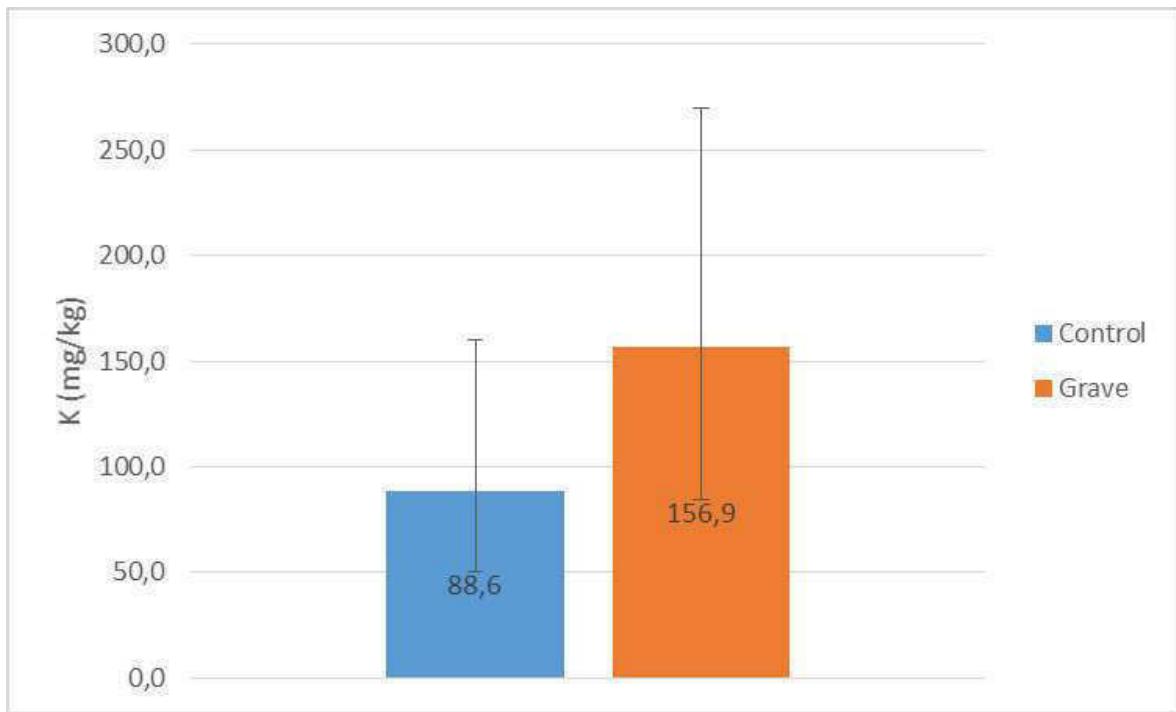


Figure 27 Average soil K values for the two areas (error bars indicate the data range)

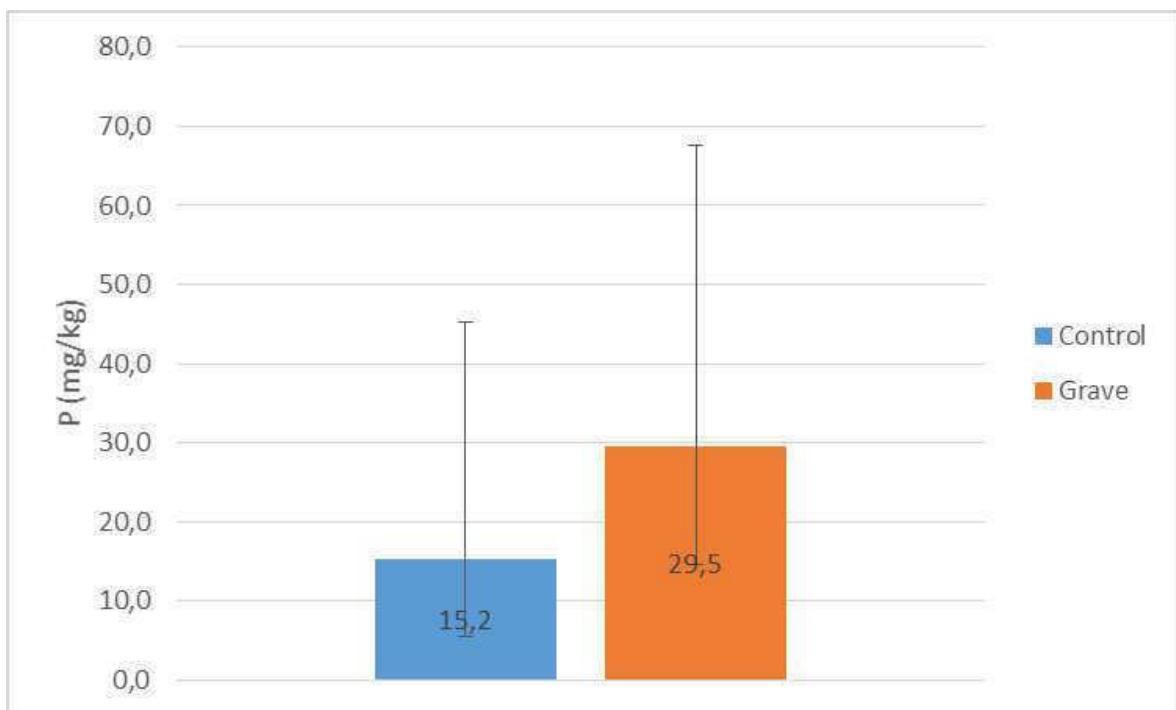


Figure 28 Average soil P values for the two areas (error bars indicate the data range)

8. SUMMARY AND CONCLUSIONS

The Linksfield site was assessed regarding grave site distribution, pathogen presence in soils and selected chemical parameters of the soils.

The distribution of the graves was established through the interpretation of historical aerial photographs and satellite images. These were found to be concentrated in three distinct areas. The two sites located along Club Road are associated with the Rietfontein Hospital. The site located on the banks of the Jukskei River appears to pre-date the hospitals main burial activities. No sites could be identified that gave the impression of haphazard burying or animal carcass burying.

During the literature survey regarding persistence of pathogens in soil all the pathogens, except for anthrax, were ruled out as risks due to poor or non-survival for prolonged periods in soil. The emphasis on anthrax was due to the reported persistence of the pathogen in soils with neutral to alkaline pH as well as elevated Ca levels and the anecdotal evidence that indicted the burial of animal carcasses of animals that died due to an anthrax outbreak. These indications informed the approach followed during the analysis phase of the investigation.

None of the human diseases identified during the literature survey could be identified in the soils. This includes anthrax. The only human pathogen in the same genus as anthrax (*Bacillus cereus*) was cultured from the soils along the Club Road graveyard soils. The pathogenicity of this organism is limited to two kinds of foodborne infections, an emetic (vomiting) intoxication due to the ingestion of a toxin (cereulide) pre-formed in the food and a diarrhoeal infection due to the ingestion of bacterial cells/spores which produce enterotoxins in the small intestine (Arnesen *et al.*, 2008). *Bacillus cereus* is ubiquitous and its spores will not be eliminated from food materials by heat treatment, apart from canning. Spores are present in almost all categories of foods before storage, generally in numbers too low to cause foodborne poisoning (Opinion of the Scientific Panel on Biological Hazards, 2005). It therefore poses a negligible risk.

The chemical analysis data of the soils was inconclusive regarding differences between control plots outside the graveyards and the graveyard soils. This was especially so for pH, Ca and Mg levels. Potassium and P levels showed a significant difference between the two soil sample zones with higher levels in the graveyard soils. From the data it therefore appears that only K and P levels were influenced by the presence of the graveyard. The reason for these increased values falls outside of the scope of this study.

The absolute values of the pH and Ca levels indicate that none of the soils can be considered conducive for the survival of anthrax, rather, the levels are low enough to confidently indicate a very low risk of anthrax survival. However, as there is a potential risk that localised infected remains may still be encountered during earthwork activity, workers will have to be given a standard operating procedure upon uncovering graves. Workers will have to be properly informed about the disease and the risks and they will have to adhere to a “biosecurity” protocol that has to

be set up with linked safety measures. Workers and general public will have to be informed of anthrax and the symptoms. If grave sites are uncovered the bones / grave site must be covered with soil, excavation must be stopped and experts must be called in to identify the origin of the bones. Samples should be taken to confirm the absence/presence of *Bacillus anthracis*. Should any sample be positive for anthrax all workers will have to receive medical care and a treatment protocol using penicillin or a cephalosporin (for penicillin susceptible individuals).

REFERENCES

- Abad, F.X., Pinto, R.M. and Bosch, A. (1994). Survival of enteric viruses on environmental fomites. *Applied and Environmental Microbiology* 60: 3704-3710.
- Adler, C. (1985). Rietfontein Hospital. *Adler Museum Bulletin* 11: 15-20.
- Aranda, E., Rodriguez, M.M., Asensio, M. A. and Cordoba, J.J. (1997). Detection of *Clostridium botulinum* types A, B, E and F in foods by PCR and DNA probe. *Letters in Applied Microbiology* 26: 186-190.
- Arnesen. L.P.S., Fagerlung, A. and Granum, P.E. (2008). From soil to gut: *Bacillus cereus* and its food poisoning toxins. *FEMS Microbiology Reviews* 32: 579-606.
- De Vos, V. (1990). The ecology of anthrax in the Kruger National Park, South Africa. *Salisbury Medical Bulletin* 68: 19–23.
- Dragon, D.C. and Rennie, R. P. (1995). The ecology of anthrax spores: tough but not invincible. *Canadian Veterinary Journal* 36: 295-301.
- Ellerbrok, H., Nattermann, H., Ozel, M., Beutin, L., Appel, B., Pauli, G. (2002). Rapid and sensitive identification of pathogenic and apathogenic *Bacillus anthracis* by real time PCR. [FEMS Microbiology Letters](#) 24: 51–59.
- Fine, A.E., Bolin, C.A., Gardiner J.C and Kaneene, J.B. (2011). A study of the persistence of *Mycobacterium bovis* in the environment under natural weather conditions in Michigan, USA. *Veterinary Medicine International* doi:10.4061/2011/765430.
- Gressel, F and Bohnel, H. (2006). Persistence and mobility of a *Clostridium* spore population introduced to soil with spiked compost. *FEMS Microbiology Ecology* 58: 384-393.
- Heninger, S.J., Anderson, C.A., Beltz G, and Onderdonk, A.B. (2009). Decontamination of *Bacillus anthracis* spores: Evaluation of Various Disinfectants. *Applied Biosafety* 14: 7-10.

Hung et al. (2008). Application of *Clostridium*-specific PCR primers on the analysis of dark fermentation hydrogen-producing bacterial communities. International Journal of Hydrogen Energy: 33 1586 – 1592.

Leppla, S.H., Robbins, J.B., Schneerson, R. & Shiloach, J. (2002). Development of an improved vaccine for anthrax. The Journal of Clinical Investigation 110: 141-144

Marston, C. K., Allen, C. A., Beaudry, J., Price, E. P., Wolken, S.R. et al. (2011) Molecular epidemiology of anthrax cases associated with recreational use of animal hides and yarn in the United States. PLoS ONE 6(12): e28274. doi:10.1371/journal.pone.0028274.

OIE. (2008). Anthrax: Manual of Diagnostic Tests and Vaccines for Terrestrial Animals, . Paris: Office International des Épizooties (OIE)

Okinaka et al. (2006) Anthrax, but not *Bacillus anthracis*? [PLoS Pathog.](#) 2:e122

Okinaka, R. T., Cloud, K., Hampton, O., Hoffmaster, A. R., Hill, K. K., Keim, P., Koehler, T.M., Lamke, G. et al. (1999). Sequence and organization of pXO1, the large *Bacillus anthracis* plasmid harboring the anthrax toxin genes. [Journal of Bacteriology](#) 181: 6509-6515.

Okinaka, R., Cloud, K., Hampton, O., Hoffmaster, A., Hill, K., Keim, P., Koehler, T., Lamke, G. et al. (1999). Sequence, assembly and analysis of pXO1 and pXO2. Journal of Applied Microbiology 87: 261-262.

Opinion of the Scientific Panel on Biological Hazards (2005). *Bacillus cereus* and other *Bacillus* spp in foodstuffs. The EFSA Journal 175,1-48.

Pirtle, E.C. and Beran, G.W. (1991). Virus survival in the environment. Rev. Sci Tech Off int Epiz 10: 733-748.

Rasko, D. A., Ravel, J., Okstad, O.A., Helgason, E., Cer, R.Z., Jiang, L., Shores, K A., Fouts, D.E. et al. (2004). The genome sequence of *Bacillus cereus* ATCC 10987 reveals metabolic adaptations and a large plasmid related to *Bacillus anthracis* pXO1. [Nucleic Acids Research](#) 32: 977-988.

Read, T.D., Salzberg, S.L., Pop, M., Shumway, M., Umayam, L., Jiang, L.X., Holtzapple, E., Busch, J.D. et al. (2002) Comparative genome sequencing for discovery of novel polymorphisms in *Bacillus anthracis*. Science 296: 2028-2033

Sinclair, R., Boone, S.A., Greenberg, D., Keim, P. and Gerba, C.P. (2008). Persistence of category A selected agents in the environment. Applied and Environmental Microbiology 74: 555-563.

Smith, K.L., De Vos, V., Bryden H., Price, L.B., Hugh-Jones, M.E. and Keim, P. (2000). *Bacillus anhtracis* diversity in Kruger National Park. Journal of Clinical Microbiology 38: 3780-3784.

Soil Classification Working Group. 1991. Soil Classification. A taxonomic system for South Africa. *Mem. Agric. Nat. Resour. S.Afr.* No.15. Pretoria.

Van Rooy, J.L. 2014. Final report on a phase 1 geotechnical site investigation for the proposed Linksfield Estate on portion of the farm Rietfontein 61-IR, Johannesburg. Report 1339

Warren et al. (2006). Differentiation of *Mycobacterium tuberculosis* complex by PCR amplification of genomic regions of difference. International Journal of Tuberculosis Lung Disease 10: 818–822.

WHO: Anthrax in humans and animals – 4th ed. (2008) World Health Organization, Geneva, <http://www.who.int/csr/resources/publications/> AnthraxGuidelines2008/en/index.html..

Wilson, J. B., and K. E. Russell. (1964). Isolation of *Bacillus anthracis* from soil stored 60 years. Journal of Bacteriology 87:237–238.

Wirth, T., Hildebrand, F., Allix-Beguec, C., Wolbeling, F., Kubica, T., Kremer, K., van Soolingen D., Rusch-Gerdes, S. et al. (2008). Origin, Spread and Demography of the *Mycobacterium tuberculosis* complex. PLoS Pathog 4(9): e1000160. doi:10.1371/journal.ppat.1000160.

Alfred

From: Bokamoso <lizelleg@mweb.co.za>
Sent: 28 March 2014 01:32 PM
To: user1@bokamoso.net
Subject: FW: Request for advice- Development of the Rietfontein/Linksfield site
Attachments: image002.jpg; image003.jpg; Linksfield Baseline Forensic Soil Gravesite Report JF comments.pdf

From: Pirate Ncube [mailto:ncube.nali@gmail.com]
Sent: 28 March 2014 01:20 PM
To: Bokamoso
Subject: Fwd: Request for advice- Development of the Rietfontein/Linksfield site

Dear Ane

Below as well as attached are further comments and suggested changes to the document from Prof Frean and Blumberg.

Kind regards

Pirate Ncube
Nali Sustainability Solutions
Tel: 012 676 8315
Fax: 086 694 1178
email: ncube.nali@gmail.com
P. Bag X1, Stand1829, Irene Farm Villages, PvR, 0045

----- Forwarded message -----

From: **Lucille Blumberg** <lucilleb@nicd.ac.za>
Date: 28 March 2014 08:34
Subject: RE: Request for advice- Development of the Rietfontein/Linksfield site
To: John Frean <johnf@nicd.ac.za>, Pirate Ncube <ncube.nali@gmail.com>

Agree with prof freans changes to document and comments below.

Prof Lucille Blumberg

Deputy Director

Division of Public Health Surveillance and Response

PRF Building, 1 Modderfontein Rd, Sandringham, Johannesburg, 2131

Tel: [+27 11 386-6337](tel:+27113866337) | Fax: [+27 11 882-9979](tel:+27118829979) | [+27 82 807 6770](tel:+27828076770)

lucilleb@nicd.ac.za | www.nicd.ac.za

PA: Irma Latsky: irmal@nicd.ac.za / [011 555-0395](tel:0115550395)



Practice Number: 5200296

From: John Frean
Sent: 28 March 2014 08:31 AM
To: Pirate Ncube
Cc: Lucille Blumberg
Subject: RE: Request for advice- Development of the Rietfontein/Linksfield site

Dear Mr Ncube

Thanks for the opportunity to comment. My annotations are attached and should pop up as you mouse over the highlighted areas. Prof Blumberg might also want to comment from her perspective.

We know that many of the alleged health issues related to the Rietfontein/Sizwe site have no scientific or factual basis. Unfortunately, in places your report gives the impression that some of these stories need to be taken seriously. For example, the statement that the Category A agents list includes most of the pathogens that caused the death of patients at Sizwe is just not true – only plague and smallpox are relevant here. No human anthrax, Ebola, Marburg, tularaemia, hantavirus, Argentinian/Bolivian HF, botulism, etc, cases occurred here.

The efforts to find anthrax and *M.tb* in the soil close to graves was predictably fruitless. Even if you had detected *Clostridium botulinum*, it is a ubiquitous organism and of no relevance to the site development plans. While on balance your report will probably allay fears, the recommendations regarding the danger of anthrax to human grave excavators is misleading, and should rather be applied to animal bone findings outside the cemetery areas.

The interpretation of positive M. tb PCR near the river will be questioned. You suggest it may be from the hospital, but provide no evidence of this. The river has a large catchment area outside the site and it is feasible that the origin of the DNA could be external to the site.

Before you submit the report, I suggest that it is carefully copyedited, as there are a fair number of typographical errors, eg Sizwe is misspelt as Siswe in several places; tuberculosis is also misspelt in places.

Regards

John Frean

Associate Professor

Centre for Opportunistic, Tropical and Hospital Infections

Parasitology Reference Laboratory

National Institute for Communicable Diseases

Tel: [011 555 0308](tel:0115550308) | Fax: [011 555 0446](tel:0115550446) | Cell: [082 906 2856](tel:0829062856)

<mailto:johnf@nicd.ac.za> | www.nicd.ac.za



Practice number: 5200296

From: Pirate Ncube [mailto:ncube.nali@gmail.com]

Sent: 27 March 2014 12:13 PM

To: John Frean

Cc: Lucille Blumberg

Subject: Re: Request for advice- Development of the Rietfontein/Linksfield site

Dear Prof Frean

Herewith a forensic study on Rietfontein site.

I will appreciate your input/comment on the study as well as any suggestions for further studies in order to allay fears of the public on the health threats resulting from the development of the site.

Kind regards

Pirate Ncube

Nali Sustainability Solutions

Tel: [012 676 8315](tel:0126768315)

Fax: [086 694 1178](tel:0866941178)

email: ncube.nali@gmail.com

P. Bag X1, Stand1829, Irene Farm Villages, PvR, 0045

On 19 March 2014 08:30, Pirate Ncube <ncube.nali@gmail.com> wrote:

Dear Prof Frean

Thankyou verymuch for your comments, much appreciated.

We are currently finalising a forensic report on the potential health threat posed by possible exposure of the graves. The report will be finalised in about two weeks time. If at all possible, I would like to request your review or comments on the findings or recommendation of the said report.

Kind regards

Pirate Ncube

Nali Sustainability Solutions

Tel: [012 676 8315](tel:0126768315)

Fax: [086 694 1178](tel:0866941178)

email: ncube.nali@gmail.com

P. Bag X1, Stand1829, Irene Farm Villages, PvR, 0045

On 18 March 2014 19:15, John Frean <johnf@nicd.ac.za> wrote:

Dear Mr Ncube

Your query has been passed on to me.

Sizwe, formerly Rietfontein, Hospital was an infectious and tropical diseases isolation hospital long before its current role as a dedicated tuberculosis hospital. It stands on a large plot of land that was originally a working farm. Since the hospital's establishment in 1895, cases of smallpox, plague, sexually transmitted diseases, leprosy, tuberculosis and many other diseases were treated there. Many patients who succumbed to their infections were buried in cemeteries in the hospital grounds, but it is many decades since the last burials took place. The human graves are very unlikely to pose a disease risk if they are disturbed in the process of land development for housing, as these pathogens will normally not survive in the environment for such extended periods.

In relation to specific diseases:

1. Some of these conditions, specifically smallpox and TB, can be infectious for a while after death, if sufficient and appropriate exposure occurs.
2. Under favourable conditions, smallpox virus can survive for a decade or so, and TB for a few weeks or months, outside a living body. Conditions in an ordinary grave would generally not favour long-term survival, as there would be degradation by moisture and saprophytic organisms.
3. Given the extreme age of the graves, there would be little risk to the exhumers and extraordinary precautions would not be required, i. e. other than normal protection against inhalation of dust and accidental eye or skin damage.

4. In view of this, in my opinion there would be no scientific reason not to exhume and rebury the remains if it is necessary.

Yours sincerely

John Frean

Associate Professor

Centre for Opportunistic, Tropical and Hospital Infections

National Institute for Communicable Diseases

Tel: [011 555 0308](tel:0115550308) | Fax: [011 555 0446](tel:0115550446) | Cell: [082 906 2856](tel:0829062856)

<mailto:johnf@nicd.ac.za> | www.nicd.ac.za



Division of the National Health Laboratory Service

Practice number: 5200296

From: Pee Nali [mailto:ncube.nali@gmail.com]

Sent: Wednesday, March 12, 2014 1:42 PM

To: Priscilla May

Subject: Request for advice- Development of the Rietfontein/Linksfield site

Dear Priscilla

As mentioned over the phone, I am an Environmental Consultant appointed by the Gauteng Provincial Department of Human Settlements to handle the Environmental Impact Assessment (EIA) for the development of the site (the open space around the Sizwe Hospital). The site has burial grounds/graves of people who died from infectious diseases. It is suspected that some of the graves are not marked which means some of them could be exposed during the development process.

We are currently undertaking specialist studies including forensic soil investigations into potential pathological risk associated with the site.

We would appreciate any information and, if possible, specialist review of the above report and/or advice on additional studies to be carried out to determine any other

risks and mitigation measures to be implemented should the development (mixed uses including residential, commercial, business and industrial) proceed.

Kind regards

Pirate Ncube

Nali Sustainability Solutions

Tel: [012 676 8315](tel:0126768315)

Fax: [086 694 1178](tel:0866941178)

email: ncube.nali@gmail.com

P. Bag X1, Stand1829, Irene Farm Villages, PvR, 0045

The views expressed in this email are, unless otherwise stated, those of the author and not those of the National Health Laboratory Service or its management. The information in this e-mail is confidential and is intended solely for the addressee. Access to this e-mail by anyone else is unauthorized. If you are not the intended recipient, any disclosure, copying, distribution or any action taken or omitted in reliance on this, is prohibited and may be unlawful. Whilst all reasonable steps are taken to ensure the accuracy and integrity of information and data transmitted electronically and to preserve the confidentiality thereof, no liability or responsibility whatsoever is accepted if information or data is, for whatever reason, corrupted or does not reach its intended destination.

The views expressed in this email are, unless otherwise stated, those of the author and not those of the National Health Laboratory Service or its management. The information in this e-mail is confidential and is intended solely for the addressee. Access to this e-mail by anyone else is unauthorized. If you are not the intended recipient, any disclosure, copying, distribution or any action taken or omitted in reliance on this, is prohibited and may be unlawful. Whilst all reasonable steps are taken to ensure the accuracy and integrity of information and data transmitted electronically and to preserve the confidentiality thereof, no liability or responsibility whatsoever is accepted if information or data is, for whatever reason, corrupted or does not reach its intended destination.



REPORT

BASELINE FORENSIC SOIL INVESTIGATION INTO POTENTIAL PATHOLOGICAL RISKS ASSOCIATED WITH DEVELOPMENT OF THE LINKSFIELD SITE, GAUTENG PROVINCE

6th February, 2014

Compiled by:
J.H. van der Waals
(PhD Soil Science, Pr.Sci.Nat)
Member of:
Soil Science Society of South Africa (SSSSA)

Accredited member of:
South African Soil Surveyors Organisation (SASSO)

Registered with:
The South African Council for Natural Scientific Professions
Registration number: 400106/08

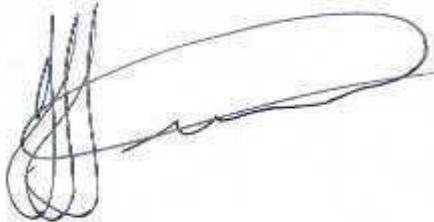
H. van Heerden
(PhD Plant Pathology)

A. Hassim
(MSc Veterinary Science)

Declaration

I, Johan Hilgard van der Waals, declare that I –

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



**J.H. VAN DER WAALS
TERRA SOIL SCIENCE**

EXECUTIVE SUMMARY

The Linksfield site was assessed regarding grave site distribution, pathogen presence in soils and selected chemical parameters of the soils.

The distribution of the graves was established through the interpretation of historical aerial photographs and satellite images. These were found to be concentrated in three distinct areas. The two sites located along Club Road are associated with the Rietfontein Hospital. The site located on the banks of the Jukskei River appears to pre-date the hospital's main burial activities. No sites could be identified that gave the impression of haphazard burying or animal carcass burying.

During the literature survey regarding persistence of pathogens in soil all the pathogens, except for anthrax, were ruled out as risks due to poor or non-survival for prolonged periods in soil. The emphasis on anthrax was due to the reported persistence of the pathogen in soils with neutral to alkaline pH as well as elevated Ca levels and the anecdotal evidence that indicated the burial of animal carcasses of animals that died due to an anthrax outbreak. These indications informed the approach followed during the analysis phase of the investigation.

None of the human diseases identified during the literature survey could be identified in the soils. This includes anthrax. The only human pathogen in the same genus as anthrax (*Bacillus cereus*) was cultured from the soils along the Club Road graveyard soils. The pathogenicity of this organism is limited to two kinds of foodborne infections, an emetic (vomiting) intoxication due to the ingestion of a toxin (cereulide) pre-formed in the food and a diarrhoeal infection due to the ingestion of bacterial cells/spores which produce enterotoxins in the small intestine (Arnesen *et al.*, 2008). *Bacillus cereus* is ubiquitous and its spores will not be eliminated from food materials by heat treatment, apart from canning. Spores are present in almost all categories of foods before storage, generally in numbers too low to cause foodborne poisoning (Opinion of the Scientific Panel on Biological Hazards, 2005). It therefore poses a negligible risk.

The chemical analysis data of the soils was inconclusive regarding differences between control plots outside the graveyards and the graveyard soils. This was especially so for pH, calcium (Ca) and magnesium (Mg) levels. Potassium and phosphorus levels showed a significant difference between the two soil sample zones with higher levels in the graveyard soils. From the data it therefore appears that only K and P levels were influenced by the presence of the graveyard. The reason for these increased values falls outside of the scope of this study.

The absolute values of the pH and Ca levels indicate that none of the soils can be considered conducive for the survival of anthrax, rather, the levels are low enough to confidently indicate a very low risk of anthrax survival. However, as there is a potential risk that localised infected remains may still be encountered during earthwork activity, workers will have to be given a standard operating procedure upon uncovering graves. Workers will have to be properly informed

about the disease and the risks and they will have to adhere to a “biosecurity” protocol that has to be set up with linked safety measures. Workers and general public will have to be informed of anthrax and the symptoms. If grave sites are uncovered the bones / grave site must be covered with soil, excavation must be stopped and experts must be called in to identify the origin of the bones. Samples should be taken to confirm the absence/presence of *Bacillus anthracis*. Should any sample be positive for anthrax all workers will have to receive medical care and a treatment protocol using penicillin or a cephalosporin (for penicillin susceptible individuals).

TABLE OF CONTENTS

1. INTRODUCTION.....	1
1.1 Terms of Reference	1
1.2 Background	1
1.3 Aim of the Investigation.....	1
1.4 Structure of the Report.....	1
2. BRIEF DESCRIPTION OF THE SURVEY AREA	2
2.1 Survey Area Boundary.....	2
2.2 Survey Area Physical Features.....	2
3. LITERATURE REVIEW.....	2
3.1 Methodology	2
3.2 Results	2
3.2.1 Rietfontein Hospital and Graves	2
3.2.2 Pathogens	4
3.2.3 Distribution of Graves/Sites	6
4. INTERPRETATION OF HISTORICAL AND RECENT AERIAL PHOTOGRAPHS	6
5. SOIL SAMPLING	13
5.1 Microbial Analysis Sampling	13
5.2 Soil Chemical Analysis Sampling	13
5.3 Soil Sampling Results / Observations	18
6. MICROBIOLOGY / PATHOLOGY ANALYSIS.....	22
6.1 Material and Methods	22
6.1.1 Culturing of Bacteria	22
6.1.2 PCR.....	23
6.2 Results	23
6.2.1 Culturing of <i>Bacillus anthracis</i>	23
6.2.2 Culturing of <i>Clostridium</i>	26
6.2.3 PCR.....	26
6.3 Discussion	30
7. SOIL ANALYSIS RESULTS	32
7.1 Soil Physical Analysis.....	32
7.2 Soil Chemical Analysis	33
7.2.1 Soil pH.....	33
7.2.2 Exchangeable Cations.....	35
7.2.3 Phosphorus	35
8. SUMMARY AND CONCLUSIONS	37
REFERENCES	38

DEFINITIONS:

Diseases

A condition of the living animal or plant body or of one of its parts that impairs normal functioning and is typically manifested by distinguishing signs and symptoms

Endophytes

An **endophyte** is an endosymbiont, often a bacterium or fungus, that lives within a plant for at least part of its life without causing apparent disease

Fomites

Objects or materials which are likely to carry infection, such as clothes, utensils, and furniture

Infectious diseases

Infectious diseases are caused by pathogenic microorganisms, such as bacteria, viruses, parasites or fungi; the diseases can be spread, directly or indirectly, from one person to another

Microorganisms

A microscopic organism, especially a bacterium, virus, or fungus

Pathogen

A bacterium, virus, or other microorganism that can cause disease

Zoonotic diseases

Infectious diseases of animals that can cause disease when transmitted to humans, such as anthrax (*Bacillus anthracis*, *Mycobacterium tuberculosis* and *M. bovis*)

BASELINE FORENSIC SOIL INVESTIGATION INTO POTENTIAL PATHOLOGICAL RISKS ASSOCIATED WITH DEVELOPMENT OF THE LINKSFIELD SITE, GAUTENG PROVINCE

1. INTRODUCTION

1.1 TERMS OF REFERENCE

Terra Soil Science was appointed by **Bokamoso** to conduct a baseline forensic soil investigation into potential human pathological risks associated with the development of the Linksfield site in the Gauteng Province.

1.2 BACKGROUND

The Rietfontein Hospital was originally established in 1895 as a **Lazaretto** (quarantine house) for increasing numbers of smallpox cases in the Johannesburg area (Adler, 1985). Although not built as a general isolation hospital and for treatment of infectious diseases it became necessary to isolate infectious diseases such as measles, scarlet fever, smallpox, plague, leprosy, syphilis, etc. There is a long history associated with Rietfontein/Sizwe Hospital as it progressed to being a tropical / infectious disease hospital, the various people who dedicated their lives to saving infectious diseases victims as well as the victims that did not survive. This is especially evident when walking around the hospital and associated cemeteries.

The site on which the hospital is situated (as well as the surrounding open area) is earmarked for urban development.

1.3 AIM OF THE INVESTIGATION

The aims of this investigation are to: 1) collect all available information regarding diseases that led to the deaths of the patients at Rietfontein Hospital as well as references to the position of the graveyards; 2) determine the distribution of the graves and extent of the gravesites; 3) report on the results of a dedicated field soil sampling exercise; 4) determine the presence of human pathogens in the soils of the site; 5) determine specific soil chemical properties linked to pathogen persistence; and 6) determine whether these infectious diseases pose a risk during the development of the surrounding sites or the graveyards.

1.4 STRUCTURE OF THE REPORT

The report was generated through:

1. The conducting of a dedicated literature search regarding the history of the hospital, fatal diseases and grave site distribution on the site;
2. The detailed assessment of historical aerial photographs and satellite images;

3. The sampling and analysis of soils for microbial / pathogen and selected chemical parameters
4. Presentation of the findings of the various components of the investigation.

2. BRIEF DESCRIPTION OF THE SURVEY AREA

2.1 SURVEY AREA BOUNDARY

The site lies between 26° 07' 46" and 26° 08' 59" south and 28° 07' 05" and 28° 08' 04" east in Linksfield in Johannesburg (**Figure 1**). The survey site is bordered by various urban developments to the north, south and west, by golf courses on the south-west and the N3 highway to the east.

2.2 SURVEY AREA PHYSICAL FEATURES

The altitude above mean sea level varies from 1540 in the north to 1610 in the south-west. The geology of the area is dominated by granite and serpentinite – leading to the dominance of beached sandy topsoil horizons overlying red and yellow coloured weathered rock subsoils.

3. LITERATURE REVIEW

3.1 METHODOLOGY

A review was conducted of the limited formal information available for the Rietfontein hospital and its associated grave sites. From the literature several diseases were identified and these were investigated in detail regarding the available information on persistence in soils. An attempt was also made to identify the grave sites from available literature.

3.2 RESULTS

3.2.1 Rietfontein Hospital and Graves

The only published report that was found is a historical article by Cyril Adler in the Adler Museum Bulletin in 1985 about Rietfontein Hospital and the diseases associated with the hospital (Adler, 1985). No records are available from the Rietfontein / Siswe Hospital. The other information consist of blog sites (<http://gravehunter-drw.blogspot.com/2013/07/rietfontein-just-wont-go-away.html>; <http://gravehunter-drw.blogspot.com/2012/11/graves-in-veld-rietfontein-hospital.html>), with a link to a newspaper report that is based on speculation and poorly verifiable facts. Adler (1985) indicated that people died of diseases like measles, scarlet fever, smallpox, plague, leprosy, tuberculosis, lassa fever, Ebola haemorrhagic fever, Marburg haemorrhagic fever, syphilis and Congo-Crimean haemorrhagic fever. This article indicates that Rietfontein / Siswe Hospital consisted of several cemeteries and that a plague camp was established at Rietfontein in 1904 where plague victims were buried (Adler, 1985).

LINKSFIELD Locality Map

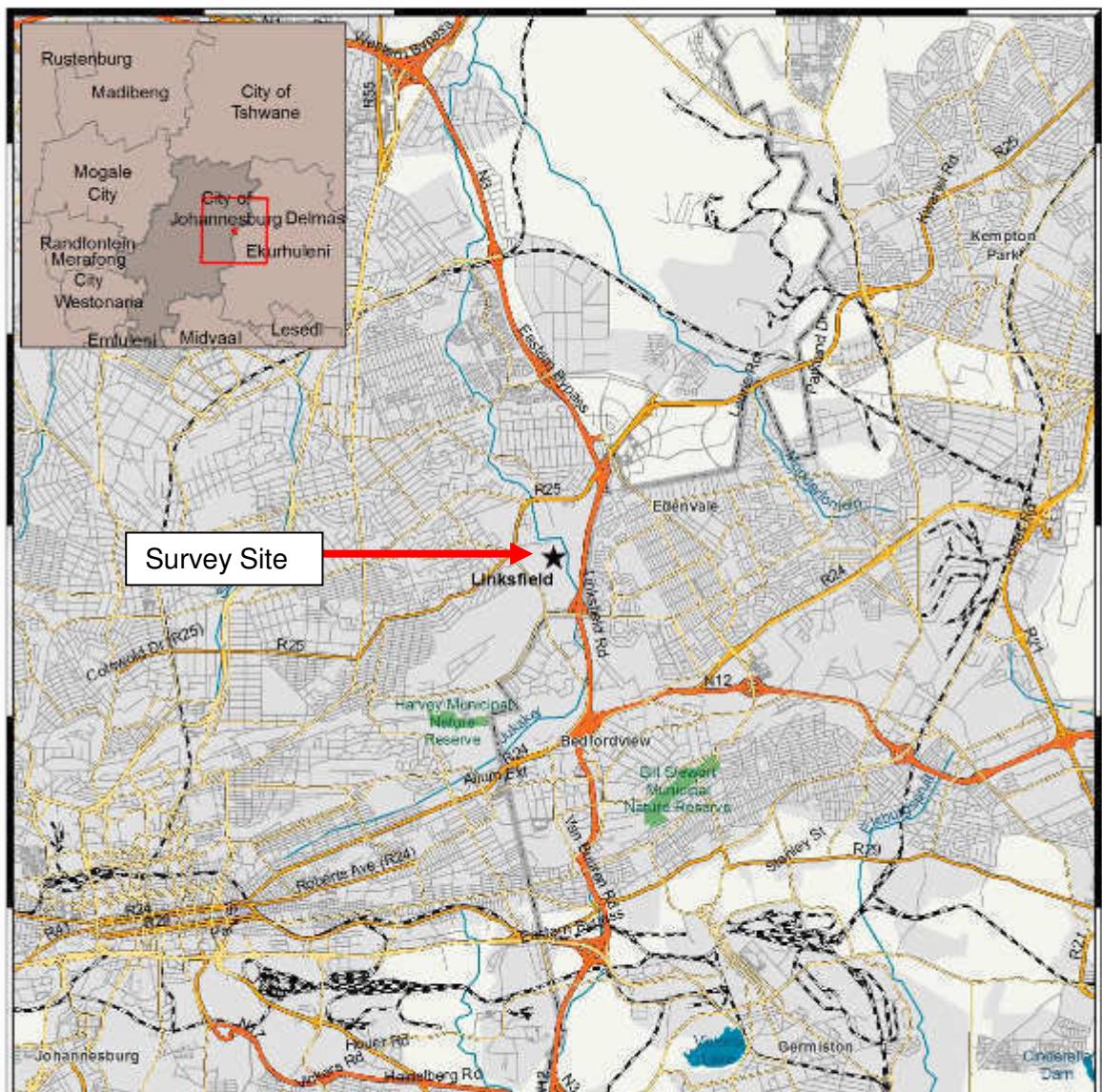


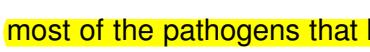
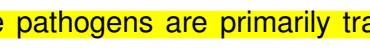
Figure 1 Location of the survey site

Anecdotal evidence (newspaper articles and word-of-mouth) suggest the existence of four cemeteries at the Rietfontein / Sizwe Hospital namely: 1) white; 2) black; 3) Jewish; and 4) leper. In addition, this evidence suggest that animals that died due to an anthrax outbreak were also buried in the area of the hospital.

3.2.2 Pathogens

The relevant diseases identified on the site from literature would have to survive in soil, water and human remains for decades to pose a risk during development. From anecdotal evidence it appears that the last persons were buried at Rietfontein  the late 1960's (although the "youngest" grave stone found by us on site dated from  1949). Important diseases of humans, which include Category A agents inclusive of potential biological terrorism agents identified by the Centres for Disease Control (CDC), were identified. Sinclair *et al.* (2008) reviewed selected Category A microorganisms and their ability to persist in the environment. These microorganisms / infectious diseases included:

- *Variola major* virus (smallpox; vaccinia virus)
- *Bacillus anthracis* (anthrax)
- *Yersinia pestis* (plague)
- *Clostridium botulinum* toxin (botulism)
- *Francisella tularensis* (tularemia)
- Viral haemorrhagic fever agents:
 - *Arenaviridae* (Lassa fever, Junin-Argentine haemorrhagic fever, and Venezuelan haemorrhagic fever)
 - *Bunyaviridae* (hantavirus)
 - *Filoviridae* (Ebola haemorrhagic fever and Marburg haemorrhagic fever)
 - *Flaviviridae* (St. Louis encephalitis and Japanese B encephalitis)

These category A agents include  most of the pathogens that killed people at Rietfontein Hospital. In the natural environment  these pathogens are primarily transmitted by insect vectors,  through animal contact or  material contaminated by infected animals. The latter refers to the risk at Rietfontein /  Sizwe Hospital cemeteries as the pathogens are released in the bodily fluids of infected humans and animals and persist with the remains when buried. The maintenance of the infectivity by any pathogen outside the host (in this case the soil at Linksfield site around Rietfontein / Sizwe Hospital) is dependent on a number of factors including temperature, relative humidity, desiccation and UV light. Temperature has the most significant effect on persistence of all the factors mentioned. Sinclair *et al.* (2008) investigated the persistence of anthrax (*B. anthracis*), plague (*Y. pestis*), smallpox (Vaccinia virus), tularemia (*F. tularensis*), haemorrhagic fever agents (including *Arenaviridae*, *Bunyaviridae*, *Filoviridae* and *Flaviviridae*) and found smallpox and anthrax to be the most persistent. Anthrax could survive 146 years in water and more than 60 years in soils (Wilson and Russel, 1964; De Vos, 1990; Sinclair *et al.*, 2008) and smallpox could survive 8 years on fomites. Therefore, anthrax would be the agent of concern, not smallpox, as it will persist in the soil for more than 50 years.

In this study the occurrence of anthrax as well as *Clostridium* species is investigated. The latter includes *C. botulinum* (botulism) and *Mycobacterium tuberculosis* (tuberculosis, TB). These were included in the investigation as *C. botulinum* (botulism) can persist in soil (Gressel and Bohnel, 2006) and TB can occur in the environment with Siswe Hospital being an HIV and TB Hospital. It is not clear though whether these will be able to persist for more than 50 years in soil.

3.2.2.1 Anthrax (*Bacillus anthracis*)

Bacillus anthracis is a Gram-positive, spore-forming bacterium that consists of a chromosome and the virulent factors occur on two plasmids (extra-chromosomal DNA) namely pXO1, that contain toxins, and pXO2, that contain capsule (WHO, 2008). Three components are found on pXO1 namely lethal factor, oedema factor and protective antigen which are not toxic individually (Okinaka *et al.*, 1999; Read *et al.*, 2003). The lethal factor combines with protective antigen to form lethal toxin whereas oedema factor combines with protective antigen to form oedema toxin. The capsule gene on pXO2 consists of a five gene operon (*capABCDE*) that interact at the bacterial cell membrane to produce a poly-gamma-D- glutamic acid which helps the vegetative cells from phagocytic killing during infection. The capsule therefore protects the anthrax organism against the host (Read *et al.*, 2003). *Bacillus anthracis* is the causative agent of anthrax, a serious and often fatal disease of wild and domestic animals, especially herbivores. It can also infect humans. The disease occurs primarily as a cutaneous (skin), pulmonary (respiratory / lungs), or gastrointestinal (ingestion / eating) infection, depending on the route of entry of the *B. anthracis* spores. Upon entry into the host, the spores germinate and the resultant vegetative cells replicate rapidly, enter the bloodstream, and result in death or septicaemia.

The remains of animals that have died of anthrax usually discharge large amount of anthrax bacilli, returning the organism to the soil. If opened, endospores / spores will be formed due to exposure to oxygen. Thus carcasses of animals where anthrax is suspected should not be opened in order to avoid the formation of spores (OIE, 2008). *Bacillus anthracis* is able to form spores that are highly resistant to harsh conditions like chemical disinfection, heat, cold, etc. These have the ability to survive in the soil for a long period. The spores are present in abundance in soil at sites where infected animals had died or been buried (Leppla *et al.*, 2002). This is especially so in soils with elevated calcium levels and pH neutral-to-alkaline soils (Dragon and Rennie, 1995; Smith *et al.*, 2000). De Vos (1990) isolated *B. anthracis* spores from bones retrieved at an archaeological site in Kruger National Park, estimated to be 200 ±50 years old.

3.2.2.2 *Clostridium botulinum* (Botulism)

Botulism is a severe flaccid paralytic disease caused by seven different neuroparalytic toxin subtypes (A to G). The botulinum neurotoxins (BoNTs) are produced by the anaerobic Gram-positive bacterium, *Clostridium botulinum* (BoNT A to F). BoNT types A, B, E, and F are mainly responsible for human botulism, whereas toxin types C and D are involved in animal botulism (Woudstra *et al.*, 2012). The most common sources of animal botulism are contaminated poultry litter, soil or carcasses. Human botulism consists of food-borne botulism caused by the toxin pre-

formed in foods as well as infant botulism caused by toxin produced in the intestine after ingestion of spores (Aranda *et al.*, 1997). *Clostridium botulinum* are found world-wide, but with limited prevalence. In areas where the bacteria are detected in soil there is potentially an increased risk for the disease; as from the soil *C. botulinum* may enter the food chain contaminating food or feed (Gressel and Bohnel, 2006).

3.2.2.3 *Mycobacterium tuberculosis*

The *Mycobacterium tuberculosis* complex (MTBC) is composed of closely related bacterial sub-species that have plagued human and animal populations for thousands of years. The most famous member of the MTBC is *M. tuberculosis*, the causal agent of tuberculosis in humans (Wirth *et al.*, 2008). *Mycobacterium bovis* the causal agent of bovine tuberculosis is also a member of MTBC. A study on the persistence of *M. bovis* in the environment indicated that it can remain in the soil for up to 88 days (Fine *et al.*, 2011).

3.2.3 Distribution of Graves/Sites

The literature search was inconclusive regarding the distribution and extent of graves / graveyards on the Linksfield site.

4. INTERPRETATION OF HISTORICAL AND RECENT AERIAL PHOTOGRAPHS

Due to the difficulty in identifying the exact boundary of the grave sites in the field a dedicated search for and interpretation of historical aerial photographs and satellite images was conducted. From the images three grave sites were identified.

The determination of the boundaries of the graveyards as well as the possible sites that were included from anecdotal evidence was challenging. As will be explained in the soil survey results most of the markers in the graveyards have been stolen or removed and only a few gravestones were evident on the site – occurring sporadically throughout. From the outset it was intended to identify the formal graveyards as well as any potential area that was used for the disposal of animal carcasses (having died from anthrax). Due to the dearth of information available from formal sources/records the only option was to obtain high resolution historical aerial photographs from Chief Directorate National Geospatial Information (CDNGI) in Mowbray, Cape Town. These images were obtained from CDNGI through the conducting of a dedicated search on their database as well as the high resolution scanning of the said images.

For the site images dating from 1937 (**Figure 2**) and 1948 (**Figure 3**) were used for the purposes of identifying the graveyard boundaries. In the 1937 image (**Figure 2**) the original boundaries of the graveyards along Club Road are clearly discernable. The older graveyard on the banks of the Jukskei River could not be identified from the image, neither could any other indication of burial activities. Significant extension of the Rietfontein Hospital buildings and developments is evident in

the 1948 (**Figure 3**) image. The graveyard signatures remain the same and again there are no indications of any other burial activities.

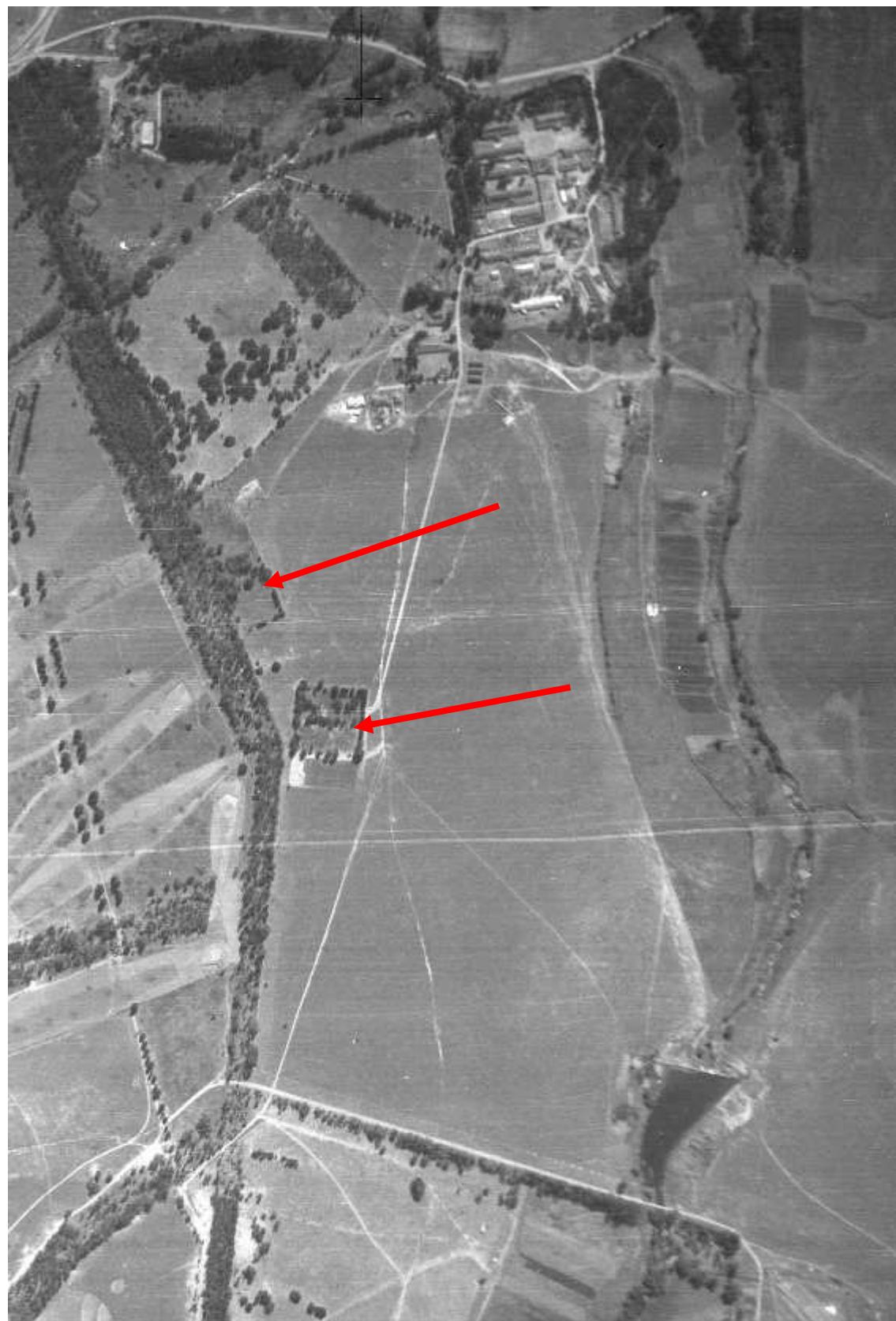


Figure 2 Extract from an aerial photograph dated 1937 indicating the original graveyard areas

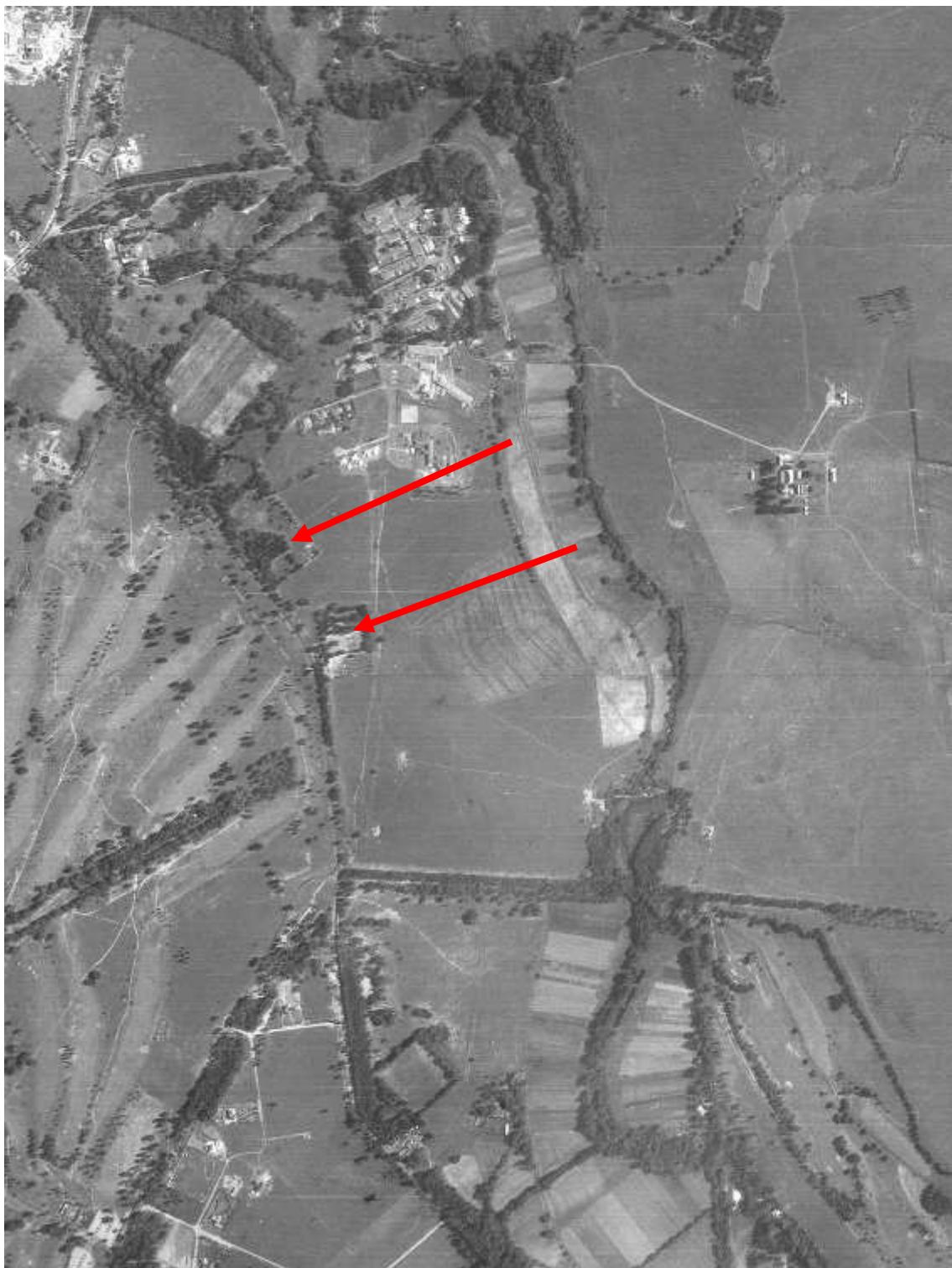


Figure 3 Extract from an aerial photograph dated 1948 indicating the original graveyard areas

The graveyards identified above are the only ones indicated on the 1:50 000 topographic map for the area dating from 1954 (**Figure 4**).

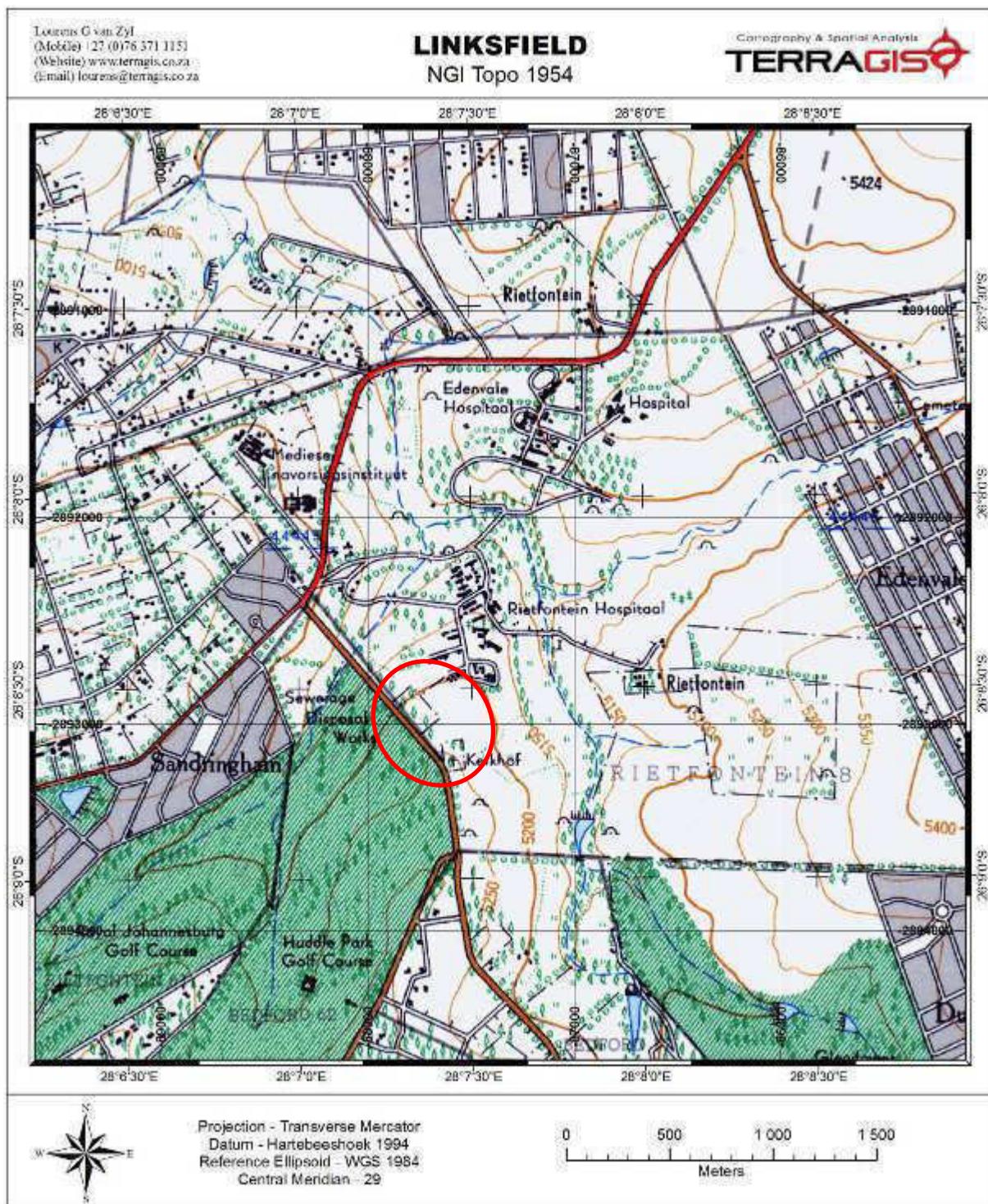


Figure 4 Extract from the 1:50 000 topographic map for the area, dating from 1954, indicating the two graveyards

Google Earth images from 2001 to 2012 (**Figures 5 to 10**) indicate the presence of the graveyards as well as the land use/cover changes on the site. This is especially evident in the removal of trees from the graveyards and the larger site as well as the significant increase in rubble around and in the graveyards along Club Road.



Figure 5 Google Earth image dated 2001/01/28 indicating the graveyards (note the presence of trees)



Figure 6 Google Earth image dated 2004/03/26 indicating the graveyards (note the cleared trees in all three the graveyards)



Figure 7 Google Earth image dated 2005/11/17 indicating the graveyards (note the cleared trees on the rest of the site)



Figure 8 Google Earth image dated 2008/09/07 indicating the graveyards (note the cleared trees on the rest of the site)



Figure 9 Google Earth image dated 2012/07/03 indicating the graveyards (note the increasing amount of rubble between and around the two main graveyards)

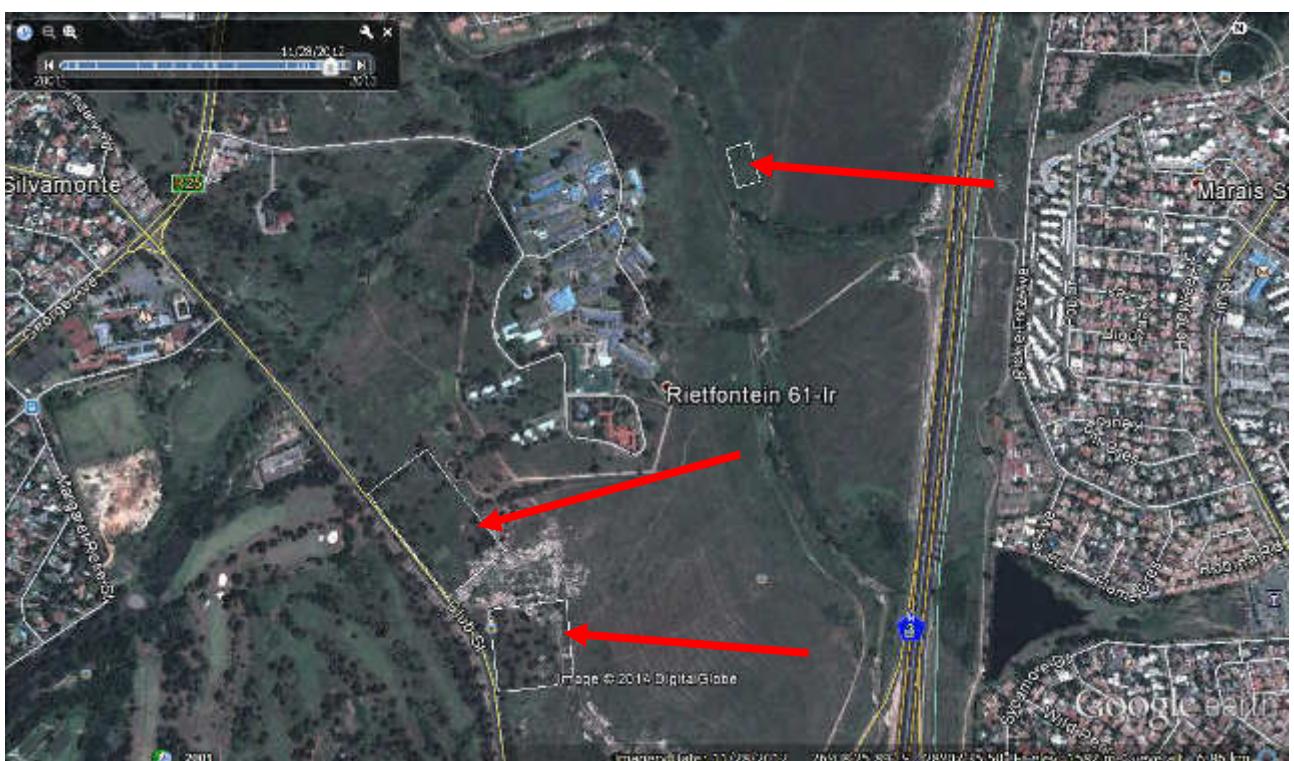


Figure 10 Google Earth image dated 2012/11/28 indicating the graveyards (note the increasing amount of rubble between and around the two main graveyards)

From the images there are no signs of other graveyards or burial sites. The dates and types of graveyards will be discussed with the results of the soil sampling exercise later in this report.

5. SOIL SAMPLING

Due to the sensitive nature of graves only the surface soil material could be sampled within the graveyards. On the outside perimeter of the graveyards, in undisturbed soils, profiles were dug for the geotechnical survey (report as produced by J Louis van Rooy, 2014). These profiles were sampled as well as described and classified according to the Taxonomic System (The Soil Classification Working Group, 1991). Two sets of soils samples were collected namely 1) small volume samples for microbial analysis and 2) larger volume samples, of a larger number, for basic soil chemical analysis.

5.1 MICROBIAL ANALYSIS SAMPLING

For the purpose of the microbial analysis samples were collected mainly from top part of soil (first 5 cm) but some samples included collection from greater depths (>5 – 60 cm) using a soil auger at different positions (outside of the graveyards) on the proposed development site (indicated by L# in **Table 1**). Soil samples were taken from mole hills in cemetery areas as this allowed for non-invasive sample collection in the cemeteries (in theory allowing sampling of soil brought from subsoil horizons to the surface by moles). In addition, as will be discussed in the results, snails were found to be associated with the mole hills in the graveyards. A live snail was collected and also subjected to analysis. Refer to **Table 1** for the listing, description and position of soil samples taken at Linksfield site. **Figure 11** provides the positions of the sample points.

5.2 SOIL CHEMICAL ANALYSIS SAMPLING

Samples were collected for the chemical analysis of the soils. The motivation being to determine 1) whether the bones had contributed to increased Ca levels in the graveyard soils; 2) whether the mole activity had brought Ca rich soil material to the surface; and 3) whether the soil chemical conditions were conducive for the survival of anthrax in the graveyard soils. For this purpose five profile pits, that were dug on the perimeter of the graveyards for the geotechnical survey, were sampled at different depths corresponding to diagnostic horizons or specific materials. These are indicated by the code LP# in **Table 2** and **Figure 12**. In the graveyard areas surface samples were taken from mole heaps only. These are indicated by the code LPG# in **Table 2** and **Figure 3**.

Table 1 Information of microbial analysis soil samples collected at Linksfield site

Sample number	Sample depth	Comments	Coordinates
L1-1	5 cm	High in organic matter	S26° 08' 19.7" E28° 07' 15.1"
L1-2	30 cm		
L1-3	60 cm	Mottled soil	
L2	Mole hill	High in organic matter	S26° 08' 28.3" E28° 07' 21.5"
L3-1	5 cm	Moist and include root matter	S26° 08' 29.4" E28° 07' 19.8"
L3-2	20 cm		
L4-1	5 cm	Depression	S26° 08' 31.1" E28° 07' 18.8"
L4-2	Mole hill	Clay	
L5	Mole hill	Near grave	S26° 08' 34.3" E28° 07' 24.6"
L6	Mole hill	Near grave of Mariah	S26° 08' 40.2" E28° 07' 27.5"
L7	Mole hill	Near grave of Sidney James	S26° 08' 40.9" E28° 07' 27.9"
L8	Mole hill		S26° 08' 42.9" E28° 07' 27.4"
L9	Mole hill	Floodplain; structured soil	S26° 08' 10.3" E28° 07' 42.1"
L10	Mole hill	Floodplain: structured soil	S26° 08' 08.9" E28° 07' 41.9"
BIO-1 (snail)		Organic matter on snail	
BIO-2 (snail)		Shell of snail	

LINKSFIELD
Pathology Sample Points

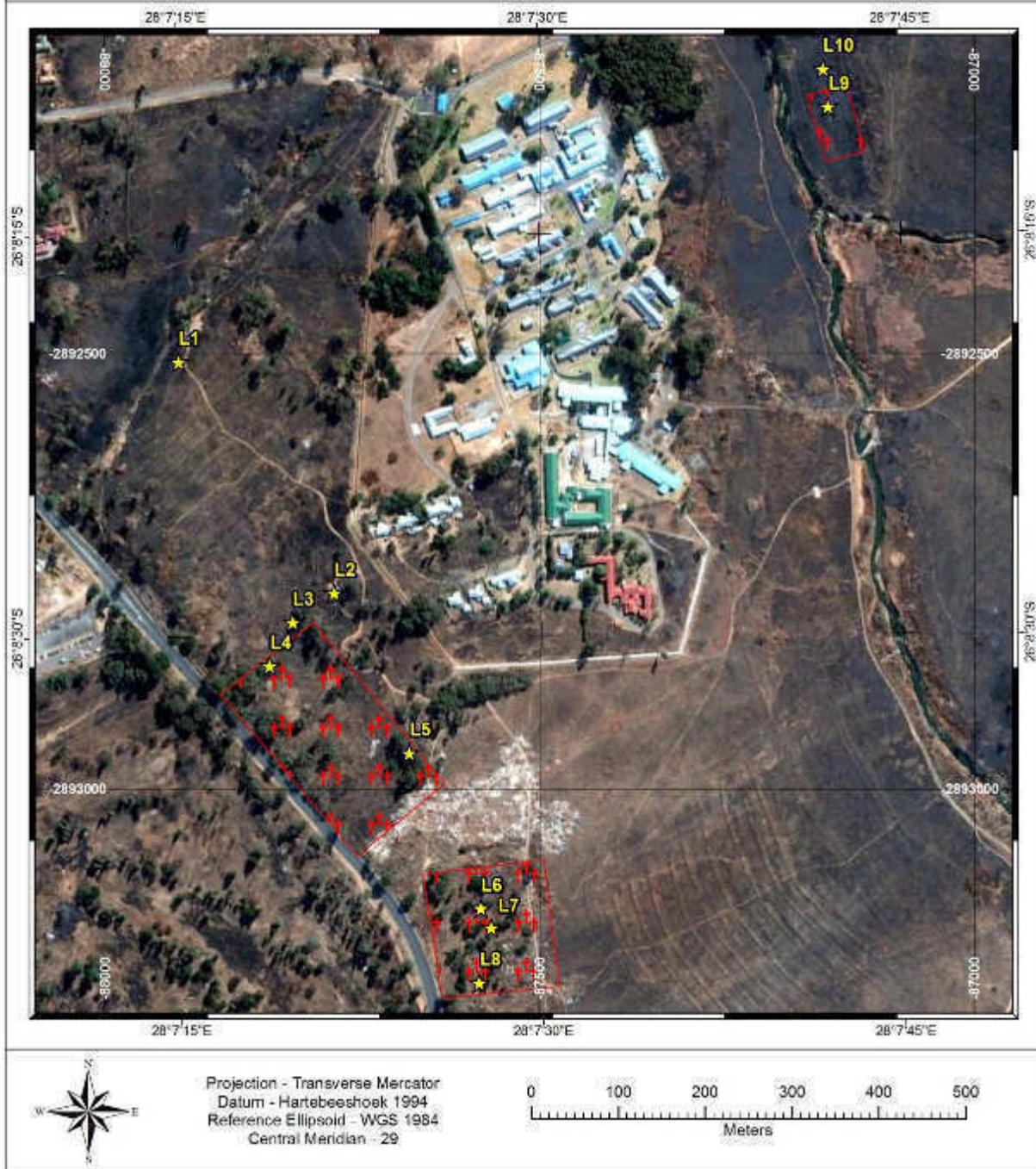


Figure 11 Location of the microbial sample collection points on the Linksfield site

Table 2 Information of chemical analysis soil samples collected at Linksfield site

Sample number	Sample Depth (cm)	Coordinates
LP1	0-10, 10-40, 40-60	S26° 08' 41.6" E28° 07' 29.9"
LP2	0-30, 30-60	S26° 08' 43.1" E28° 07' 27.5"
LP3	0-30, 30-60	S26° 08' 36.8" E28° 07' 24.5"
LP4	0-30, 30-60	S26° 08' 33.1" E28° 07' 24.3"
LP5	0-20, 20-40, 40-60	S26° 08' 29.6" E28° 07' 19.0"
LPG1	0-10	S26° 08' 33.7" E28° 07' 23.6"
LPG2	0-10	S26° 08' 34.9" E28° 07' 22.2"
LPG3	0-10	S26° 08' 35.0" E28° 07' 21.4"
LPG4	0-10	S26° 08' 31.8" E28° 07' 23.0"
LPG5	0-10	S26° 08' 29.9" E28° 07' 18.9"
LPG6	0-10	S26° 08' 31.3" E28° 07' 22.1"
LPG7	0-10	S26° 08' 31.7" E28° 07' 21.6"
LPG8	0-10	S26° 08' 32.2" E28° 07' 19.8"
LPG9	0-10	S26° 08' 40.1" E28° 07' 28.3"
LPG10	0-10	S26° 08' 40.6" E28° 07' 27.1"
LPG11	0-10	S26° 08' 41.1" E28° 07' 26.4"

LINKSFIELD
Chemical Analysis Sample Points

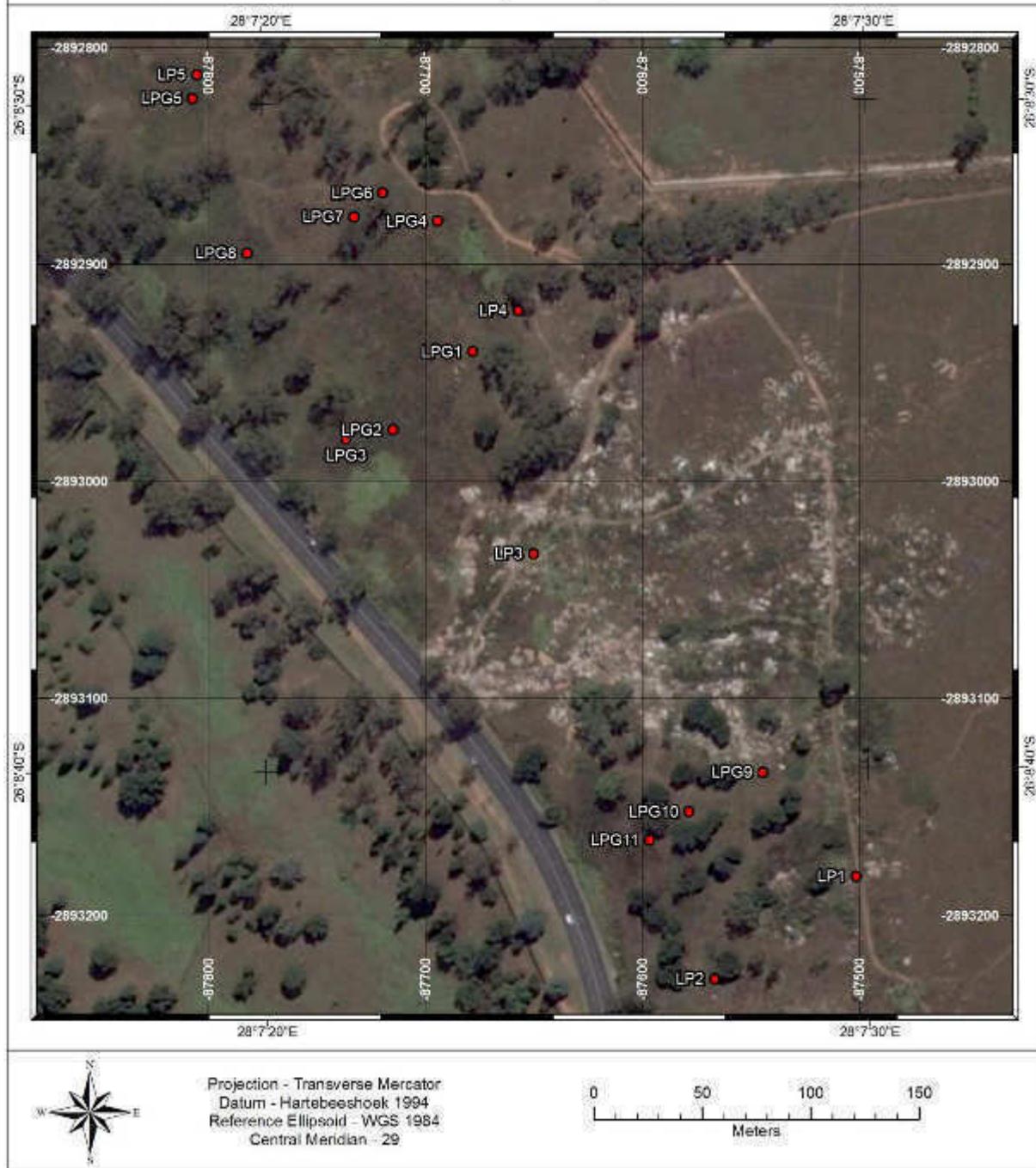


Figure 12 Location of the chemical sample collection points on the Linksfield site

5.3 SOIL SAMPLING RESULTS / OBSERVATIONS

The sampling process in the graveyard areas was restricted due to different sets of legislation (such as the National Heritage Resources Act – Act No. 25 of 1999) that govern the disturbance of such sites that precluded unauthorised digging and auguring. During the site visit it was observed that there was very intensive mole activity among the graves (**Figures 13 and 14**). Upon closer inspection it was evident that the soils in the graveyard areas have been disturbed drastically through the digging of the graves as well as the subsequent mole activity. It was postulated that the moles had mixed the soil material as well as brought decaying bone remains to the surface. This postulation became more credible as large numbers of snails were encountered among the graves (**Figures 15 to 17**). It is well known that snails can only develop and multiply in soils with enough Ca for shell formation.

The soils in the graveyard area are predominantly of the Glenrosa form. These soils have a sandy orthic A horizon (bleached in the lower slope areas of the site) overlying a varyingly weathered serpentine/greenstone rock subsoil (lithocutanic B horizon) that is often red in colour. The interface between the topsoil horizon and the weathered rock subsoil is often characterised by a distinct quartz pebble marker. This marker is found in undisturbed soil profiles outside of the graveyard at a depth of 30 to 50 cm (**Figures 18 and 19**). These pebbles are encountered at the soil surface in the graveyard due to the mixing of material during grave digging as well as due to mole activity. Mole hills contain both coarse (including pebbles) and fine soil material when fresh. The latter is removed with rainfall events and the result is that the pebbles are distinctly visible on the soil surface (**Figure 13**). The presence of the pebbles on the surface is considered to be a good indication of the degree of mixing that the soils have been subjected to.

The depth of the weathered rock profile leads to an additional postulation that the graves were not 1.8 m deep (as is convention). This postulation is confirmed by the lack of weathering greenstone-serpentine rock material on the surface amongst the quartz pebble marker material. We postulate therefore that the graves are at best 0.6 to 0.7 m deep. Under these conditions it is entirely plausible that human remains (and the weathering products of bone material – Ca rich soil) would have been brought to the soils surface by mole activity. The presence of copious amounts of snails in the graveyard areas provides further credibility to this postulation.

Under the conditions as described above it was considered entirely adequate to collect soil material from mole hills for further analysis. The sample points indicated in **Figures 2 and 3** and **Tables 1 and 2** relate predominantly to such material. Outside of the graveyards the conventional manner of auguring was used to collect the relevant samples. In the latter areas the presence of the stone marker at depth inhibited further auguring.



Figure set 13 Mole activity in the graveyard area



Figure set 14 Mole activity among the graves in the graveyard area



Figure 15 Snail shell found among the graves



Figure 16 Snail shell found among the graves



Figure 17 Live snails found among the graves

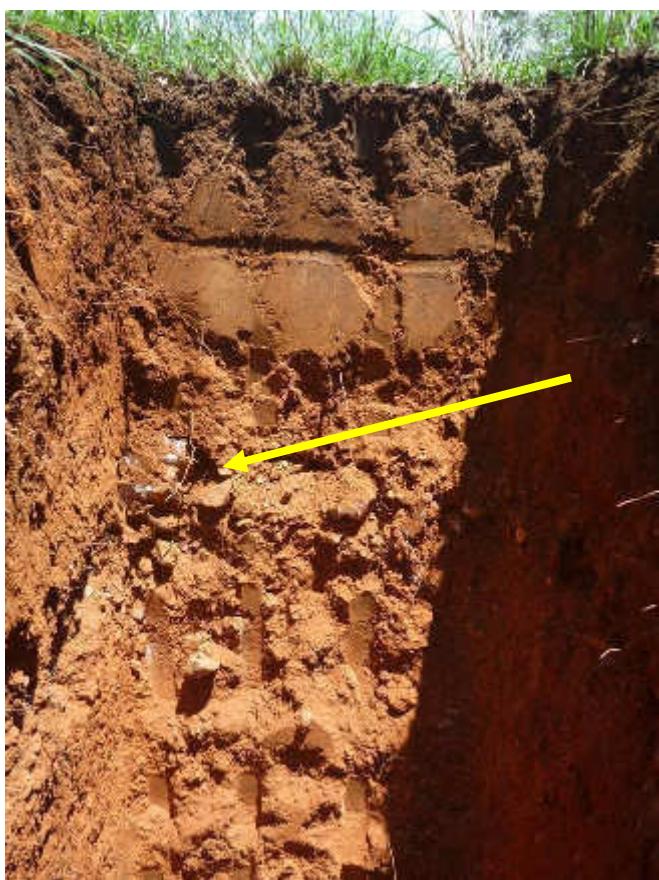


Figure 18 Profile next to the graveyard with distinct pebble marker (yellow arrow)



Figure 19 Profile next to the graveyard with distinct pebble marker (yellow arrow)

6. MICROBIOLOGY / PATHOLOGY ANALYSIS

6.1 MATERIAL AND METHODS

6.1.1 Culturing of Bacteria

Soil samples were processed to allow culturing of *Bacillus anthracis* (causal agent of anthrax) and *Clostridium* species. Soil (1 g) was aliquoted into 9 ml of phosphate buffered saline (PBS) in duplicate for each sample. The samples were shaken for 3 hours and one was plated directly onto nutrient agar while the second sample was heat treated. Heat shock treatment kills off all vegetative bacterial cells and is a means of selecting for the more resistant spore-forming bacteria (*Bacillus* and *Clostridium* species). The 3-hour samples plated onto nutrient agar were pooled for anaerobic culturing of *Clostridium* species by the Bacteriology Laboratory, Department of Veterinary Tropical Diseases, Onderstepoort. *Bacillus anthracis* strains were confirmed using real time PCR as described by Ellerbrok *et al.* (2002) that detect *B. anthracis* chromosomal region (SASP), protective antigen (pXO1 target BAPA) and capsule (pXO2 target capC) regions.

The heat treated set of samples were plated out onto selective media (PLET) and incubated at 37°C for 8 hours to select for *Bacillus* spp. Both the untreated and heat treated nutrient agar plates were incubated in 5% CO₂ at 37°C overnight to select for other bacteria. The bacterial

lawns were harvested in 1 ml PBS after incubation and split into 2 samples; one for crude boiling DNA extraction and the other for further culturing after serial dilution up to 10^{-8} . The raw soil and PBS solution were also crude boiled at a 110°C for 20 min and the supernatants collected for PCR.

6.1.2 PCR

6.1.2.1 *Bacillus anthracis* Real Time PCR

Bacillus anthracis consists of a chromosome (target SASP) and the virulent factors occurring on two plasmids namely pXO1 (target BAPA) that contain toxins and pXO2 that contain capsule (target CapC). Real time PCR was done as described by Ellerbrok *et al.* (2002).

6.1.2.2 *Clostridium* Conventional PCR

Universal *Clostridium* primers (Chis150/Clostir primers) as described by Hung *et al.* (2008) amplify all *Clostridium* species, which include both pathogenic and environmental strains. The *Clostridium* PCR reaction and condition used by Hung *et al.* (2008) were used in this study.

6.1.2.3 *Mycobacterium* PCR

The *Mycobacterium* PCR targets the RD4 and RD9 regions that identified *B. tuberculosis* and *B. bovis* (Warren *et al.*, 2006). The RD4 region produce a PCR product of 268 bp (size of PCR target in base pairs) for *M. bovis* and 172 bp (base pairs) for *M. tuberculosis*, whereas RD9 region produce 108 bp for *M. bovis* and 235 bp for *M. tuberculosis*.

6.2 RESULTS

6.2.1 Culturing of *Bacillus anthracis*

Soil depth plays a role in the isolation of pathogens and presence of soil endophytes (**Figure 20**). There is a logarithmic decrease in spore counts the deeper the soil is collected. The deeper soil fractions are more representative of typical soil endophytes such as *Bacillus subtilis*, *B. megaterium* and *B. endophyticus*.

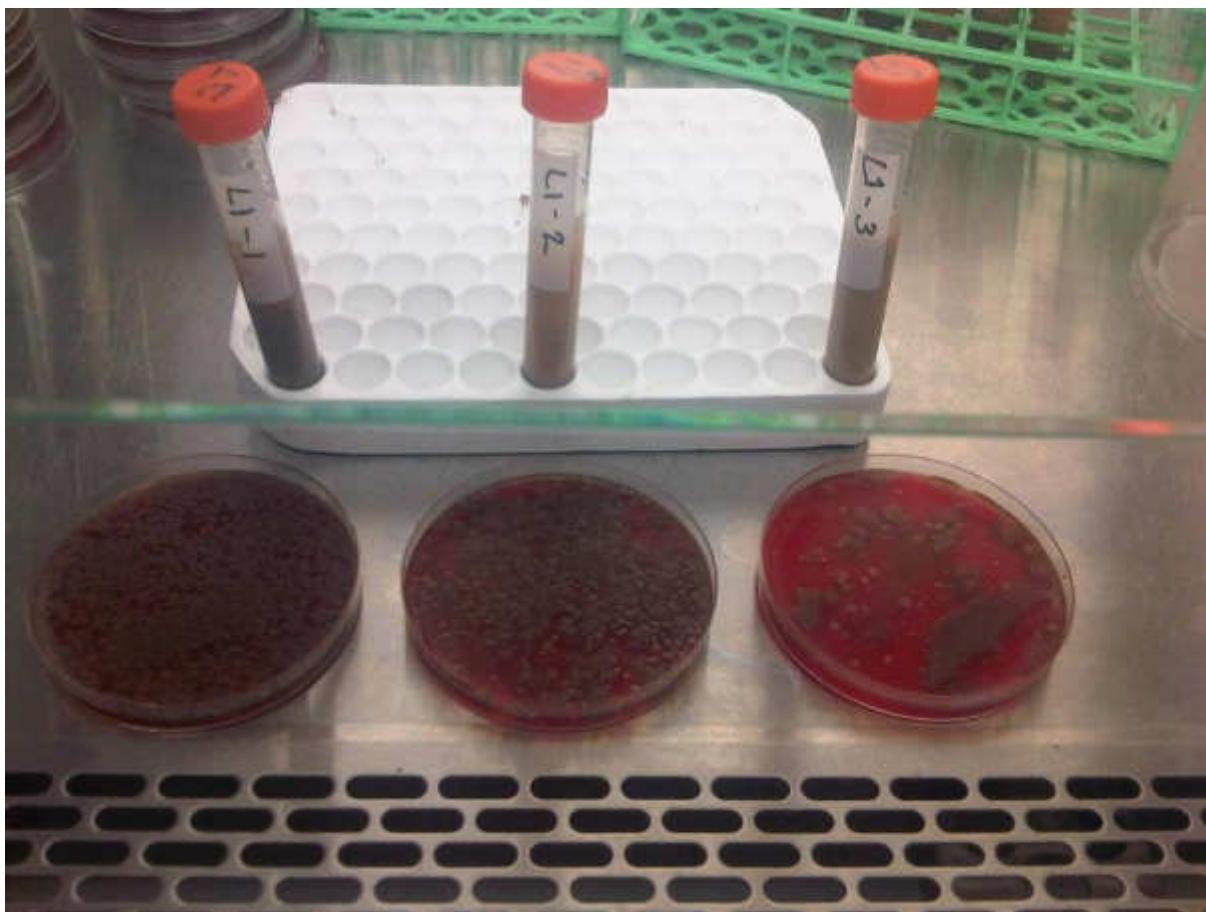


Figure 20 Growth of spore-forming bacteria on blood agar plates from different soil depths at the same site after incubation at 37°C for 8 hours. L1-1 (left) is from the top 5 cm of soil. L1-2 (middle) shows growth from a soil depth of 30 cm and L1-3 (right) is from a depth of 60cm. The decreasing spore-forming bacteria counts are evidenced in the deeper soil fractions.

The bacterial growths observed on blood agar plates were typical for the usual soil endophytes. *Bacillus cereus* was present on all the plates as *B. cereus* circular colonies appear granular being haemolytic (clear zones) (**Figure 21**). *Bacillus cereus* is the most abundant spore former in the area especially in the surface soil fraction. This is not surprising because of the organic/plant root matter present in the topsoil to which *B. cereus* is generally associated.

Soil samples L9 and L10 demonstrated a different assemblage of bacterial populations to the other plates. Colonies on blood agar plates (undiluted) for L1-L8 were all haemolytic while L9 and L10 had haemolytic and non-haemolytic colonies (**Figure 22**). These non-haemolytic colonies were sub-cultured and purified and appear to be *Bacillus thuringiensis* which is a typical soil borne insect pathogen.



Figure 21 Image with typical *Bacillus cereus* colonies on blood agar plates (samples L1-L8 at a dilution of 10^{-6}) from soils at Linksfield site.



Figure 22 (I) Haemolytic colonies (yellow blotches) and non-haemolytic colonies (red) from samples L9 and L10. Colonies were purified by streaking on blood agar plates and (II) indicate a purified non-haemolytic *B. thuringiensis* culture.

6.2.2 Culturing of *Clostridium*

Refer to the attached report of the Bacteriology Laboratory indicating that pooled soil sample was negative for *Clostridium*.

6.2.3 PCR

6.2.3.1 Real Time PCR for *Bacillus anthracis*

Refer to attached *Bacillus anthracis* Real time PCR report 1 and 2:

Report 1 indicates the real time PCR targeting the toxin plasmid (pXO1, BAPA target). Positive real time PCR results for BAPA (target pXO1 region; page 2 of 4 (Report 1) indicated by samples with CP value and amplification curves (page 3 of 4). The positive control *B. anthracis* Vollum and Sterne strains were positive as well as samples L1-1, L2, L3-1, L3-2, L4-2, L5 and L6.

Report 2 indicates the real time PCR results for *B. anthracis* chromosome (SAPA) and capsule plasmid, pXO2 (capC). The report shows positive PCR results for only positive *B. anthracis* Ames strain on page 2-3 of 5 (see CP values and amplification peak). *Bacillus anthracis* real time PCR products must be positive for all three targets as virulent *B. cereus* (a close relative to *B. anthracis*) is known from literature to contain similar BAPA (pXO1) (Okinaka *et al.*, 1999, Rasko *et al.*, 2004; Okinaka *et al.*, 2006) region. *Bacillus anthracis* is therefore not present in any of the samples as the chromosomal (SAPA) and pOX2 (capC) real time PCR target regions are absent.

6.2.3.2 *Clostridium* PCR

The presence of spore-forming bacterium *Clostridium* was tested using universal Chis150/Clostr primers (Hung *et al.* 2008) for *Clostridium* cluster I species that include both pathogenic (such as *C. botulinum*) and environmental strains. Ten (L1-1, L2, L3-2, L4-1, L4-2, L6-10) of the enriched bacterial lawns (sample number indicated in red in **Figure 23**) showed positive amplification for *Clostridium* spp. However it is interesting to note that from the crude boiled soil lysate, only L9 showed faint amplification (sample numbers in blue) (**Figure 23**).

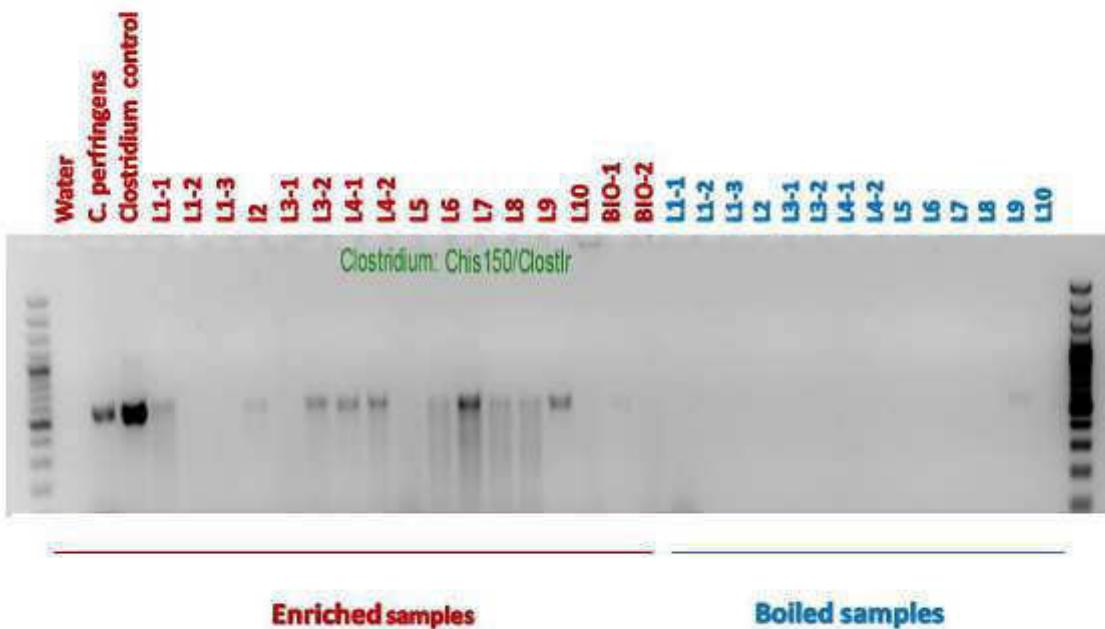


Figure 23 PCR gel image showing PCR products (amplification) for the 2 positive *Clostridium perfringens* and unidentified *Clostridium* species as well as some enriched soil samples (indicated in red) and faint positive PCR product (L9 in blue for crude boiled soil lysate).

6.2.3.3 *Mycobacterium* PCR

The *Mycobacterium* PCR targets the RD4 and RD9 regions that differentiate species within the *Mycobacterium* complex (Warren *et al.* 2006). With the RD4 PCR region, none of the samples were positive for either *Mycobacterium tuberculosis* or *M. bovis*. The RD9 PCR region indicated non-specific PCR products (not the right size; indicated in green in **Figure 24**) due to the presence of non-tuberculosis *Mycobacteria* (NTM's) and faint PCR products for *M. tuberculosis* in sample L9 and L10 (**Figure 24**).

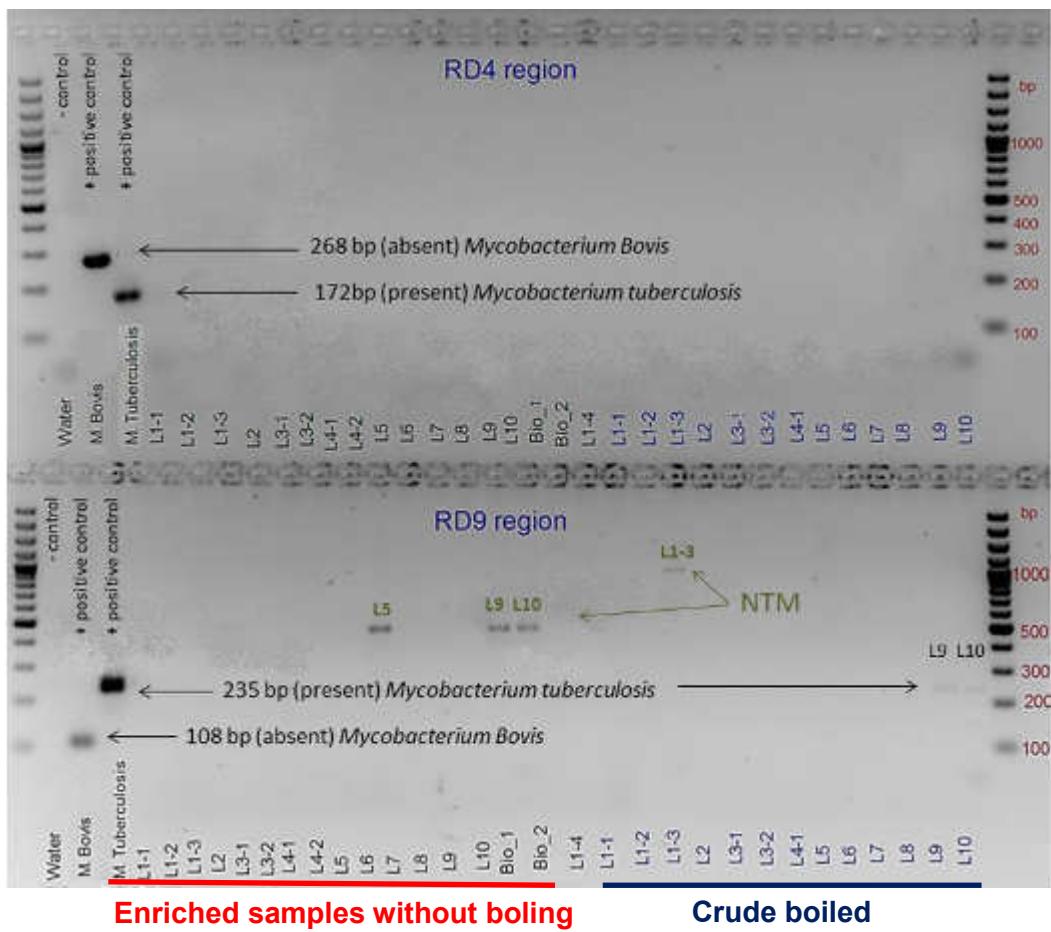


Figure 24 PCR gel image of RD4 and RD9 *Mycobacterium* PCR of enriched samples (in red) and crude boiled samples (in blue). No amplification where obtained in samples collected from Linksfield site for *M. tuberculosis* and *M. bovis* RD4 PCR. With *M. tuberculosis* and *M. bovis* RD9 PCR amplification of 235 bp products were obtain with sample L9 and 10. Non-specific PCR products of 500 bp and larger where obtained for L5, L9, L10 (enriched samples) and L1-3 (crude boiled sample).

6.2.3.4 Results summary

Table 2 provides a summary of the results in terms of positive findings.

Table 2 Summary of positive results

Sample	Depth	Comment	<i>Clostridium</i>	<i>Mycobacterium</i>	<i>Bacillus</i>	
L1	1	5cm high in organic matter	+		+	
	2	30cm				
	3	60cm mottled soil				
L2	mole hill	high in organic matter	+		+	
L3	1	5 cm moist + includes root matter			+	
	2	20cm			+	
L4	1	5cm depression: possible cattle burial site?	+			
	2	30cm clay	+		+	
L5	mole hill	near Human grave	+		+	
L6	mole hill	near grave of Mariah			+	
L7	mole hill	near grave of Sidney James	+			
L8	mole hill		+			
L9	mole hill	floodplane: well structured soil	+	+		
L10	mole hill	floodplane: well structured soil	+	+		
Bio	1	snail organic	+			
	2	snail shell				

6.3 DISCUSSION

Bacillus anthracis (causal agent of anthrax) was not found at the site but the unconfirmed / undocumented reports of anthrax cases buried at the site poses a possible health risk as *B. anthracis* can survive for extended periods in the soil. From the literature investigating the persistence of bacteria and viruses it was clear that anthrax (approximately 200 years) and smallpox (8 years) persist for extended periods (Pirtle and Beran, 1991; Gressel and Bohnel, 2006; Fine *et al.*, 2011; Sinclair *et al.*, 2008). De Vos (1990) isolated *B. anthracis* spores from bones retrieved at an archaeological site in Kruger National Park, estimated to be 200 ±50 years old. *Bacillus anthracis* can remain in the soil for decades and humans could contract it through skin lesions or through inhalation from breathing in airborne anthrax spores. This will only occur if buried carcasses are uncovered during development. However the soil composition lowers the health risk anthrax poses since the soils in the black and white cemeteries are mildly acidic unlike the soils associated with endemic anthrax with elevated calcium and neutral-to-alkaline soils (Dragon and Rennie, 1995; Smith *et al.*, 2000).

Humans occasionally become infected by coming into direct contact with blood, excreta, wool, skin or meat of infected animals. Drum makers have contracted the diseases working with infected hides over an extended period (Marston *et al.*, 2011). The health risk will be associated with exposure of anthrax infected carcass. Persons can develop lesions only at the site of a skin wound. This condition is treatable with antibiotics. Note that humans are usually highly resistant to this disease. However, as there is a potential risk, workers will have to be given a standard operating procedure upon uncovering graves. Workers will have to be properly informed about the disease and the risks. Workers will have to adhere to a "biosecurity" protocol that will be set up and safety measures will have to be in place. Workers and general public will have to be informed of anthrax and the symptoms. If grave sites are uncovered the bones / grave site must be covered with soil, excavation must be stopped and experts must be called in to identify the origin of the bones. Samples should be taken to confirm the absence/presence of *Bacillus anthracis*. Should any sample be positive for anthrax all workers will have to receive medical care and a treatment protocol using penicillin or a cephalosporin (penicillin susceptible individuals).

The cost will be difficult to determine since there might be unknown grave sites exposed during excavation. However the presence or absence of anthrax must be confirmed in exposed graves. If anthrax is found, that specific grave site will have to be decontaminated using a prescribed protocol. However most of the prescribe protocols are for laboratories and for solid surfaces. Chemical are used for cleaning anthrax-contaminated sites or materials. Mainly oxidizing agents such as peroxides, ethylene oxide, chlorine dioxide, peracetic acid, hypochlorous acid and liquid bleach containing hypochlorite. Many of the anthrax decontamination technologies have been demonstrated to be effective in laboratory tests (Heninger *et al.*, 2009). Clean up of anthrax-contaminated areas on ranches and in the wild is much more problematic. Carcasses have been soaked in formaldehyde to kill spores, though this has environmental contamination issues. Therefore research will have to be done on the effect of the agents on the spores and the environment. The use of different chemical agents can be viewed at the following websites:

<http://www.epa.gov/pesticides/factsheets/chemicals/chlorinedioxidefactsheet.htm>

http://www.epa.gov/pesticides/factsheets/chemicals/hydrogenperoxide_peroxyaceticacid_factsheet.htm

<http://www.epa.gov/pesticides/factsheets/chemicals/etofactsheet.htm>

Clostridium species (including pathogenic and non-pathogenic) DNA was detected using conventional PCR but no *Clostridium* could be cultured. The presence of *Clostridium* DNA means that the organism was present at some stage but not currently as we could not isolate *Clostridium* from the samples. *Clostridium* DNA poses no health risk. *Clostridium* botulism is a Category A agent but the botulinum neurotoxins types A, B, E, and F are responsible for human botulism, whereas toxin types C and D are involved in animal botulism. There is no record of any human death due to botulism and if animals were buried that died of animal botulism the toxin (types C and D) pose no threat to humans (Woudstra *et al.* 2012).

Mycobacterium tuberculosis, the causal agent of human tuberculosis, is a slow growing organism and culturing will take up to 3 months. PCR was used to detect whether *M. tuberculosis* is present on the site. *Mycobacterium tuberculosis* DNA was present in 'floodplain' sites (L9 and 10). However it is possible that the DNA was present due to the presence of hospital effluent from the HIV and tuberculosis hospital (although this is just one of many possibilities). It is important to note that presence of DNA does not pose a health risk, but is merely used as a guide or diagnostic for bacterial isolation. *Mycobacterium tuberculosis* poses a very low risk as it requires a host and does not survive in soil. However it might pose a higher risk to people living currently on the site. The effluent and waste disposal of Siswe Hospital will have to be investigated to ensure it poses no health risk to people currently living in the area or people living on the site in future. We could not confirm the presence of *M. leprae* DNA (agent of leprosy) at all through the molecular tests available to us.

With the culture and real time PCR no anthrax (*B. anthracis*) was detected. Only pathogenic *B. cereus* was cultured. *Bacillus cereus* is the cause of two kinds of foodborne diseases, an emetic (vomiting) intoxication due to the ingestion of a toxin (cereulide) pre-formed in the food and a diarrhoeal infection due to the ingestion of bacterial cells/spores which produce enterotoxins in the small intestine (Arnesen *et al.*, 2008). *Bacillus cereus* is ubiquitous and its spores will not be eliminated from food materials by heat treatment, apart from canning. Spores are present in almost all categories of foods before storage, generally in numbers too low to cause foodborne poisoning (Opinion of the Scientific Panel on Biological Hazards, 2005). It therefore poses a negligible risk.

7. SOIL ANALYSIS RESULTS

7.1 Soil Physical Analysis

During the sampling and field survey it was observed that a large fraction of the soil consisted of material coarser than 2 mm. Soil is defined as the fraction smaller than 2 mm. The samples that were collected were sieved through a 2 mm sieve for preparation for chemical analysis. The coarse fraction was retained and weighed as was the fraction smaller than 2 mm. The results of this determination are presented in **Table 3**. The samples collected from profile pits showed a general increase in coarse fraction from the surface downwards, although this was not observed in all profiles. The coarse fractions varied significantly from 27 to 77 %. In the graveyard soils (only surface material) the variation was significantly less viz. 26 to 48 %. Although this data is of very little significance it is interesting to note that the graveyard soils could exhibit the smaller variation due to the mixing of materials due to grave excavation and subsequent mole activity leading to more homogenised profiles.

Table 3 Percentage coarse fraction (> 2 mm) in the samples

Sample	Depth	> 2 mm (g)	< 2mm (g)	Total	% coarse
LP1	0-10	233.5	621.0	854.5	27.3
LP1	10-40	604.8	514.6	1119.4	54.0
LP1	40-60	429.5	181.4	610.9	70.3
LP2	0-30	405.3	525.9	931.2	43.5
LP2	30-60	1033.8	353.1	1386.9	74.5
LP3	0-30	1794.8	713.0	2507.8	71.6
LP3	30-60	592.5	506.3	1098.8	53.9
LP4	0-30	570.5	1027.8	1598.3	35.7
LP4	30-60	708.8	1350.0	2058.8	34.4
LP5	0-20	726.6	1168.1	1894.7	38.3
LP5	20-40	1478.4	635.8	2114.2	69.9
LP5	40-60	1322.0	396.0	1718.0	76.9
LPg1	0-10	460.5	1298.7	1759.2	26.2
LPg2	0-10	742.6	966.0	1708.6	43.5
LPg3	0-10	882.7	949.2	1831.9	48.2
LPg4	0-10	451.4	916.4	1367.8	33.0
LPg5	0-10	854.4	1100.6	1955.0	43.7
LPg6	0-10	641.5	953.9	1595.4	40.2
LPg7	0-10	597.8	810.6	1408.4	42.4
LPg8	0-10	788.2	1138.9	1927.1	40.9
LPg9	0-10	527.1	933.8	1460.9	36.1
LPg10	0-10	733.6	1003.7	1737.3	42.2
LPg11	0-10	697.2	1147.6	1844.8	37.8

7.2 Soil Chemical Analysis

The results of the chemical analysis of the samples are provided in **Table 4**. The data set was split for control soils outside of the graveyard areas and graveyards soils. For each set a standard set of statistical parameters were calculated. These include: average (or mean), standard deviation, coefficient of variation, and minimum and maximum values indicating the range.

7.2.1 Soil pH

The pH values for the control plots as well as the graveyard ranged roughly between 4.5 and 6.3 (**Figure 25**). Although there was a slightly larger variation in the graveyard plots the averages were similar and in the range of 5.1 to 5.3. These two values are not considered to be significantly different and the fact that the ranges overlap distinctly indicate that there is no significant difference between the control and graveyard soils. These pH values are not conducive to the survival of anthrax (*B. anthracis*) in soil as its survival requires much higher pH values.

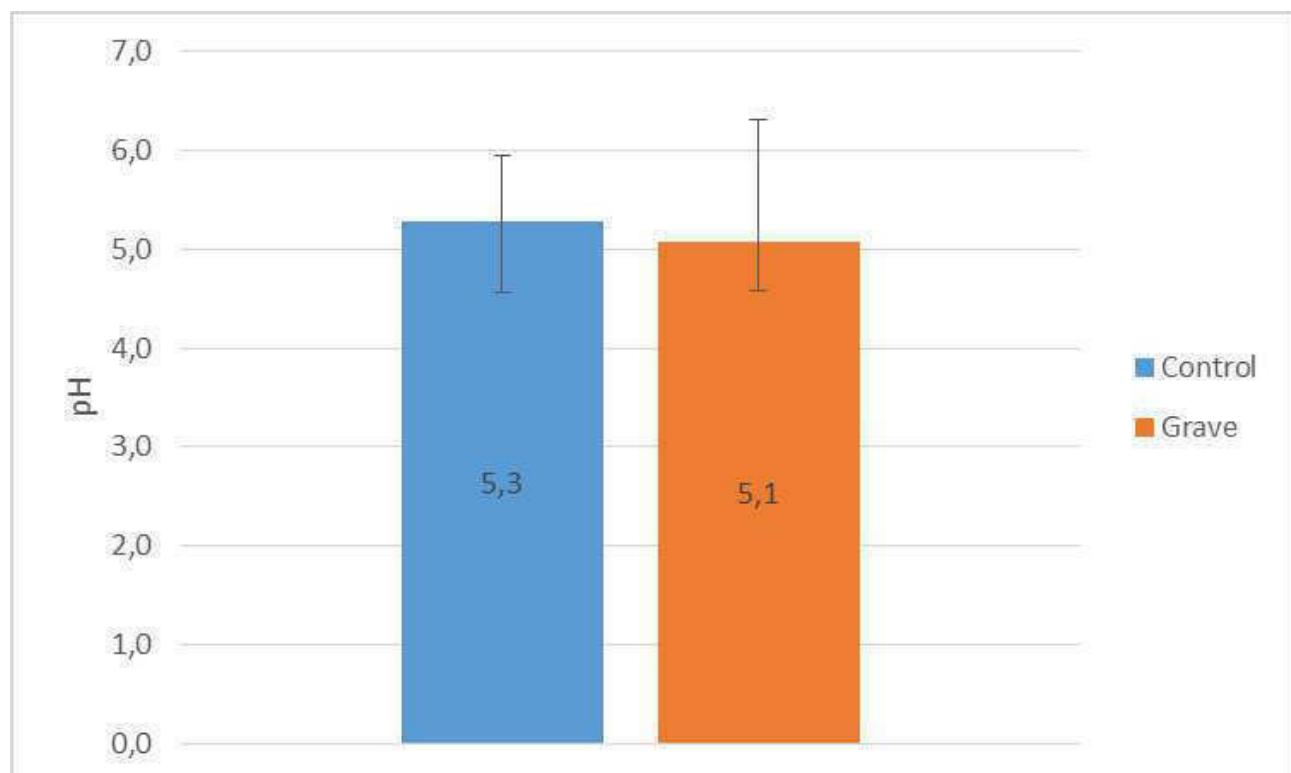


Figure 25 Average soil pH values for the two areas (error bars indicate the data range)

Table 4 Selected chemical parameters of the sampled soils

Sample	Depth	pH (water)	Exchangeable Cations (ammonium acetate)				Bray 1
			K (mg/kg)	Mg (mg/kg)	Ca (mg/kg)	Na (mg/kg)	
Control pits / outside of graveyards							
LP1	0-10	5.6	159.9	188.4	1840.7	6.5	15.7
LP1	10-40	5.7	69.2	172.8	1237.7	6.5	9.0
LP1	40-60	6.0	79.1	462.4	1453.7	11.2	5.5
LP2	0-30	5.9	82.0	83.2	1766.7	6.7	10.1
LP2	30-60	5.2	50.4	65.1	521.2	6.2	11.9
LP3	0-30	5.6	99.1	104.9	1218.7	6.0	14.6
LP3	30-60	5.0	97.3	95.5	573.9	7.0	7.8
LP4	0-30	4.9	116.9	55.2	475.2	6.1	14.5
LP4	30-60	4.6	70.1	82.0	276.3	6.6	11.8
LP5	0-20	5.1	94.3	70.4	896.2	5.0	45.3
LP5	20-40	5.0	81.7	53.8	476.6	4.4	23.8
LP5	40-60	5.1	63.1	80.6	618.7	4.4	12.3
Average		5.3	88.6	126.2	946.3	6.4	15.2
Standard deviation		0.4	28.8	114.2	540.2	1.8	10.6
Coefficient of variation		8.3	32.5	90.5	57.1	27.5	69.5
Minimum value		4.6	50.4	53.8	276.3	4.4	5.5
Maximum value		6.0	159.9	462.4	1840.7	11.2	45.3
Graveyards							
LPg1	0-10	4.9	84.1	38.5	394.0	6.3	23.2
LPg2	0-10	4.8	114.2	63.9	489.2	3.9	24.5
LPg3	0-10	5.2	232.0	98.8	1407.7	8.1	21.8
LPg4	0-10	4.8	130.9	46.8	567.6	7.3	23.8
LPg5	0-10	5.4	203.7	121.1	1682.7	9.9	67.6
LPg6	0-10	5.1	127.2	41.4	697.7	4.3	30.2
LPg7	0-10	5.2	151.7	64.9	982.7	13.0	23.8
LPg8	0-10	4.6	168.6	98.3	1119.7	8.1	31.3
LPg9	0-10	6.3	269.9	196.5	1007.7	5.3	14.6
LPg10	0-10	4.7	109.5	93.9	994.7	6.7	32.1
LPg11	0-10	4.9	135.1	221.9	1516.7	7.5	32.1
Average		5.1	157.0	98.7	987.3	7.3	29.5
Standard deviation		0.5	56.7	61.0	426.5	2.6	13.7
Coefficient of variation		9.6	36.1	61.8	43.2	35.7	46.4
Minimum value		4.6	84.1	38.5	394.0	3.9	14.6
Maximum value		6.3	269.9	221.9	1682.7	13.0	67.6

7.2.2 Exchangeable Cations

The exchangeable cations Ca, Mg and Na showed the same extent of variation as the pH values with no significant difference between the control and the graveyard areas. The results for Ca are indicated in **Figure 26**. Even though the range is slightly larger in the control soils the data overlaps significantly and it is therefore considered not to be significantly different.

The similarity in Ca levels is significant in that it negates any deductions on the degree of bone degradation and dissolution in the soils as well as mixing of soil material by moles. The Ca data is therefore inconclusive regarding such deductions.

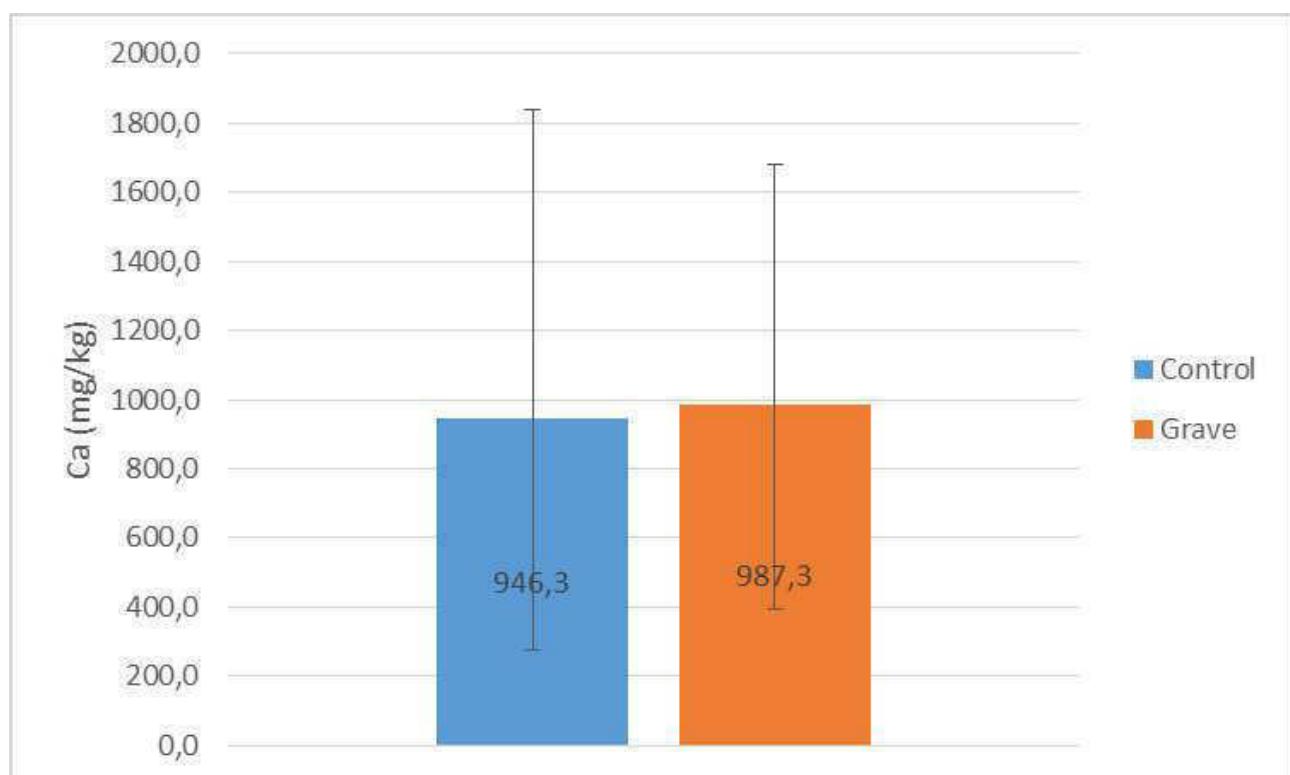


Figure 26 Average soil Ca values for the two areas (error bars indicate the data range)

The K values did indicate a large degree of difference in that the graveyards soils exhibited significantly higher levels compared to the control soils (**Figure 27**). This phenomenon could be ascribed to a range of factors other than graves so there is not much significance assigned to it. It is possible that the decaying bodies in the graveyard contributed to the higher K levels in these soils but this aspect is outside of the scope and interest of this study.

7.2.3 Phosphorus

Phosphorus exhibits a similar trend to K in the graveyard soils (**Figure 28**) and the conclusions reached for the K data apply to the P data as well.

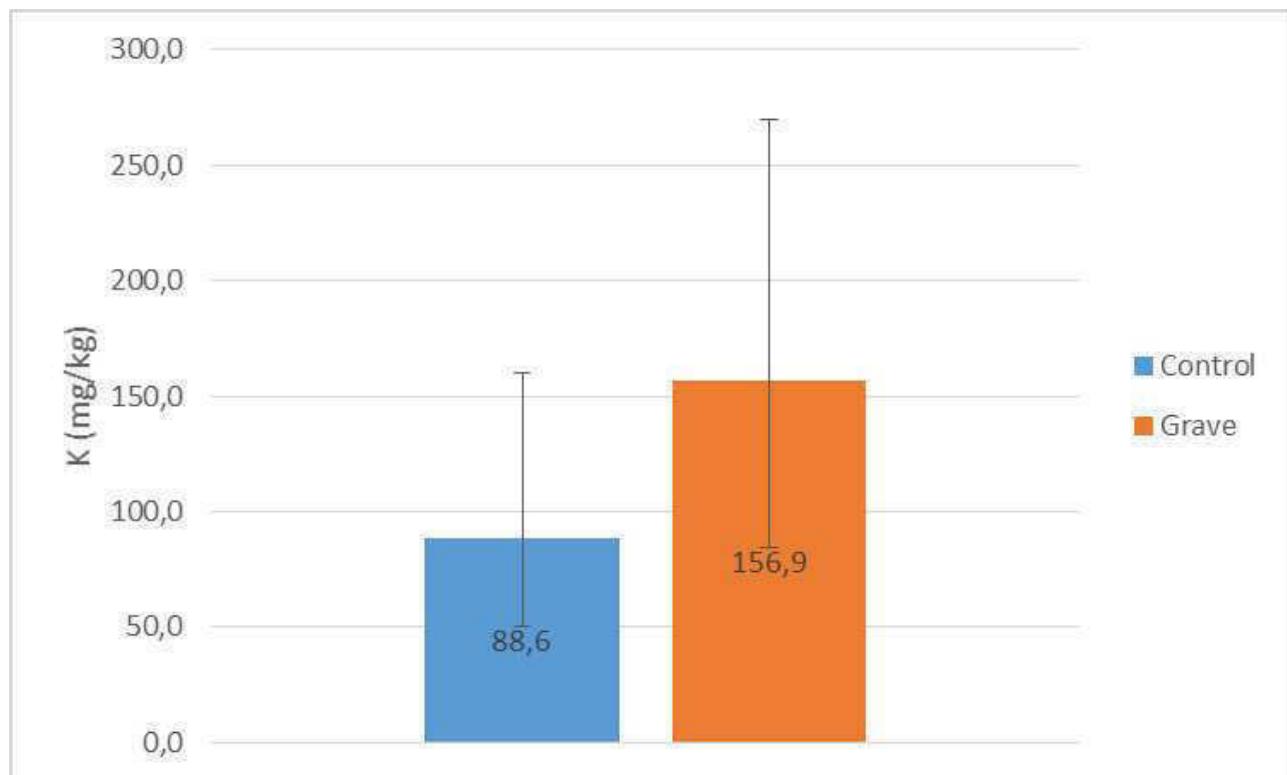


Figure 27 Average soil K values for the two areas (error bars indicate the data range)

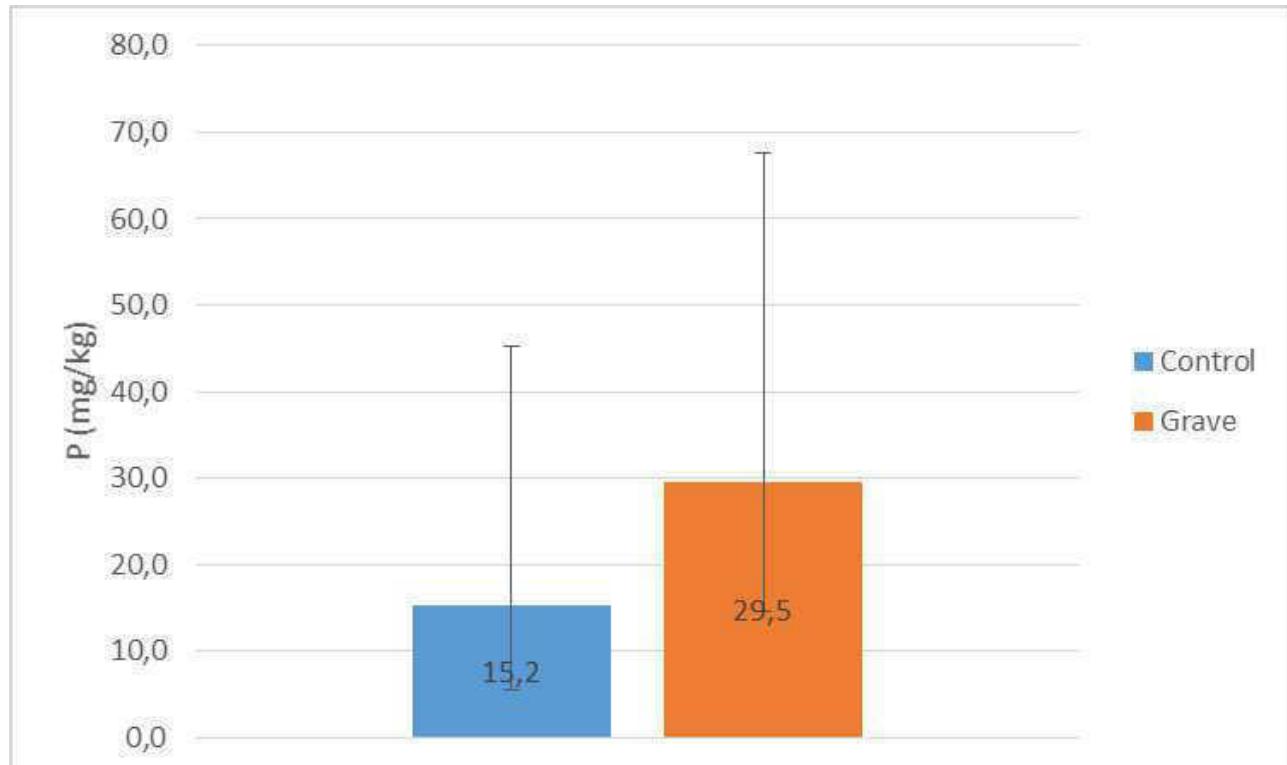


Figure 28 Average soil P values for the two areas (error bars indicate the data range)

8. SUMMARY AND CONCLUSIONS

The Linksfield site was assessed regarding grave site distribution, pathogen presence in soils and selected chemical parameters of the soils.

The distribution of the graves was established through the interpretation of historical aerial photographs and satellite images. These were found to be concentrated in three distinct areas. The two sites located along Club Road are associated with the Rietfontein Hospital. The site located on the banks of the Jukskei River appears to pre-date the hospitals main burial activities. No sites could be identified that gave the impression of haphazard burying or animal carcass burying.

During the literature survey regarding persistence of pathogens in soil all the pathogens, except for anthrax, were ruled out as risks due to poor or non-survival for prolonged periods in soil. The emphasis on anthrax was due to the reported persistence of the pathogen in soils with neutral to alkaline pH as well as elevated Ca levels and the anecdotal evidence that indicted the burial of animal carcasses of animals that died due to an anthrax outbreak. These indications informed the approach followed during the analysis phase of the investigation.

None of the human diseases identified during the literature survey could be identified in the soils. This includes anthrax. The only human pathogen in the same genus as anthrax (*Bacillus cereus*) was cultured from the soils along the Club Road graveyard soils. The pathogenicity of this organism is limited to two kinds of foodborne infections, an emetic (vomiting) intoxication due to the ingestion of a toxin (cereulide) pre-formed in the food and a diarrhoeal infection due to the ingestion of bacterial cells/spores which produce enterotoxins in the small intestine (Arnesen *et al.*, 2008). *Bacillus cereus* is ubiquitous and its spores will not be eliminated from food materials by heat treatment, apart from canning. Spores are present in almost all categories of foods before storage, generally in numbers too low to cause foodborne poisoning (Opinion of the Scientific Panel on Biological Hazards, 2005). It therefore poses a negligible risk.

The chemical analysis data of the soils was inconclusive regarding differences between control plots outside the graveyards and the graveyard soils. This was especially so for pH, Ca and Mg levels. Potassium and P levels showed a significant difference between the two soil sample zones with higher levels in the graveyard soils. From the data it therefore appears that only K and P levels were influenced by the presence of the graveyard. The reason for these increased values falls outside of the scope of this study.

The absolute values of the pH and Ca levels indicate that none of the soils can be considered conducive for the survival of anthrax, rather, the levels are low enough to confidently indicate a very low risk of anthrax survival. However, as there is a potential risk that localised infected remains may still be encountered during earthwork activity, workers will have to be given a standard operating procedure upon uncovering graves. Workers will have to be properly informed about the disease and the risks and they will have to adhere to a "biosecurity" protocol that has to

be set up with linked safety measures. Workers and general public will have to be informed of anthrax and the symptoms. If grave sites are uncovered the bones / grave site must be covered with soil, excavation must be stopped and experts must be called in to identify the origin of the bones. Samples should be taken to confirm the absence/presence of *Bacillus anthracis*. Should any sample be positive for anthrax all workers will have to receive medical care and a treatment protocol using penicillin or a cephalosporin (for penicillin susceptible individuals).

REFERENCES

- Abad, F.X., Pinto, R.M. and Bosch, A. (1994). Survival of enteric viruses on environmental fomites. *Applied and Environmental Microbiology* 60: 3704-3710.
- Adler, C. (1985). Rietfontein Hospital. *Adler Museum Bulletin* 11: 15-20.
- Aranda, E., Rodriguez, M.M., Asensio, M. A. and Cordoba, J.J. (1997). Detection of *Clostridium botulinum* types A, B, E and F in foods by PCR and DNA probe. *Letters in Applied Microbiology* 26: 186-190.
- Arnesen. L.P.S., Fagerlung, A. and Granum, P.E. (2008). From soil to gut: *Bacillus cereus* and its food poisoning toxins. *FEMS Microbiology Reviews* 32: 579-606.
- De Vos, V. (1990). The ecology of anthrax in the Kruger National Park, South Africa. *Salisbury Medical Bulletin* 68: 19–23.
- Dragon, D.C. and Rennie, R. P. (1995). The ecology of anthrax spores: tough but not invincible. *Canadian Veterinary Journal* 36: 295-301.
- Ellerbrok, H., Nattermann, H., Ozel, M., Beutin, L., Appel, B., Pauli, G. (2002). Rapid and sensitive identification of pathogenic and apathogenic *Bacillus anthracis* by real time PCR. [FEMS Microbiology Letters](#) 24: 51–59.
- Fine, A.E., Bolin, C.A., Gardiner J.C and Kaneene, J.B. (2011). A study of the persistence of *Mycobacterium bovis* in the environment under natural weather conditions in Michigan, USA. *Veterinary Medicine International* doi:10.4061/2011/765430.
- Gressel, F and Bohnel, H. (2006). Persistence and mobility of a *Clostridium* spore population introduced to soil with spiked compost. *FEMS Microbiology Ecology* 58: 384-393.
- Heninger, S.J., Anderson, C.A., Beltz G, and Onderdonk, A.B. (2009). Decontamination of *Bacillus anthracis* spores: Evaluation of Various Disinfectants. *Applied Biosafety* 14: 7-10.

Hung et al. (2008). Application of *Clostridium*-specific PCR primers on the analysis of dark fermentation hydrogen-producing bacterial communities. International Journal of Hydrogen Energy: 33 1586 – 1592.

Leppla, S.H., Robbins, J.B., Schneerson, R. & Shiloach, J. (2002). Development of an improved vaccine for anthrax. The Journal of Clinical Investigation 110: 141-144

Marston, C. K., Allen, C. A., Beaudry, J., Price, E. P., Wolken, S.R. et al. (2011) Molecular epidemiology of anthrax cases associated with recreational use of animal hides and yarn in the United States. PLoS ONE 6(12): e28274. doi:10.1371/journal.pone.0028274.

OIE. (2008). Anthrax: Manual of Diagnostic Tests and Vaccines for Terrestrial Animals, . Paris: Office International des Épizooties (OIE)

Okinaka et al. (2006) Anthrax, but not *Bacillus anthracis*? [PLoS Pathog.](#) 2:e122

Okinaka, R. T., Cloud, K., Hampton, O., Hoffmaster, A. R., Hill, K. K., Keim, P., Koehler, T.M., Lamke, G. et al. (1999). Sequence and organization of pXO1, the large *Bacillus anthracis* plasmid harboring the anthrax toxin genes. [Journal of Bacteriology](#) 181: 6509-6515.

Okinaka, R., Cloud, K., Hampton, O., Hoffmaster, A., Hill, K., Keim, P., Koehler, T., Lamke, G. et al. (1999). Sequence, assembly and analysis of pXO1 and pXO2. Journal of Applied Microbiology 87: 261-262.

Opinion of the Scientific Panel on Biological Hazards (2005). *Bacillus cereus* and other *Bacillus* spp in foodstuffs. The EFSA Journal 175,1-48.

Pirtle, E.C. and Beran, G.W. (1991). Virus survival in the environment. Rev. Sci Tech Off int Epiz 10: 733-748.

Rasko, D. A., Ravel, J., Okstad, O.A., Helgason, E., Cer, R.Z., Jiang, L., Shores, K A., Fouts, D.E. et al. (2004). The genome sequence of *Bacillus cereus* ATCC 10987 reveals metabolic adaptations and a large plasmid related to *Bacillus anthracis* pXO1. [Nucleic Acids Research](#) 32: 977-988.

Read, T.D., Salzberg, S.L., Pop, M., Shumway, M., Umayam, L., Jiang, L.X., Holtapple, E., Busch, J.D. et al. (2002) Comparative genome sequencing for discovery of novel polymorphisms in *Bacillus anthracis*. Science 296: 2028-2033

Sinclair, R., Boone, S.A., Greenberg, D., Keim, P. and Gerba, C.P. (2008). Persistence of category A selected agents in the environment. Applied and Environmental Microbiology 74: 555-563.

Smith, K.L., De Vos, V., Bryden H., Price, L.B., Hugh-Jones, M.E. and Keim, P. (2000). *Bacillus anhtracis* diversity in Kruger National Park. Journal of Clinical Microbiology 38: 3780-3784.

Soil Classification Working Group. 1991. Soil Classification. A taxonomic system for South Africa. *Mem. Agric. Nat. Resour. S.Afr.* No.15. Pretoria.

Van Rooy, J.L. 2014. Final report on a phase 1 geotechnical site investigation for the proposed Linksfield Estate on portion of the farm Rietfontein 61-IR, Johannesburg. Report 1339

Warren et al. (2006). Differentiation of *Mycobacterium tuberculosis* complex by PCR amplification of genomic regions of difference. International Journal of Tuberculosis Lung Disease 10: 818–822.

WHO: Anthrax in humans and animals – 4th ed. (2008) World Health Organization, Geneva, <http://www.who.int/csr/resources/publications/> AnthraxGuidelines2008/en/index.html..

Wilson, J. B., and K. E. Russell. (1964). Isolation of *Bacillus anthracis* from soil stored 60 years. Journal of Bacteriology 87:237–238.

Wirth, T., Hildebrand, F., Allix-Beguec, C., Wolbeling, F., Kubica, T., Kremer, K., van Soolingen D., Rusch-Gerdes, S. et al. (2008). Origin, Spread and Demography of the *Mycobacterium tuberculosis* complex. PLoS Pathog 4(9): e1000160. doi:10.1371/journal.ppat.1000160.

Minutes of the meeting with Dr W. Basson

Annexure M

LEBOMBO GARDEN BUILDING
36 LEBOMBO ROAD
ASHLEA GARDENS
0081

P.O. BOX 11375
MAROELANA
0161

Tel: (012) 346 3810
Fax: 086 570 5659
E-mail: lizelleg@mweb.co.za
Website: www.bokamoso.biz



MINUTES OF THE MEETING HELD WITH DR. WOUTER BASSON FOR THE LINKSFIELD PROJECT ON 14TH OF MAY 2014

ATTENDEES:

Mrs. Lizelle Gregory.	Bokamoso Environmental
Mr. Michael Bishop	Century Developments (Pty) Ltd
Mrs. Joanne Reynolds	Century Developments (Pty) Ltd
Mr. Francois Bredenkamp	Boogertman and Partners
Dr. Wouter Basson	Cardiologist and Anthrax Expert

INTRODUCTION AND BACKGROUND:

Note:

Even though Dr. Wouter Basson is not formally part of the Linksfield project team or group of experts/specialists appointed to assist with the investigations and inputs relating to the issues regarding the communicable diseases that were associated with the Sizwe Hospital and some of the speople/carcasses that were apparently buried on the study area, we regarded it as crucial to also obtain his expert opinion regarding the risks associated with developments on land that could still be contaminated by the

serious diseases treated by the hospital. Dr. Basson did many years' of research on anthrax and other lethal diseases for the former South-African Government and we wanted to test the preliminary results of the experts appointed to address the dangers associated with the communicable diseases with him. Prior to the meeting Bokamoso prepared a background document and questions to be asked during the meeting and the minutes below is a brief summary of the discussion with Dr. Basson.

The meeting started at 17h30 on the 14th May 2014. Mrs. Lizelle Gregory of Bokamoso Environmental welcomed all and handed out a background document, information booklet and questions regarding the infectious diseases involved. A short background and history of the project was given, which were followed by a brief summary of the expertise of all the various specialists and scientist that form part of the "special specialist forum" that was appointed to assist with the detailed investigation of the *status quo* of the study area with regards to the presence of graves, the presence of Anthrax and other spores on the property (especially in the soil and in the ground water) and the risks associated with the various communicable diseases.

Discussion as well as questions and answers:

Numerous questions were raised to Dr. Basson in search for answers and confirmation of answers already received. To follow now is the discussion, questions and answers that followed.

WB: You can bury corpses of humans that died of any viral communicable diseases, as long as you prepare the soil and the graves are deep enough

(more than 6 feet). Lime was poured into the graves to hydrolyse and oxidize them.

The carcasses and bodies of animals and humans that died of bacterial or spore forming diseases would have to be burned at that time. Such carcasses and bodies had to be burnt before the spores were formed but before they were burned. There is a possibility for spores to still survive burning. It was crucial to burn the corpses and carcasses while the bacteria are still in an active form.

Did you test the soil for anthrax spores?

MB: We've done, yes, we have done extensive tests. We are now testing the water. We have already tested the soil. The soils are not deep there, it is about 60cm deep. There is an impermeably greenstone layer underneath the soil layer and the excavability on this site is very low.

WB: Probably not even the spores can go there.

LG: LG gave more information regarding the project background and goals. She also showed a layout map and explained the proposed layout. She also showed the available aerial photographs (including the historical photographs). The aerial photographs dated back to the 1947 where you can already see at least two graveyards (cemeteries). Another cemetery was found in close proximity of the river. No other graveyards/ graves were identified. Nothing close to the flood line.

No other traces of graves or waste sites were found on the study area. Lizelle supplied Dr. Basson with a summary of the objections and requested that Dr. Basson supply his opinion regarding the disease related objections.

WB: Who are the objectors?

LG: We received approximately 4 000 objections from surrounding residents and other members of the public. The perception is that the exposed areas will cause dust pollution and the soil on the study area is contaminated by Antrax spores and people in the area will inhale the spores and die.

LG: Apparently there are more than 6000 graves on the site, but we could only identify 3 graveyards and the plan is to exclude the graves from the development. The graveyards will most probably be renovated and fenced and it will be treated as memorials on the study area. Apparently there are newspaper articles with more detail regarding the graves, but we could not manage to find anything concrete.

WB: 6 000 graves?

MB: If you do a square meter calculation there can only be 1 500.

WB: I wanted to say because 6 000 graves, there are no graveyard in South Africa of that size. Woltemade graveyard is large and only 2000 and something.

LG: That is amongst the objections we have received. Then I just wanted to know whether you knew anything else about the hospital? But what is great, you said that they had to burn the bodies and carcasses of humans and animals that died of bacterial diseases.

WB: It is standard procedure. If anything dies from a virus you are allowed to bury it.

JR: At what depth? You said it is a certain depth.

WB: Well it is usually six feet or deeper than six feet. But if it died from bacteria it was always burnt. But if it is a human it does not matter, because a human that dies from anthrax won't form spores.

LG: Are you aware of any people that died of anthrax?

WB: It is not anthrax. They would not have died. There are no records of anthrax deaths in South Africa in humans, animals yes. In Botswana there were a few that died but not here. I challenge anyone to supply details of humans that died of Anthrax in South-Africa.

LG: Since the 1900's there are no records?

LG: We have actually formed a specialist forum. All specialists work together in an integrated manner on the project. LG provided list names of specialists involved. We also had discussions from a Dr. Awake from Onderstepoort but he is from Ethiopia and could not really assist. Then we

had a meeting with Professor Blumberg form NICD who actually agrees with your arguments and who is in support of the proposed development.

LG: Then Dr. John Frean, associate professor, he also supports the development. Dr de Vos, you know him, we met with him last week. They form part of our working forum. He actually worked on a shopping centre in Mobraay, Cape-Town, which is apparently also built across an animal carcass graveyard for animals that died of anthrax. Dr. De Vos confirmed that only animal carcasses were buried on the site in Cape-Town. Apparently Dr. De Vos found some spores on that site.

WB: Well I mean if any animal dies in the veld you will most likely find a spore or two. You can walk out to the street anywhere and maybe you find a spore or two. But I mean it is not endemic quantities.

LG: Dr. De Vos also agrees that there are no risks associated with the proposed development. We also spoke to Dr. Henriëtte van Heerden. She is a senior lecturer at the Department of Tropical Diseases at the University of Pretoria and an Anthrax specialist and she mentioned that she now fills Dr. de Vos's post at the University of Pretoria. Dr. De Vos recently retired and she has taken over from him. We also have Dr. Johan van der Waals on our team, he is a soil scientist. He took soil samples, he gave the samples to Dr. Henriëtte van Heerden at the University to test. They did not find any traces of Anthrax spores. Furthermore, the soil tests proved that there are acid soils on the study area. According to Dr. van Heerden and Dr. De Vos, anthrax spores die in soils with high acidity.

MB: The Only thing they found was something that might give you gastro.

LG: Yes, what they actually found was TB in the effluent of the hospital. At present some of the hospital's effluent is leaking out onto the ground. This problem must be addressed, because it contributes to the contamination of the Jukskei River.

We also have a pathologist (Dr. Eugene Fourie) on our team. The cultural and historical specialists appointed to conduct the required cultural and historical report s are Leonie Marais-Botes in association with Dr. van Vollenhoven. We also appointed Dr. Mannie Levin to assist from a geo-hydrological point of view. He recently took samples of the groundwater and surface water and we are waiting for the results. The ground water test results will also be used as baseline data throughout the entire construction and operational phase if the project is approved.

Will it be necessary to burn the parts of the hospital that are earmarked for demolition (from a disease spreading point of view)?

WB: That totally depends what type of patients were treated there. In the case of TB, the buildings can only be cleaned. The buildings must only be burnt if bacterial diseases are treated there. TB does not form spores. As far as I know no anthrax patients were treated there.

LG: There are also rumours that the infected patient's coffins were lined with lead.

WB: This method was used in the olden days but that was because people were uninformed. But in the initial coffins, before the first or second world war if you had died of any infections, they always made sure that the bacteria could not escape from the coffin.

MB: Yes that is the only thing we are worried about.

LG: Yes, some people referred to lead-lined coffins on the site and indicated that they were worried about the led.

MB: We are also testing for lead in the extracted water.

WB: Who was buried there?

LG: We don't know.

MB: Apparently all the records were destroyed by a fire.

LG: Apparently the Adler Museum has some information, but we are struggling to get feedback from them. We will keep on trying. We already had some preliminary discussions with them.

MB: If some coffins are lined by lead, the acidity of the soils will most probably cause some lead leachate into the ground water.

LG: As mentioned we are also testing the water for traces of lead. If we find lead in any of the water samples taken from boreholes, the borehole position

will most probably give an indication of possible positions of lead lines coffins under the ground.

We requested that each specialist in the forum compile a 2 pager opinion regarding the risks associated (as viewed from the specialist's specific field of expertise) with the development, if the site is disturbed. We also requested that all experts read one another's 2 pager opinions and that they confirm whether they agree with the different opinions and recommendations supplied.

LG: We will also appreciate it if you could peruse the expert reports and also confirm whether you agree with their findings. According to Dr. Henriette van Heerden the small pox is not a problem, because the virus only survives on soil for approximately 8 years.

WB: Smallpox?

LG: Yes. She actually read an article about that recently.

WB: I have never heard of smallpox lasting a couple of months or even years. We have not had smallpox for how many years now? If I can recall there was no case of small pox since the early 1960s.

WB: Well with:

- Variola major virus (smallpox) – no problem.
- Bacillus anthracis (anthrax) – we will talk about that later.
- Yersinia pestis (plague) – no problem

- Clostridium botulinum toxin (botulism) – you can find it anywhere in the soil, it is all over the show. You can walk across Cape Town and find it anywhere.
- Francisella tularensis (tularemia) – you got to kill the rats for that. It is associated with a plaque.
- Viral haemorrhagic fever agents – nothing, they die so quickly, they can't make you sick unless it is in you and you spit on a person. That is the only way or if it comes in contact with blood. You can spit on the floor and two hours later you pick it up or nothing will happen to you.

Nothing of those can cause any potential future problem for anybody unless you are in contact with a live patient. The only problem could be that of anthrax but there should not be any. Because nobody worked with it and if there were patients with it they should have been burned, they should have been cremated and if they were buried in lead cases then you have to get the lead cases and put them somewhere else and not break them open. That's all. As long as you leave them alone you are okay.

WB: This is clearly a nonsense story, all agree on that. My immediate opinion now is that unless you get in contact with a live patient. If this disease was spread through soil the entire population would have been destroyed. Then all would have been dead, because it does not work that way, you have to be in contact with a live patient for every one of these diseases except the anthrax that is all. And there should not be any anthrax. There should not be more anthrax spores than there would be on any other site in Sandton,

because animals have been dying from anthrax for years. Before Sandton was developed livestock have roamed there and died of anthrax.

LG: What we also think is that the study area could have been significantly bigger and development (i.e. roads, schools etc.) most probably already took place across the larger site. Developments (i.e. houses) in the larger farm could actually be on the graveyards.

MB: The other thing that was discussed is obviously people associate anthrax with news reports on television on all of that stuff engineered can apparently be modified and mixed with powder or something and it is inhaled it could be deadly.

WB: If anthrax spread in nature by aerosol form, then half of the game population in Botswana would have been gone. It doesn't do that easily. Those spores are heavy, they stick to the soil and even if you get them in soil they do not float far enough. You have to micronize them and add magnesium sulphate powder. That is the only way they can spread and be inhaled.

MB: The fear of people is that when we put a bulldozer on site to do the roads and we hit bones and the dust travels through the air and people inhale the spores in the air. Dr. De Vos and Dr. Fourie (part of the specialist forum) confirmed that this is not possible, because the spores are heavy and too big to inhale and to enter the lungs.

WB: It is not light enough, it will stop in your nose and maybe get contagious anthrax. But even then, the chances are so small. The problem is the chance is one in a million. Nobody knows what the chances are. Even that island where the Brit's tested their anthrax 80 years later, and if some is still there but none of the birds are getting it and none of the animals are getting it, I mean it is gone by now, it is buried. They tried to clean it up a couple of times but you can't really. But they had an anthrax research centre.

LG: Is it that island in Italy?

WB: No it is England. Where they spread the stuff purposely as a biological warfare testing area. I mean blows from there to nowhere / anywhere. The soil is wetter.

LG: I would like to know, is it by anyway possible to write a report on your opinion and give some information on all these micro-organisms.

WB: None of the mentioned diseases are regarded as dangerous except the *Bacillus Anthracis* (anthrax), as you need a live carrier for all of them, either a human, mouse or a monkey but the anthrax is the only one you could possibly think of and you have to realise that the concentration of anthrax spores all over South Africa is high anywhere.

As far as I know, but I will check it up, there will be no human anthrax deaths in South Africa, definitely not after the war. That is for sure. And if there were any experimentation done I will be surprised. The only experimentation I know that was done at the Roodeplaat Research Centre outside of Pretoria and all the stuff used was burned and incinerated.

MB: Well, Eugene gave those statistics to a guy working in a goat skin factory. They were breathing 1 300 spores in a day when they were working and they did not get infected with anthrax. But you are never going to get a situation where a resident is exposed to 1 300 spores a day.

WB: He has got a better chance of getting it on a game drive in Botswana when wind down from a carcass. People don't like development.

MB: This particular site has always had a stigma and people are afraid of the unknown.

LG: Apparently a few people tried to do a development there.

MB: Previous a developer applied for a shopping centre but got scared because everybody got freaked out. That is why we are trying to do a peer review to get all the experts.

LG: Like Dr. de Vos said in anyway, if the people are scared of anthrax it is better to put the site under concrete and then leave it like that.

WB: Why? Why would that be? Where does it come from? Who died of anthrax?

LG: No records.

WB: Any farm, any of these farms, you can go there and find anthrax. You can't do anything with it because they are all dead spores. They may cause cutaneous anthrax and that is it! Which is a big sore that you can cure.

MB: But mitigations that you can use are tests, soil tests on the individual site where we want to put a building.

WB: Even if you do that, that means you are going to have to do this on every single site in future that you ever want to develop on.

MB: In that area.

WB: All just for the spores? Then everyone that wants to develop on semi-agricultural land will need to test for spores.

MB: The guys always turn it around.

WB: Any place where an animal has died has the potential for anthrax spores. There was no experimentation done in natural communication of diseases, as far as I know, on anthrax whatsoever. The plaque was there but Soweto and the whole of Johannesburg is full of plague areas. 30% of rats in Johannesburg plague particles.

MB: So why don't you hear of anybody getting it?

WB: Unless there is no direct fluent contact you will not get it.

CLOSURE:

LG thanked everyone attending the meeting.

More detail regarding discussions with different parties

Annexure N

LINKSFIELD MEETING – MARIAN LASERSON.

Date of meeting: 16th April 2014.

Attendants to the meeting:

Lizelle Gregory	Bokamoso Environmental.
Ane Agenbacht	Bokamoso Environmental.
Joanne	Century.
Marian Laserson	I&AP.

Lizelle Gregory welcomes everyone attending the meeting with Marian Laserson.

LG: Commented that to the opinion as an Environmental Consultant the development cannot commence without proper research and investigation.

Marian Laserson's reasons for being against the development:

ENVIRONMENT:

In 1994 the centenary celebrations of the Rietfontein Hospital took place. Johan Strydom, a horticulturist had been appointed to look at the gardens especially for this occasion. He identified 20 to 30ha of pristine grassland – to be called the Egoli grassland - South of the hospital where the present fence is.

Marian Laserson together with the journalist Cynthia Willar and others, formed the Rietfontein Action Group, in order to save and preserve the grassland. Marian Laserson sent Bokamoso Environmental the information.

ML: Mentioned the Town Planner's plans that she included with the documents that were sent to Bokamoso Environmental. These plans refer to and include the mentioned grasslands. (Fred Kobus). It also show the status quo of the Sizwe Hospital with the surrounding grasslands, which are seen as a natural treasure. There are estimated over 500 plant species and 15 – 15 types of grasses to be

found there. Other plant species which are most assuredly red data plants also to be found there.

LG: Mentioned that the biodiversity requirements are very strict today. She also mentioned over 28 – 35 red data species had been listed. Bokamoso Environmental appointed all the different specialists to do the surveys. Lizelle promised to give ML's information to all appointed specialists. It will also be included in Bokamoso Environmental's Study. The latter will peruse her information and react on it and address the problems.

WETLANDS/RIVERS:

LG: Referred to the vegetation and wetlands of the site. She mentioned that Dr. Johan van der Waals did the wetland survey. Dr. Johan van der Waals is a person of great integrity.

ML: Is most concerned about the wetland area on the golf course. She is of the opinion that the area could be destroyed by the contractor. Anthrax on the Linksfield site is mentioned but does not probe to be problematic.

LG: Explained that the soil tested there's ph is too low for the anthrax spores to survive in. Dr Johan van der Waals is not concerned about it.

She also mentioned Dr W. Basson, Prof. Lucille Blumberg and Dr. de Vos. Bokamoso Environmental will make the specialists' reports available to ML. LG expects of every specialist signing off his/her report and to take responsibility for their reports. All information of the specialist reports will be integrated and will be made available.

ML: The situation around river is a very big issue for her. She advised LG: to consult Paul Farrell if she inquires more information concerning the Jukskei River. ML described it as a very delicate situation. She felt very strongly about the fact that if the Egoli grassland is to be preserved, that a wide enough buffer area down to the river must be included. This will cut the corridor right through the property, which means no roads.

DUMPING:

There is a large rubbish dump next to the freeway.(This must be mentioned to Leonie Botes). There is also a lot of disturbance on the site as well as dumping and excavation going on. ML wants to stop the bulldozer clearing away the rubbish there.

LG: Gave the assurance that Bokamoso's report will be transparent. She explained that Bokamoso is involved in many developments. She further explained that if there should be any compliance of the site, the contractor will be stopped on site. Bokamoso Environmental will ensure that everything will be done according to the EIA Report. A Draft report will be sent to the developer's team, after Bokamoso's site visits. If there is any contravention of any act, it will be reported. LG though is not worried about the construction fase – it could be mitigated.

Heritage:

The Sizwe Hospital could rather be renovated into a Medical centre which is a much needed facility for the area.

THE OLD INCINERATOR:

EIA: Recommended demolition of all the buildings – fixed buildings.

TRAFFIC:

LG: There is an existing traffic report done for the client. It was submitted to Bokamoso by Urban Dynamics.

ML: To preserve the Egoli grasslands on the Linksfield site, there could be no roads, as it would cut right through the property when a buffer zone goes down to the Jukskei River.

The LInksfield Road has 3 peak hours of traffic per day. With the school there one does get hold up for at least 20 minutes. There is no short way around. According

to ML the traffic study should be done again. According to her the existing one is out dated.

SEWAGE LINE:

According to ML: the existing sewage line is out dated and the situation should be investigated. (In servitude) Many sewage spills occur. One very big one relates to the shopping centre. Their pipeline stretches over the river and somehow there was a fat spill with fat all over the place. As this pipe was stolen the Municipality of Johannesburg replaced the pipe.

HOSPITAL WASTE:

ML: Is very concerned about bacterial contamination, from the multi drug resistant TB – very dangerous. She referred to Dr John Simm, a pathologist , who had all information concerning the diseases treated at the Rietfontein/Sizwe Hospital. He was actively involved with the Hospital but unfortunately passed away.

THE GRAVE SITES:

ML: Referred to a Naomi Dinur who knows and contacted a man with a memory of many graves to be in the area. They went together in search for graves and found a lot more than predicted. They actually found graves with tombstones. Apparently this man has got a living memory of the grave sites and ML plans also to go with this man to investigate for herself.

She also mentions a gentleman who was investigating the site for the Jewish grave site, but could not find it. This man is of the opinion that one of the newer hospital wards was built over it. (Cannot be proofed). ML also mentioned graves to be left in the floodline.

SERVICES:

ML: Old and outdated – should be replaced and updated. The top engineers of Johannesburg Area all left. The reports coming from the Johannesburg

Municipality not credible. Electricity to the North Eastern suburbs is running low. The council brought in an 88kv line from Kelvin which comes underground, just at the corner of Margaret Road and Edward St. Six years ago an attempt was made to upgrade the substation to a proper one and to improve the electrical feed to the Northern suburbs.

ML: Suggested that the substation should be erected near the Sizwe Hospital as it is presently in a wetland area.

She inquired whether the Johannesburg Municipality is able to supply electricity to this proposed development, as the electricity supply to the Northern suburbs is so problematic. ML will send the RSDF to Lizelle to peruse.

CLUB STREET AND LINKSFIELD ROAD:

On the corner of the above mentioned roads you'll find a restaurant, a nightclub and a paint ball station. The owner now plans to erect a new storage place – a forklift warehouse. The council has instituted a court order that those buildings should be demolished – because of no approved plans for those buildings. But the court order was not executed.

The owner went to the Public Protector. The Johannesburg Legal Department is waiting for the Public Protector's comments. In the meantime the noise coming from the nightclub is unbearable.

RAND AID PROPERTY:

ML: On the North-West side – ML accuses Urban Dynamics of being absurd to suggest that the Linksfield site is situated on the East of the motorway. She wanted to know from LG why Bokamoso Environmental indicates that some of the property is on the Eastern side of the motorway. She referred to one of our maps. But it is not indicated as such by Urban Dynamics. She advised LG to go through our documentation and do the necessary corrections.

ML: suggested that Kirstin Ottman found quite a lot of errors in the EIA Bokamoso Environmental compiled. Prior to urban dynamics making the Application. She

adamantly suggested that this mentioned Application was done very premature. She is not happy with it at all. She met with Rand Aid, Kristin Ottman and Pieter Roos. The latter is a town planner who Rand Aid is now employing to handle both The EIA and Township Application. ML is now working on a strategy to curtail as much as possible!

LG: Asked her whether the general feeling is against the development.

ML: Answered positively with a 'yes'.

LG: Again put it to ML that if the team addresses all the issues, could she go with development?

ML: Pieter Roos is worried about the development's commencement. She believes him to be a very experienced town planner.

JOANNE: Asked whether ML really knows what is planned for the site.

ML: Answered that she knows through Bokamoso's Report and through the Urban Dynamics Application.

ML: She stressed the fact that Dr. John Simm and a Dr. Odis recommended that the Sizwe Hospital should be upgraded – the area that is not a grassland and is not a gravesite area, should be developed into a medical facility, that could enhance the research and treatment of tropical diseases.

Very carefully constructed housing only for the people working at the hospital should be built there. She mentioned that there were three other organizations interested in such a development at that time with Dr. Simm. She would have no objection to such a development as mentioned above, but all the ecological issues should be taken care of.

The hospital as it is at the moment, is ideally built with the wards separated away from each other. It could be a world class facility according to ML. The latter does not want another Cosmo City Development to be constructed on this site.

PROPERTY VALUES:

ML: Would hate to think what such a development will do to property values in the area. She surmises the fact about squatters and vagrants to be used as an excuse for the proposed development. She described it as putting ‘a horror’ on to the property.

LG: Explained about the workshop meetings Bokamoso Environmental attends every 14 days. Also that Bokamoso Environmental is finalizing all the specialist reports. Urban Dynamics will have to submit their Application. Lizelle also explained that Bokamoso Environmental will do the necessary amendments to the layouts if found to be necessary. It will become part of the EIA process.

LG: Mentioned that ML’s proposal will also be included as an alternative. She also explained to ML that if an open area is not too sensitive, it can be used for urban development. She also declared that whatever is coming to the table, everything will be taken into consideration concerning this development. Bokamoso Environmental will also supply the maps and the explanations why the layout is the way it is, also to look at the alternatives. We are busy compiling an issues map at this point of time – a sensitivity map.

ML: Is very skeptical about EAP’S . She evaluates everything and wishes she could give Lizelle the benefit of the doubt. She is also very skeptical about the construction workers – very negative. Predict all kinds of problems.

LG: Ensured ML that there will definitely be someone to supervise and oversee the construction work on a daily basis.

ML: Will insist that there should be someone from the public on site as well to monitor to what is going on.

LG: Thanked her for her time and encourage her to contact her or Ane any time if they could be of any help or assistance. LG gave her cellphone number to ML.

Copy of the application submitted to GDARD

Annexure 0

APPLICATION FORM [REGULATION 12 (1)&(2)(A)(B)(I)(II)]



Gauteng Department of Agriculture and Rural Development

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010 (Version 1)

Kindly note that:

1. This application form is to be completed for both the Basic Assessment process and the Scoping & EA process.
2. This application form is current as of 2 August 2010. It is the responsibility of the EAP to ascertain whether subsequent versions of the form have been published or produced by the competent authority.
3. The application must be typed within the spaces provided in the form. The sizes of the spaces provided are not necessarily indicative of the amount of information to be provided. It is in the form of a table that can extend itself as each space is filled with typing.
4. Selected boxes must be indicated by a cross and, when the form is completed electronically, must also be highlighted.
5. Incomplete applications may be returned to the applicant for revision.
6. The use of "not applicable" in the report must be done with circumspection because if it is used in respect of material information that is required by the competent authority for assessing the application, it may result in the rejection of the application as provided for in the regulations.
7. Three copies of this form and the attachments must be handed in at the offices of the relevant competent authority as detailed below.
8. No faxed or e-mailed applications shall be accepted. Only hand delivered or posted applications will be accepted.
9. Unless protected by law, and clearly indicated as such, all information filled in on this application will become public information on receipt by the competent authority. The applicant/Environmental Assessment Practitioner (EAP) must provide any Interested and Affected Party (I&APs) with the information contained in this application on request, during any stage of the application process.
10. Attachments, where applicable, to this document are to be ordered in the following prescribed manner

Annexure - A	Locality map
Annexure - B	a) Proof of notification to the Land owner b) Proof of receipt of such notice by the owner
Annexure - C	List of all organs of state and State Departments of where the draft report will be submitted, their full contact details and contact person

Annexure - D	Property description list
Annexure - E	Current land use zonings list
Addendum-A	Declaration of Independence by EAP to be submitted with the report if the application form was submitted by applicant.

DEPARTMENTAL DETAILS

Gauteng Department of Agriculture and Rural Development
Attention: Administrative Unit of the Sustainable Utilisation of the Environment (SUE) Branch
P.O. Box 8769
Johannesburg
2000

Administrative Unit of the Sustainable Utilisation of the Environment (SUE) Branch
18th floor Glen Calm Building
73 Market Street, Johannesburg

Administrative Unit telephone number: (011) 356 1345
Department central telephone number: (011) 355 1900

APPLICATION FORM [REGULATION 12 (1)&(2)(A)(B)(I)(II)]

File Reference
Number:
Application Number:
Date Received:

(For official use only)

1. NATURE OF THE ACTIVITY

Mixed use Township Establishment

Select the appropriate box with regards to the application form submission

An application for conducting a basic assessment (as defined in the regulations)?

X

A resubmission of an application for conducting a basic assessment (as defined in the regulations)?

An application for conducting a Scoping & EIA process (as defined in the regulations)?

A resubmission of an application for conducting a SIA & EIA process (as defined in the regulations)?

If this is a class application, has a copy of approval letter to undertake such an application been attached as such application may/hall not be undertaken without an approval from this Department

--

Has this project or a substantial similar project which has been previously submitted by the applicant been denied authorisation by the relevant authority in the last three (3) years

YES	NO
YES	NO

If yes will the application contain new or additional material not submitted previously To be noted that Regulation 68 of EIA Regulations, 2010 states that no applicant may resubmit an application which is substantially similar to an application previously denied authorisation by the relevant authority unless 3 years has lapsed since the refusal or new material is to be presented

2. PROJECT DETAILS

Project title:

Linksfield Mixed Use Development

To be noted that the project will be registered under this title and this title must be duplicated through the application

life of the project

Local authority(ies) in whose jurisdiction the proposed application will fall

City of Johannesburg Metropolitan Municipality

3. ACTIVITY POSITION

Indicate the position of the activity using the latitude and longitude of the centre point of the site for each alternative site. The co-ordinates should be in decimal degrees. The degrees should have at least six decimals to ensure adequate accuracy. The projection that must be used in all cases is the WGS84 spheroid in a national or local

Alternative:

Latitude (S):	Longitude (E):
-26.138698°	28.126636°

In the case of linear activities:

Alternative:

- Starting point of the activity
- Middle point of the activity
- End point of the activity

Latitude (S):	Longitude (E):

For route alternatives that are longer than 600m, please provide co-ordinates taken every 250 meters along the route and attached in the appropriate Appendix

Addendum of route alternatives attached

--

APPLICATION FORM [REGULATION 12 (1)&(2)(A)(B)(I)(II)]

Property description:

The Remainder of Portion 1 of the Farm Rietfontein 61 IR

(Farm name, portion etc.) Where a large number of properties (including alternatives) are involved (e.g. linear activities), please attach a list of the property descriptions to this application.

4. ACTIVITIES APPLIED FOR

Describe the activity and associated infrastructure, which is being applied for, in detail

Proposed mixed use township encompassing educational, commercial, show rooms, business, retail, shops, places of amusement, restaurants, hotel, offices, residential uses and associated infrastructure.

Which Listing Notice is the activity(ies) listed under?

Listing Notice 1

Listing Notice 2

Listing Notice 3

If "or also" listed under Listing Notice 3, describe the Geographical Area triggering the activity and its regional, provincial, national & international significance

- Sites Identified as Irreplaceable or Important in the Gauteng Conservation plan.
- Construction within a watercourse or within 32 metres of a watercourse.

An application may be made for more than one listed or specified activity that, together, make up one development proposal. All the listed activities that make up this application must be listed.

Indicate the number and date of the relevant Government Notice:

Activity No (s) (in terms of the relevant notice) Describe each listed activity as per the wording in the relevant listing notice:

GN R 544	LN 1, Activity 9	<p>The construction of facilities or infrastructure exceeding 1000metres in length for the bulk transportation of water, sewage or storm water</p> <p>i) with an internal diameter of 0,36 metres or more; or</p> <p>ii) with a peak throughput of 120 litres per second or more,</p> <p>excluding where:</p> <p>a. such facilities or infrastructure are for bulk transportation of water, sewage or storm water or storm water drainage Inside a road reserve; or</p> <p>b. where such construction will occur within urban areas but further than 32 metres from a watercourse, measured from the edge of the watercourse.</p>
GN R544	LN 1. Activity 10	<p>The construction of facilities or infrastructure for the transmission and distribution of electricity</p> <p>The construction of:</p> <p>i. outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts or;</p> <p>ii. inside urban areas or industrial complexes with a capacity of 275 kilovolts or more.</p>
GN R544	LN 1. Activity 11	<p>The construction of:</p> <p>i. canals;</p> <p>ii. channels;</p> <p>iii. bridges;</p> <p>iv. dams</p> <p>v. weirs;</p>

APPLICATION FORM [REGULATION 12 (1)&(2)(A)(B)(I)(II)]

		<p>vi. bulk stormwater outlets structures;</p> <p>vii. ..</p> <p>viii. ..</p> <p>ix. ..</p> <p>x. Buildings exceeding 50 square metres in size; or</p> <p>xi. Infrastructure or structures covering 50 square metres or more</p> <p>where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of watercourse, excluding where such construction will occur behind the development setback line.</p>
GN R544	LN 1, Activity 18	<p>The Infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from:</p> <p>(i) a watercourse;</p> <p>(ii) the sea;</p> <p>(iii) the seashore;</p> <p>(iv) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater;</p> <p>but excluding where such Infilling, depositing, dredging, excavation, removal or moving:</p> <p>(i) is for maintenance purposes undertaken in accordance with a management plan agreed to by the relevant environmental authority; or</p> <p>(ii) occurs behind the development setback line.</p>
GN R544	LN 1, Activity 21	The establishment of cemeteries of 2500 square metres or more in size.
GN R544	LN 1, Activity 37	<p>The expansion of facilities or infrastructure for the bulk transportation of water, sewage or stormwater where:</p> <p>i. the facility or infrastructure is expanded by more than 1 000 metres in length; or</p> <p>ii. where the throughput capacity of the facility or infrastructure will be increased by more than 10% or more.</p> <p>excluding where such expansion</p> <p>a. Relates to transportation of water, sewage or stormwater within a road reserve; or</p> <p>b. Where such expansion will occur within urban areas but further than 32metres from a water course, measured from the edge of a watercourse.</p>
GN R544	LN 1, Activity 39	<p>The expansion of:</p> <p>i. canals;</p> <p>ii. channels;</p> <p>iii. bridges;</p> <p>iv. weirs;</p> <p>v. bulk stormwater outlets structures;</p> <p>vi. marinas</p>

APPLICATION FORM [REGULATION 12 (1)&(2)(A)(B)(I)(II)]

		within a watercourse or within 32metres of a watercourse, measured from the edge of a watercourse, where such expansion will result in an increased development footprint but excluding where such expansion will occur behind a development setback line.
GN R544	LN 1, Activity 37	
G N R 545, 18 June 2010	LN 2, Activity 15	Physical alteration of undeveloped, vacant or derelict land for residential, retail, commercial, recreational, industrial or institutional use where the total area to be transformed is 20 hectares or more
G N R 546, 18 June 2010	LN 3, Activity 4	Construction of a road wider than 4 metres with a reserve less than 13,5 metres: In Gauteng: v. Sites identified as irreplaceable or important in the Gauteng Conservation plan; vi. Areas larger than 2 hectares zoned for use as public open space,
	LN 3, Activity 6	Construction of resorts, lodges or other tourism accommodation facilities that sleep 16 people or more. In Gauteng: v. Sites identified as irreplaceable or important in the Gauteng Conservation Plan; vi. Within 100 metres of from the edge of a watercourse.
	LN 3, Activity 13	The clearance of an area of 1 hectare or more of vegetation where 75% or more of the vegetative cover constitutes Indigenous vegetation, except where such removal of vegetation is required for: 1. The undertaking of a process or activity included in the list of waste management activities published in terms of section 19 of NEM: Waste Act, 2008 (Act No. 59 of 2008); 2. the undertaking of a linear activity falling below the thresholds mentioned in Listing Notice 1 in terms of GN No. 544 of 2010. In Gauteng: ... v. Sites identified as irreplaceable or important in the Gauteng Conservation Plan
	LN 3, Activity 16	The construction of : iii. buildings with a footprint exceeding 10 square metres in size; or

APPLICATION FORM [REGULATION 12 (1)&(2)(A)(B)(I)(II)]

		<p>IV. Infrastructure covering 10 square metres or more</p> <p>where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind a development setback line.</p> <p>In Gauteng:</p> <p>...</p> <p>V. Sites identified as irreplaceable or important in the Gauteng Conservation Plan</p>
--	--	---

Please note that any authorisation that may result from this application will only cover activities specifically applied for.

5. OTHER AUTHORISATIONS REQUIRED

5.1 DO YOU NEED ANY AUTHORISATIONS IN TERMS OF ANY OF THE FOLLOWING LAWS?

4.1.1 National Environmental Management: Waste Act	Yes/No
4.1.2 National Environmental Management: Air Quality Act	Yes/No
4.1.3 National Environmental Management: Protected Areas Act	Yes/No
4.1.4 National Environmental Management: Biodiversity Act	Yes/No
4.1.5 Mineral Petroleum Development Resources Act	Yes/No
4.1.6 National Water Act	Yes/No
4.1.7 National Heritage Resources Act	Yes/No
4.1.8 Other (please specify)	Yes/No
4.2 Have such applications been lodged already?	Yes/No

6. BACKGROUND INFORMATION

Project applicant:

Gauteng Department of Local Government & Housing

Trading name (if any):

Rethabile Nkosi

Contact person:

37 Sauer Street, Bank of Lisbon Building, Marshall Town
2147

Physical address:

Private Bag X79, Marshalltown

Postal address:

2107

Cell: 0824167511

Postal code:

(011) 355 4205

Fax: +27 11 355 4000

Telephone:

E-mail:

Project Environmental Assessment Practitioner:

Bakamoso Landscape Architects & Environmental Consultants cc

Contact person:

Lizelle Gregory

Postal address:

P.O. Box 11375, Maroelaana

Postal code:

0161

Cell: 083 255 8384

Telephone:

012 346 8810

Fax: 086 570 5659

E-mail:

lizelle@nwweb.co.za

APPLICATION FORM [REGULATION 12 (1)&(2)(A)(B)(I)(II)]

EAP qualifications & relevant experience

Registered Landscape Architect & Environmental Consultant
 (degree obtained from the University of Pretoria), with more than 21 years of experience in:

- The compilation of Environmental Evaluation Reports;
- Environmental Management Plans;
- Strategic Environmental Assessments;
- All stages of Environmental Input;
- EIA under the ECA and the new and amended NEMA Regulations; and
- Various other Environmental Reports and documents

Professional affiliation(s) (If any)

The South African Council of the Landscape Architects Profession (SACLAP); Institute for Landscape Architects in South Africa (ILASA); and Institute for Environmental Management and Assessment (IEMAS); Member of the Institute of Impact Assessment Practitioners (IIAP).

Landowner:

Gauteng Department of Human Settlements

Contact person:

Rethabile Nkosi

Postal address:

Private Bag X79, Marshalltown

Postal code:

2107

Telephone:

(011) 355 4205

E-mail:

Cell: **0824167511**

Fax: **+27 11 355 4000**

In instances where there is more than one landowner (including for alternative sites), please attach a list of landowners with their contact details to this application. In instances where the landowner is not the applicant – attach proof of notification of the landowner and a proof of receipt of such notice by the owner, manager or person in control of the land.

List of the land owner is attached

Landowner notification proof is attached

Landowner proof of receipt of such notification is attached

Local authority in whose jurisdiction the proposed activity will fall:

City of Johannesburg Metropolitan Municipality

Contact person:

Lebo Molete

Postal address:

PO Box 1049, JOHANNESBURG, , Block A

Postal code:

2000

Telephone:

011 407 6520

E-mail:

lebm@joburg.org.za

Cell: **011 403 4142**

In instances where there is more than one local authority involved (including for alternative sites), please attach a list of local authorities with their contact details to this application.

List of local authorities is attached

List of properties is attached

Town(s) or district(s):

Johannesburg

Street/Physical address:

Metropolitan Centre, 1st Floor Council Chamber Wing, 158 Loveday Street, Braamfontein, Johannesburg

In instances where there is more than one town or district involved, please attach a list of towns or districts to this application.

List of towns or districts is attached

APPLICATION FORM [REGULATION 12 (1)&(2)(A)(B)(I)(II)]

State Departments
administering a law
affecting the
environment:
Contact person:
Postal address:
Postal code:
Telephone:
E-mail:

Department of Water Affairs

Mr. Justice Maluleke

Private Bag X313, Pretoria

0001

012 336 6507

Cell:

Fax:

012 336 8311

In instances where there is more than one State Department involved, please attach a list of all State Departments with their contact details.

Current land-use zoning:

Agricultural

In instances where there is more than one current land-use zoning (including alternatives), please attach a list of current land use zonings that also indicate which portion each use pertains to, to this application.

List of current land use zonings is attached

Locality map:

A locality map(s) (including alternatives) must be attached to the back of this document, as Annexure A. The scale of the locality map must be between 1:10 000 and 1:50 000. The scale must be indicated on the map. The map must indicate the following:

- an accurate indication of the project site position as well as the positions of the alternative sites, if any;
- road access from all major roads in the area;
- road names or numbers of all major roads as well as the roads that provide access to the site(s);
- all roads within a 1km radius of the site or alternative sites;
- all rivers within a 1km radius of the site or alternative sites; and
- a north arrow;

7. COMPLIANCE WITH CONDITIONS

Have you ever been in non-compliance with a condition of an authorisation or exemption issued by this Department or any other provincial or national environmental department in terms of the Environment Conservation Act (No 73 of 1989) or the National Environmental Management Act (No 107 of 1998) as amended?

YES	NO
-----	----

If yes, indicate details of non-compliance together with reasons for non-compliance:

Attach all relevant documentation e.g. compliance audit reports, pre-directives, directives, compliance notices

8. ACTIVITY INFORMATION

Socio-economic value of the activity

What is the expected capital value of the activity on completion?

R8,2 Billion

n/a

YES	NO
-----	----

YES	NO
-----	----

21000

What is the expected yearly income that will be generated by or as a result of the activity?

Will the activity contribute to service infrastructure?

Will the activity contribute to a public amenity

Total number of new employment opportunities to be created in the development phase of this activity.

Of these opportunities how many are:

Women

6200

People with disabilities

Female

10

Male

10

APPLICATION FORM [REGULATION 12 (1)&(2)(A)(B)(I)(II)]

Youth

Female

Male

What is the expected value of the employment opportunities during the development phase?

What percentage of this will accrue to previously disadvantaged individuals?

Total number of new employment opportunities to be created in the operational phase of this activity.

1800
2800
R700 million
60%
18612
2412
10
10
4800
3100
R812 million
60%

Of these opportunities how many are:

Women

People with disabilities

Female

Male

Youth

Female

Male

What is the expected current value of the employment opportunities during the first 10 years?

What percentage of this will accrue to previously disadvantaged individuals?

Need and desirability of the activity

Indicate and explain the need and desirability of the activity (including demand for the activity):

The Application is for mixed use township which will include residential development, business, industrial and commercial uses. This will provide the much needed economic development, associated infrastructure improvements and employment opportunities in the area.

Indicate any benefits that the activity will have for society in general:

- Economic development
- Infill development
- Increased rates and taxes
- Employment opportunities
- Housing opportunities
- Improved infrastructure
- Prevention of illegal occupation

Indicate any benefits that the activity will have for the local communities where the activity will be located:

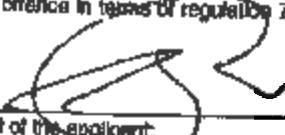
- Economic opportunities
- Housing
- Employment opportunities
- Managed development
- Access to and improved services
- Improved Infrastructure

APPLICATION FORM (REGULATION 12 (1)&(2)(A)(B)(I)(II))

9. DECLARATIONS

The Applicant Mr. Bongani More (A/HOD) on behalf of
Gauteng Department of Human Settlements declares that I -

- the applicant in this application for **Lynkfield Mixed Use Township**
- has appointed an environmental assessment practitioner to act as the independent environmental assessment practitioner for this application
- will provide the environmental assessment practitioner and the competent authority with access to all information at my disposal that is relevant to the application;
- will be responsible for the costs incurred in complying with the Environmental Impact Assessment Regulations, 2010, including but not limited to -
 - costs incurred in connection with the appointment of the environmental assessment practitioner or any person contracted by the environmental assessment practitioner;
 - costs incurred in respect of the undertaking of any process required in terms of the Regulations;
 - costs in respect of any fee prescribed by the Minister or MEC in respect of the Regulations;
 - costs in respect of specialist review, if the competent authority decides to recover costs; and
 - the provision of security to ensure compliance with conditions attached to an environmental authorisation, should it be required by the competent authority;
- will ensure that the environmental assessment practitioner is competent to comply with the requirements of these Regulations and will take reasonable steps to verify whether the EAP complies with the Regulations;
- will inform all registered interested and affected parties of any suspension of the application as well as of any decisions taken by the competent authority in this regard;
- am responsible for complying with the conditions of any environmental authorisation issued by the competent authority;
- hereby indemnify the Government of the Republic, the competent authority and all its officers, agents and employees, from any liability arising out of the content of any report, any procedure or any action which the applicant or environmental assessment practitioner is responsible for in terms of these Regulations;
- will not hold the competent authority responsible for any costs that may be incurred by the applicant in proceeding with an activity prior to obtaining an environmental authorisation or prior to an appeal being decided in terms of these Regulations;
- will perform all other obligations as expected from an applicant in terms of the Regulations;
- all the particulars furnished by me in this form are true and correct; and
- I am aware that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.


Signature of the applicant/ Signature on behalf of the applicant:

Gauteng Department of Human Settlements

Name of company (if applicable):

August 2013

Date:

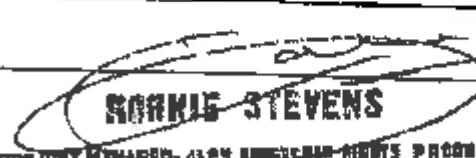

Signature of the Commissioner of Oaths:

28/08/13
Deputy Director

Date:

Designation:

Commissioner of Oaths Official stamp (below)


RONNIE STEVENS
PROJECT MANAGER-ENVIRONMENTAL RIGHTS PROGRAM
EX-OFFICIO COMMISSIONER OF OATHS-REF. #FSA.
CERTIFIED A TRUE COPY OF THE ORIGINAL
25 PRITCHARD STREET 062 601 5056

¹ If the applicant is a juristic person, a signature on behalf of the applicant is required as well as proof of such authority.

APPLICATION FORM [REGULATION 12 (1)&(2)(A)(B)(I)(II)]

ADDENDUM A

10. DECLARATIONS²

The Environmental Assessment Practitioner:

Lizelle Gregory

declare under oath that:

- I act as the independent environmental practitioner for this application **Linksfield Mixed Use Township**
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting environmental impact assessments, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in regulation 8 of the regulations when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will ensure that the comments of all interested and affected parties are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by interested and affected parties in respect of a final report that will be submitted to the competent authority may be attached to the report without further amendment to the report;
- I will keep a register of all interested and affected parties that participated in a public participation process; and
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not;
- all the particulars furnished by me in this form are true and correct;
- will perform all other obligations as expected from an environmental assessment practitioner in terms of the Regulations; and
- I realise that a false declaration is an offence in terms of regulation 71 and is punishable in terms of section 24F of the Act.

For Scoping/ EIA applications I further declare under oath that:

- I will fix the site notice(s) in a conspicuous place, on the property(ies) where it is intended to undertake the activity(ies);
- I will place a notice in the required newspaper(s);
- I will provide the following with all the project information and give I&AP's an opportunity to register as an I&AP
 - landowners and occupiers of adjacent land
 - landowners and occupiers of land within 100 metres of the boundary of the property
 - the ward councillor
 - any organisation that represents the community in the area of the application
 - the municipality which has jurisdiction over the area in which the proposed activity will be undertaken
 - any organ of state that may have jurisdiction over any aspect of the activity of the applicant's intention to submit an application to the competent authority; and
- I will include on the register all persons as required per Regulation 55 (1) (c)
- The Reports as submitted will contain the same information (including layout, project design and mitigation) as provided to the registered I&APs for comment
- All issues raised by the I&APs during the public participation process will be included in the Comments and Response Report as attached


Signature of the Environmental Assessment Practitioner:

Bokamoso Landscape Architects & Environmental Consultants cc

Name of company:

4/9/2013

Date:

² Addendum A must be completed and submitted with the report if application form was done and submitted by the applicant.

APPLICATION FORM [REGULATION 12 (1)&(2)(A)(B)(I)(II)]

Signature of the Commissioner of Oaths:

4/9/2013

Date:

Designation:

Commissioner of Oaths Official stamp (below)

11. CHECKLIST

To ensure that all information that the Department needs to be able to process this application, please check that:

- Where requested, supporting documentation has been attached;
- All relevant sections of the form have been completed; and
- The form has been signed by the applicant, by the EAP or both.

**GEBESTELDE EN WARE AFSKRIF
VAN DIE OORSPRONKLIKE
CERTIFIED A TRUE COPY OF THE ORIGINAL**

A. SWART

Commissioner of Oaths-Kommisaris van Ede
Professionele Rekenmeester (SAIPA). Lic no : 2140
Chris Houbardstr 262, Wierdapark, 0145

Town Planning Memorandum

Annexure P



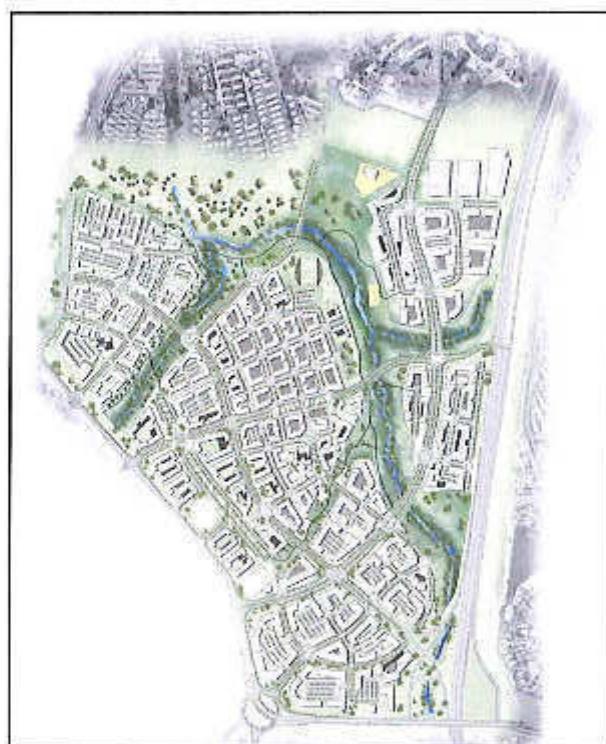
interchange solution for the Club Road corridor forms an integral part of the proposed design intervention.

Precincts: The development will consist of various precincts ranging from business, entertainment, residential and educational - all interlinked to create a functional mixed use development.

7.3 The Proposed Development

The development of the Linksfield site forms part of the densification strategy in the Greater Johannesburg Metropolitan Municipality. The proposed development aims to reconnect various nodal activities in the city, by linear corridor development between nodes in order to develop the city at a macro scale.

As this represents a development initiative initiated by the Gauteng Department of Human Settlement, **Inclusionary Housing** is considered the central theme of the development.



The development is envisioned as a high quality and multi-faceted living environment with development rights that will allow the following mix of land uses:

- Residential Apartments
- Offices & Business Parks
- Convenience Retail
- Entertainment & Restaurants
- Commercial & Light Industrial use
- Hotels & Conference Facilities
- Show Rooms
- Gymnasium
- Educational Uses including:
- Schools and a University/ Tertiary Education Facility
- Active and Passive Recreational Space

Figure 6: Linksfield Master Plan

7.4 Developmental Precincts

▪ The Proposed Residential Development

The housing development will comprise of approximately **10 085** residential units with associated facilities and supportive land uses. The housing development will be integrated and include units ranging from upper-end penthouse apartments to bonded and financed (Gap housing) apartments. Approximately 50% of the housing products will cater for families earning between R3 500 and R15 000 per month; providing housing that is underserviced in an area that was previously out of reach to these families.



MOTIVATING MEMORANDUM

AUGUST 2014



TABLE OF CONTENTS

EXECUTIVE SUMMARY	4
1. INTRODUCTION AND BACKGROUND	7
2. THE APPLICATION	8
3. PARTICULARS OF THE APPLICATION	8
3.1. Introduction	8
3.2. Legal Information	9
3.2.1 Property Description, Ownership and Size	9
3.2.2 Current Town Planning and Legal Status	11
3.2.3 Mineral Rights and Related Issues	11
3.2.4 Mortgage Bonds.....	11
3.2.5 Restrictive Title Conditions & Servitudes	11
3.2.6 Special Power of Attorney	15
3.3. Physical Information and Site Context	15
3.3.1 Regional Context	15
3.3.2 Topography and Drainage	16
3.3.3 Existing Zoning	16
3.4 Existing Land Use.....	16
3.5 Existing Road Infrastructure.....	18
3.6 Flood lines	18
4. ENVIRONMENTAL INVESTIGATIONS	18
4.1 Introduction.....	18
4.2 Environmental Impact Assessment.....	19
4.3 Wetland Delineation.....	19
4.4 Heritage Study	19
4.5 Geotechnical Investigation.....	19
5. MARKET ASSESSMENT STUDY	21
6. ENGINEERING SERVICES.....	22
6.1 Introduction	22
6.2 Bulk Civil Engineering Services Report	22
6.3 Electrical Statement.....	23
6.4 Traffic Impact Assessment.....	24
7. LAYOUT CONCEPT AND DESIGN	25
7.1 Introduction	25
7.2 Design Concept and Approach	25
7.3 The Proposed Development	27
7.4 Developmental Precincts	27
7.5 Road Network within the Proposed Development	28
7.6 Promote Public Transport, Non-Motorized Transport, Pedestrian Movement and Walkability..	29



7.7	Developmental Rights	30
7.8	Layout plan.....	30
8.	MOTIVATION	33
8.1	Introduction.....	33
8.2	Need.....	33
8.3	Desirability.....	37
9.	CONCLUSION	49

LIST OF TABLES

Table 1: Property Description	10
Table 2 : Title Conditions & Servitudes	14
Table 3: Property Zoning	16
Table 4: Geotechnical Classification	21
Table 5: Sunningdale Extensions 13 to 20 Land Use Table	32
Table 6: "Region E" RSDF Objectives.....	42

LIST OF FIGURES

Figure 1: Schematic presentation of the Linksfield Mixed Use Inclusionary Development.....	7
Figure 2: Sketch Plan of Linksfield Farm Portions.....	10
Figure 3: Locality Plan of Proposed Site	15
Figure 4: Surrounding Land Use	17
Figure 5: Linksfield Design Approach.....	26
Figure 6: Linksfield Master Plan	27
Figure 7: Linksfield : Proposed Road Hierarchy	29
Figure 8: The proposed Layout Concept for Sunningdale Extensions 13 to 20.....	31

LIST OF ANNEXURES

ANNEXURE A	:	Title Deed
ANNEXURE B	:	Conveyancer's Certificate
ANNEXURE C	:	Land Surveyor's Certificate
ANNEXURE D	:	Special Power of Attorney
ANNEXURE E	:	Regional Locality Plan
ANNEXURE F	:	Locality Plan
ANNEXURE G	:	Zoning Certificate
ANNEXURE H	:	Zoning Plan
ANNEXURE I	:	Land Use Plan
ANNEXURE J	:	Environmental Impact Assessment Report
ANNEXURE K	:	Final Report on Phase 1 Geotechnical Site Investigation
ANNEXURE L	:	Bulk Civil Engineering Services Report
ANNEXURE M	:	Bulk Electrical Statement
ANNEXURE N	:	Traffic Impact Assessment
ANNEXURE O	:	Composite Layout Plan



EXECUTIVE SUMMARY

The Gauteng Department of Human Settlements (DHS) appointed Urban Dynamics Gauteng Inc. to submit an application for the establishment of a township, commonly referred to as the “Linksfield Mixed Use Inclusionary Development”, but the formal township names are the eight (8) different “registration” phases as allocated by the City of Johannesburg Municipality. The official names allocated by the City of Johannesburg for these eight (8) different “registration” phases are:

- Sunningdale Extension 13
- Sunningdale Extension 14
- Sunningdale Extension 15
- Sunningdale Extension 16
- Sunningdale Extension 17
- Sunningdale Extension 18
- Sunningdale Extension 19
- Sunningdale Extension 20

The proposed development will consist of various residential types of typologies, offices, business parks, commercial, light industrial, retail, hotels, conference centres, university, schools, recreational spaces and entertainment.

It is the mission of the Department of Human Settlements to “Facilitate the creation of sustainable Human Settlements and improved quality of household life”. The Linksfield Mixed Use Development creates an opportunity for the Department to accelerate the delivery of housing opportunities while catering for a variety of income groups. The Department has identified the following as areas of priority to meet their objective of sustainable human settlements:

- Accelerated delivery of housing opportunities
- Access to basic services
- More efficient land use
- An improved property market

The fundamental principle of the proposed Linksfield Mixed Use Development is creating an integrated development where individuals can thrive socially and economically. The development will further enhance the Departments priority areas, creating a sustainable development which can be used as an example/ implementing tool for creating sustainable human settlements.

The City of Johannesburg (CoJ) has recognised the need for drastic transformation with the adoption of a new spatial vision for the city based on corridor Transit-oriented Development. The City of Johannesburg envisage a future where ¹“The city will consist of well-planned transport - arteries Corridors of Freedom – linked to mixed use development nodes with high density accommodation, supported by office buildings, retail developments and opportunities for education, leisure and recreation”. The proposed development aims to incorporate these very principles/fundamentals in it development concept.

According to contemporary housing policy (2004) also referred to as the Breaking New Ground (BNG) policy, sustainable human settlements are described as “The present and

¹ City of Johannesburg Corridors of Freedom: Re-stitching our City to create a New Future



future inhabitants of sustainable human settlements located both in urban and rural areas, live in a safe and secure environment and have adequate access to economic opportunities, a mix of safe and secure housing and tenure types, reliable and affordable basic services, educational, entertainment, cultural activities and health, welfare and police services."

The BNG Policy suggests that there is a need to move away from a housing-only approach towards the more holistic development of human settlements, including the provision of social and economic infrastructure. This policy guideline calls for the optimization of investments already made in terms of existing development of services infrastructure. The proposed development is located in close proximity to existing bulk sewer, bulk water, electrical infrastructure as well as existing road infrastructure.

The Linksfield site is well located along the N3 economic corridor between the Modderfontein and Linksfield off-ramps. The site is furthermore situated within ±10km of Sandton CBD, ±13km from Johannesburg CBD and ±16km from OR Tambo Airport. Its location is synonymous with the existing mixed uses of the Greenstone Retail Node, Longmeadow- and Linbro Business Parks, the Edenvale Hospital, various schools and a variety of extensive recreational uses such as the Royal Johannesburg and Kensington Golf Club and Huddle Park.

The development of the Linksfield site forms part of the densification strategy in the Greater Johannesburg Metropolitan Municipality. The proposed development aims to reconnect various nodal activities in the City, by linear corridor development between nodes in order to enhance the city at a macro scale.

As this represents a development initiative initiated by the Gauteng Department of Human Settlements, **Inclusionary Housing** is considered the central theme of the development. The various development components within this proposed mixed use development are:

- **The Housing Precinct;**
- **Community Facilities;**
- **Commercial Precinct; and**
- **Green Spaces**

Boogertman + Partners Architects were the appointed urban design team for the Linksfield development. The design approach adopted for the Linksfield development is that (hard) commercial and business activities be situated on the edge of the development while (soft) residential and community uses be located on the inside.

Based on the Market Assessment by Urban Studies and the Urban Design Framework completed for the Linksfield Mixed Use Development, a total of eight (8) separate phases are proposed. The phases will be known as:

SUNNINGDALE PROPOSED PHASES	
Phase 1	Sunningdale Extension 15
Phase 2	Sunningdale Extension 13
Phase 3	Sunningdale Extension 14
Phase 4	Sunningdale Extension 16
Phase 5	Sunningdale Extension 17
Phase 6	Sunningdale Extension 18
Phase 7	Sunningdale Extension 19
Phase 8	Sunningdale Extension 20



It is noted that these “registration” phases will not necessarily be developed sequentially as illustrated above; however implementation will be based on growing market demand as well as the phased increased availability of municipal services.

In summary, the applicant hereby applies to the City of Johannesburg for permission to implement a well-planned and unique land development opportunity in the City of Johannesburg Metropolitan Municipality. This unique investment presents an opportunity for this strategically located, but under-utilized land holding to be developed to its highest potential at an appropriate scale and in an economically viable way.

The National Development Plan² - SA long term vision for 2030, proposes a bold strategy to address the challenge of apartheid geography through developments/planning that is environmentally sustainable with living and working environments. By 2030 the plan envisions that most South Africans will have affordable access to services and quality environments. New development will break away from old patterns and significant progress will be made in retrofitting existing settlements. The proposed Linksfield Mixed Use Inclusionary development offers a unique integrated approach towards creating a functioning and sustainable human settlement. The proposed development will offer access to employment opportunities, good schools, public transport, good business location, passive and active recreational spaces thus creating a sustainable living and working environment.

It is our opinion that the proposed township establishment of Linksfield Mixed Use Inclusionary Development will not only benefit the future residents in the area but it will also help urban integration and infill development. The proposed development will further assist in achieving the overall development strategies of the City of Johannesburg Metropolitan Municipality and Gauteng Province.

The Gauteng Visionary Document for 2055³ acknowledges Gauteng is South Africa's most important political and economic node, the largest urban economy in Africa. The fast growing economies in developing countries, with the emergence of BRICS (Brazil, Russia, India, China and South Africa) requires unique development that broadens the provinces opportunities. The proposed Linksfield development aims to be a distinctive development that will contribute towards building Gauteng as a first choice to live and conduct business.

² National Planning Commission: National Development Plan (2011:234)

³ Gauteng Department of Economic Development - Gauteng Vision 2055: The Future Starts Here (7)



1. INTRODUCTION AND BACKGROUND

Urban Dynamics Gauteng Inc. was appointed by the Gauteng Department of Human Settlements to submit an application for the establishment of township to be known as Sunningdale Extensions 13 to 20 (Linksfield Mixed Use Inclusionary Development). This township establishment application is submitted in terms of Section 96 (as read with Section 69) of the Town Planning and Townships Ordinance, 1986 (Ordinance 15 of 1986).

The development of the Linksfield site forms part of the densification strategy of the Greater Johannesburg Metropolitan Municipality. The proposed development aims to reconnect various nodal activities in the city, by linear corridor development between nodes in order to enrich the city at a macro scale.

The development's main focus will be on promoting the uniquely South African outdoor lifestyle and integrate South Africans from diverse backgrounds and socio-economic standing into the development precinct. Its prime focus will be on building and **reinforcing the family unit** which is so vital, considering the frantic pace at which most people live today.

The development will comprise of various different precincts that will include amongst other uses some **10 085 homes**. Of these residential units approximately 50% will be targeted at the gap market for families earning below R15 000 per month. This will provide housing to a sector that is under-serviced in an area that previously was out of reach to these individuals and families. The remaining residential units will be bonded apartments, marketed and sold in the open market.

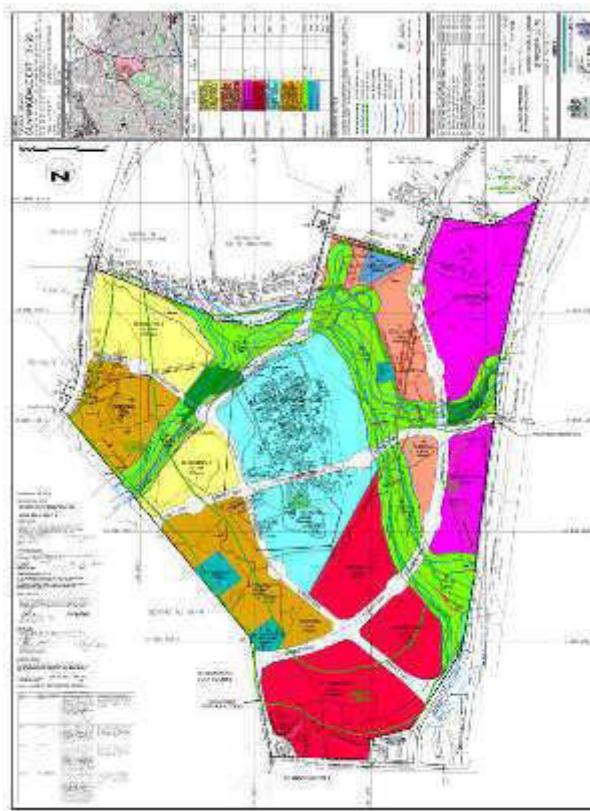


Figure 1: Schematic presentation of the Linksfield Mixed Use Inclusionary Development

Thus, the purpose of this application is to establish a residential township which encompasses multifaceted living including apartments, offices, retail, entertainment, restaurants, shopping



centres, business parks, light industrial areas, conference facilities, hotels, show rooms, hospital, retirement villages, gymnasium, neighbourhood shopping and residential suburbs.

The public amenities such as schools, hospitals and libraries create a rich mix of social interaction. Access to retail centers creates entertainment and job opportunities. The light industrial uses along the eastern edge of the site allow job opportunities within close proximity. The integration of the Linksfield intervention aims at densifying and connecting the site with the larger metropolitan context.

This will create a township establishment which is integrated and sustainable, bringing about much needed cosmopolitan nodes in the province. *The interconnectivity of the site with the associated land uses is important for the socio economic sustainability of the site.*

In this Motivating Memorandum, the applicant details information with regards to the site and its surrounds, detailing policies in support of the development. The various studies undertaken, including environmental investigations, engineering service reports and traffic impact assessment will also be discussed. The institutional framework and a motivation is given in terms of need and desirability as prescribed by the Town Planning and Townships Ordinance, 1986 (Ordinance 15 of 1986).

2. THE APPLICATION

Application is made for the township establishment of **Sunningdale Extensions 13 to 20** situated on a part of Re Portion 1, Ptn 137, Ptn 138 and Ptn 149 Rietfontein 61 IR, in terms of Section 96(1) of the Town Planning and Townships Ordinance, 1986 (Ordinance 15 of 1986).

3. PARTICULARS OF THE APPLICATION

3.1. Introduction

This section of the Motivating Memorandum, relating to the establishment of the **Sunningdale Extensions 13 to 20**, contains information on all pertinent issues regarding the application and the land in question. Throughout this section, and in compliance with the requirements of the Ordinance, continuous reference will be made to supportive documentation. The supportive documents are attached as annexures to this report and include the following:

- ANNEXURE A :** Title Deed
- ANNEXURE B :** Conveyancer's Certificate
- ANNEXURE C :** Land Surveyor's Certificate
- ANNEXURE D :** Special Power of Attorney
- ANNEXURE E :** Regional Locality Plan
- ANNEXURE F :** Locality Plan
- ANNEXURE G :** Zoning Certificate
- ANNEXURE H :** Zoning Plan
- ANNEXURE I :** Land Use Plan



ANNEXURE J :	Environmental Impact Assessment Report
ANNEXURE K :	Phase 1 Geotechnical Site Investigation
ANNEXURE L :	Bulk Civil Engineering Services Report
ANNEXURE M :	Bulk Electrical Statement
ANNEXURE N :	Traffic Impact Statement
ANNEXURE O :	Composite Layout Plan

The objective of this section of the application is to provide a summary and overview of supplied information and therefore to assimilate the information. This is done for ease of creating a better understanding of the relevant issues at hand that have been taken into consideration in the extensive planning phases of the proposed township.

This section of the Motivating Memorandum is divided into main categories relating to:

- Legal information
- Physical Information; and
- Site Context

3.2. Legal Information

3.2.1 Property Description, Ownership and Size

The Linksfield site is made up of a number of farm portions. The development will be on the Portions 137, 148 & 149 (Portions of remainder of portion 1) Rietfontein 61 – IR. Ownership vests with the Gauteng Provincial Government.

Portions 137, 148 and 149 (Portions of remainder of Portion 1) were subdivided but not registered at the Deeds Office and therefore still form part of the Remaining Extent of Portion 1 of the farm Rietfontein 61 IR. As such, this report therefore focuses on the Remaining Extend of Portion 1 Rietfontein 61 IR.

There are some adjoining farm portions that may potentially be impacted by the development:

- Portion 128 & 136 of the Farm Rietfontein 61-IR which includes the Retirement Villages to the North-west

Based on the Land Surveyor's diagram and Title Deed (T1329/1895), the total site area is 271, 5712 Ha in extent. However, the actual township establishment area measures approximately 194.05ha. The reason for this lies in the fact that the surrounding road reserves, although not proclaimed, constitutes 77.5212 Ha of the total extent of the site. The road reserves will remain as farm portions controlled by the local authority.

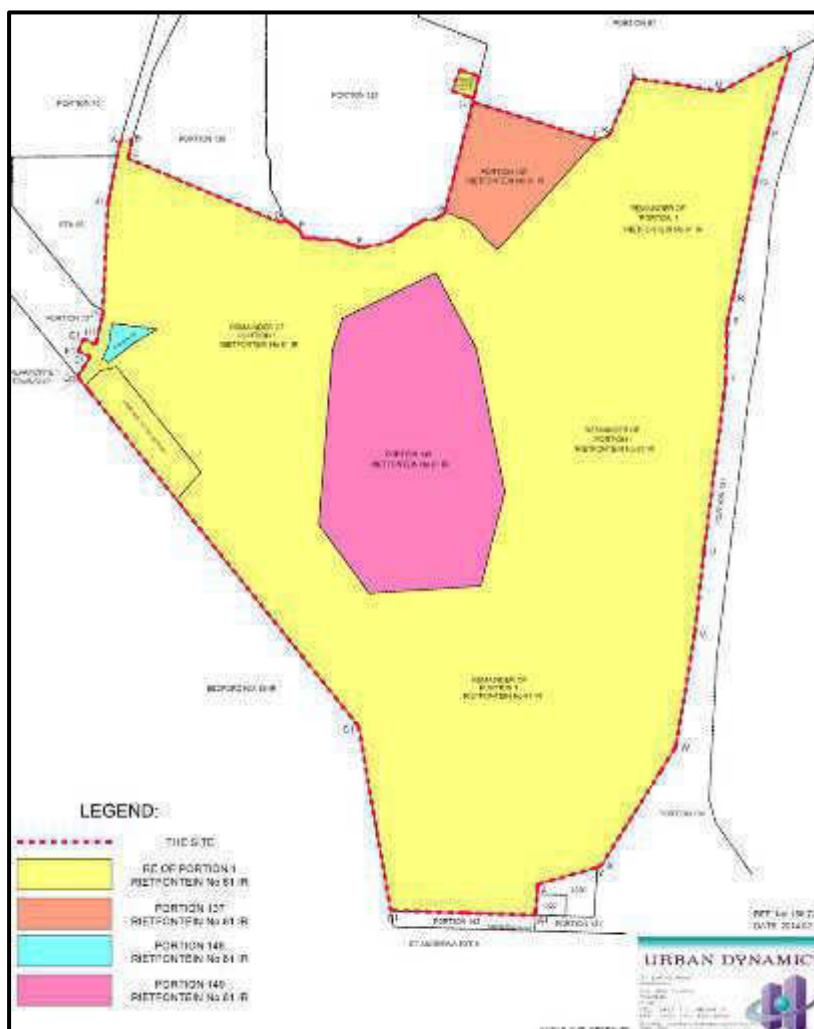
The registered Title Deed description of the land on which the proposed development will take place is described below:



PROPERTY DESCRIPTION	TITLE DEED NUMBER	OWNERSHIP	SIZE
<p>Remaining Extent of Portion 1 of the farm Rietfontein 61 IR.</p> <p>Subdivided but not registered Portions:</p> <ul style="list-style-type: none"> ▪ Portion 137 Rietfontein 61 IR ▪ Portion 148 Rietfontein 61 IR ▪ Portion 149 Rietfontein 61 IR 	T1329/1895	Provincial Government of Gauteng	271,5712 Ha (development area is ± 194.05ha subject to final survey)

Table 1: Property Description

Figure 2 is a sketch plan outlining the site with the relevant subdivided portions which have not being registered.

**Figure 2:** Sketch Plan of Linksfield Farm Portions



3.2.2 Current Town Planning and Legal Status

For clarification purposes, the portion of land in question is included in the Edenvale Town Planning Scheme 1980 and is zoned "Agricultural". The subject land is not subject to any other township establishment application process.

The following status is noted:

- **Town Planning Status** – The land represents unproclaimed land under an "Agricultural" zoning (as per Edenvale Town Planning Scheme, 1980) which allows for a variety of non-residential uses capped at a Bulk FAR (Floor Area Ratio) of 1.5. There is an existing hospital on site with associated land uses.
- **Environmental Status** – According to the information at the disposal of the applicant at the time of the drafting of this Memorandum, the land does not fall within any protected terrestrial reserve nor has it been designated as land forming part of any formal conservation – related urban, rural, archeological or natural area. It is recorded that Bokamoso Landscape Architects & Environmental Consultants have been appointed to conduct an Environmental Impact assessment (EIA) for the proposed Linksfield Mixed Use Inclusionary Development.
- **Legal Status** – The land is registered on freehold title in favour of the Provincial Government of Gauteng. As is confirmed in the Conveyancer's Certificate (**Annexure B**) there are no legal matters adversely restricting the proposed development of the land.

3.2.3 Mineral Rights and Related Issues

There are no current mining activities on the site. The application for township establishment will be circulated to the Department of Mineral Resources of their comments and consent in terms of Section 53 of the Minerals and Petroleum Act, 2002.

3.2.4 Mortgage Bonds

With reference to the Title Deed which is attached as **Annexure A** to this memorandum and the Conveyancers Certificate (**Annexure B**), there are no mortgage bonds registered against the property title. Consent from a mortgage lender is therefore not required.

3.2.5 Restrictive Title Conditions & Servitudes

The properties are subject to a number of title conditions and servitudes. In terms of the Conveyancers Certificate and Land Survey Certificate attached hereto as **Annexure C**, the following title conditions and servitudes are contained in the title deeds which will be dealt with as described in the Table 2.



TYPE	DESCRIPTION OF CONDITIONS	ACTION REQUIRED
Servitudes	<p>1. By virtue of Notarial Deed of Servitude K1103/1955S dated 22 August 1955, the Property is subject to a right in perpetuity to convey electricity over the Property in perpetuity by means of 4 (four) separate underground cables and 1 (one) overhead Powerline with underground cables or other appliances in favour of Eskom, as indicated by the figures AB, CDEF, HJKL, MN and OPQ on diagram SG No A7156/1954, as will more fully appear from the said Notarial Deed.</p> <p>2. By virtue of Notarial Deed of Servitude K1104/1955S dated 22 August 1955, the Property is subject to the exclusive use in perpetuity of a portion of the Property in extend 3965, 3613 square metres in favour of Eskom for the purposes of a substation and transformer site, as it moreover appears from diagram SG No A5627/1953, as will more fully appear from the said Notarial Deed – and does not affect the property.</p> <p>3. Notarial Deed of Servitude K256/1956S</p> <p>4. By virtue of Notarial Deed of Servitude K1266/1960S dated 17 August 1960, the Property is subject to a perpetual right of way servitude over and the right to use a portion of the Property for the laying and maintaining of transmission power lines in favour of the City Council of Johannesburg, measuring 22, 7560 hectares and indicated by the figure ABCDEFGHJKLMNOPQRS on diagram SG No A1550/1959, as will more fully appear from the said Notarial Deed</p> <p>5. By virtue of Notarial Deed of Servitude K642/1962S dated 22 May 1962, the Property is subject to a perpetual servitude of outfall sewer in favour of The Town Council of Edenvale, as it moreover appears from diagram SG No A4013/1959, as will more fully appear from the said Notarial Deed.</p>	<p>Will not be carried forward to title deeds of erven in the township because it does not affect the township due to location.</p> <p>Will not be carried forward to title deeds of erven in the township.</p> <p>No detail available at the Deeds Office, as this condition is not legible on the original Title Deed. To be confirmed with Eskom or other services providers.</p> <p>Affects the township and will be registered against affected erven in the township.</p> <p>Affects the township and will be registered against affected erven in the township.</p>



TYPE	DESCRIPTION OF CONDITIONS	ACTION REQUIRED
	6. Notarial Deed of Servitude K945/1961S	No details available at the Deeds Office. To be confirmed with Eskom or other services providers.
	7. By virtue of Notarial Deed of Servitude K1307/1962SS dated 22 October 1962, the Property is subject to a perpetual right of way servitude over and the right to use a portion of the Property for sewer services in favour of City Council of Johannesburg, measuring 0, 7931 square metres wide and indicated by the figure ABCDEFGHJKLMNOPQRS on diagram SG No A1880/1961, as will more fully appear from the said Notarial Deed.	Affects the township and will be registered against affected erven in the township.
	8. By virtue of Notarial Deed of Servitude K1630/1972S dated 20 December 1972, the property is subject to a perpetual right of way over the Remaining Extent of Portion 1 of the farm Rietfontein No 61, I.R. being a strip of ground 3, 78 metres wide traversing the said Remaining Extent along a line of route more fully indicated on Diagram S.G. No A1824/1969, by the figure A B C D E F G H J K L M N O P Q R S T U V W X Y Z A' B' C' D' E' F' G' H' J' K' L' M' N' O' P' Q' R' S' T' U' V' W' X' Y' Z' A'' B'' C'' D'' E'' F'' G'' H'' J'' K'' L'' M'' N'' O'' P'' Q'' R'' S'' T'' U'' V'' W'' X'' Y'' Z'' A'''.	Affects the township and will be registered against affected erven in the township.
	9. By virtue of Notarial Deed of Servitude K1310/1974S dated 10 June 1974, the Property is subject to a perpetual water pipeline servitude in favour of the City Council of Johannesburg, measuring 3 (three) metres wide and indicated by the figure ABCDEFGHJKLMN on diagram SG No A365/1973, as will more fully appear from the said Notarial Deed.	Affects the township and will be registered against affected erven in the township.
	10. By virtue of Notarial Deed of Amendment of Servitude K2665/1978S dated 29 September 1978, the route which has been granted to the City Council of Johannesburg for a perpetual right of way over and the right to use a portion of the Property for the laying and maintaining of transmission power lines, as it moreover appears from Notarial Deed of Servitude K1266/1960S, has been diverted, which led to the cancellation of a part of the servitude and indicated by the figure ABCD on diagram SG No A450/1978 and ABCD on diagram SG No 449/1978, as will more fully appear from the said Notarial Deed	Will not be carried forward to title deeds of erven in the township.



TYPE	DESCRIPTION OF CONDITIONS	ACTION REQUIRED
	<p>11. By virtue of Notarial Deed of Lease K2551/1970L dated 29 March 1979, the Property is subject to a 25 year lease which has been granted to the Society for the Jewish Handicapped, measuring 2, 8537 hectares and indicated by the figure ABCDEFA on diagram SG No A1275/1974, as will more fully appear from the said Notarial Deed.</p> <p>12. By virtue of Notarial Deed of Servitude K3010/1985 dated 24 September 1985, the Property is subject to a perpetual servitude of water pipeline in favour of Rand Aid Association, measuring 3 metres wide and indicated by the figure ABCD on diagram A1303/1985, as will more fully appear from the said Notarial Deed.</p> <p>13. By virtue of Notarial Deed of Servitude K3039/1986S dated 21 May 1986, the Property is subject to a perpetual servitude for municipal purposes in favour of City Council of Johannesburg, measuring 4, 0021 hectares and indicated by the figure ABCDEFGHJKLMNPQ on SG No A10639/1983, as will more fully appear from the said Notarial Deed.</p> <p>14. By virtue of Deed of Servitude K538/1946S dated 29 May 1946, the Property is subject to a right in perpetuity to convey electricity across the property by means of 3 separate and distinct overhead power lines and/or underground cables or other appliances in favour of Electricity Supply Commission and indicated by the figure BCDEFGH, CJ, AB, ABCDEFGHJ diagrams SG No A1708/1943 and A3158/1944, as will more fully appear from the said Notarial Deed</p> <p>15. By virtue of Notarial Deed of Servitude K1630/1972S dated 18 February 1971, the Property is subject to a perpetual right of way over a strip of ground 3,78 meters wide traversing the Property in favour of the City Council of Johannesburg with the right to use in perpetuity the property for municipal sewer services only and indicated by the figure B''C''D''E''F''G''H''J''K''L''M''N''O''P''Q''R''S ''T''U''V''W''X''Y''Z''A''' on diagram SG No 1824/1969, as will more fully appear from the said Notarial Deed</p>	Affects the township and will be registered against affected erven in the township.
Restrictive Conditions	None	No action required

Table 2 : Title Conditions & Servitudes



3.2.6 Special Power of Attorney

The applicant for this application to establish a township to be known as **Sunningdale Extensions 13 to 20** is Urban Dynamics Gauteng Inc. as appointed by Gauteng Department of Human Settlements to prepare and submit this application on their behalf; the Special Power of Attorney is attached hereto as **Annexure D**.

3.3. Physical Information and Site Context

3.3.1 Regional Context

The Linksfield site is well located along the N3 between the Modderfontein and Linksfield off-ramps. Refer to **Annexure E** for the Regional Locating Plan. The site is situated within 10km of Sandton CBD, 13km from Johannesburg CBD and 16km from OR Tambo Airport. Its location is in close proximity with the existing mixed uses of the Greenstone Retail Node, Longmeadow and Linbro Business Parks, the Edenvale Hospital, various schools and a variety of extensive recreational uses such as the Royal Johannesburg and Kensington Golf Club and Huddle Park.



Figure 3: Locality Plan of Proposed Site

Figure 3 illustrates the site's local context. A more detailed Locality Plan is attached to this memorandum as **Annexure F**. The site falls within the City of Johannesburg Metropolitan Municipality (CoJ), Administrative Region E. The surrounding neighbourhoods include Edenvale, Dowerglen, Sandrigham, Silvamonte and Lyndhurst. In this area, the municipal



boundary between City of Johannesburg and Ekurhuleni Metropolitan Municipality is along the N3 Highway.

3.3.2 Topography and Drainage

Site topography is characterised by moderated gradients that slope towards the Jukskei River. The Jukskei river routes from the south-eastern side to the northern point of the site at an average gradient of 2.1%. The site topography is characterised by gradients sloping towards the Jukskei river.

3.3.3 Existing Zoning

The property is zoned "Agricultural" in terms of the Edenvale Town Planning Scheme 1980 and has the following development controls:

Property Zoning	
Property Description	Remainder of Portion 1, Ptn 137, 148 and Ptn 149 Rietfontein 61 IR
Use Zone	Agricultural
Height Zone	0 (Four storeys)
Floor Area Ratio	1.5
Coverage	66%
Density	No Density
Building Line	10m street boundaries and 5m all other boundaries
Parking	As per scheme

Table 3: Property Zoning

The Zoning Certificate confirming the existing zoning is attached hereto as **Annexure G** and a Zoning Plan attached as **Annexure H**.

Of relevance is that the site, under its existing zoning can accommodate 4 073 581 m² of non-residential/commercial land uses.

3.4 Existing Land Use

The existing land uses on site include the Sizwe Tropical Disease Hospital and Pharmacy which specialise in the treatment of Tuberculosis (Multidrug-Resistant Tuberculosis and Extensively Drug-Resistant Tuberculosis), HIV testing/counselling and tropical diseases. Over the years the hospital has gained a negative stigma and patients are resistant/unwilling to use the facilities for treatment. A new modern ward is currently being constructed in the Edenvale Hospital Campus for the treatment of TB and tropical diseases. This new ward will offer state of the art facilities and technology for patients, thus making it a suitable replacement for the current ageing hospital.

There is a retirement village – Elphin Lodge Retirement Village, north of the site, offering 119 two bedroom cottages, 40 one bedroom and 64 two bedroom apartments. The surrounding land uses, indicated in Figure 4, include:

- Pikit Up
- Sandringham SAPS
- National Health Laboratories Service
- Linksfield Terrace Shopping Centre
- Edenvale Hospital



Edenvale Hospital



Pikit Up Site



Club street parallel to site



Entrance leading to Sizwe Tropical Disease Hospital



Elphin Retirement Village



Linksfield Terrace Shopping Centre

Figure 4: Surrounding Land Use

There are also associated residential uses, low intensity commercial uses along Club Street and Linksfield Road and large pockets of vacant and unutilized land. Refer to **Annexure I** for a detailed Land Use Plan.

Surrounding land uses within a ±5 km to ±7km radius of the site include industrial and commercial nodes such as:

- Greenstone Regional Malls



- Edenvale CBD
- Orange Grove
- Bedfordview
- AECL and associated industry at Modderfontein
- Linbro Park Business Park (Frankenwald)
- Longmeadow Business Estate.

The Johannesburg Spatial Development Framework 2010/11 (Region E) describes the above as specialist nodes, which are of a specialised nature in terms of being used for a single retail entertainment, commercial or industrial use. The proposed development presents an opportunity for infill development which will increase the diversity of land uses in an area with specialist nodes.

3.5 Existing Road Infrastructure

The N3 Highway is the closest National route linking the site to the greater Johannesburg metropolitan area and Ekurhuleni municipality. Collector or distributor roads in close proximity to the site include Linksfield Drive (M16), Modderfontian Road (R25) and its interchange with Club Street.

3.6 Flood lines

WSP SA Civil and Structural Engineers (Pty) Ltd are the appointed engineers for the Linksfield Mixed Use Inclusionary Development and have completed a Civil Engineer Service Report, attached as **Annexure L**. The report concluded there is a 1:50 and 1:100 year floodline (Jekskei River) towards the north-eastern and western side of the proposed Development Area. The 1:50 and 1:100 year floodlines are indicated and certified on the Composite Layout Plan, which is attached hereto as **Annexure O**.

4. ENVIRONMENTAL INVESTIGATIONS

4.1 Introduction

This section of the report is aimed at providing a brief overview with regards to the environmental investigations conducted for the site. In fulfilment of the environmental requirements the following studies were undertaken:

- **Environmental Final Scoping Report** conducted by Bokamoso Landscape Architects & Environmental Consultants, Reference Gaut: 002/13-14/E0153, dated February 2014 attached to this memorandum as **Annexure J**.
- **Wetlands Delineation** conducted by Terra Soil Science appointed by Bokamoso Landscape Architects and Environmental Consultants.
- **Heritage Study** conducted by African Heritage Consultants CC for Bokamoso Landscape Architects & Environmental Consultants.
- **Geotechnical Investigation** conducted by J Louis Van Rooy Engineering Geologist, dated January 2014, Reference 1339, attached as **Annexure K**.

As the environmental process is still on-going, it is noted that all the abovementioned studies are currently being finalised by the respective professionals. Therefore this report will highlight some of the key findings from the environmental investigations.



4.2 Environmental Impact Assessment

Bokamoso Landscape Architects & Environmental Consultants was appointed to conduct an Environmental Impact Assessment for the Linksfield Mixed Use Development. The Scoping Report is the culmination of the preliminary phase of the assessments and identification of the key environmental issues for the proposed development; additional specialist studies required for the next phase in the Application process were also identified. A summary of the geology, soil and hydrology properties are detail below:

- Geology and soil: According to the assessment, the site is located in an area underlain by both mafic and granitic rocks. In the southeast of the Johannesburg Granite Dome the so-called Edenvale Modderfontein Complex Greenstones are present. The site is not underlain by dolomitic bedrock and a stability investigation therefore not required. The site is, however, underlain by soils with possible geotechnical constraints that will warrant precautionary foundation measures. A Phase 1 geotechnical investigation was conducted and geotechnical zones indicated on layout plan.
- Hydrology: The study area is affected by 1:50 and 1:100 year floodlines. The Jekskei River floodplain as well as its tributaries and associated valley bottom wetland systems flow through/ occur on the site. Two small wetlands, located on the north eastern portion of the site feeding into the Jekskei River, were identified. Although severely compromised, these could be rehabilitated and kept as open spaces on the site provided adequate storm water planning and designs are implemented. The layout plan makes provision for open spaces and the floodlines are indicated on the layout plan.

One of the key issues identified during the EIA scoping is the existence of graves and potential risk posed by exposure to exhumation of those graves. It is the intention of the developer to maintain these old graves and retain them as part of the site's rich heritage as "Private Open Space".

More detail on the environmental aspects of the site can be found in the **Final Environmental Scoping Report** attached as **Annexure J**.

4.3 Wetland Delineation

Terra Soil Science was appointed by Bokamoso Landscape Architects and Environmental Consultants to conduct a wetland assessment for the Linksfield Mixed Use Development area to verify the presence or absence of any wetlands. The study concluded that the site is affected by wetland areas as indicated on the Composite layout plan, attached hereto as **Annexure O**. A terrain indicator was used to identify the wetland areas and confirmed the presence of the wetlands.

4.4 Heritage Study

A heritage study was conducted by African Heritage Consultants CC for the Linksfield Development. The study indicated that there are some historic graveyards on the site. It is the intention of the developer to maintain these old graves and retain them as "Private Open Space".

4.5 Geotechnical Investigation

J Louis Van Rooy Engineering Geologist was appointed to conduct a Geotechnical Assessment for the township establishment of the Linksfield development. The report details



the soil profile, geotechnical evaluation and site classification coupled with foundation recommendations. The geotechnical report covers four (4) geotechnical zones, detailed in Table 4 below:

ZONE	NHBRC CLASSIFICATION	GEOTECHNICAL CHARACTERISTICS	FOUNDATION RECOMMENDATION
Zone I	C/2ABF	This zone covers the north and north-eastern portion. Most of the profiles exposed transported and residual soils that are slightly voided and pinholed with moderate collapse expected as well as compressibility characteristics and a low to medium soil heave expected. Intermediate excavation is expected due to the refusal of the TLB within the upper 1.5m of the profile, on weathered bedrock.	Recommended foundations for single storey masonry structures are: Normal construction (strip footing or slab-on-the ground foundation) with good site drainage.
Zone II	C1/2ABE	This zone covers the central portion of the site up to the river and its surrounding floodplain. Most of the profiles exposed transported and residual soils that are voided and pinholed with moderate collapse expected as well as compressibility characteristics, and a low soil heave expected	Recommended foundations for single storey masonry structures are: modified normal, compaction of in situ soils below individual footings, deep strip foundations, soil raft.
Zone III	C1/2ABE	This zone covers the southern and south-western portion of the site adjacent to the site boundary. The zone is underlain by granitic bedrock. Most of the profiles exposed transported and residual granitic soils that are voided and pinholed with moderate collapse expected as well as compressibility characteristics, and a low soil heave expected. It is evident from the surficial soils that the soil profile has erodible characteristics.	Recommended foundations for single storey masonry structures are: modified normal, compaction of in situ soils below individual footings, deep strip foundations, soil raft.
Zone IV	P (Uncontrolled fill)	This zone covers only localised portions in the northern part of the site as well as along the edges of all the major roads. Due to the large volumes of dumped material in the north, the extent and properties of the	It is therefore recommended that further investigation be conducted when detailed site inspection are executed during the final site layout



		underlying natural soils were not quantified or investigated. The variability and random dumping of builder's and other industrial wastes will warrant special measures that may include the removal of the material prior to any development taking place.	phase.
--	--	---	--------

Table 4: Geotechnical Classification

The soil classifications are also indicated on the Layout Plan, which was certified by the geologist and is attached as **Annexure O**. More detail on the final report on **Phase I Geotechnical Site Investigation** for the proposed Linksfield Development is attached as **Annexure K**.

5. MARKET ASSESSMENT STUDY

A Market Assessment Study was finalised by Urban Studies for the Linksfield Mixed Use Inclusionary Development in order to assess economic and demographic trends in the area and thus model the need and extent of the proposed land uses.

The market study report indicated that the area is already well provided with retail facilities, and a total of **180 000m²** retail supply already exists. Some of the existing retail facilities in the sub-region include:

- Greenstone Shopping Centre
- Stoneridge Centre
- Van Riebeeck Mall
- Eden Mall
- Edenvale Shopping Centre
- Sandringham Centre

Although there are a number of retail facilities in the area, it is important to note that the shopping centres to the west and the east of the Linksfield development have their own and different market profiles. The majority of the retail floor area is at the Greenstone regional node and the other centres are smaller neighbourhood centres in the surrounding areas.

The outcome of study indicated the following:

- The residential micro location rating is currently 81% meaning the site is regarded as a good location in terms of residential development.
- The retail micro location rating is currently 78%. This is regarded as a good location for retail purposes.
- The office micro location rating is 69% and is regarded as an average office location site. This rating will improve in future as this area becomes established accessible.
- The sites along the N3 Highway with good access to the N3 Highway should be considered for Distribution and Warehouse facilities. The location rating for



distribution and warehousing is 80% and regarded as a very good site for this type of development.

The report highlighted that the most important aspect with regards to the proposed Linksfield node is the fact that it does not form part of the major north/south office axis from Johannesburg CBD through Rosebank and Sandton into Midrand. This area will always remain a secondary office market. It is clear from the site evaluation ratings that the best land uses for this particular site are residential, industrial (distribution and warehousing) and retail.

6. ENGINEERING SERVICES

6.1 Introduction

This section contains information about the investigations completed for the Linksfield Mixed Use Inclusionary Development in respect of bulk services, technical requirements and infrastructure upgrading proposed to implement the Linksfield Mixed Development. The technical reports include:

- **Bulk Civil Engineering Services Report** prepared by WSP SA Civil and Structural Engineers (Pty) Ltd, Project Number 16013, dated 2013/01/30, attached to this memorandum as **Annexure L**.
- **Bulk Electrical Statement** prepared by LTE Civil and Structural (Pty) Ltd, attached as to this memorandum as **Annexure M**.
- **Traffic Impact Assessment** conducted by WSP Group Africa (Pty) Ltd dated 2014/02/21 attached hereto as **Annexure N**.

Please refer to each of these reports for detailed information and plans. For ease of reference, summarized information was extracted from these reports and follows below.

6.2 Bulk Civil Engineering Services Report

The bulk service report prepared by WSP SA Civil and Structural Engineers Pty (Ltd) investigate water reticulation with new construction, transfer infrastructure, sewer reticulation and storm water management. The outcome of the bulk service report are discussed below:

➤ Water Reticulation

The Linksfield development water utilisation will have an impact on existing bulk infrastructure systems. The report indicates that the average daily water demand for the full development is projected at 9900 m³/d. The instantaneous demand however is recommended to be four times higher (peak factor of 4) than the daily average would advocate. The instantaneous demand, therefore translates to 458 l/s. The instantaneous demand is a key parameter in the hydraulic assessment of the development's impact on existing water transfer infrastructure.

The construction of new transfer infrastructure for water supply is through a new 600 mm pipe (Item LRR1.1) and PRV (Item LRR1.2), to be connected to the existing 750 mm Ø pipeline running from the Linksfield Reservoir. The pipeline will run parallel to the northern side of Club Street (M16) between Grand Road and a point approximately 225 m measured along Club street from the intersection with Linksfield Road. The length of the new pipeline section is approximately 2030 m.



➤ **Sewer Reticulation**

The bulk services report indicates that the Bruma Outfall has limited spare capacity available to accommodate the proposed Linksfield Development sewage, but capacity will be sufficient once the diversion of the Illiondale pump station to the Modderfontein outfall has been completed. The sewage system is currently undergoing upgrades and will have enough capacity to accommodate the entire Linksfield Development sewage.

➤ **Stormwater**

The report indicated that run-off volumes will increase and accumulate at a quicker rate. The natural drainage system (i.e. Jukskei River) will have to transfer additional stormwater. In order to offset the potential impact of post development change in development hydrology, stormwater attenuation is essential. Two strategies have been identified to mitigate the above:

- Attenuation of accumulated stormwater in the Jukskei River; and
- Attenuation of stormwater before draining into the Jukskei River i.e. segregated on-site attenuation.

Both the strategies will have the same effect, i.e. ensuring that the downstream post development hydrograph is unaltered. This suggests that pre-development and post-development run-off volume and stormwater accumulation rate is unaltered.

In conclusion the report indicates that the potable water infrastructure system requires an upgrade and improvement to the existing sewerage system will accommodate the development sewerage.

More detail on the Bulk Civil Engineering Services of the site can be found in the **Bulk Civil Engineering Services Report** attached as **Annexure L**.

6.3 Electrical Statement

LTE Civil and Structural (Pty) Ltd was appointed to investigate the electrical supply for the proposed development. Their investigation indicated that there is existing bulk electricity networks in the proposed development area which is both underground and overhead and falls under City Power's jurisdiction.

It is estimated that the electrical power requirement is 40MVA based on the assumption that alternative energy sources will be utilised.

City Power indicated that there should be sufficient capacity to supply the proposed development from their underground 11kV network but highlighted that there might be a need to supply the development from several 11kV circuits in order to meet the total load.

City Power also indicated that they would be agreeable to metering the entire development at the single bulk supply point. The developer will then be responsible for metering and recovery of costs from all downstream consumers.



Alternative energy sources that will be utilised in the development include:

- **Solar Water Heating:** Low pressure water heating systems without any electrical back-up will be installed for all residential units, and utilized as much as possible in the commercial and mixed-use portions of the development.
- **Solar lighting:** Street lights utilizing pole mounted PV modules as well as energy efficient LED (light emitting diode) lamps will be utilized for the development.
- **Natural Gas:** It is proposed that the entire development will include a natural gas network to allow the distribution of natural gas to every unit as well as commercial, institutional, and mixed use portions of the development.

The Bulk Electrical Statement by LTE Civil and Structural (Pty) Ltd is attached hereto as **Annexure M**.

6.4 Traffic Impact Assessment

A Traffic Impact Assessment (TIA) was prepared by WSP Group Africa (Pty) Ltd to make recommendations for the required upgrading of the existing road network. The study investigated the existing and expected future traffic flow conditions along the adjacent roads and determines the anticipated traffic impact of the proposed development.

The report states that Local access to the proposed development has been adequately planned, with new intersections proposed along Club Street and Modderfontein Road. The Linksfield interchange will also be upgraded to include a ramp into the proposed development.

The implementation of the proposed Linksfield Development will impact the traffic conditions by increasing traffic volumes and if not mitigated, cause congestion. As a result, road upgrades will be required to mitigate the aggravated congestion levels. Road improvements may be required along the following roads:

- The N3 Freeway
- Club Street
- Modderfontein Road; and
- Linksfield Road

The TIA report indicates that given the scale of the proposed development and the expected traffic demand to be generated, public transport and non-motorised transport options need to be integrated as part of the development transport system. A new Bus Rapid Transit (BRT) trunk with feeder route is proposed to accommodate the development's public transport demand. This proposed system should serve as a mitigating measure to attenuate the expected congestion levels. The proposed development will also have various pedestrian and cycle routes to encourage non-motorised transport use in the site.

Final analysis of the report concluded that the traffic impact of the proposed Linksfield Development on the external transport network is expected to be of overall medium significance. It is therefore recommended that the proposed development be supported from a traffic engineering perspective.

Specific comments and proposals are made in respect of the proposed site access and road/intersection/link upgrades, as well as on public transport. The TIA may be found in **Annexure N** of this memorandum.



7. LAYOUT CONCEPT AND DESIGN

7.1 Introduction

The Linksfield project is situated on state land located in Johannesburg - the fastest growing metropolis in Africa. The vision for the development of this land is to establish an Inclusionary Mixed Use Development that will maximise on the potential that the site offers due to its locality, size and the convenient availability of a large range of social amenities and services.

It is the vision of the Gauteng Department of Human Settlements that the Linksfield development will mark the creation of a new era of lifestyle for South Africans of a truly multi-class, multi-racial working and living environment and therefore be a multi-use precinct where one can live, work and play.

7.2 Design Concept and Approach

An urban design team, Boogertman + Partners Architects, was appointed and their design approach adopted for the Linksfield development is that "hard" commercial and business activities be situated on the edge of the development while "soft" residential and community uses are located on the inside.

The Urban Design approach towards the Linksfield urban precinct is inclusionary on all levels of urban life. The integration of socio economic, gender and racial predispositions lies at the heart of the intervention. Transport integration and inclusionary housing forms the basis of urban form and connectivity to the greater Johannesburg and Gauteng province at large.



The **design approach** is described below:

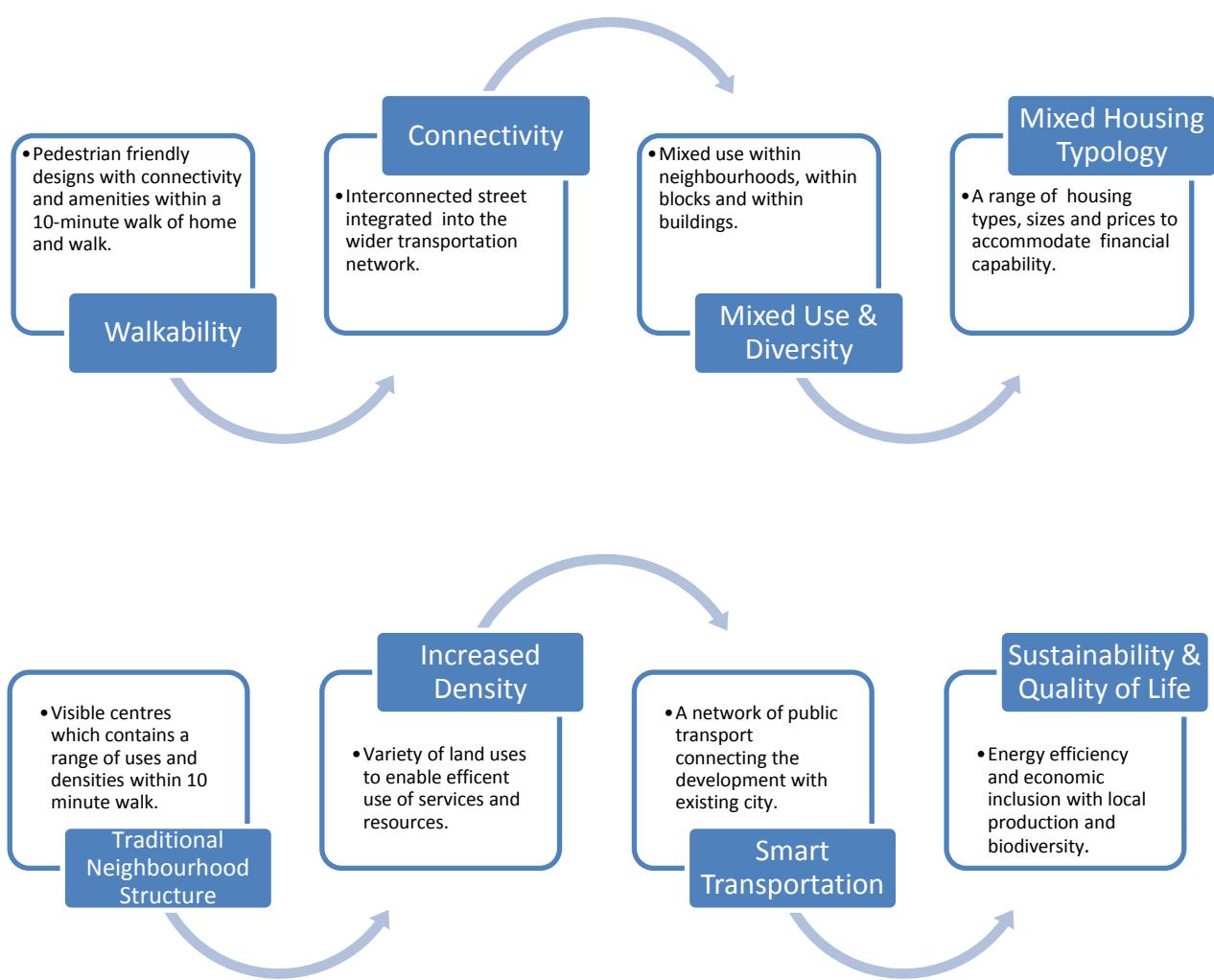


Figure 5: Linksfield Design Approach

The design concept will therefore incorporate:

Hard Outer Edge: Creating a high density edge towards the N3 highway; this forms the eastern boundary of the site and provides visibility and exposure for commercial land uses.

Soft Inner Space: The softer interior will have a lower density and be the heart of the community, comprising of residential, institutional (educational) and community facilities.

Green Belt: The natural topography of the site and river edge defines several distinct precincts in the site. The natural landscape will act as the “Green Spine” flowing through the entire development.

Connectivity: Inner arterial routes will be developed with the intention to increase connectivity to surrounding communities of the Greater Johannesburg. The development proposes an extension of the BRT system along Modderfontein Road towards the Greenstone taxi rank to increase the site's connectivity. The proposed transport



interchange solution for the Club Road corridor forms an integral part of the proposed design intervention.

Precincts: The development will consist of various precincts ranging from business, entertainment, residential and educational - all interlinked to create a functional mixed use development.

7.3 The Proposed Development

The development of the Linksfield site forms part of the densification strategy in the Greater Johannesburg Metropolitan Municipality. The proposed development aims to reconnect various nodal activities in the city, by linear corridor development between nodes in order to develop the city at a macro scale.

As this represents a development initiative initiated by the Gauteng Department of Human Settlement, **Inclusionary Housing** is considered the central theme of the development.



The development is envisioned as a high quality and multi-faceted living environment with development rights that will allow the following mix of land uses:

- Residential Apartments
- Offices & Business Parks
- Convenience Retail
- Entertainment & Restaurants
- Commercial & Light Industrial use
- Hotels & Conference Facilities
- Show Rooms
- Gymnasium
- Educational Uses including:
- Schools and a University/ Tertiary Education Facility
- Active and Passive Recreational Space

Figure 6: Linksfield Master Plan

7.4 Developmental Precincts

▪ The Proposed Residential Development

The housing development will comprise of approximately **10 085** residential units with associated facilities and supportive land uses. The housing development will be integrated and include units ranging from upper-end penthouse apartments to bonded and financed (Gap housing) apartments. Approximately 50% of the housing products will cater for families earning between R3 500 and R15 000 per month; providing housing that is underserviced in an area that was previously out of reach to these families.



- **Commercial Development**

The commercial component will be limited to 35% of the ± 194.05ha developable site. This component will be situated adjacent to the N3 highway to maximise on the benefits that the freeway exposure offers. The commercial precinct, which will potentially consist of mixed business, commercial and light industrial uses can potentially yield up to 800, 000m² of bulk and create over 25 000 jobs.

- **Community Facilities**

The community facilities will cater for both the development as well as for surrounding neighbourhoods. It is a precondition that all social facilities be planned and developed at the same time as the residential development in consultation with the various provincial and municipal departments. At a minimum, the community facilities should include two new public schools, a community centre, tertiary education (proposed university), a business centre, social halls, satellite police station, youth centre, Fire station and various community parks.

- **Green Space**

Access to the natural landscape and amenities will be a fundamental theme in the development as the vast majority of open space in the site will be utilised for recreational activities. The integration of natural and landscaped green elements such as parks along the river edge in the urban form, are planned to create a natural hierarchy of active and passive recreation space and contribute to the precinct definition.

7.5 Road Network within the Proposed Development

The N3 and main arterial connector routes such as Modderfontein Road and Linksfield Drive define the boundaries of the proposed Linksfield development. The layout plan (see **Annexure O**) propose access along the 7km perimeter of the site that will allow vehicular access to the site. The road network within the development will connect to the wider public transportation network facilities which will ensure economic integration with the region, illustrated in Figure 7.

The **Primary routes** create an outer road around the centre of the development that connects the various precincts. A **Secondary** inner ring road will connect the development to the centre. The network of **Tertiary roads** in turn will allow access to the finer grain of the neighbourhood structure. A **pedestrian and cycle network** is proposed along all the roads which accesses the green open spaces to enhance walkability and pedestrian connectivity.

The nodes within the development are strategically placed to allow 10 minute walk distance to all part of the development.

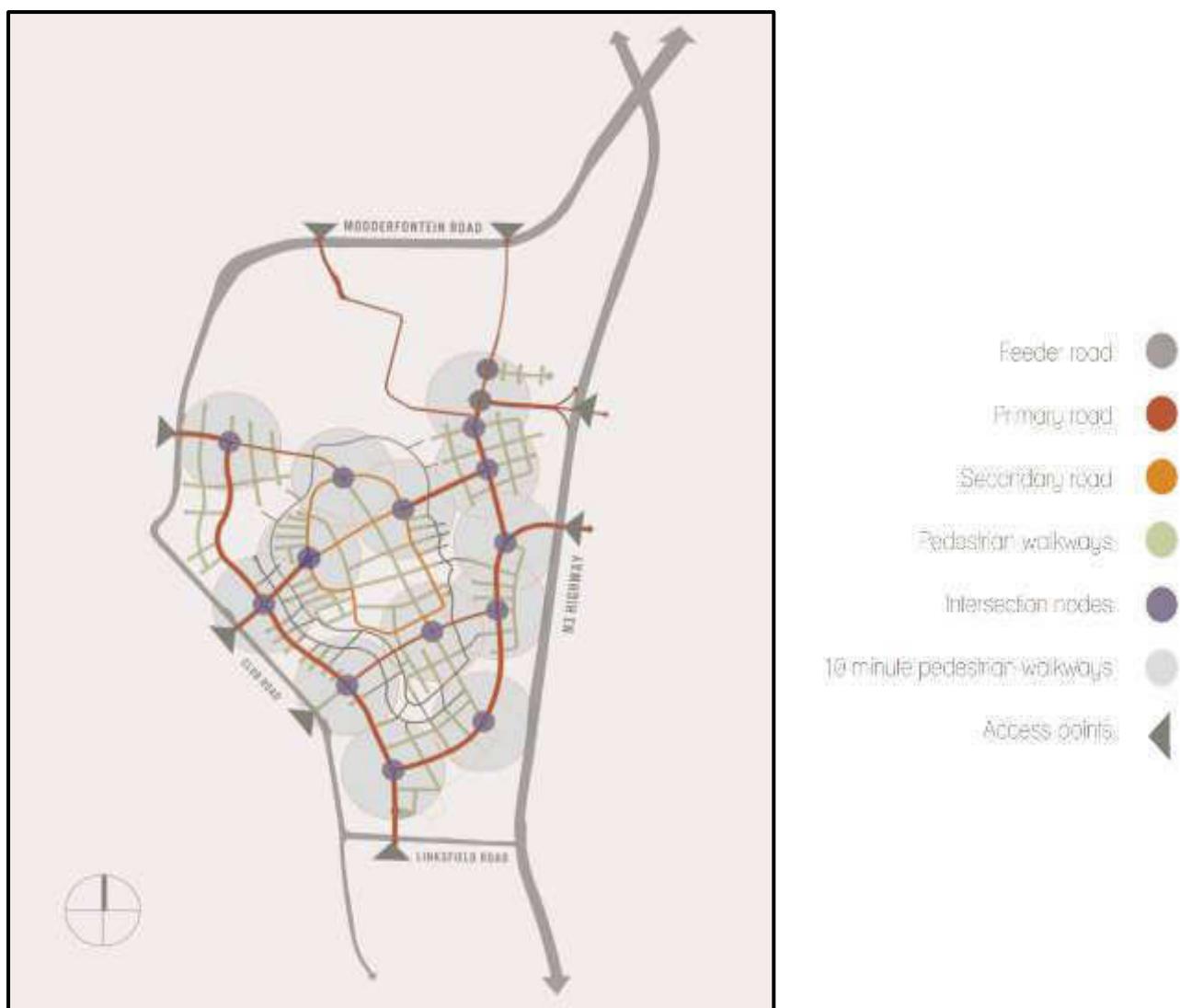


Figure 7: Linksfield : Proposed Road Hierarchy

7.6 Promote Public Transport, Non-Motorized Transport, Pedestrian Movement and Walkability

The public transport is focused to support the development of a central urban core (including a centralised public transport facility/ TOD). There is a proposed Bus Rapid Transit (BRT) extension along the northern boundary of the site meant to enhance public connectivity to the site and region, extending the system towards the Greenstone taxi rank and beyond. The BRT system and integration of the informal minibus taxi industry will create a support network to the major arterial connections. The proposed transport interchange solution for the Club road corridor, further forms an integral part of the proposed design intervention.

The development proposes pedestrian-friendly street designs to encourage a greater use of bicycles, motor-cycles and pedestrian walking routes. This network will create opportunities for effective use of alternative transport as well as running/walking tracks. At the intersections of main routes, a transport interchange is proposed that can accommodate all modes of transport and drop-off facilities. These nodes are again strategically placed to allow 10 minute walkable distance to all areas of the development.



One of the fundamental design principles for the proposed development is "Smart Transportation" which aims at creating a network of high-quality public transport options connecting the proposed development with existing surrounding towns/neighbourhoods. The principle also encourages a network of pedestrian routes and "green" fingers that will link a system of courtyards, open parks and potentially even agricultural allotments.

The Linksfield Mixed Use Development will cater for a variety of income groups, making an efficient public transport important. The transport and pedestrian routes will be designed to cater for households without access to vehicles, making it easy to move across the site by foot.

The proposed urban development could promote pedestrian movement and transform the development into a walkable community. The image above, illustrates the development of walkable neighbourhoods.

In conclusion the Linksfield Design Concept seeks to build on the principle of integrated development learning from previous mixed use developments such as Brickfield, Cosmo City, Fleurhof. The vision is for an individual to live within their means, where they can walk to work, drop off kids at school, buy shopping goods and still have the advantage of being connected to Johannesburg's metropolitan area at large.

The development offers a practical design with mixed land uses, social and economic amenities along public routes, accessible public transport/walkways making it an ideal mixed use development. The diverse dwelling with the mixed precincts will attract a range of investors to the area. The design framework for the proposed development is a sustainable one offering residential development with economic opportunities and considers the existing environmental system by reducing the development's ecological footprint.

7.7 Developmental Rights

Boogertman + Partners was successfully appointed as lead urban designers and architects through the Linksfield Urban Design Competition. Various Architects were given an opportunity to create the Linksfield Master Plan aimed at creating an integrated living environment and distinct urban character. The layout concept is based on an Urban Design Framework that was prepared by the winning concept of Boogertman + Partners Architects.

This concept further is grounded on the applicant's response to the SDF policies of the City of Johannesburg. The proposed Linksfield Master Plan aims at creating an integrated living environment and distinct urban character. The mix use approach to land use and building typology define the proposed urban form.

7.8 Layout plan

It is the intention of the proposed development to establish a mixed use township with a range of economic, social and recreational facilities for its local residents. The proposed layout plan for Sunningdale Extensions 13 to 20 is indicated in Figure 8.

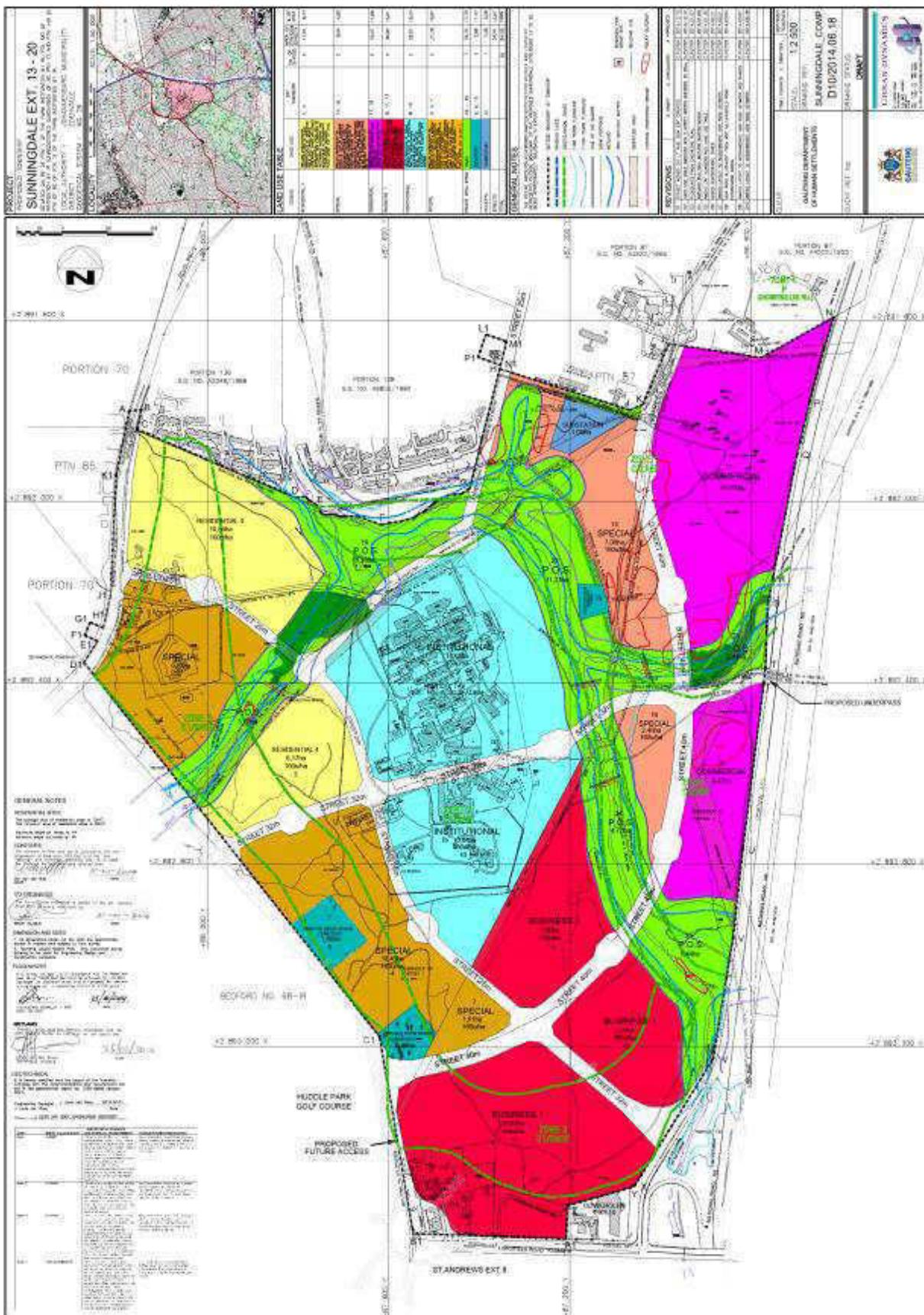


Figure 8: The proposed Layout Concept for Sunningdale Extensions 13 to 20



The following Land Uses are provided in terms of the layout plan:

LINKSFIELD MIXED LAND USE DEVELOPMENT NEW				
Erf No.	Zoning	Primary Rights	Size	No. of Stands
1, 3, 4, 12	Residential 4	Dwelling units, Residential Buildings, Places of Public Worship, Places of Instruction, Retail, Public Open Space, Private Open Space, Public and Private Roads, Municipal and the following uses subservient to the principle residential use: Shops, Places of Refreshment, Offices, Special Buildings, Public Garage only on erven	26.33	4
19, 21	Special	Dwelling Houses, Block Or Blocks Of Flats (At A Maximum Density Of 160u/Ha), Residential Buildings, Institutional Uses, Educational Uses, Shops, Offices, Commercial Purposes, Place Of Public Worship, Place Of Amusement, Public Street, Private Open Space Including such supportive Uses as may be supported by Council. Erf 19 to include Self Storage Units	10.95	2
22, 23	Commercial	Commercial Uses, offices, Motor-related Uses. Erf 23 to include Self Storage Units and Public Garage	23.13	2
10, 16, 17	Business 1	Shops, Offices, Retail and Business Park, Warehouses and Distribution, Business buildings, Offices, Professional room, Places of Amusement, Social Hall, Residential building except on ground floor	21.48	3
13, 15	Institutional	Institutions, Places Of Public Worship, Places Of Instruction, Dwelling Houses, Special Buildings, Social Halls, retail, shops, places of refreshments and Residential Buildings for student type housing, Police Station and Fire Station.	23.94	2
2, 6, 8, 9, 11, 14	Special	Dwelling Houses, Block Or Blocks Of Flats (At A Maximum Density Of 160u/Ha), Residential Buildings, Institutional Uses, Educational Uses, Shops, Offices, Place Of Public Worship, Place Of Amusement, Places of Refreshment, Public Street, Public Garage, Private Open Space Including such supportive Uses as may be supported by Council. Erf 8 to include Public Garage	28.18	6
19-30	Private Open Space	Private Open Space	34.00	7
5, 7, 20	Private Open Space	Cemetery	2.91	3
18	Municipal	Substation	1.09	1
	Public Streets		22.04	
TOTAL			194.05	30

Table 5: Sunningdale Extensions 13 to 20 Land Use Table



8. MOTIVATION

8.1 INTRODUCTION

This section contains a motivation for the proposed development in terms of need and desirability as prescribed in Section 18 of the Town Planning and Townships Ordinance, 1986 (Ordinance 15 of 1986).

A development of this nature and size invariably affects many facets of the physical and socio-economic environment. In addition to this, the fact that the attached composite layout plan (Refer to **Annexure O**) represents a plan created through a multi-disciplinary process of needs determination, environmental scoping and urban design, results in the opportunity to motivate the establishment of Linksfield Mixed Use Inclusionary Development on a number of levels.

An attempt will therefore be made to motivate this development from a range of different viewpoints while keeping with the legislative prescriptions, in motivating the proposed development it in terms of need and desirability. The development principles of *Spatial Planning and Land Use Management Act (SPLUMA)*, Act 16 of 2013 will also be discussed as these influence spatial and land development on local level.

The need and desirability of the proposed development are discussed below.

8.2 NEED

Need refers to something that is essential or a requirement rather than something being desirable. The provision of adequate housing is a basic human right that every South African is entitled to. There is an increasing need for the provision of adequate housing located close to transport, employment and other urban opportunities. This section of the report entails the need for proposed development.

8.2.1 **Mixed Use Development**

The social and economic segregation of South African cities requires developments that are inclusionary and able to create socio economic benefits for local residents. The proposed development will encompass inclusionary and bonded housing, commercial development, retail, offices and convenience shopping centres to create a functional economic node. The proposed development will cater for various income groups and the mixed commercial, retail and residential space will ensure a 24 hour operational economy, with various activities operational throughout the day.

The advantage of a mixed use development creates opportunities for new businesses to thrive as residential activities are incorporated into the development, providing a wider catchment. The impact of retail and office development goes beyond economic production as it also contributes to social well-being, convenience for local residents and is a key driver for recreational and "sense of place", which residents can identify with. Mixed use developments are in general considered more sustainable as they provide abundant land uses that support and complement each other, thus making them more self-reliant.



The activities in the proposed development will be integrated into the bigger regional context and not operate in isolation, increasing competitiveness for the area and integration of existing activities.

8.2.2 Employment and Economic Opportunities

Gauteng Province is in dire need for employment with the Gauteng Employment Growth and Development Strategy (GEGDS)⁴ indicating that although great strides have been made since the end of Apartheid, there remain significant structural challenges to be addressed. The proposed development is estimated to create more than 25 000 jobs during the construction and operational phase, which will bring much needed job creation in the region. This mixed use development will also promote the expansion of SMME's as it will offer maximum exposure to the highway and offer state of the art technology office space. The agglomeration of activities will promote optimal use of existing infrastructure and take advantage of the surrounding road network.

The development of a University (higher education institution) can serve as an economic "anchor" as it can contribute to create jobs, offer training and skills development for local residents which may in turn support local businesses. Universities these days form working relationships with government, businesses and research institutions to create economic opportunities and skills development for local residents, more so the youth.

8.2.3 Inclusionary Housing

The proposed township establishment is in fact a requirement of the Johannesburg Metropolitan Municipality towards its "**Inclusionary Housing Policy**" and is therefore merely implementing that requirement. The growing gap between income and the cost of housing does not affect only lower income households but also households with middle-range incomes that struggle to find affordable housing.

There are a growing number of South African households that are willing and able to buy or rent a non-subsidized house or apartment. However, many of these families simply have nowhere to go as there is little suitable housing stock made available to them in good localities. Many of these families resort to subsidized housing as an alternative residential option thereby creating shortage of subsidized housing supply. A need exists to create inclusionary housing for middle income households who are willing to purchase or rent non-subsidized housing and thereby participate in the financed and bonded housing market.

The proposed Linksfield Mixed Use development proposes to address the need to initiate an Upward Mobility Trend "Gap Housing" which addresses the gap between what middle income families earn and the affordability of housing offered.

"Gap Housing" is therefore aimed at widening the availability of housing stock for the lower income families. This proposed development commits itself to providing opportunities in the "gap housing" market — so named because it addresses the gap between what middle income families earn and what houses they can afford. This will be achieved by bridging the gap between the high and low income housing types.

⁴ Gauteng Employment, Growth and Development Strategy for (2009-2014: 4)



8.2.4 Addressing the Dispersed City through Integrated Development

The challenge of South African dispersed cities puts pressure on engineering services and increases travel time from residential to work places. Gauteng Province as a whole is working towards an integrated city region with mixed use development along transport routes. The Gauteng Spatial Development Framework guides growth towards a spatial structure that addresses the dispersed city through a polycentric model anchored by nodes of different sizes. The framework indicates that these nodes serve dedicated functions appropriate to their position in the metropolitan system, set within strongly configured urban corridors. The proposed development aims to reconnect various nodal activities in the city, by linear corridor development between such nodes in order to enhance the city at a macro scale.

8.2.5 Infill Development along Corridors

The development of the Linksfield site forms part of the densification strategy of the Greater Johannesburg Metropolitan Municipality, where development will be concentrated along well-planned transportation arteries. The Joburg Growth and Development Strategy 2040, focuses on Transit-Oriented Development with mixed use development such as higher density accommodation, supported by office buildings, retail developments and recreation along transport routes. The proposed development will encourage infill development along major routes, including the N3, Modderfontein Road and Club Street transforming settlement patterns by bringing economic opportunities and access to jobs closer to local residents.

8.2.6 Impact on City of Johannesburg BRT Proposal

There is a growing need for compact, liveable and accessible urban areas where residential development is integrated with place of employment with the aim of reducing travel time and carbon emissions. Transit Orientated Development (TOD) is a fast growing trend with the implementation of the BRT system in the City of Johannesburg to integrate mixed land uses along transport routes.

It is the long term vision for the BRT system to link the north-east of the city to be integrated with the Ekurhuleni municipality. The proposed routes that the long term network will service, as per the Strategic Integrated Transport Plan Framework for the City of Joburg, include Ivory Park and Longmeadow using Republic Road and Modderfontein Road (R25). The proposed Linksfield Mixed Use development has the ability to play a key role in integrating local residents with economic opportunities taking advantage of the high volumes of activities along the major route.

8.2.7 City of Johannesburg Corridors of Freedom

The city aims to restructure the dispersed/segregated apartheid cities through linking people to jobs on Transit-oriented development routes known as "Corridors of Freedom". The corridors objectives are to give residents increased freedom of movement as well as economic freedom, making use of transport means such as the BRT Rea Vaya routes.

The concept of Corridors of Freedom as stated by CoJ is well planned transport arteries linked to mixed use development nodes with high density accommodation,



supported by office buildings, retail developments and opportunities for education, leisure and recreation. The proposed development encompasses this very principle as it will take advantage of the future BRT link on Modderfontein Road (R25) and provide a mixed use inclusionary development.

8.2.8 Infrastructure Development

Effective spatial planning requires increased strategic, socio-economic and bulk infrastructure investment that encourages infrastructure-led growth and increase the performance of the economy. To provide energy efficient and coordinated cities optimum utilisation of all resources including land, engineering services, transportation infrastructure, social infrastructure and ecological resources, is required. The proposed development was designed to be one which is compact, and will take advantage of the above principles. The proposed development will also encourage infrastructure upgrades in the area as new bulk services will accompany the development and be integrated into the existing networks. The development of new infrastructure will also assist in maintenance of ageing infrastructure in surrounding neighbourhoods.

8.2.9 Eco-Friendly Technologies

Sustainable development requires the implementation of environmentally friendly infrastructure that is efficient and easily adoptable to the environment. The City of Johannesburg is encouraging use of eco-friendly technologies as seen with the city hosting the C40 Cities Climate Leadership Group Mayors Summit during February 2014. Alternative energy sources such as solar water heating, solar lighting, natural gas will be utilized for the proposed development, reducing the pressure on the City Power supply grid.

The design approach for the proposed development is to have minimal environmental impact of development and its operations. Thus eco-friendly technologies will be used, to respect the ecology and value of natural systems. This will ensure sustainable development and reduce operational cost for the occupants.

8.2.10 Better Utilisation of Land

The land is strategically located and is one of the last remaining publically owned open tracts of land in the city located between the City of Johannesburg and Ekurhuleni Municipality. The land is currently underutilised. The Breaking New Ground policy places emphasis on public owned land to be developed in a strategic manner which can enhance the location of new housing projects. Thus the application for a mixed use inclusionary development will ensure optimum utilisation of the subject property without defeating any of the primary considerations in respect of conservation and environmental issues. The proposed development will contribute towards diversifying land use and economic activities in the sub-region catering for a diverse clientele and attracting investment into the area.

8.2.11 Impact of Development on Surrounding Neighbourhoods

Currently, the majority of the site is vacant and underutilised. The proposed development will make efficient use of the land by creating a variety of land uses and taking advantage of existing major road linkages. The proposed development



introduces both an alternative investment opportunity and strengthening of what clearly has become the most rapidly developing part of Johannesburg.

The Gauteng Province is the fastest growing metropolitan region on the African continent and attracts large commercial and industrial developments which in turn increase the need for adequate housing. The Gauteng Department of Human Settlement faces a challenge of not only providing housing for the low income but the growing middle class, ensuring sustainable human settlements that offer educational, economic and social opportunities for all residents.

The proposed land uses within the development will be complimentary to the existing landscape offering job opportunities to the existing and surrounding residential population, the educational facilities (university and schools) will establish the area as a "knowledge hub" increasing skills in the region. The generation of rates and taxes will contribute to Municipal income regeneration while mitigating challenges faced by the municipality such as job creation, upgrading of infrastructure, SMME growth and social/human development.

8.2.11 *Public Private Partnership (PPP)*

The importance of public private partnerships is emphasised through various policies in the Province such as the Gauteng Employment, Growth and Development strategy, IDP and Gauteng SMME Policy Framework. The investment in public infrastructure is seen an essential part of maintaining economic development within the Province. The IDP indicates that the City needs to partner with the private sector to foster commercial activity and develop formal retail/business activities. The proposed development has the potential to increase SMME Development in the region as it will offer an operational environment for business with state of the art technology and along the N3 highway. The facilities and infrastructure offered by the office and commercial space will allow businesses to compete successfully in the province with other business parks.

From the above it is evident that the proposed development is demand driven and will meet the growing need/demand for sustainable human settlement, integrating housing with social, economic and environmental amenities.

8.3 DESIRABILITY

Whereas need is easily quantified, desirability is often based upon personal opinion and more qualitative aspects. Critical factors that influence existing and new developments are the National, Provincial and Local legislative framework, which is discussed below:

8.3.1 *Legislative Framework*

The legislative framework provides a developmental vision for the city which all new and existing developments should promote. The legislative framework will analyse policies and frameworks on national, provincial and local level supportive of mixed use inclusionary development. The policies influencing and affecting National development and Gauteng Province more so the City of Johannesburg are discussed below:

- **National Development Plan**



The National Development Plan (NDP) offers a long-term perspective for the development of South Africa aimed at eliminating poverty and reducing inequality by 2030. The importance of creating sustainable human settlements is emphasised by the NDP. The key target for human settlements as described by the plan includes⁵:

- More people living closer to their places of work.
- Better quality public transport.
- More jobs in or close to dense urban townships.
- Clear strategy for densification of cities through land use planning and focused strategy on the housing gap.

The proposed Linksfield development will offer various employment opportunities in close proximity to residential activities as the development will be one that has integrated land uses (residential, offices, commercial, retail). The road network within the site linked with the larger public transport route ensures an efficient public transport system benefiting local and surrounding residents. The Linksfield development will also address the issue of providing densification along major routes in a growing region as well as meeting the ever increasing housing gap market.

It can be interpreted that the proposed development will assist in realising the vision of the National Development Plan by creating a development that is compact offering employment opportunities and quality public transport.

▪ **Breaking New Grounds: Comprehensive Plan for Development of Sustainable Human Settlements**

The Breaking New Ground Plan (also referred to as BNG) was published by the National Department of Housing in 2004 to provide guidelines for the development of sustainable human settlements. The policy, BNG, takes a different approach of creating sustainable human settlements as compared to only providing houses. Sustainable human settlements envisioned by BNG is one where inhabitants have adequate access to economic opportunities, mix of safe and secure housing/tenure types, reliable basic services, educational, health, and social services. The Linksfield Mixed Use Inclusionary Development builds upon these very principles and aims to provide a development where one can Live, Work and Play.

The BNG guidelines⁶, relevant to new development and how the proposed Linksfield development will incorporate these guidelines are discussed below:

Residents should live in a safe and secure environment, and have **adequate access** to economic opportunities, a mix of safe and secure housing, and tenure types, reliable and affordable basic services, educational, entertainment and cultural activities, and health, welfare and police services.

The proposed Linksfield will incorporate all of the above mentioned amenities as the development will be a mixed land use inclusionary development. The development will offer a range of housing types, sizes and prices to accommodate financial capability. Apart from the residential activities, the development will also comprise of

⁵ National Planning Commission: National Development Plan (2011:33)

⁶ Breaking New Grounds: Comprehensive Plan for Development of Sustainable Human Settlements 2004.

<http://www.tshwane.gov.za/Services/Housing%20and%20Human%20Settlement/Housing%20Documents/BreakingNewGroundPolicyHousingStrategy.pdf>



offices, business parks, commercial, light industrial, retail, hotels, conference centres, university, schools, recreational spaces and entertainment.

Ensure the development of **compact, mixed land use**, diverse, life-enhancing environments with maximum possibilities for **pedestrian movement and transit** via safe and efficient public transport in cases where motorised means of movement is imperative.

The road network within the proposed development is one that caters to both motorised and non-motorised movements. Pedestrian and cycle networks are also proposed along the roads which accesses the green open spaces to enhance walkability and pedestrian connectivity. The nodes/activities areas within the site will be placed strategically to allow 10 minute walk distance to the development. The proposed development will also take advantage of City of Joburg long term BRT extension towards Modderfontein Road and ensure the road network within the site link with the larger public transport route.

Ensure that low-income housing is provided in **close proximity to areas of opportunity**.

The mixed use inclusionary development will provide all income groups in the development with economic opportunities in close proximity as individuals will have access to retail centres, light industrial along the eastern edge of the site and access the commercial precinct.

Integrate previously excluded groups into the city, and the benefits it offers, and to ensure the development of more **integrated, functional and environmentally sustainable** human settlements, towns and cities. The latter includes densification.

The proposed development aims to be inclusionary on all levels of urban life. The integration of socio economic, gender and racial predispositions lies at the heart of the intervention. The development will be integrated with the greater Johannesburg and Gauteng province making it a functioning sustainable human settlement.

There is a need to move away from a housing-only approach to a more **holistic development of human settlements**, including the provision of social and economic infrastructure.

The proposed development will consist of various residential typologies, offices, business parks, commercial, light industrial, retail, hotels, conference centres, university, schools, recreational spaces and entertainment. It is the mission of the proposed development to be inclusionary of social and economic amenities providing for a truly inclusionary development.

Social housing must be understood to accommodate a **range of housing product** designs to meet spatial and affordability requirements. Social housing products may include Multi-level flat, or apartment options, for higher income groups, incorporating beneficiary mixes to support the principle of integration and cross-subsidisation.

The development will comprise of various residential units with 50% targeted at gap market for families earning below R15 000 per month, providing for a sector that highly requires entry into the housing market. The residential component in the development will also include bonded apartments, marketed and sold in the open market.



- **Gauteng Spatial Development Framework (GSDF) 2011**

Gauteng Spatial Development Framework (GSDF)⁷ aims to achieve an equitable and sustainable urban system and structure the urban form. The GSDF does not replace municipalities SDF but enables the creation of a coherent framework, which forms the basis for future development and decision-making processes (e.g. policy, resources and socioeconomic profiles). The framework aims to achieve the following for the province:

- Functional efficiency (so that individual elements work together as a whole);
- Environmental harmony; (creating development processes and forms that are environmentally sustainable);
- A sense of place (creating a place that is recognisably distinct, strengthens local identity, and simultaneously plays its role within the wider urban system); and
- Socio-economically sustainable (is viable, enabling economic growth and expansion and supports all social activities and the development of its communities).

The proposed Linksfield development will encourage the above mentioned principles as it will take a holistic approach towards delivering a township establishment that is efficient and socio-economically sustainable.

- **The Strategic Integrated Transport Plan (SITP) Framework for the City of Joburg 2013**

The aim of the Johannesburg SITP framework highlights the status quo of the transport system with major developments and shortcoming in the last ten years. The objectives of the framework relevant to proposed development include the long term network expansion of the BRT system to the Ekurhuleni Municipality with the use of Modderfontein Road. The framework also identifies that there is a need to establish more economic opportunities where people live, or create new settlements close to centres of work, thus providing sustainable transport services that are efficient/inclusive and linked to the SA's cities.

One of the strategic thrust of the framework is to improve and expand provision of quality public transport and use of non-motorised transport. The proposed Linksfield development will offer pedestrian and cycle network encouraging a greater use of bicycles, motor-cycles and pedestrian walking routes. All these routes will be connected to nodes within the development. These nodes will be strategically placed to allow 10 minute walking distance to all part of the development. The SITP Framework highlights that an important aspect of "quality public transport" is convenience, and integration between different public transport services (and also non-motorised access), which the proposed Linksfield development will promote.

- **City of Johannesburg Integrated Development Plan (IDP) 2012/16**

The Johannesburg IDP is a long and short term planning tool which provides structure for the development of the municipality in an integrated and coordinated manner. The policy envisions a city that is resilient, sustainable and liveable. This will be achieved through various integrated developmental strategies. One of these is the Spatial Development Frameworks. The spatial development strategies and how the

⁷ Gauteng Spatial Development Framework (2011:49-51)



proposed Linksfield development will encourage these principles are discussed below:

- **Supporting an efficient movement system:** The proposed development will have a road network that encourage efficient movement within the development and connects with the larger region. The development will also cater for multi-modal transportation that supports public transport, pedestrian and cycling infrastructure.
- **Ensuring strong viable nodes:** The Linksfield mixed use development will incorporate various activities ranging from residential, commercial, retail and institutional within close proximity to each other. The various activities within the development will make it efficient and sustainable, thus creating a strong viable mixed use node in the city.
- **Supporting sustainable environmental management:** The natural landscapes will be a fundamental theme in the development as the vast majority of open space in the site will be utilised for recreational activities. Emphasis will be placed on quality public space, pedestrian environment, public parks and protection of biodiversity areas.
- **Initiating and implementing corridor development:** The proposed development is located along the Modderfontein Road and Linksfield Drive which have been classified as Mobility Roads. The proposed Linksfield development will encourage infrastructure development along these corridors.
- **Increased densification of strategic locations:** The Linksfield mixed land use development will have higher densities and clustered activities which will coordinate investment infrastructure and encourage densification in the area. Thus optimizing on infrastructure investment.
- **Facilitating sustainable housing environments in appropriate locations:** The development will offer a variety of housing topologies catering for different income groups and conserve the natural landscape of the site.

From the above, it is clear, that the proposed development is in line with the development strategies aimed at creating a city that is integrated, resilient, sustainable and liveable.



▪ **Regional Spatial Development Framework (RSDF) - Administrative Region E**

The proposed development falls within Region E, Sub Area 28 of the City of Johannesburg. The developmental objectives of the sub area are described below:

SUB AREA 28 (FARM RIETFONTEIN)	
(Dowerglen Extensions, Farm Rietfontein) (Various medical institutions: Edenvale Hospital, National Institute for Virology, Rand Aid Association, Sizwe Tropical Disease Hospital and the South African Institute for medical research)	
Development objectives	
To reinforce this area as an institutional node focusing on the medical field. To promote residential development.	
Interventions	Guidelines
Modderfontien road has been identified as a Mobility Spine	<ul style="list-style-type: none"> ▪ Ensure easy access to the medical facilities. ▪ Provide sufficient public transport, pedestrian pathways in order to improve the accessibility of Edenvale Hospital
Club street, George Avenue, Linksfield Drive have been classified as Mobility Roads.	<ul style="list-style-type: none"> ▪ Limit direct access from these Mobility Roads.
Protect the quality and integrity of the environment.	<ul style="list-style-type: none"> ▪ Protect environmentally sensitive areas within the Sub Area from illegal dumping so that they may form part of the Johannesburg Open Space System.

Table 6: "Region E" RSDF Objectives

The area is a critical region for public health institutions and the remaining vacant land parcels are currently under-utilised. The proposed development will encourage the realization of the above objectives as it will provide support services such as community facilities, educational, retail, commercial, residential activities to enhance economic development in the area. Mixed land uses will further encourage densification along the mobility spines and provide a hierarchy of road networks allowing for ease of access within the site. The development will also ensure a concentration of different land uses for the sub area.

Implications of the Legislative Framework on the Proposed Development

The policies discussed give an indication of legislation that is related to mixed use inclusionary development and the principles that guide development in the City of Johannesburg Metropolitan area.

Based on the legislative framework governing planning in the Gauteng Province, it is clear that the proposed development is consistent with the principles and priorities of the abovementioned policies. Important emphasise is based on restructuring dispersed apartheid cities and working towards creating sustainable, economically functioning human settlements, which the proposed development aims to do.



The emphasis of creating sustainable human settlements is echoed throughout Provincial and Local policies. The proposed development is consistent with the principles and priorities of the above mentioned policies, which stress the importance of restructuring dispersed apartheid cities and working towards creating sustainable human settlements. The Linksfield Mixed Use Inclusionary Development will not only promote the vision and development objectives of the Province but will also assist the Department of Human Settlements achieve its vision of creating sustainable human settlements with improved quality of household life.

8.3.3 MOTIVATION IN TERMS OF THE DEVELOPMENT PRINCIPLES OF THE SPATIAL PLANNING LAND USE MANAGEMENT (SPLUMA) ACT NO. 16 OF 2013

The SPLUMA act intends to provide a uniform framework for spatial planning and land use management in the republic. It seeks to promote consistency and uniformity in procedures and decision-making in spatial planning. The objectives of the Act are:

- Provide for a uniform, effective and comprehensive system of spatial planning and land use management for the Republic;
- Ensure that the system of spatial planning and land use management promotes social and economic inclusion;
- Provide for development principles and norms and standards;
- Provide for the sustainable and efficient use of land;
- Provide for cooperative government and intergovernmental relations amongst the national, provincial and local spheres of government; and
- Redress the imbalances of the past and to ensure that there is equity.

Implications of the Act on the Proposed Development

The application of the SPLUMA principles applies to all organs of state and other authorities responsible for implementation of legislation regulating the use and development of land. The following principles, with relevant sub principles, apply to spatial planning, land development and land use management. These principles are discussed below:

(a) Principle of Spatial Justice, whereby -

- | | |
|-----|---|
| (i) | Past spatial and other development imbalances must be redressed through improved access to and uses of land |
|-----|---|

The Department of Human Settlement has identified this strategically located, inactive piece of land to develop an inclusionary mixed land use development, which will cater for a variety of income groups. The proposed development will offer various housing typologies and inclusionary housing addressing the distorted spatial space in Johannesburg. The development will improve ownership for previously disadvantaged individuals.

The proposal of a mixed use development will provide for a cohesive social and economic environment, meeting basic needs of local residents as well as addressing past spatial imbalance. The proposed development will improve access to housing and employment opportunities for previously excluded/disadvantaged groups,



ensuring a development that is integrated, functional and environmentally sustainable human settlement.

- (ii) Spatial development frameworks and policies at all spheres of government must address the inclusion of persons and areas that were previously excluded, with an emphasis on informal settlements, former homeland areas and areas characterised by widespread poverty and deprivation;

The proposed development will provide for inclusionary housing to those who were not able to own/buy property in competitive residential market. The proposed development is within an urban context. Inclusionary Housing is considered the central theme of the development and the proposed development will promote the above principle by making provision for previously disadvantaged persons to participate in the property market.

(b) Principle of spatial sustainability, whereby spatial planning and land use management systems must -

- (i) Promote land development that is within the fiscal, institutional and administrative means of the Republic

The proposed development is an initiative between the Gauteng Department of Human Settlements in collaboration with the private sector aimed at providing a mixed use development with inclusionary housing. This forms a public private partnership which will ensure a collaborative partnership of managing and administrating the development short and long term.

The proposed development will deliver formal housing with socio-economic facilities attracting investors and financial investment into the area. The proposed development is one that will be financially viable, with input from both the public and private sector. The province and municipal departments together with the private sector will have sufficient capacity to develop and operate the proposed development.

- (ii) Ensure that special consideration is given to the protection of prime and unique agricultural land;

The land partly presents undeveloped / vacant land within an urban setting. Surrounding agricultural areas will not be negatively affected by this proposed township. Furthermore, no natural features like streams will be destroyed by the development to the detriment of rural areas. The proposed development strives for the optimum utilization of this prime/unique piece of land delivering much needed housing and employment opportunities, while increasing the land value.

- (iii) Uphold consistency of land use measures in accordance with environmental management instruments

The proposed development is structured in a manner that is in accordance with the environmental framework of the City of Johannesburg and Gauteng Department of Agriculture and Rural Development (GDARD), which aims at managing the city's scarce environmental resources to achieve sustainable development. The



application has taken into consideration the existing natural environment and how best to develop the land with minimal impact. An Environmental Impact Assessment in accordance with the National Environmental Management Act (NEMA) 1998 (Act No.17 of 1998) is currently being conducted for the site as it will trigger activities listed in terms of Notice No.R544. The study assesses the suitability of the area to be developed and its impact on surrounding environment.

The city of Johannesburg is currently promoting development that is environmentally friendly and sustainable. It is noted that the proposed development will employ eco-friendly technologies and alternative energy sources such as gas, solar water heating and solar energy, reducing the effect that this development will have on its natural environment.

The proposed development is aimed at providing a high quality interface between proposed urban elements and the natural environment in a controlled manner to ensure that these elements benefit from one another. All sensitive environmental features such as wetlands will be protected and the natural landscape will act as the "Green Spine" flowing through the entire development.

The proposed development confine with the City's environmental management framework, as it promotes sustainable development and abides with NEMA regulations. The application will also be circulated to various environmental departments within the city for comments and recommendations.

- (iv) Promote and stimulate the effective and equitable functioning of land markets

The Gauteng Department of Housing analysed the housing demand and supply in the Gauteng province and identified the Rietfontein Farm (state owned land) as a potential catalyst to meet the housing demand. The current housing market in South Africa is distorted with high income groups able to participate in the residential market and middle income groups, earning between R3 500 to R15 000, not able to access either state housing or participate in the private property market. The property market in SA is not functioning effectively as there is a lack of supply for the gap market.

The proposed development will provide for a variety of housing stock catering for the "gap housing" market and high income housing types, addressing the distorted housing market in Gauteng.

- (v) Consider all current and future costs to all parties for the provision of infrastructure and social services in land developments

The application for a provision of mixed use inclusionary development will be circulated to the different government departments, Municipal Owned Entities (MOE) and parastatals (Eskom, Telkom, Transnet etc.) for technical coordination and consultation. The developer will be responsible for providing the necessary infrastructure development or upgrades to the satisfaction of the local authority. The developer will enter into the necessary agreements (e.g. waste management



agreements) with the relevant MOEs and council to ensure long term maintenance of infrastructure.

The occupants will benefit from the use of alternative energy sources adopted in the proposed development, reducing operation cost. The social services such as schools, police station and community centres will be at the inner core of the development allowing for easy access. The maintenance of these social services will also be discussed and developed to the satisfaction of council.

(vi) Promote land development in locations that are sustainable and limit urban sprawl

In many instances, the legacy of Apartheid and planning practices of the past have resulted in sprawling urban areas characterized as being uneconomical and offering one-dimensional opportunities to residents. The proposed development is partly classified as infill development in terms of the Gauteng Spatial Development Framework on vacant land within the urban environment (Provincial Economic Core).

The proposed development therefore will contribute to the re-engineering of the existing urban form, the establishment of a more compact city and also contribute to the optimization of the use of existing infrastructure such as bulk sewer lines, bulk roads and water.

(vii) Result in communities that are viable

The proposed development adopts a holistic approach to providing a well-functioning, sustainable community. The development will offer compact mixed land uses with maximum possibilities for pedestrian movement and transit via safe and efficient public transport. The provision of inclusionary housing in close proximity to areas of economic opportunity will promote the principle of spatial sustainability.

(c) Principle of Efficiency, whereby

(i) Land development optimises the use of existing resources and infrastructure

This principle calls for the optimization of investment already made in terms of existing development of services infrastructure. The proposed development is located in close proximity to existing bulk sewer, bulk water, electrical infrastructure as well as existing road infrastructure. Some basic services are already available on the borders of the site and in surrounding townships and this development will seek to optimize on the infrastructure already provided in the area but will also upgrade the bulk services and infrastructure in the area. The fact that it partly represents infill land development in an urban setting will ensure that the existing resources are optimized.

(d) Principle of spatial resilience, whereby flexibility in spatial plans, policies and land use management systems are accommodated to ensure sustainable livelihoods in communities most likely to suffer the impacts of economic and environmental shocks;

The proposed development is in an urban area context and will cater for both the social and economic need of local residents. Since the proposed development is a



mixed land use development, by its nature, it is therefore not exclusively residential, recreational or commercial but in fact proposes a combination of all.

The development is envisioned as a high quality and multi-faceted living environment including the following land uses:

- Residential Apartments
- Offices & Business Parks
- Convenience Retail
- Entertainment & Restaurants
- Commercial and Light Industrial uses
- Hotels & Conference Facilities
- Show Rooms
- The Hospital Complex
- Retirement Villages & Gymnasium Passive Recreational Space
- Educational Uses including Schools and Tertiary Education, and
- Active and Passive Recreational Space

This clearly provides a diversity of land uses to support the residential land use and thus also provides the community with supportive facilities. Most of the supportive land uses are located in nodes at the intersections of the main arterials through the township.

The township will partly be a formal and new development and should be addressed with the same urgency as existing informal settlements as it will make provision for housing.

(e) Principle of good administration

- (i) All spheres of government ensure an integrated approach to land use and land development that is guided by the spatial planning and land use management systems as embodied in this Act;

The proposed development is an initiative by the Gauteng Department of Human Settlements, thus making inclusionary housing the heartbeat of the development. The development builds upon the principles and legislative framework governing development in the Gauteng Province and City of Johannesburg, such as the:

- National Development Plan
- Breaking New Grounds: Comprehensive Plan for Development of Sustainable Human Settlements
- Gauteng Spatial Development Framework (GSDF) 2011
- The Strategic Integrated Transport Plan (SITP) Framework for the City of Joburg 2013
- City of Johannesburg Integrated Development Plan (IDP) 2012/16
- Regional Spatial Development Framework (RSDF) - Administrative Region E

The above legislations are aimed at promoting human settlements that are integrated, offering employment opportunities to previously disadvantaged individuals in order to address the distorted apartheid cities. The proposed development is in line with the spatial planning and land use management systems of the City of Johannesburg and promotes the development objective of the Gauteng



province. The proposed development is a formal land development based on the establishment of Land Use Rights in terms of existing policies and administrative practices.

- (ii) All government departments must provide their sector inputs and comply with any other prescribed requirements during the preparation or amendment of spatial development frameworks;

The application will be circulated to the relevant government departments, both external and internal department, for comments. A total of 35 copies of the application/motivating memorandum will be submitted to council to ensure timeous circulation of the application to all relevant departments. The departments will receive a period of 60 days (from the date which a copy of the application is submitted/lodged) to comment on the application, in terms of the requirements of Section 69 (6)(iv) of the Town Planning and Township Ordinance (15 of 1986). This will ensure coordination of all technical, social, economic and environmental issues affecting to the development. The inputs and comments received from the different departments will be incorporated in the development.

- (iii) The requirements of any law relating to land development and land use are met timeously;

The application for the township establishment of Sunningdale Extension 13 to 20 is made in terms of Section 96(i) of the Town Planning and Townships Ordinance, 1986 (Ordinance 15 of 1986), as read together with the Edenvale Town Planning Scheme 1980. The Environmental Impact Assessment is conducted in terms of National Environmental Management Act. The application abides with all legislations governing and regulating land development in the Johannesburg Metropolitan.

- (iv) The preparation and amendment of spatial plans, policies, land use schemes as well as procedures for development applications, include transparent processes of public participation that afford all parties the opportunity to provide inputs on matters affecting them; and

Particulars of the application will lie for inspection during normal office hours at the office of the Executive Director: Department of Development Planning and Urban Management, Room 8100, 8th Floor, Block A, Civic Centre, 158 Loveday Street, Braamfontein, 2107, for a period of 28 days from the first day of publication.

- (v) Policies, legislation and procedures must be clearly set in order to inform and empower members of the public.

The above principles call for a transparent and clear public participation process with all parties adhering to allocated timeframes. The public also be given a chance to object, make representations and comment on the development. The proposed development will be advertised in the Bleed, Citizen Newspapers and Gazette, informing the public of the development and relevant contact person to acquire information. Site notices will also be visibly placed around the site, to ensure all members of the public have sufficient resources to make informative decisions.



9. CONCLUSION

It is our opinion that the proposed township establishment of Sunningdale Extensions 13 to 20 will not only benefit the future residents in the area but it will also help urban integration, infill development and assist to achieve the overall development strategies of the City of Johannesburg Metropolitan Municipality.

This application represents an opportunity for this vacant government owned piece of land to be developed to its highest potential at an appropriate scale and in an economically viable way.

We have demonstrated that the proposed development is needed, will be economically viable and desirable on an engineering, town planning and economical level. The approval of this application in terms of the Town Planning and Townships Ordinance, 1986 (Ordinance 15 of 1986) is appropriate.

The report provides background and general information pertaining to the township. It also serves as a motivation in compliance with the General Principles for land development as set out in contemporary spatial planning and development policies. In light of the motivation provided in this report, the application for township establishment is desirable and can be supported based on the following:

- The proposed application complies with the Development Principles set out in **SPATIAL PLANNING LAND USE MANAGEMENT (SPLUMA) ACT NO. 16 OF 2013**.
- The proposed township establishment is aligned with the SDF and RSDF of City of Johannesburg Metropolitan Municipality, Administrative Region E.
- There are no legal or technical impediments to the proposed township establishment.
- Since the proposed development can be defined as an infill development within an established area, bulk services are already in place on / or bordering the property.
- The proposed township establishment can be considered as necessary and desirable from a town planning point of view.
- The proposed township establishment will help to alleviate the current need for housing, which is one of South Africa's highest development priorities.

It can therefore be concluded that this application is desirable and that it will be in the interest of the broader public. The favourable consideration of this township establishment is therefore requested.



Cultural and Historical Report

Annexure Q

**PHASE 1 HERITAGE IMPACT ASSESSMENT FOR THE PROPOSED
ESTABLISHMENT OF A MIXED-USE DEVELOPMENT ON THE REMAINDER
OF PORTION 1 OF THE FARM RIETFONTEIN 61-IR JOHANNESBURG
METROPOLITAN MUNICIPALITY (ALSO REFERRED TO AS THE
PROPOSED LINKSFIELD MIXED-USE DEVELOPMENT)**

	
<p>Archaetnos Archaeologists and Heritage Consultants Dr A.C. van Vollenhoven</p> <p>PO Box 55 GROENKLOOF 0027</p> <p>Mobile: 083 291 6104 E-mail: antony@archaetnos.co.za</p>	<p>Leonie Marais-Botes Heritage Practitioner</p> <p>868 Endeman Street Wonderboom South Pretoria 0084</p> <p>Mobile: 082 576 6253 E-mail: leoniembotes@gmail.com</p>
<p>BA, BA (Hons), DTO, NDM, MA (Archaeology) [UP], MA (Culture History) [US], DPhil (Archaeology) [UP], Man Dip [TUT], DPhil (History)[US], L Akad [SA]</p>	<p>BA (Cultural History and Archaeology) (UP), BA (Hons) Cultural History (UP), Post Grad Dip Museology (UP), Cert Conservation of Traditional Buildings (Univ of Canberra) Post Grad Dip: Heritage (Wits)</p>
<p>Accredited member: SA Society for Cultural History (CH001)</p> <p>Accredited member: ASAPA</p>	<p>Accredited member: SA Society for Cultural History (CH002)</p>

For

BOKAMOSO ENVIRONMENTAL
PO BOX 11375
MAROELANA
0161

February/September 2014

© Copyright
Leonie Marais-Botes Heritage Practitioner/
Archaetnos Archaeologists and Heritage Consultants.
The information contained in this report is the sole intellectual property of Leonie
Marais-Botes Heritage Practitioner/ Archaetnos Archaeologists and Heritage
Consultants. It may only be used for the purposes it was commissioned for by the
client.

DISCLAIMER:

Although all possible care is taken to identify/find all sites of cultural importance
during the initial survey of the study area, the nature of archaeological and
historical sites are as such that it is always possible that hidden or sub-surface
sites could be overlooked during the study. Leonie Marais-Botes Heritage
Practitioner/Archaetnos Archaeologists and Heritage Consultants will not be held
liable for such oversights or for the costs incurred as a result thereof.

ACKNOWLEDGEMENTS

Australia ICOMOS. The Burra Charter.

Bergh, J.S. Geskiedenis Atlas van Suid-Afrika. Die vier Noordelike Provincies. Van Schaik Uitgewers, 1998.

Beyers C.J. (Editor-in-Chief). Dictionary of South African Biography (Vol I – V). Pretoria, 1987.

Coertze, P.J. & Coertze, R.D. Verklarende vakwoordeboek vir Antropologie en Argeologie. Pretoria, 1996.

Collins, T.F.B., Johan Max Mehlliss, M.D. an early Transvaal medical pioneer *in SA MEDIESE TYDSKRIF SPESIALE UITGawe 29 JUNIE 1983*.

Huffman, T.N. A Handbook to the Iron Age: The Archaeology of Pre- Colonial Farming Societies in Southern Africa. University of KwaZulu-Natal Press, 2007

Human Tissues Act (Act 65 of 1983 as amended)

Government Printers. 1: 50 000

National Heritage Legislation (Act 25 of 1999)

National Environmental Management Act (Act 107 of 1998)

Ordinance on Exhumations (no 12 of 1980)

Potgieter, D.J. (editor-in-chief) Standard Encyclopaedia of Southern Africa. London 1971.

Rosenthal E. (Editor) Encyclopaedia of Southern Africa, 1973

The National Archives of South Africa databases.

CONTENTS PAGE

<u>CONTENTS</u>	<u>PAGE</u>
ABOUT THIS REPORT	5
EXECUTIVE SUMMARY	6
1.1 INTRODUCTION	7
1.2 LOCATION OF THE GREATER STUDY AREA	7
1.3 METHOD	8
1.4 PHOTOGRAPHIC RECORD OF THE STUDY AREA	8
1.5 HISTORY OF THE RIETFONTEIN HOSPITAL SITE	19
2. FINDINGS	20
2.1 Pre-Colonial Heritage Sites	20
2.2 Historical Sites	20
2.3 Original Landscape	21
2.4 Intangible Heritage	21
3. CATEGORIES OF HERITAGE VALUE ACT 25 OF 1999	21
3.1 HERITAGE VALUE OF WEIGHED AGAINST GENERAL CULTURAL SIGNIFICANCE CATEGORIES	23
3.2 CATEGORIES INVESTIGATED AS PER NATIONAL HERITAGE LEGISLATION	24
3.3 ASSESSMENT OF SIGNIFICANCE STRUCTURE GROUPS SITUATED IN STUDY AREA	27
4. CONCLUSION AND RECOMMENDATIONS	43
5. THE WAY FORWARD	44

ABOUT THIS REPORT

The heritage report must reflect that consideration has been given to the history and heritage significance of the study area and that the proposed work is in accordance with provincial, national and international heritage best practise standards.

The heritage report must refer to the heritage resources currently in the study area.

The opinion of an independent heritage consultant is required to evaluate the proposed work and whether it is acceptable in terms of international heritage best practice.

The National Heritage Resources Act (Act 25 of 1999) is the guideline document for a report of this nature.

Leonie Marais-Botes Heritage Practitioner/ Archaetnos Archaeologists and Heritage Consultants was appointed by Bokamoso Environmental to prepare a Phase 1 Heritage Impact Assessment (HIA) for the proposed mixed-use development on the Remainder of Portion 1 of the Farm Rietfontein 61-IR.

This report provides an overview of the history of the site and an analysis of the cultural significance of the site with special reference to the existing Rietfontein Hospital for Tropical Diseases (currently called Sizwe Hospital).

EXECUTIVE SUMMARY

The Gauteng Department of Local Government and Housing (Human Settlements) in collaboration with private partners proposes the establishment of a mixed use township encompassing Residential, Commercial, Light Industrial, Educational, Community, Retail, Offices and Mixed Use on the site earmarked for development. The project is called the proposed Linksfield Mixed-Use Development.

Graves and buildings older than sixty years are present in the area earmarked for development.

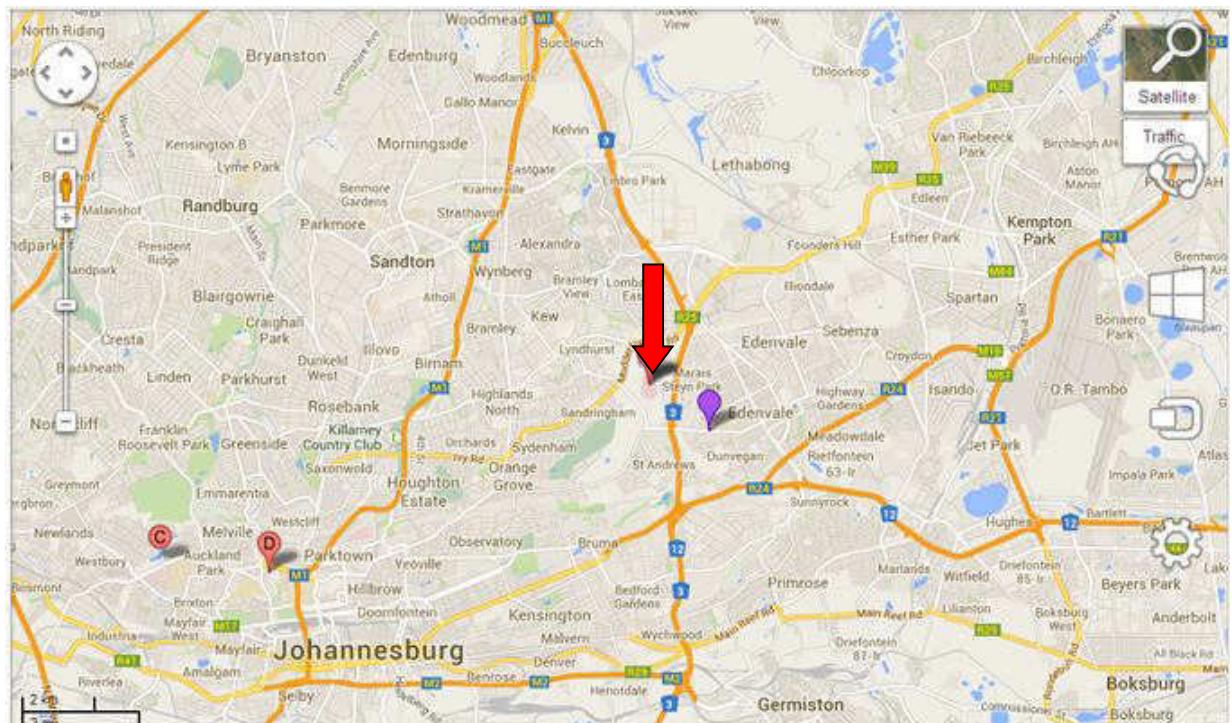
This project may impact on any types and ranges of heritage resources that are outlined in Section 3 of the National Heritage Resources Act (Act 25 of 1999) subsequently a Phase 1 Heritage Impact Assessment was commissioned by Bokamoso Environmental and conducted by Leonie Marais-Botes (Heritage Practitioner)/Archaetnos Archaeologists and Heritage Consultants

1.1 INTRODUCTION

The proposed Linksfield Mixed-Use Development aims at creating an integrated living environment and distinct urban character defined by a mixed use approach to land use and building typology. The concept seeks to achieve high quality urban environment providing spaces to live, work and play. The approach is in line with the urban densification strategy and will provide a mixed-use node connecting with other polycentric nodes within the city.

The site earmarked for development comprise of 158 hectares of prime estate surrounded by Sandringham, Glenhazel, Sunningdale, Lyndhurst, Corlett Gardens, Rembrandt Park, Edenvale Ext 1, Marais Steyn Park, Dowerglen, Senderwood and the golfing ground, Huddle Park. Approximately 15 hectares of the site is occupied by the Sizwe Hospital. The N3 Highway and the main arterial connector routes around the development create an edge condition that defines the boundaries of the proposed Linksfield Mixed-Use Development.

1.2 SITE LOCATION



1.3 METHOD

The objective of this study was to gain an overall understanding of the heritage sensitivities of the area and indicate how they may be impacted on through development activities.

In order to establish heritage significance the following method was followed:

- Investigation of primary resources (archival information)
- Investigation of secondary resources (literature, maps and drawings)
- Physical evidence (site investigation)
- Determining Heritage Significance

1.4 PHOTOGRAPHIC RECORD OF STUDY AREA

1.4.1 Site in general

Photograph taken to the east



Photograph taken to the south



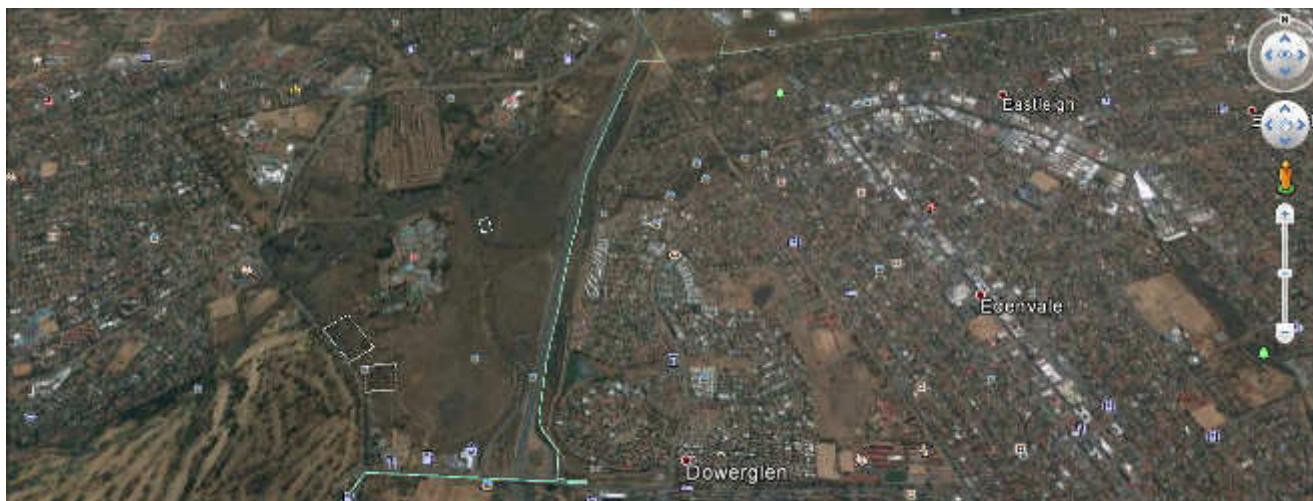
Photograph taken towards the west



Photograph taken towards the south



1.4.2 Grave sites situated in the study area



Numerous graves are situated near Club Street, south west section of the site earmarked for development.

It appears that there are two cemeteries.

- 1. The Black and Coloured**
- 2. European (White)**

The Black/Coloured graves face east and the European (White) graves slightly north east which is consistent with the 1952 aerial photograph.











Grave site east of the hospital complex





1.4.3 Structures situated opposite Sandringham SA Police Services Station



1.4.4 Rietfontein Tropical Disease Hospital Structures and Graves

Original Wards (Corrugated Iron), Mehliss Residence and Cow Shed (cc. 1895-1910)





Second layer structures cc late 1920's – 1930's (including staff accommodation)



Third layer structures cc 1970's



There is also a very modern building to the south of the site (from the very recent past) (4th layer)



Graves situated inside Rietfontein Hospital grounds



1.5 HISTORY OF THE RIETFONTEIN HOSPITAL SITE

The development history of the Rietfontein Hospital is closely linked to the life and work of John Max Mehliss (MD). John Max Mehliss was born in Grahamstown in 1868. He was educated at Dale College in King William's Town, where he proved to be an outstanding student and athlete. He studied medicine in Germany at the universities of München and Gottingen.

Returning from Germany about 1893 John rejoined his family in the very new mining camp of Johannesburg. It is believed that Dr Mehliss was in private practice on the Witwatersrand for some years. His first official appointment was as District Surgeon at Krugersdorp and in 1895 he was put in charge of the smallpox lazaret established on the Farm Rietfontein, purchased by the government for that purpose the previous year. He became full-time medical superintendent in 1896, when he probably moved into the official residence.

Rietfontein Hospital was originally established on its present site because it was 'a day's march from Johannesburg' and a safe distance for such an infectious disease as smallpox. This made it convenient place for other unpleasant diseases too. In the early months of 1898, when leprosy was frequently being diagnosed in rural Blacks recruited for the mines, it was decided on the advice of Dr Mehliss to build a leper asylum. In this way began the group of institutions known as the 'Rietfontein Hospitals'.

Dr Mehliss participated in the Anglo Boer War (1899-1902) on Boer side and after the war married an Englishwoman called Henrietta Barrett. They had five children, Henrietta died during the 1918 influenza epidemic.

As a student in Germany Mehliss worked with Ehrlich on the development of salvarson or '606'. That was considered to be a wonder drug for the treatment of syphilis. He applied for a licence to import the above and with salvarson the fame of Rietfontein spread.

In 1905 a 27- year- old missionary lady arrived at Rietfontein on a battered bicycle and sought leave to hold a service in the hospital. Permission was given and until 1914 Theodora Williams visited Rietfontein two or three times a year. Theodora Williams and Henrietta became great friends.

At the outbreak of World War I Theodora returned to Europe and served as a nurse in France and later in Russia. Back in England early in 1919 she was wondering what to do next when a telegram arrived from Johannesburg: "Marry me without delay, Max". He met her in Cape Town and they were married in Claremont.

The couple with the children from the previous marriage, lived in the "big house" (Mehliss Residence).

John Max Mehliss died at the age 59 years in the Johannesburg General Hospital shortly before he was to retire¹.

2. FINDINGS

2.1 PRE-COLONIAL HERITAGE SITES

Possibilities: Greater study area taken into account.

Stone Age

The Stone Age is the period in human history when stone material was mainly used to produce tools². In South Africa the Stone Age can be divided in three periods³:

- Early Stone Age 2 000 000 – 150 000 years ago
- Middle Stone Age 150 000 – 30 000 years ago
- Late Stone Age 40 000 years ago - +/- 1850 AD
-

Iron Age

The Iron Age is the period in human history when metal was mainly used to produce artefacts⁴. In South Africa the Iron Age can be divided in three periods;

- Early Iron Age 250-900 AD
- Middle Iron Age 900-1300 AD
- Late Iron Age 1300-1840 AD⁵

There are no pre-colonial heritage sites evident in the study area. This can be attributed to the extensive farming and infra-structure development activities in the study area.

2.2 HISTORICAL PERIOD HERITAGE SITES

Possibilities: Greater study area taken into account.

- Pioneer sites;
- Sites associated with early mining;
- Structures older than 60 years;
- Graves (Graves younger than 60 years, graves older than 60 years, but younger than 100 years, graves older than 100 years, graves of victims of conflict or of individuals of royal descent).

¹ T.F.B. Collins, Johan Max Mehliss, M.D. and early Transvaal Medical pioneer in SA MEDIESE TYDSKRIF SPESIALE UITGawe 23 JUNIE 1983.

² P. J. Coertze & R.D. Coertze, Verklarende vakwoordeboek vir Antropologie en Argeologie.

³ S.A. Korsman & A. Meyer, Die Steentydperk en rotskuns in J.S. Bergh (red) Geskiedenisatlas van Suid-Afrika. Die vier noordelike provinsies.

⁴ P.J. Coertze & R.D. Coertze, Verklarende vakwoordeboek vir Antropologie en Argeologie.

⁵ M.M. van der Ryst & A Meyer. Die Ystertydperk in J.S. Bergh (red) Geskiedenisatlas van Suid-Afrika. Die vier noordelike provinsies and T.N Huffman, A Handbook to the Iron Age: The Archaeology of Pre-Colonial Farming Societies in Southern Africa.

There are structures and graves older than 60 years situated in the study area.

2.3 ORIGINAL LANDSCAPE

Most of the original landscape did not survive the urbanisation process.

2.4 INTANGIBLE HERITAGE

Like in many townships and suburbs the intangible heritage of the greater study area is found in the stories told by past and present residents.

3. CATEGORIES OF HERITAGE VALUE (ACT 25 OF 1999)

The National Heritage Resources Act (Act 25 of 1999) identifies the following categories of value under section 3(1) and (2) of the Act under the heading “National Estate”:

- “3 (1) For the purpose of this Act, those heritage resources of South Africa which are of cultural significance or other special value for the present community and for future generations must be considered part of the national estate and fall within the sphere of operations of heritage resources authorities.
- (2) Without limiting the generality of subsection (1), the national estate may include-
- (a) places, buildings, structures and equipment of cultural significance;
 - (b) places which oral traditions are attached or which are associated with living heritage;
 - (c) historical settlements and townscapes;
 - (d) landscapes and natural features of cultural significance;
 - (e) geological sites of scientific or cultural importance;
 - (f) archaeological and palaeontological sites;
 - (g) graves and burial grounds, including-
 - (i) ancestral graves;
 - (ii) royal graves and graves of traditional leaders;

- (iii) graves of victims of conflict;
 - (iv) graves of individuals designated by the Minister by notice in the Gazette
 - (v) historical graves and cemeteries; and
 - (vi) other human remains which are not covered in terms of the Human Tissue Act, 1983 (Act No. 65 of 1983);
- (h) sites of significance relating to the history in South Africa;
- (i) movable objects, including-
- (i) objects recovered from the soil or waters of South Africa including archaeological and palaeontological objects and material, meteorites and rare geological specimens;
 - (ii) objects to which oral traditions are attached or which are associated with living heritage;
 - (iii) ethnographic art and objects;
 - (iv) military objects
 - (v) objects of decorative or fine art;
 - (vi) objects of scientific or technological interests; and
 - (vii) books, records, documents, photographic positives and negatives, graphic, film or video material or sound recordings, excluding those that are public records as defined in section I (xiv) of the National Archives of South Africa Act, 1996 (Act No. 43 of 1996).
- (3) Without limiting the generality of the subsections (1) and (2), a place or object is to be considered part of the national estate if it has cultural significance or other special value because of-
- (a) Its importance in the community, or pattern of South Africa's history;
 - (b) Its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
 - (c) Its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
 - (d) Its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural objects;

- (e) Its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
- (f) Its importance in demonstrating a high degree of creative or technical achievement at a particular period;
- (g) Its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
- (h) Its strong or special association with the life and work of a person, group or organisation of importance in the history of South Africa; and
- (i) Sites of significance relating to the history of slavery in South Africa.”

3.1 HERITAGE VALUE OF WEIGHED AGAINST GENERAL CULTURAL SIGNIFICANCE CATEGORIES

3.1.1 Spiritual value

During the site visit/field work no indication of any spiritual activity was observed on/near the proposed site. Thus no sites of spiritual value will be impacted on by the proposed project.

3.1.2 Scientific value

The work of Dr Mehliss and successors can be regarded of scientific value.

3.1.3 Historical value

Historical value associated with the proposed site was found in primary and secondary sources.

3.1.4 Aesthetic value

No structures with exceptional aesthetic value are situated in the study area.

3.1.5 Social value

Social value is attributed to sites that are used by the community for recreation and formal and informal meetings regarding matters that are important to the community. These sites include parks, community halls, sport fields etc. Visually none of the above is evident in the study area. These sites include parks, community halls, sport fields etc. Visually none of the above is evident in the study area.

3.2 SPECIFIC CATEGORIES INVESTIGATED AS PER SECTION 3 (1) AND (2) OF THE NATIONAL HERITAGE LEGISLATION (ACT 25 OF 1999)

3.2.1 Does the site/s provide the context for a wider number of places, buildings, structures and equipment of cultural significance?

The study area does provide context for a wider number of places, buildings, structures and equipment of cultural significance. These structures include the Rietfontein (Sizwe) Hospital for Tropical Diseases as well as the SA Police Services (SAPS) Station and SAPS staff accommodation.

3.2.2 Does the site/s contain places to which oral traditions are attached or which are associated with living heritage?

Places to which oral traditions are attached or associated with living heritage are usually find in conjunction with traditional settlements and villages which still practises age old traditions. None of these are evident near or on the proposed site.

3.2.3 Does the site/s contain historical settlements?

No historical settlements are located on or near the proposed site.

3.2.4 Does the site/s contain landscapes and natural features of cultural significance?

The site does not contain landscapes and natural features of cultural significance.

3.2.5 Does the site/s contain geological sites of cultural importance?

Geological sites of cultural importance include meteorite sites (Tswaing Crater and Vredefort Dome), fossil sites (Karoo and Krugersdorp area), important mountain ranges or ridges (Magaliesburg, Drakensberg etc.). The proposed site is not located in an area known for sites of this importance.

3.2.6 Does the site/s contain a wide range of archaeological sites?

The site does not contain archaeological sites.

The possibility of sub-surface findings always exists and should be taken into consideration in the Environmental Management Plan.

If sub-surface archaeological material is discovered work must stop and a heritage practitioner preferably an archaeologist contacted to assess the find and make recommendations.

3.2.7 Does the site/s contain any marked graves and burial grounds?

The site earmarked for development contains 4 known grave sites. Three with multiple graves, the other with only three graves (one a double grave). The graves that could be identified in the south western cemeteries are listed in the table below.

Padi died 1937	S 26° 08' 31.2" E028° 07' 20.0"
Cement Cross	S 26° 08' 30.5" E028° 07' 20.5"
"Here Rest"	S 26° 08' 32.0" E028° 07' 19.6"
Thomas Miobe died 1923	S 26° 08' 32.9" E028° 07' 19.7"
Marked, no name	S 26° 08' 32.7" E028° 07' 21.1"
Sarah Selepe died 1943	S 26° 08' 32.2" E028° 07' 22.0"
Elzam Mlangini	S 26° 08' 32.1" E028° 07' 22.2"
Aslitta Sithole died 1945	S 26° 08' 31.8" E028° 07' 27.3"
Petros Qwabe died 1945	S 26° 08' 31.8" E028° 07' 27.3"
Ngezi	S 26° 08' 32.3" E028° 07' 22.5"
Jaikie Pietersen died 1949	S 26° 08' 33.5" E028° 07' 22.3"
John Pietersen died 1915	S 26° 08' 34.2" E028° 07' 22.4"
Catherine Molepe	S 26° 08' 35.8" E028° 07' 24.2"
Albert Hirsch	S 26° 08' 40.6" E028° 07' 27.9"
Replacement marker numbered 965 for Frederick Mehliss (1930) and Caroline Mehliss (1908)	S 26° 08' 40.9" E028° 07' 27.9"
Sidney James Sandford died 1921	S 26° 08' 40.8" E028° 07' 27.8"
Gideon J. van der Merwe died 1912	S 26° 08' 41.3" E028° 07' 27.0"
Helena Johanna van der Merwe died 1938	S 26° 08' 42.0" E028° 07' 27.0"
Guthrie 1945	S 26° 08' 42.5" E028° 07' 27.0"
Three graves together of Kotzé (Catherina Elizabeth), Jean? And Human cc1950's	S 26° 08' 42.8" E028° 07' 27.5"

Graves situated in the hospital area (exhumed and reburied 1995 with centenary)

Graves at hospital		
Grave of Jane Willis	26°08' 39, 96"	28°07' 29, 16"
Grave of Corrie Thomson	26°08' 40, 32"	28° 07' 27,90"
Grave of Frederick and Caroline Mehliss	26°08' 40.32"	28°07' 27, 90"

The possibility of graves not visible to the human eye always exists and this should be taken into consideration in the Environmental Management Plan.

It is important to note that all graves and cemeteries are of high significance and are protected by various laws. Legislation with regard to graves includes the National Heritage Resources Act (Act 25 of 1999) whenever graves are 60 years and older. Other legislation with regard to graves includes those when graves are exhumed and relocated, namely the Ordinance on Exhumations (no 12 of 1980) and the Human Tissues Act (Act 65 of 1983 as amended).

If sub-surface graves are discovered work should stop and a professional preferably an archaeologist contacted to assess the age of the grave/graves and to advise on the way forward.

3.2.8 Does the site/s contain aspects that relate to the history of slavery?

This is not an area associated with the history of slavery like the Western Cape Province.

3.2.9 Can the place be considered as a place that is important to the community or in the pattern of South African history?

In secondary sources the proposed site is described as important to the community because of the involvement of the Rietfontein (Sizwe) Hospital for Tropical Diseases in the care of mainly the underprivileged⁶.

3.2.10 Does the site/s embody the quality of a place possessing uncommon or rare endangered aspects of South Africa's natural and cultural heritage?

The proposed site does not possess uncommon, rare or endangered aspects of South Africa's natural and cultural heritage. These sites are usually regarded as Grade 1 or World Heritage Sites.

3.2.11 Does the site/s demonstrate the principal characteristics of South Africa's natural or cultural places?

The proposed site does not demonstrate the principal characteristics of South Africa's natural or cultural places. These characteristics are usually associated with aesthetic significance.

3.2.12 Does the site/s exhibit particular aesthetic characteristics valued by the community or cultural groups?

This part of the greater study area does not exhibit particular aesthetic characteristics valued by the community or cultural groups.

3.2.13 Does the site/s contain elements, which are important in demonstrating a high degree of creative technical achievement?

The site does not contain elements which are important in demonstrating a high degree of creative technical achievement. Reason being none of the above evident on site.

3.2.14 Does the site/s have strong and special associations with particular communities and cultural groups for social, cultural and spiritual reasons?

It does not appear that the proposed site have a strong or special association with particular communities and cultural groups for social, cultural and spiritual reasons, this may be contradicted during the public participation process, but from primary and secondary sources no information in this regard could be obtained.

⁶T.F.B. Collins, Johan Max Mehliss, M.D. and early Transvaal Medical pioneer *in SA MEDIESE TYDSKRIF SPESIALE UITGawe 23 JUNIE 1983.*

3.2.15 Does the site/s have a strong and special association with the life or work of a person, group or organisation?

Yes the site do have a strong a special association with the life and work of Dr John Max Mehliss, the first medical practitioner at Rietvlei (Sizwe) Hospital⁷.

3.3 ASSESSMENT OF SIGNIFICANCE OF STRUCTURE GROUPS SITUATED IN STUDY AREA

Original wards, cowshed and Mehliss Residence

Evaluation Historical Significance of above

Historical Significance	No/Yes/ Some	Representative-ness	No/Yes/ Some	Rarity	No/Yes/ Some
Shows evidence of significant human occupation or activity	No	Has the principal characteristics of an important class or group of items	No	Provides evidence of a defunct custom, way of life or process	No
Is associated with a significant activity, event, historical phase or person	Yes	Has attributes typical of a particular way of life, philosophy, custom, process, design, technique or activity	No	Demonstrates a process, custom or other human activity that is in danger of being lost	No
Maintains or shows the continuity of a historical process or activity	Yes	Is a significant variation to a class of items	No	Is a scarce example of a particular style, custom or activity	No
		Is part of a group which collectively illustrates a representative type	No	Shows unusually accurate evidence of significant human activity	No
		Is outstanding because of its setting, condition or size	No	Is the only example of its type	No

⁷ T.F.B. Collins, Johan Max mehliss, M.D. and early Transvaal Medical pioneer in SA MEDIESE TYDSKRIF SPESIALE UITGawe 23 JUNIE 1983.

Evaluation of Aesthetic Significance of above

Aesthetic Significance	No/Yes/ Some	Representativeness	No/Yes/ Some	Rarity	No/Yes/ Some
Shows or is associated with creative, or technical innovation or achievement	No	Is a fine example of its type	No	Provides evidence of a defunct custom, way of life or process	No
Is the inspiration for a creative or technical innovation or achievement	No	Has attributes typical of a significant process, design or technique	No	Demonstrates designs or techniques of exceptional interest	No
Is aesthetically distinctive	No	Is a significant variation to a class of items	No	Is a scarce example of a particular style, custom or activity	No
Has landmark qualities	No	Is part of a group which collectively illustrates a representative type	No	Shows unusually accurate evidence of significant human activity	No
Exemplifies a particular taste, style or technology	No	Is outstanding because of its setting, condition or size	No	Is the only example of its type	No

Evaluation of Technical/Research Significance of the above structures

Technical/Research Significance	No/Yes/ Some	Representative-ness	No/Yes/ Some	Rarity	No/Yes/ Some
Is yielding, or has the potential to yield new or further substantial scientific, historical, cultural, technical and/or archaeological information	No	Is a fine example of its type	No	Provides evidence of a defunct custom, way of life or process	No
Is an important benchmark or reference site or type	No	Has attributes typical of a particular way of life, philosophy, custom, process, design, technique or activity	No	Demonstrates designs or techniques of exceptional interest	No
Provides evidence of past technologies or cultures or human behaviour patterns that is unavailable elsewhere	No	Is a significant variation to a class of items	No	Demonstrates a process, custom, or other human activity that is in danger of being lost	No
		Is part of a group which collectively illustrates a significant type	No	Is a scarce example of a particular style, custom or activity	No
		Is outstanding because of its setting, condition or size	No	Shows unusual accurate evidence of a significant human activity	No
				Is the only example of its type	No

Social Significance of the above structures

Social Significance	No/Yes/ Some	Representativeness	No/Yes/ Some	Rarity	No/Yes/ Some
Is important for its associations with an identifiable group	No	Has the principal characteristics of an important class or group of items valued by the community	No	Is a scarce example of a particular style, custom or activity esteemed by the community	No
Is crucial to a community's sense of place	No	Is a seminal or optimal example of a class of items valued by the community	No	Shows rare evidence of a significant human activity important to the community	No
		Is outstanding because of the integrity of the esteem in which it is held	No		

Second Layer Structures cc. late 1920's, early 1930's

Evaluation Historical Significance of above structures

Historical Significance	No/Yes/Some	Representativeness	No/Yes/Some	Rarity	No/Yes/Some
Shows evidence of significant human occupation or activity	No	Has the principal characteristics of an important class or group of items	No	Provides evidence of a defunct custom, way of life or process	No
Is associated with a significant activity, event, historical phase or person	No	Has attributes typical of a particular way of life, philosophy, custom, process, design, technique or activity	No	Demonstrates a process, custom or other human activity that is in danger of being lost	No
Maintains or shows the continuity of a historical process or activity	No	Is a significant variation to a class of items	No	Is a scarce example of a particular style, custom or activity	No
		Is part of a group which collectively illustrates a representative type	No	Shows unusually accurate evidence of significant human activity	No
		Is outstanding because of its setting, condition or size	No	Is the only example of its type	No

Evaluation Aesthetic Significance of the above structures

Aesthetic Significance	No/Yes/Some	Representative-ness	No/Yes/Some	Rarity	No/Yes/Some
Shows or is associated with creative, or technical innovation or achievement	No	Is a fine example of its type	No	Provides evidence of a defunct custom, way of life or process	No
Is the inspiration for a creative or technical innovation or achievement	No	Has attributes typical of a significant process, design or technique	No	Demonstrates designs or techniques of exceptional interest	No
Is aesthetically distinctive	No	Is a significant variation to a class of items	No	Is a scarce example of a particular style, custom or activity	No
Has landmark qualities	No	Is part of a group which collectively illustrates a representative type	No	Shows unusually accurate evidence of significant human activity	No
Exemplifies a particular taste, style or technology	No	Is outstanding because of its setting, condition or size	No	Is the only example of its type	No

Evaluation Technical/Research Significance of the above structures

Technical/Research Significance	No/Yes/Some	Representativeness	No/Yes/Some	Rarity	No/Yes/Some
Is yielding, or has the potential to yield new or further substantial scientific, historical, cultural, technical and/or archaeological information	No	Is a fine example of its type	No	Provides evidence of a defunct custom, way of life or process	No
Is an important benchmark or reference site or type	No	Has attributes typical of a particular way of life, philosophy, custom, process, design, technique or activity	No	Demonstrates designs or techniques of exceptional interest	No
Provides evidence of past technologies or cultures or human behaviour patterns that is unavailable elsewhere	No	Is a significant variation to a class of items	No	Demonstrates a process, custom, or other human activity that is in danger of being lost	No
		Is part of a group which collectively illustrates a significant type	No	Is a scarce example of a particular style, custom or activity	No
		Is outstanding because of its setting, condition or size	No	Shows unusual accurate evidence of a significant human activity	No
				Is the only example of its type	No

Evaluation of the social significance of the above structures

Social Significance	No/Yes/ Some	Representativeness	No/Yes/ Some	Rarity	No/Yes/ Some
Is important for its associations with an identifiable group	No	Has the principal characteristics of an important class or group of items valued by the community	No	Is a scarce example of a particular style, custom or activity esteemed by the community	No
Is crucial to a community's sense of place	No	Is a seminal or optimal example of a class of items valued by the community	No	Shows rare evidence of a significant human activity important to the community	No
		Is outstanding because of the integrity of the esteem in which it is held	No		

Third layer structures cc. 1970's

Evaluation Historical Significance of the above structures

Historical Significance	No/Yes/ Some	Representative-ness	No/Yes/ Some	Rarity	No/Yes/ Some
Shows evidence of significant human occupation or activity	No	Has the principal characteristics of an important class or group of items	No	Provides evidence of a defunct custom, way of life or process	No
Is associated with a significant activity, event, historical phase or person	No	Has attributes typical of a particular way of life, philosophy, custom, process, design, technique or activity	No	Demonstrates a process, custom or other human activity that is in danger of being lost	No
Maintains or shows the continuity of a historical process or activity	No	Is a significant variation to a class of items	No	Is a scarce example of a particular style, custom or activity	No
		Is part of a group which collectively illustrates a representative type	No	Shows unusually accurate evidence of significant human activity	No
		Is outstanding because of its setting, condition or size	No	Is the only example of its type	No

Evaluation Aesthetic Significance of the above structures

Aesthetic Significance	No/Yes/Some	Representative-ness	No/Yes/Some	Rarity	No/Yes/Some
Shows or is associated with creative, or technical innovation or achievement	No	Is a fine example of its type	No	Provides evidence of a defunct custom, way of life or process	No
Is the inspiration for a creative or technical innovation or achievement	No	Has attributes typical of a significant process, design or technique	No	Demonstrates designs or techniques of exceptional interest	No
Is aesthetically distinctive	No	Is a significant variation to a class of items	No	Is a scarce example of a particular style, custom or activity	No
Has landmark qualities	No	Is part of a group which collectively illustrates a representative type	No	Shows unusually accurate evidence of significant human activity	No
Exemplifies a particular taste, style or technology	No	Is outstanding because of its setting, condition or size	No	Is the only example of its type	No

Evaluation Technical/Research Significance of the above structures

Technical/Research Significance	No/Yes/Some	Representativeness	No/Yes/Some	Rarity	No/Yes/Some
Is yielding, or has the potential to yield new or further substantial scientific, historical, cultural, technical and/or archaeological information	No	Is a fine example of its type	No	Provides evidence of a defunct custom, way of life or process	No
Is an important benchmark or reference site or type	No	Has attributes typical of a particular way of life, philosophy, custom, process, design, technique or activity	No	Demonstrates designs or techniques of exceptional interest	No
Provides evidence of past technologies or cultures or human behaviour patterns that is unavailable elsewhere	No	Is a significant variation to a class of items	No	Demonstrates a process, custom, or other human activity that is in danger of being lost	No
		Is part of a group which collectively illustrates a significant type	No	Is a scarce example of a particular style, custom or activity	No
		Is outstanding because of its setting, condition or size	No	Shows unusual accurate evidence of a significant human activity	No
				Is the only example of its type	No

Evaluation of the social significance of the above structures

Social Significance	No/Yes/ Some	Representativeness	No/Yes/ Some	Rarity	No/Yes/ Some
Is important for its associations with an identifiable group	No	Has the principal characteristics of an important class or group of items valued by the community	No	Is a scarce example of a particular style, custom or activity esteemed by the community	No
Is crucial to a community's sense of place	No	Is a seminal or optimal example of a class of items valued by the community	No	Shows rare evidence of a significant human activity important to the community	No
		Is outstanding because of the integrity of the esteem in which it is held	No		

Structures opposite Sandringham Police Station

Evaluation Historical Significance of the above structures

Historical Significance	No/Yes/ Some	Representative-ness	No/Yes/ Some	Rarity	No/Yes/ Some
Shows evidence of significant human occupation or activity	No	Has the principal characteristics of an important class or group of items	No	Provides evidence of a defunct custom, way of life or process	No
Is associated with a significant activity, event, historical phase or person	No	Has attributes typical of a particular way of life, philosophy, custom, process, design, technique or activity	No	Demonstrates a process, custom or other human activity that is in danger of being lost	No
Maintains or shows the continuity of a historical process or activity	No	Is a significant variation to a class of items	No	Is a scarce example of a particular style, custom or activity	No
		Is part of a group which collectively illustrates a representative type	No	Shows unusually accurate evidence of significant human activity	No
		Is outstanding because of its setting, condition or size	No	Is the only example of its type	No

Evaluation Aesthetic Significance of the above structures

Aesthetic Significance	No/Yes/Some	Representative-ness	No/Yes/Some	Rarity	No/Yes/Some
Shows or is associated with creative, or technical innovation or achievement	No	Is a fine example of its type	No	Provides evidence of a defunct custom, way of life or process	No
Is the inspiration for a creative or technical innovation or achievement	No	Has attributes typical of a significant process, design or technique	No	Demonstrates designs or techniques of exceptional interest	No
Is aesthetically distinctive	No	Is a significant variation to a class of items	No	Is a scarce example of a particular style, custom or activity	No
Has landmark qualities	No	Is part of a group which collectively illustrates a representative type	No	Shows unusually accurate evidence of significant human activity	No
Exemplifies a particular taste, style or technology	No	Is outstanding because of its setting, condition or size	No	Is the only example of its type	No

Evaluation Technical/Research Significance of the above structures

Technical/Research Significance	No/Yes/Some	Representativeness	No/Yes/Some	Rarity	No/Yes/Some
Is yielding, or has the potential to yield new or further substantial scientific, historical, cultural, technical and/or archaeological information	No	Is a fine example of its type	No	Provides evidence of a defunct custom, way of life or process	No
Is an important benchmark or reference site or type	No	Has attributes typical of a particular way of life, philosophy, custom, process, design, technique or activity	No	Demonstrates designs or techniques of exceptional interest	No
Provides evidence of past technologies or cultures or human behaviour patterns that is unavailable elsewhere	No	Is a significant variation to a class of items	No	Demonstrates a process, custom, or other human activity that is in danger of being lost	No
		Is part of a group which collectively illustrates a significant type	No	Is a scarce example of a particular style, custom or activity	No
		Is outstanding because of its setting, condition or size	No	Shows unusual accurate evidence of a significant human activity	No
				Is the only example of its type	No

Evaluation of the social significance of the above structures

Social Significance	No/Yes/ Some	Representativeness	No/Yes/ Some	Rarity	No/Yes/ Some
Is important for its associations with an identifiable group	No	Has the principal characteristics of an important class or group of items valued by the community	No	Is a scarce example of a particular style, custom or activity esteemed by the community	No
Is crucial to a community's sense of place	No	Is a seminal or optimal example of a class of items valued by the community	No	Shows rare evidence of a significant human activity important to the community	No
		Is outstanding because of the integrity of the esteem in which it is held	No		

4 CONCLUSION AND RECOMMENDATIONS

Conclusion

- The Rietfontein (Sizwe) Hospital site is of historical and to a certain degree of scientific significance.
- The above site is also important to the community because of its work under the underprivileged.
- The cemeteries associated with the site can be regarded as of high significance.

Recommendations

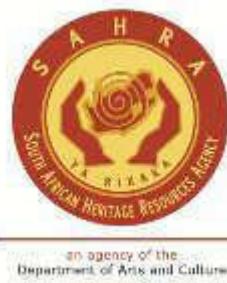
- It is recommended that the historical significance, scientific and community contributions of the Rietfontein (Sizwe) Hospital be commemorated at a central point in the new development. As some of the hospital buildings may need to be demolished the layout of the hospital site should form part of this display.
- It is further recommended that the two cemeteries situated in the south west section of the site as well as the cemetery east of the hospital be conserved *in situ*.
- It is also recommended that the three graves situated in the hospital grounds be exhumed and the remains reburied at the Mehliss residence. This will aid in future conservation of the said graves.
- It is accepted that new access roads may mean that some of the hospital buildings may need to be demolished. The Mehliss residence and first wards are the significant layer and should be regarded as important and conservation worthy. As soon as the final site development plan is available the structures earmarked for demolition are listed and submitted to the Heritage Impact Assessment Committee of the Provincial Heritage Authority of Gauteng (PHRAG) for approval/comment. In addition alterations to buildings older than 60 years must also be submitted to the Provincial Heritage Resources Authority of Gauteng (PHRAG) for approval.
- Management Plans be written and implemented for all remaining structures older than 60 years as well as grave sites to ensure regular maintenance on these structures and grave sites in future.
- 3.2.6 and 3.2.7 be written into the Environmental Management Plan.

5 THE WAY FORWARD

- Submit this report to the Provincial Heritage Resources Authority of Gauteng (PHRAG) for comment.

SAHRA comments

Annexure Qi



Letter

In terms of Section of the National Heritage Resources Act (Act 25 of 1999)

Attention: Gauteng Department of Local Government & Housing

Portions 87, 148, 149 and the Remainder of Portion 1 of the Farm Rietfontein 61 IR

Thank you for your notification regarding this development.

In terms of the National Heritage Resources Act, no 25 of 1999, heritage resources, including archaeological or palaeontological sites over 100 years old, graves older than 60 years, structures older than 60 years are protected. They may not be disturbed without a permit from the relevant heritage resources authority. This means that prior to development it is incumbent on the developer to ensure that a **Heritage Impact Assessment** is done. This must include the archaeological component (Phase 1) and any other applicable heritage components. Appropriate (Phase 2) mitigation, which involves recording, sampling and dating sites that are to be destroyed, must be done as required.

The quickest process to follow for the archaeological component is to contract an accredited specialist (see the web site of the Association of Southern African Professional Archaeologists www.asapa.org.za) to provide a Phase 1 Archaeological Impact Assessment Report. This must be done before any large development takes place.

The Phase 1 Impact Assessment Report will identify the archaeological sites and assess their significance. It should also make recommendations (as indicated in section 38) about the process to be followed. For example, there may need to be a mitigation phase (Phase 2) where the specialist will collect or excavate material and date the site. At the end of the process the heritage authority may give permission for destruction of the sites.

Where bedrock is to be affected, or where there are coastal sediments, or marine or river terraces and in potentially fossiliferous superficial deposits, a Palaeontological Desk Top study must be undertaken to assess whether or not the development will impact upon palaeontological resources - or at least a letter of exemption from a Palaeontologist is needed to indicate that this is unnecessary. If the area is deemed sensitive, a full Phase 1 Palaeontological Impact Assessment will be required and if necessary a Phase 2 rescue operation might be necessary.

If the property is very small or disturbed and there is no significant site the heritage specialist may choose to send a letter to the heritage authority to indicate that there is no necessity for any further assessment.

Any other heritage resources that may be impacted such as built structures over 60 years old, sites of cultural



Linksfiled Mixed Use Development

Our Ref: 9/2/228/0099

Enquiries: Andrew Salomon
Tel: 021 462 4502
Email: asalomon@sahra.org.za
CaseID: 3870

Date: Wednesday October 30, 2013

Page No: 2



significance associated with oral histories, burial grounds and graves, graves of victims of conflict, and cultural landscapes or viewscapes must also be assessed.

Should you have any further queries, please contact the designated official using the case number quoted above in the case header.

Yours faithfully

A handwritten signature in black ink, appearing to read "Andrew Salomon".

Andrew Salomon
Heritage Officer: Archaeology
South African Heritage Resources Agency

A handwritten signature in black ink, appearing to read "Colette Scheermeyer".

Colette Scheermeyer
SAHRA Head Archaeologist
South African Heritage Resources Agency

ADMIN:

Direct URL to case: <http://www.sahra.org.za/node/135150>
(GDARD, Ref: Gaut: 002/13-14/E0153)

Terms & Conditions:

1. This approval does not exonerate the applicant from obtaining local authority approval or any other necessary approval for proposed work.
2. If any heritage resources, including graves or human remains, are encountered they must be reported to SAHRA immediately.
3. SAHRA reserves the right to request additional information as required.



The South African Heritage Resources Agency

Street Address: 111 Harrington Street, Cape Town 8000 * Postal Address: PO Box 4637, Cape Town 8000
* Tel: +27 21 462 4502 * Fax: +27 21 462 4509 * Web: <http://www.sahra.org.za>

Visual impacts/artistic images of proposed development

Annexure R

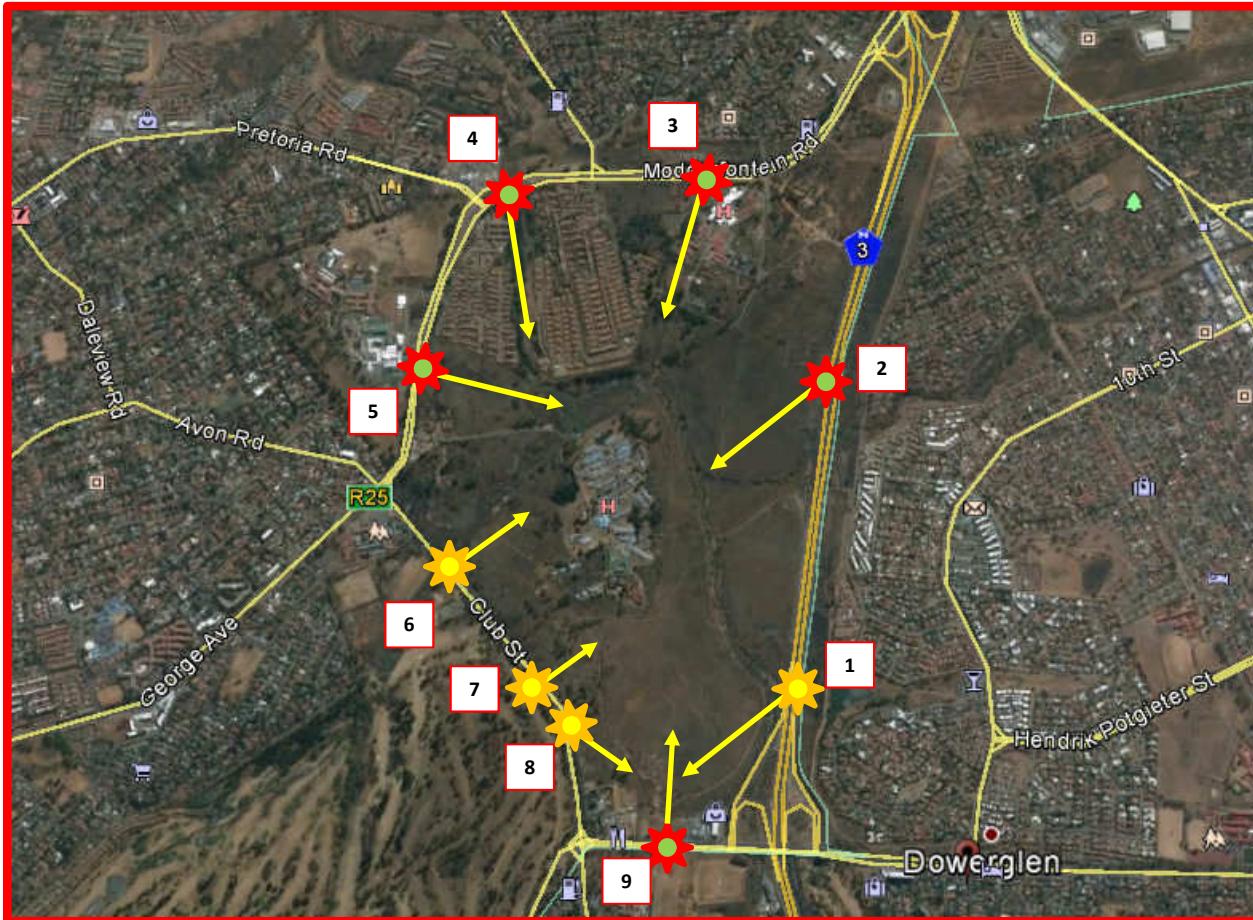


Figure 18: Visibility of the Linksfield Study Area

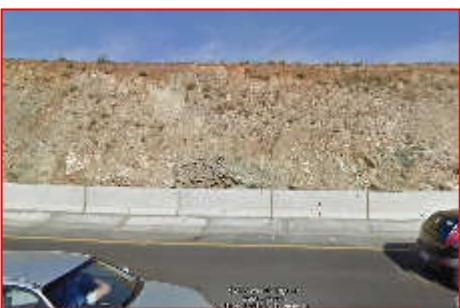
- Direction of Photograph
- ★ High Visibility
- ✿ Low Visibility



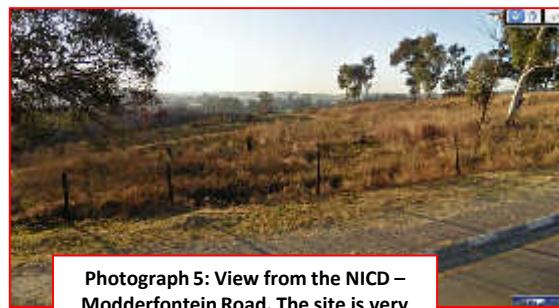
Photograph 1 : The site is very visible from this section of the N3 – the view is onto the highest point (south-western corner) of the study area



Photograph 4: View from Modderfontein Road onto the Jukskei River, which flows through the Rand Aid Residential Development. The study area is not visible from this point. Riparian vegetation acts as screen.



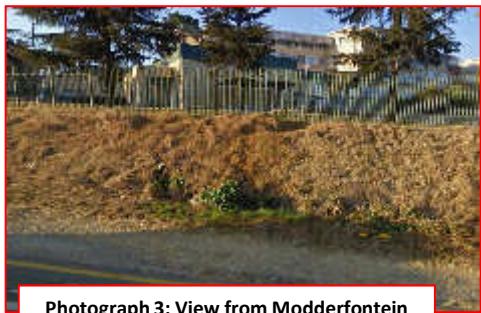
Photograph 2: At this point the N3 is in cut and the study area is not very visible



Photograph 5: View from the NICD – Modderfontein Road. The site is very visible from this point.



Photograph 7: View from Club Street – the site is still very visible



Photograph 3: View from Modderfontein Road. Due to the topography, the study area is not visible from this point. The Edenvale Hospital is visible in the foreground.



Photograph 6: View from Club Street towards the Sizwe Hospital – this section of the study area is also very visible from the areas to the south-west, including the golf course.



Photograph 8: View from Club Street towards the highest point of the study area – the south-western corner. Attractive views are experienced from this section of the study area



Photograph 9: View from Linksfield Road – Only a small part of the study area is visible

Figure ??: Photographs to Illustrate the Visibility of the Linksfield Study Area from the Surrounding Area

Visual Impact Assessment

Annexure R

PROPOSED LINKSFIELD MIXED-USE DEVELOPMENT

Portion 137 and the Remainder of Portion 1 of the Farm Rietfontein No. 61 IR,
Johannesburg Metropolitan Municipality, Gauteng Province

ANNEXURE 1

DECLARATION OF INDEPENDENCE

6 DECEMBER 2013

PROJECT NO: VIA_251013.BE

Produced for:

The Gauteng Department of Local Government and Housing (Human Settlements) & Private Partners

On behalf of:

Bokamoso Environmental



PROPOSED LINSFIELD MIXED-USE DEVELOPMENT

Portion 137 and the Remainder of Portion 1 of the Farm Rietfontein No. 61 IR,
Johannesburg Metropolitan Municipality, Gauteng Province

ANNEXURE 2

SELECTED OBSERVATION POINT VIEWSHEDS AND ASSESSMENTS

6 DECEMBER 2013

PROJECT NO: VIA_251013.BE

Produced for:

The Gauteng Department of Local Government and Housing (Human Settlements) & Private Partners

On behalf of:

Bokamoso Environmental



PROPOSED LINKSFIELD MIXED-USE DEVELOPMENT

Portion 137 and the Remainder of Portion 1 of the Farm Rietfontein No. 61 IR,
Johannesburg Metropolitan Municipality, Gauteng Province

ANNEXURE 3

LIST OF PLANS

6 DECEMBER 2013

PROJECT NO: VIA_251013.BE

Produced for:

The Gauteng Department of Local Government and Housing (Human Settlements) & Private Partners

On behalf of:

Bokamoso Environmental



TABLE OF CONTENTS

1	INTRODUCTION	1
1.1	Background and purpose of the report	1
1.2	Components of the report	1
1.3	Study methodology	1
1.4	Supplementary documentation	2
1.5	Gaps in knowledge, Assumptions and Limitations	2
2	THE AFFECTED ENVIRONMENT	3
2.1	Locality	3
2.1.1	Intrinsic Values of the Region	5
2.2	Project site description	6
2.2.1	Landscape character	7
3	PROJECT DESCRIPTION	8
3.1	Conclusion on the development concept	10
3.2	Potential 'triggers' or key issues	11
3.3	Development category	12
4	VIEW SHED ANALYSIS	13
4.1	Dominant view corridors	13
4.2	Relevant topographic and physical characteristics	14
4.3	Photographic study as supplementary component	15
5	DIGITAL VIEW SHED ANALYSIS	16
5.1	Key aspects of the viewshed	18
6	VISUAL IMPACT ASSESSMENT	18
6.1	Selection of observation points	18
6.2	Assessment process	18
6.3	Summary of assessment	20
6.3.1	Assessment criteria	20
6.4	Assessment of impacts	21
6.4.1	Assessment of impact on sensitive receptors in the foreground	21
6.4.2	Assessment of impact on sense of place	23
6.4.3	Assessment of impact of artificial lighting	24
6.4.4	Assessment of impact of pollution of the natural systems	26
7	POLICY CONTEXT	27
7.1	Growth Management Strategy	29
8	IMPACT STATEMENT	29
8.1	Recommendations	29
9	ENVIRONMENTAL MANAGEMENT PROGRAMME	30
10	REFERENCES	33

LIST OF FIGURES

Figure 1:	Methodology adopted for the VIA.	2
Figure 2:	Regional context of the project site.	4
Figure 3:	The Linksfield Terrance Development to the south of the project site	5
Figure 4:	Nature of the project site as viewed from the east, opposite the N3 highway.	6
Figure 5:	Extent of the subject property and surroundings.	6
Figure 6:	Local extent of a portion of the project site as taken from Club Street to the south.	7
Figure 7:	Artists' illustration of a north-easterly view of the proposed Linksfield development.	10
Figure 8:	Artists' illustration of a westerly view of the proposed Linksfield development.	10
Figure 9:	Digital Elevation Model illustrating major ridgelines and dominant view corridors in the sub-region.	14
Figure 10:	The main Witwatersrand Ridge Policy.	15
Figure 11:	Panoramic northerly view of the project site as taken from Club Street.	16
Figure 12:	Viewshed generated from the highest point of the project site.	17
Figure 13:	Artists' rendering of the proposed development at night.	26
Figure 14:	Spatial Plan for Sub Area 28.	28
Figure 15:	Proposed recommendations.	30

LIST OF TABLES

Table 1:	Potential triggers.	11
Table 2:	Categorization of expected visual impact.	12
Table 3:	VIA methodology and process.	18
Table 4:	Summary of criteria used to assess the potential impacts of the proposed activity.	20
Table 5:	Impact table summarising the significance of visual impact on the sensitive receptors in the foreground.	22
Table 6:	Impact table summarising the significance of visual impact on sense of place.	23
Table 7:	Impact table summarising the significance of visual impact of artificial lighting.	24
Table 8:	Impact table summarising the significance of visual impact of pollution of the natural systems.	26
Table 9:	Environmental Management Programme – Planning Phase	31
Table 10:	Environmental Management Programme – Construction Phase	31
Table 11:	Environmental Management Programme – Operational Phase	32

LIST OF ANNEXURES

Annexure 1:	Declaration of independence.
Annexure 2:	Selected observation point viewsheds and assessments.
Annexure 3:	List of Plans

1 SELECTED OBSERVATION POINT ASSESSMENTS

The selected *observation points* were categorized and assessed in terms of the following assessment criteria.

KEY	DESCRIPTION
NUMBER	Each observation point was allocated a reference number.
CO-ORDINATES	The co-ordinates of each of the observation points are provided.
ALTITUDE	The altitude of the observation point was provided in meters above sea level.
DESCRIPTION	A brief description where the observation point is located is provided.
TYPE	Each observation point is categorized according to its location and significance rating. These criteria include the following: a) Tourist-related areas. b) Corridors, including linear geographical areas visible to users of a route or vantage points. c) Residential Areas/Farmstead. d) Areas of cultural significance.
PHOTOGRAPH	A photograph was taken from each observation point in the direction of the project site to verify the digitally generated view-shed.
PROPERTY LOCATION	The location of the property was described as <i>foreground</i> , <i>middle ground</i> or <i>background</i> .
PROXIMITY	The distance between the observation point and the project site was provided in kilometres.
VISUAL SENSITIVITY OF RECEPTORS	The visual impact considered acceptable is dependent on the type of receptors. A high (e.g. residential areas, nature reserves and scenic routes or trails), moderate (e.g. sporting or recreational areas, or places of work), or low sensitivity (e.g. industrial, mining or degraded areas) was awarded to each observation point.
VISUAL EXPOSURE	Exposure or visual impact tends to diminish exponentially with distance. A high (dominant or clearly visible), moderate (recognizable to the viewer) or low exposure (not particularly visible to the viewer) rating was allocated to each observation point.
VISUAL ABSORPTION CAPACITY (VAC)	The potential of the landscape to conceal the proposed development was assessed. A rating of high (effective screening by topography and vegetation), moderate (partial screening) and low (little screening) was allocated to each observation point.
VISUAL INTRUSION	The potential of the development to fit in with the surrounding environment was determined. The visual intrusion relates to the context of the proposed development while maintaining the integrity of the landscape. A rating of high (noticeable change), moderate (partially fits into the surroundings) or low (blends in well with the surroundings) was allocated.
DURATION	With regard to roads, the distance (in kilometres) and duration (in seconds) for which the property will be visible to the road user, were calculated for each observation point.

2 KEY OBSERVATION POINT 3

KOP3 is situated on the N3 north, some 1km south of the project site. The GIS-generated viewshed indicates that only the southern and northern tips of the project site would be visible from this point. Photograph 1 confirms this, as the observation point is located relatively low down. The infrastructure in the vicinity of the observation point, coupled with the natural topography results in a very high visual absorption capacity. The visual impact from this point is therefore negligible.



Figure 1: KOP3 Viewshed. Areas shaded yellow is theoretically visible from KOP3.

NUMBER:	KOP3	CO-ORDINATES:	S	E
ALTITUDE:	1582m		26°09'19.42"	28°07'57.59"
DESCRIPTION:	KOP3 is located on the N3 north.			
TYPE:	National road	PHOTO:	Photograph 1	
PROP. LOCATION:	Foreground	PROXIMITY:	1.0km	
VISUAL SENSITIVITY:	Low			
VISUAL EXPOSURE:	Low	VAC:	High	
VISUAL INTRUSION:	Low	DURATION:	4.4km @ 120km/h 2.2min northwards	



Photograph 1: View towards the project site from KOP3. Note the infrastructure in the vicinity of this point which draws the eye away from the project site in the distance.

3 KEY OBSERVATION POINT 7

KOP7 represents the observation point closest to the project site. This observation point is situated at the intersection of Club Street and Modderfontein Road, to the west of the project site. As illustrated by the figure below and confirmed by Photograph 2, only defined portions of the project site is visible from this point. Notwithstanding the existing large trees on the project site, any proposed development will have a visual impact on observers at this observation point.



Figure 2: KOP7 Viewshed. Areas shaded yellow is theoretically visible from KOP7.

NUMBER:	KOP7	CO-ORDINATES:	S	E
ALTITUDE:	1594m		26°08'15.21"	28°07'03.71"
DESCRIPTION:	KOP7 is located at the intersection of Club Street and Modderfontein Road.			
TYPE:	Local distributors	PHOTO:	Photograph 2	
PROP. LOCATION:	Foreground	PROXIMITY:	10m	
VISUAL SENSITIVITY:	Low			
VISUAL EXPOSURE:	High	VAC:	Low	
VISUAL INTRUSION:	Medium	DURATION:	N/A	



Photograph 2: View from KOP7 towards the project site (Source: Google Streetview).

4 KEY OBSERVATION POINT 9

KOP9 is situated in the Marais Steyn Park residential neighbourhood, adjacent to the N3 highway. Residents in this neighbourhood will have a relatively unobstructed view of the proposed development as the area slopes downwards in an east-west direction. As illustrated by Photograph 3, it is noted that the local ridge is not evident from this observation point. The skyline will therefore also not be broken, as viewed from this point.

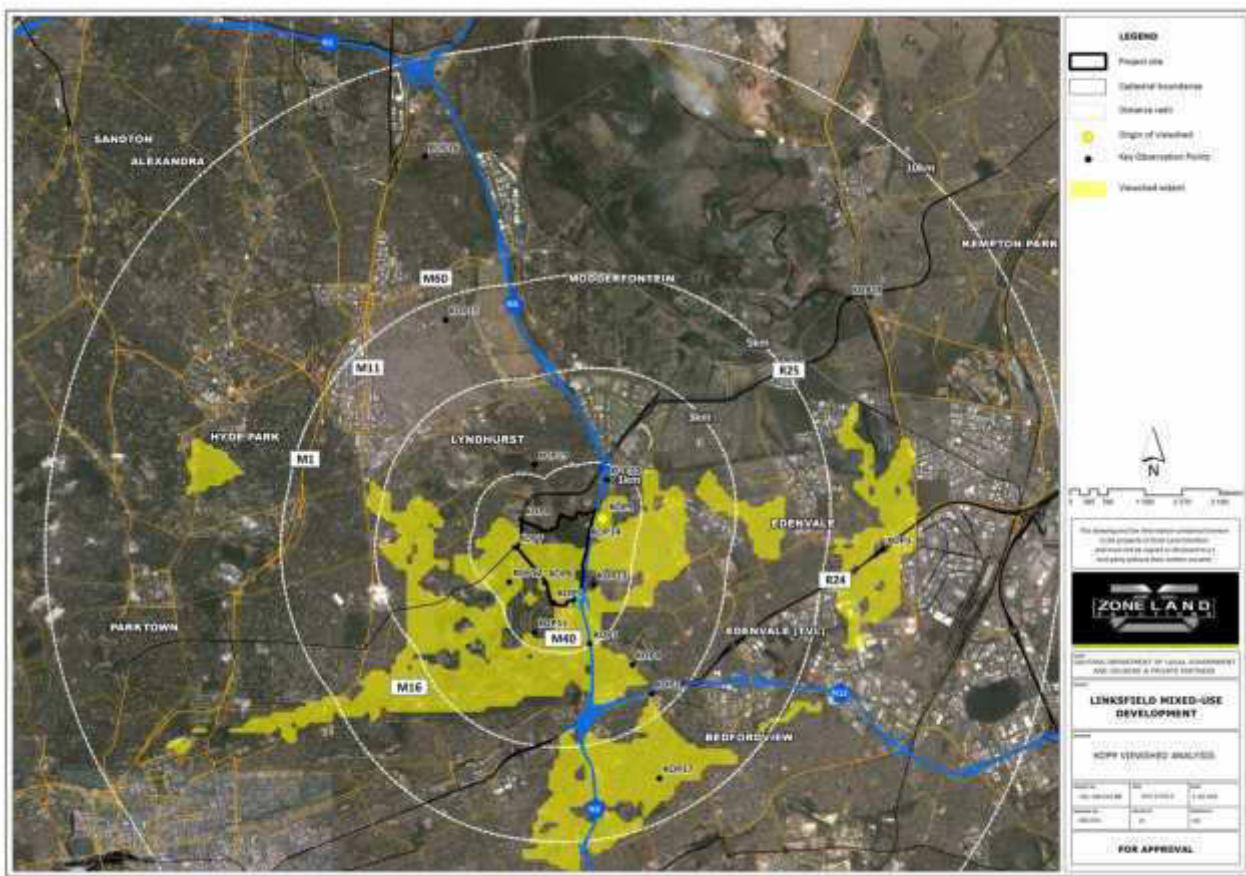


Figure 3: KOP9 Viewshed. Areas shaded yellow is theoretically visible from KOP9.

NUMBER:	KOP9	CO-ORDINATES:	S	E
ALTITUDE:	1574m		26°07'56.11"	28°08'11.17"
DESCRIPTION:	KOP9 is situated in the Marais Steyn Park neighbourhood.			
TYPE:	Residential	PHOTO:	Photographs 3	
PROP. LOCATION:	Foreground	PROXIMITY:	286m	
VISUAL SENSITIVITY:	High			
VISUAL EXPOSURE:	High	VAC:	Low	
VISUAL INTRUSION:	High	DURATION:	N/A	



Photograph 3: View from KOP9 towards the project site.

5 KEY OBSERVATION POINT 10

KOP10 is located at the R25 off-ramp onto the N3 south. Notwithstanding the fact that the observation point is higher in altitude than the project site, the GIS-generated viewshed indicates that only the south-western portion of the project site would be visible from this point. Photograph 1 confirms this. Also to be noted on the photograph is the large embankment to the left, which effectively results in a much narrower visual field. The visual impact from this point is considered to be low.

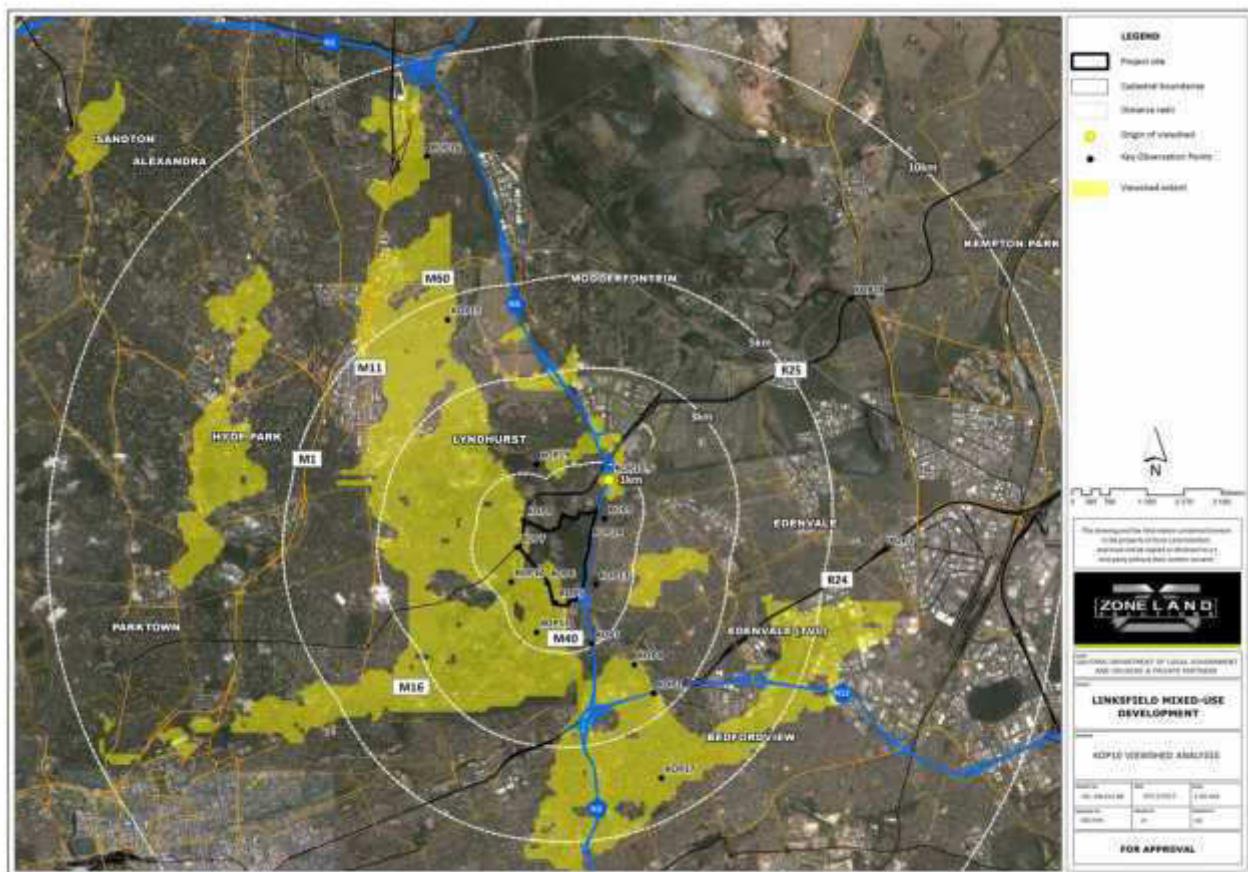


Figure 4: KOP10 Viewshed. Areas shaded yellow is theoretically visible from KOP10.

NUMBER:	KOP10	CO-ORDINATES:	S	E
ALTITUDE:	1629m		26°07'30.30"	28°08'11.38"
DESCRIPTION:	KOP10 is located at the R25 off-ramp onto the N3 south.			
TYPE:	National road	PHOTO:	Photograph 4	
PROP. LOCATION:	Foreground	PROXIMITY:	925m	
VISUAL SENSITIVITY:	Low			
VISUAL EXPOSURE:	Low	VAC:	High	
VISUAL INTRUSION:	Low	DURATION:	2.55km @ 12km/h 1.275min southwards	



Photograph 4: View from KOP10 towards the project site.

6 KEY OBSERVATION POINT 11

KOP11 is located in Club Street adjacent to the Royal Johannesburg and Kensington Golf Club. Even though the observation point is situated at an elevated high in comparison to the project site, the latter is not visible from this particular point. The expected visual impact is therefore expected to be negligible from this point.

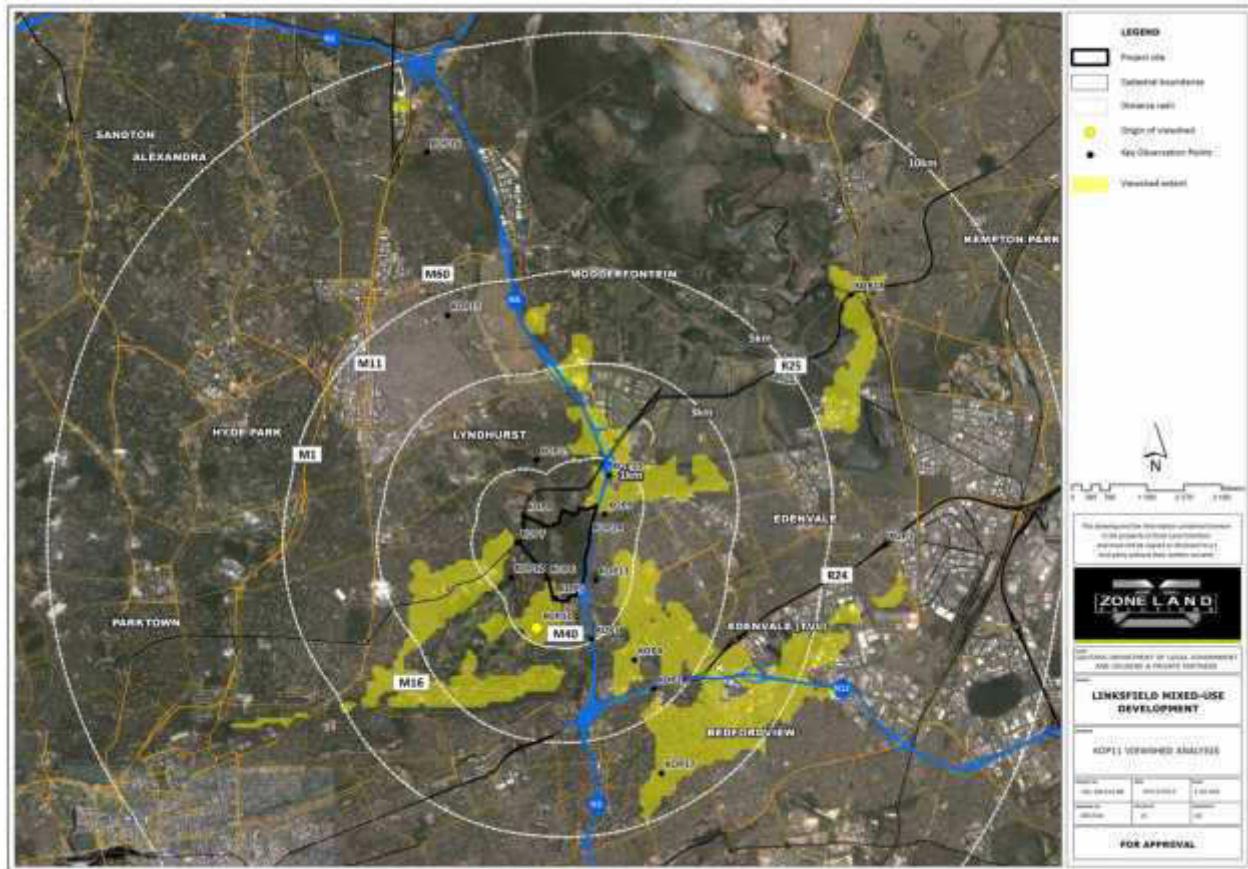


Figure 5: KOP11 Viewshed. Areas shaded yellow is theoretically visible from KOP11.

NUMBER:	KOP11	CO-ORDINATES:	S	E
ALTITUDE:	1625m		26°12'19.01"	28°32'42.41"
DESCRIPTION:	KOP11 is located adjacent to the Royal Johannesburg and Kensington Golf Course.			
TYPE:	Recreational	PHOTO:	Photograph 5 & 6	
PROP. LOCATION:	Foreground	PROXIMITY:	1.0km	
VISUAL SENSITIVITY:	High			
VISUAL EXPOSURE:	Low	VAC:	High	
VISUAL INTRUSION:	Low	DURATION:	N/A	



Photograph 5: View from KOP11 towards the project site in the north (Source: Google Streetview).



Photograph 6: View from hole 6 of the East Course at Royal Johannesburg and Kensington Golf Club
(Source: Google Streetview).

6 KEY OBSERVATION POINT 18

KOP8 is located at the R25/M39 intersection, some 7.4km from the project site. Even though the observation point is located some 57m higher than the project site, due to the distance from the site and the nature of the landscape en route to the site, the visual impact of the proposed activity on this observation point is expected to be negligible.



Figure 5: KOP18 Viewshed. Areas shaded yellow is theoretically visible from KOP18.

NUMBER:	KOP18	CO-ORDINATES:	S	E
ALTITUDE:	1674m		26°05'32.37"	28°11'06.77"
DESCRIPTION:	KOP18 is located at the R25/M39 interchange.			
TYPE:	Regional distributor	PHOTO:	Photograph 7	
PROP. LOCATION:	Background	PROXIMITY:	7.4km	
VISUAL SENSITIVITY:	Low			
VISUAL EXPOSURE:	Low	VAC:	High	
VISUAL INTRUSION:	Low	DURATION:	N/A	



Photograph 7: View from KOP18 towards the project site.

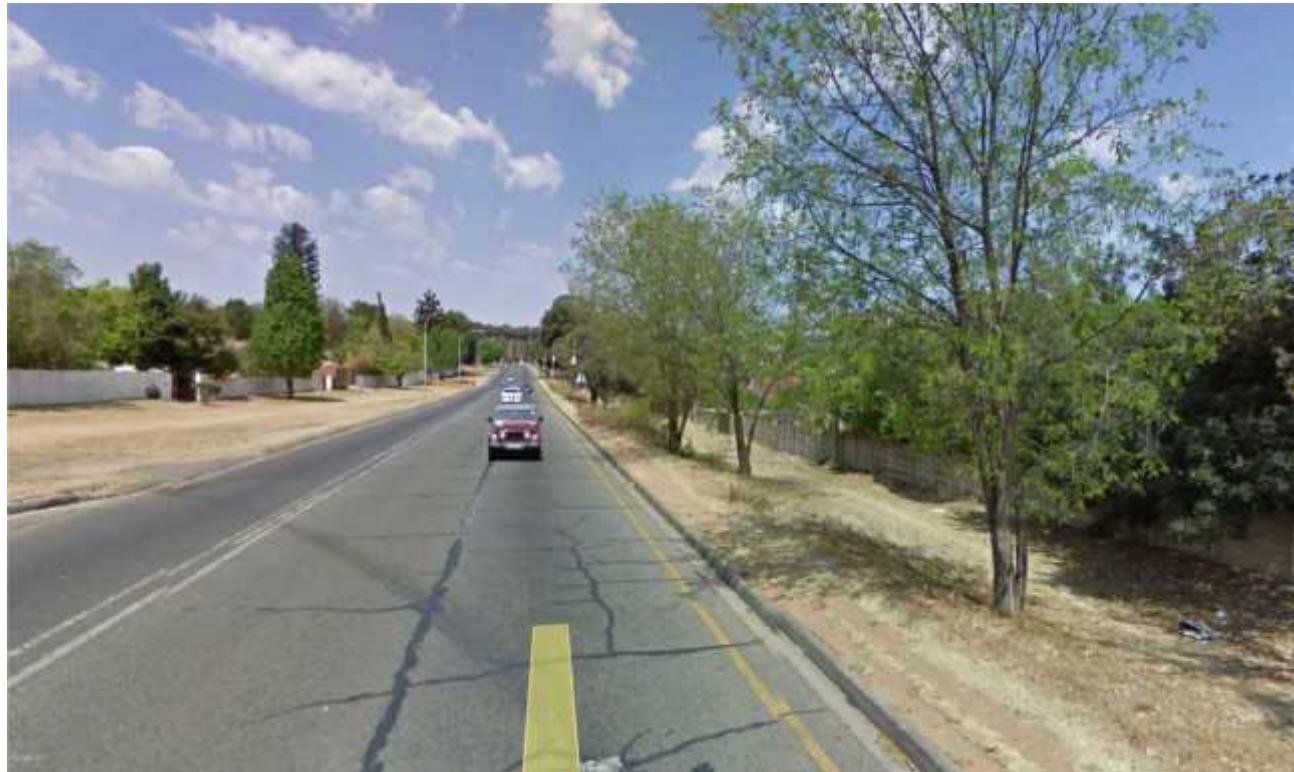
6 KEY OBSERVATION POINT 19

KOP19 is located in Wordsworth Road, north of the project site. The latter road links the R25 (Modderfontein Road) with the M40 (London Road). The GIS-generated viewshed indicates that portions of the project site would be visible from this point, however, Photograph 8 disputes this as no portions of the site has been found to be visible from this observation point. The visual impact is therefore expected to be negligible from this point.



Figure 5: KOP19 Viewshed. Areas shaded yellow is theoretically visible from KOP19.

NUMBER:	KOP19	CO-ORDINATES:	S	E
ALTITUDE:	1566m		26°07'19.61"	28°07'16.29"
DESCRIPTION:	KOP19 is located north of the project site along Wordsworth Road.			
TYPE:	Local distributor	PHOTO:	Photograph 8	
PROP. LOCATION:	Middle ground	PROXIMITY:	1.4km	
VISUAL SENSITIVITY:	Low			
VISUAL EXPOSURE:	Low	VAC:	High	
VISUAL INTRUSION:	Low	DURATION:	1.45km @ 60km/h 1.45min southwards	



Photograph 8: View from KOP19 towards the project site in the south (Source: Google Streetview).

FINAL

PROPOSED LINKSFIELD MIXED-USE DEVELOPMENT

**Portion 137 and the Remainder of Portion 1 of the Farm Rietfontein No. 61 IR,
Johannesburg Metropolitan Municipality, Gauteng Province**

VISUAL IMPACT ASSESSMENT

Prepared as part of an Environmental Impact Assessment Process undertaken in terms of the National Environmental Management Act, 107 of 1998

6 DECEMBER 2013

PROJECT NO: VIA_251013.BE

Produced for:

The Gauteng Department of Local Government and Housing (Human Settlements) & Private Partners

On behalf of:

Bokamoso Environmental



Produced by:



www.zonesolutions.co.za

1 INTRODUCTION

1.1 Background and Purpose of Report

The Gauteng Department of Local Government and Housing (Human Settlements) in collaboration with private partners intend to establish a mixed-use township on approximately 164ha of Portion 137 and the Remainder of Portion 1 of the Farm Rietfontein No. 61 IR, adjacent to the eastern by-pass in the Johannesburg Metropolitan Municipality.

This Visual Impact Assessment (VIA) is undertaken as part of the Environmental Impact Assessment (EIA) process being facilitated by Bokamoso Environmental Consultants, in terms of the National Environmental Management Act 107 of 1998 (NEMA). As such, the purpose of this report is to assess the proposed activity for the site(s) in terms of the *Guidelines for Involving Visual and Aesthetic Specialists in the EIA Process* and the *NEMA EIA Regulations of 2010*.

1.2 Components of the Report

The aspects addressed in this report are as follows:

- a) Description of the methodology adopted in preparing the report.
- b) Description of the receiving environment.
- c) Description of the view catchment area, view corridors, viewpoints and receptors.
- d) Identification and evaluation of potential visual impacts associated with the proposed activity and the alternatives identified, by using the established criteria, including potential lighting impacts at night.
- e) Identification in terms of best practical environmental option in terms of visual impact.
- f) Addressing of additional issues such as:
 - Impact on skyline.
 - Negative visual impact.
 - Impact on aesthetic quality and character of place.
- g) Assumptions made and uncertainties or gaps in knowledge.
- h) Recommendations in respect of mitigation measures that should be considered by the applicant and competent authority.

1.3 Study Methodology

As stated previously, this VIA was undertaken in accordance with the *Guideline for Involving Visual and Aesthetic Specialists in EIA Processes*, as issued by the Western Cape Government's Department of Environmental Affairs and Development Planning during 2005¹.

¹ No similar policy exists for the Gauteng Province. However, the Guidelines are based upon universally accepted principles and are therefore applicable to the said project.

The VIA was undertaken in distinct steps, each of which informed the subsequent steps. The figure below summarises the methodology adopted for undertaking the assessment.



Figure 1: Methodology adopted for the VIA.

1.4 Supplementary Documentation

This report is to be read together with Annexure 2 (Selected observation point viewsheds and assessments), which provides an identification of selected observation points and visual assessment of the proposed activity from each of these points.

1.5 Gaps in Knowledge, Assumptions and Limitations

This assessment was undertaken during the planning stage of the project and is based on the information and Terms of Reference provided by Bokamoso Environmental Consultants in the Background Information Document and associated information on 10 October 2013, for the mentioned project.

Assessments of this nature generally suffer from a number of defects that must be acknowledged:

- **Limited time:** A comprehensive assessment requires a systematic assessment of the environment at different times of the day. Such luxury is not always possible and therefore most assessments are based on observations made at a specific time of day. Educated estimates are made, where applicable, based on the knowledge of the area.
- **Availability of literature:** A thorough assessment requires that all relevant literature on the subject matter is studied, acknowledged and incorporated in the report. Due to a range of factors, forward planning documents are not always available for all spheres of government.

Notwithstanding the above, it is believed that this assessment identified all issues of likely importance from a visual point of view.

2 THE AFFECTED ENVIRONMENT

2.1 Locality

The project site is located in Ward 81 (Region E) of the Johannesburg Metropolitan Municipality, as part of the Gauteng Province. Administrative Region E is one of seven Administrative Regions that make up the City of Johannesburg. The region is located in the east of the City of Johannesburg, north of the Johannesburg Central Business District, south of Midrand, east of Randburg and west of the Ekurhuleni Metropolitan Municipality.

The region is centrally located geographically within the Gauteng City Region - positioned between Tshwane Metropolitan Municipality in the north, the Johannesburg CBD in the south, Mogale City in the West and Ekurhuleni Metropolitan Municipality in the east. Region E forms an interface between the City of Johannesburg and the Ekurhuleni Metropolitan Municipality to the east (RSDF, 2010).

The project site is conveniently situated amongst the residential suburbs of Sandringham, Glenhazel, Sunningdale, Lyndhurst, Corlett Gardens, Rembrandt Park Edenvale Ext 1, Marais Steyn Park, Dowerglen, Senderwood and the golfing ground, Huddle Park. Approximately 15 ha of the site are occupied by the Sizwe Tropical Disease Hospital.

The Linksfield site is well located from a connectivity point of view. Being situated adjacent to the N3 (Eastern by-pass), Linksfield Road to the south, Club Street to the west and the R25 (Modderfontein Road) to the north, the site is readily accessible. Various taxi routes exist around the site but, generally, connectivity to public transport remains underprovided.

Within Region E there remain some of the last extensive areas of undeveloped public and privately held land within the City. A prime example of such land is the Farm Rietfontein at some ± 150ha.

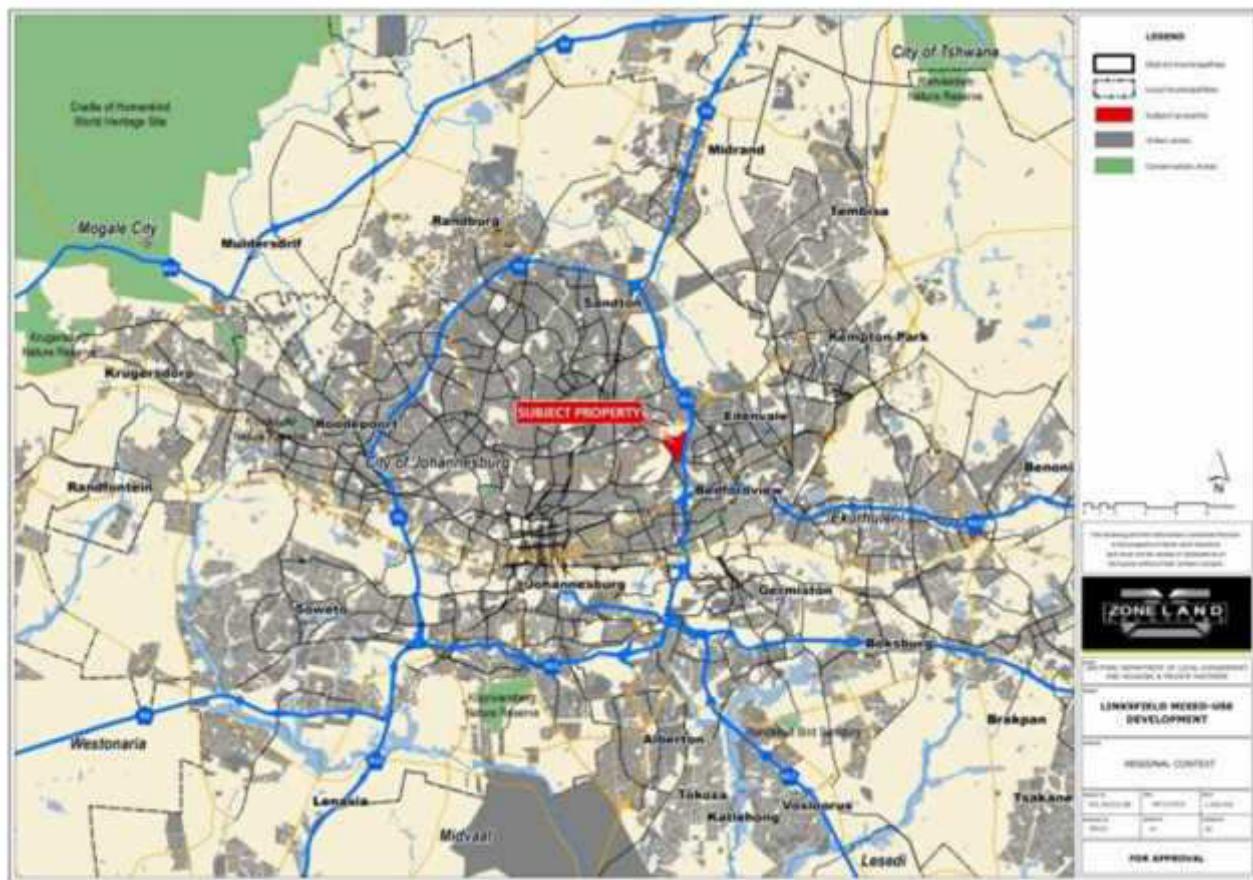


Figure 2: Regional context of the project site.

Natural resources make a significant and direct contribution to the atmosphere and characteristics of the project site. Contributing the rural characteristics of the project site is the Sandringham Stream and Edenvale Spruit that flows into the Jukskei River immediately north of the Sizwe Hospital. These natural characteristics must be incorporated into the development proposal to be utilised for recreational activities and natural park-like functions along the river edge. It is stated in the Linksfield project prospectus that the site itself forms an important link of these green open space systems and biological connectivity that needs to be maintained.

In the wider context, several conservation areas and heritage resources are located outside of the Johannesburg Metropolitan Municipality. Given their distance from the project site, these should not impact on the proposed development.

The land uses surrounding the project site consists of a mix of residential, recreational, institutional and retail.

These uses are manifested in the surrounding residential neighbourhoods of Sandringham, Glenhazel, Sunningdale, Lyndhurst, Corlett Gardens, Rembrandt Park Edenvale Ext 1, Marais Steyn Park, Dowerglen, Senderwood, the Royal Johannesburg and Kensington Golf Course to the south and the Sizwe Tropical Disease Hospital in the centre of the project site and the

South African Institute for Medical Research and Edenvale Hospital to the north-west and north, respectively. Another noteworthy institutional facility is the Sandringham High School to the south of the project site. Immediately bordering the project site to the south, on Linksfield Road, is the Linksfield Terrace retail centre.



Figure 3: The Linksfield Terrance Development to the south of the project site.

2.1.1 Intrinsic Values of the Region

It is a common principle of planning that each place has a specific intrinsic, instrumental and systemic value and that such values need to be carefully considered when contemplating the current and future use of any particular place.

Broadly -speaking, two different philosophical perspectives are possible when considering the value of any place or object, namely **what is it good for?** and **what is its own good?** The first question relates to its instrumental value, while the second deals with intrinsic value. Instrumental value uses something as a '*means to an end*' while intrinsic value refers to being '*worthwhile in itself*' (Rolston, 1994).

Systemic value relates to the fact that '*things do not have their separate natures merely in, and for themselves, but they face outward and co-fit into broader natures. Value seeps out into the system and the individual lose its status as sole locus of value*' (Rolston, 1994:174). Systemic value refers to the relations that things have with other things, and to the role they play in larger wholes.

The value system of Rietfontein Farm was determined in the various collaborative, participative processes undertaken during the drafting of forward planning documentation, policy and guidelines. As such, the intrinsic value of the area is found in the urban environment with strong linkages to the natural environment, i.e. rivers and streams.

2.2 Project Site Description

As illustrated by the Figure 5 below, the project site consists of Portion 137 and the Remainder of Portion 1 of the Farm Rietfontein No. 61 IR as well as an unreferenced portion of land, upon which the Sizwe Tropical Disease Hospital is built. The combined project site is approximately 164ha in extent, with the hospital occupying approximately 24ha. The remainder of the property has been laying fallow for a considerable period of time.



Figure 4: Nature of the project site as viewed from the east, opposite the N3 highway.

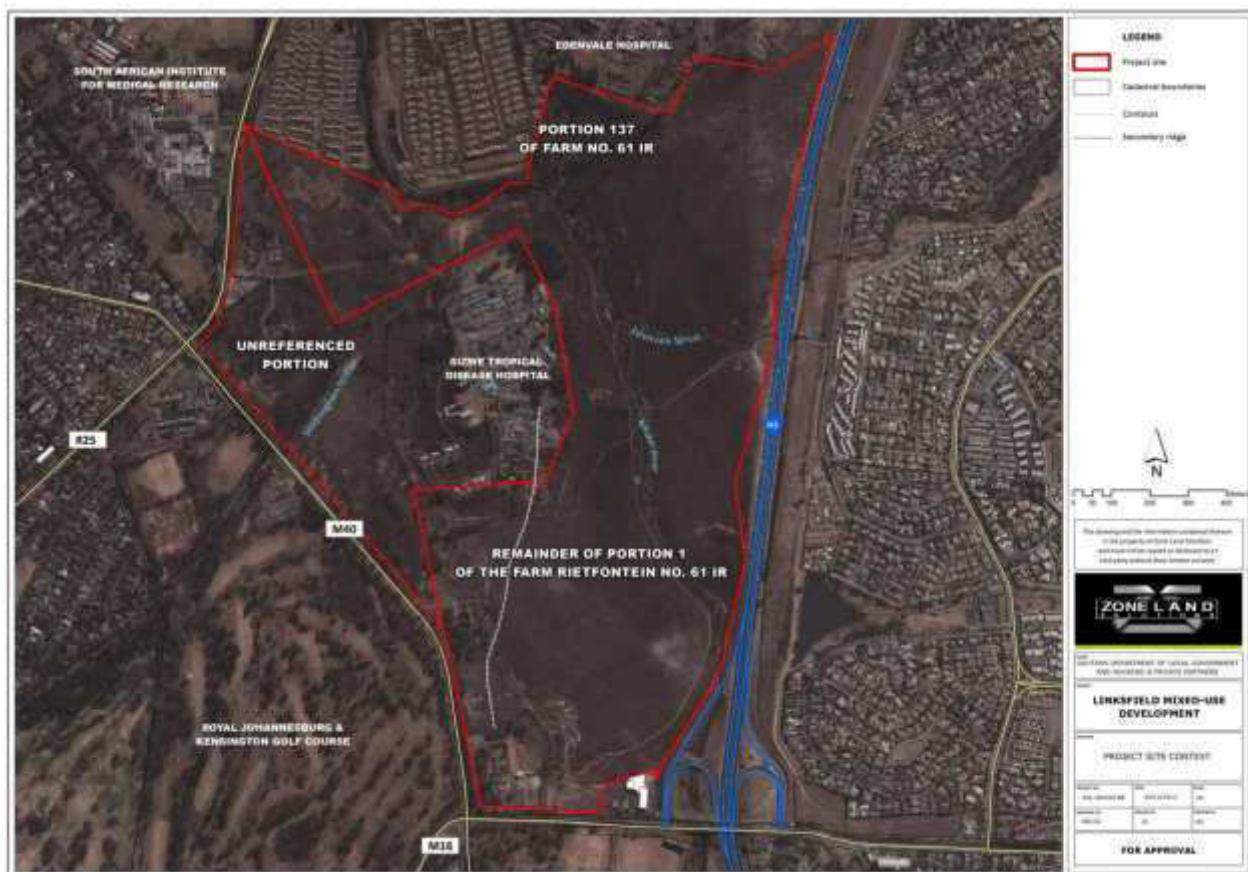


Figure 5: Extent of the project site and surroundings.



Figure 6: Local extent of a portion of the project site as taken from Club Street to the south (Source: Google Earth Streetview).

It should be noted that the draft development proposal is currently being assessed by the individual specialists. The final layout is therefore still to be determined by means of the EIA process.

2.2.1 Landscape Character

As mentioned above, several natural streams are present on site. These natural channels make for an interesting and undulating project site. As such, the height variation of the project site varies between 1555m and 1617m above mean sea level. This equates to a variation in height of 62 vertical metres.

No major ridge lines are present on site, but as a result of the undulating nature, a secondary ridgeline is found in the centre of the site.

Johannesburg experiences an annual rainfall of approximately 604mm with most rain occurring during summer. The average midday temperatures range from approximately 16.6°C in June to 26.2°C in January. The region is the coldest during July when the mercury drops to 0.8°C on average during the night.

As illustrated by Figure 6 above, several large trees (albeit exotic *Eucalyptus* trees) are present on site. Several specimen trees also line Club Street to the south and Modderfontein Road to

the west. These trees lend a particular atmosphere to the site and should be protected to the extent possible in the eventual development.

In terms of the underlying vegetation type, the project site is dominated by Egoli Granite Grassland (Gm10). According to Mucina and Rutherford (2006), the landscape features of this vegetation type support tall, usually *Hyparrhenia hirta*-dominated grassland, with some woody species on rocky outcrops. Other characteristics include rocky habitats that show a high diversity of woody species, which occur in the form of scattered shrub groups or solitary trees.

Mucina and Rutherford further note that this grassland is considered by some to be primary, though it is heavily utilised, is poor in species and is degraded, and often resembles secondary grassland that developed on old fields.

It is further noted that only 3% of this vegetation type is formally conserved in statutory reserves (namely Diepsloot and Melville Koppies Nature Reserves) and a number of private conservation areas including Motsetse and Isaac Stegmann Nature Reserves, Kingskloof Natural Heritage Site, Melrone and Beaulieu Bird Sanctuaries as well as the Walter Sisulu National Botanical Garden. More than two thirds of this vegetation group has already undergone transformation by mostly urbanisation, cultivation or by infrastructure.

3 PROJECT DESCRIPTION

A single development proposal was presented for assessment. No alternatives were put forward, either in terms of layout, location or technologies.

The proposed Linksfield node aims at creating an integrated living environment and distinct urban character defined by a mixed use approach to land use and building typology. The concept seeks to achieve high quality urban environment providing spaces to live, work and play. The approach will provide a mixed-use node connecting with other polycentric nodes within the city. The key principles that this project intervention seeks to achieve include, among others:

- a) Connectivity and amenities within a 10-minute walk of home and work;
- b) Interconnected street grid network that disperses traffic and eases walking;
- c) A mix of shops, offices, light industrial, apartments, and homes on site.
- d) Mixed housing typologies providing a range of types, sizes and prices in closer proximity.
- e) Emphasis on beauty, aesthetics, human comfort, and creating a sense of place; Special placement of uses and sites within community. Human scale architecture & beautiful surroundings to nourish the human spirit.
- f) Neighbourhood concept emphasizing quality public realm and public open space designed as civic art;
- g) Increased density with buildings, residences, shops, and services closer together for ease of walking, to enable a more efficient use of services and resources, and to create a more convenient, enjoyable place to live.

- h) A network of high-quality public transport connecting cities, towns, and neighbourhoods together.
- i) Sustainability –environmental, economic and social imperatives;

Taken together, the above add up to a high quality of life well worth living, and create places that enrich, uplift, and inspire the human spirit.

In particular, the project proposals make provision for the development of several districts. These districts will comprise the following land uses, namely:

- A market square,
- Primary, secondary and tertiary education facilities,
- A high performance sports centre,
- An aquatic centre,
- A youth community library,
- Local government offices,
- A community centre,
- A police and fire station,
- A court house,
- A clinic, and
- Residential units.

The densification strategy of the urban development has an inverted character from a strategic planning point of view. The outer edge of the development contains the higher density environment with a softer and lower density inner core. The rationale behind this approach is to allow ease of accessibility to the major transportation network that allows connectivity to the greater city scale. The outer edge utilises the visibility of the main arterials for commercial purposes and accessibility of services. The lower density inner core allow for softer land uses such as schools and community centres. It is estimated that the high-density units will be developed at approximately 6-8 stories, the medium-density units at 4-2 stories and the low-density at 1-2 stories.



Figure 7: Artists' illustration of a north-easterly view of the proposed Linksfield development.



Figure 8: Artists' illustration of a westerly view of the proposed Linksfield development.

3.1 Conclusion on the development concept

The proposed Linksfield urban intervention forms part of the strategic densification of the greater Johannesburg. The nature of the development creates a walkable environment with

good accessibility and connectivity to the city. A mixed use environment creates an activated street level interface at strategic points within the development. This is supported by the proposed mixed housing typologies that cater for a wide socio economic demographic.

The quality of the architecture and space in between will create an identifiable character and sense of place. The traditional neighbourhood structure with a community based centre and increased densities towards the edge culminates in an enjoyable place to live with all the amenities to support a thriving family orientated environment. The proposed BRT extension will increase the connectivity of the development and impact on the economic sustainability of the community. The sustainable approach to all aspects of the development is aimed in increasing the quality of life within the precincts and ensures the longevity of the residents.

3.2 Potential ‘triggers’ or Key Issues

A ‘trigger’ is a characteristic of either the receiving environment or the proposed project which indicates that visibility and aesthetics are likely to be key issues and may require further specialist involvement (DEA&DP, 2005).

The ‘triggers’, as it relates to the proposed project refer to the following:

Table 1: Potential triggers.

KEY ISSUE	FOCAL POINTS	DESCRIPTION
a) Nature of the receiving environment:	<i>Areas with a recognised special character or sense of place.</i>	The character of the project site is defined by the natural attributes of the site, namely the local streams, vegetation and topography.
	<i>Areas with visually prominent ridgelines or skylines.</i>	The project site consists of an undulating landscape with only a secondary ridgeline in the centre of the site.
b) Nature of the project:	<i>High intensity type projects including large-scale infrastructure.</i>	The proposed project includes a broad range of land use activities.
	<i>A change in land use from the prevailing use.</i>	The prevailing use will change on the majority of the project site. The proposed mitigation measures aim to reduce the visual impact of the proposed land use.
	<i>A significant change to the fabric and character of the area.</i>	The current and prevailing use of the area will change in accordance with the proposed land uses.
	<i>Possible visual intrusion in the landscape.</i>	The proposed activity is particularly visually prominent from defined observation points, the impact of which will be assessed through this VIA.

3.3 Development Category

Based upon the ‘triggers’ and key issues and the environmental context summarised above, the proposed activity is categorised as a **Category 4 Development**.

This categorisation is based upon the *Guidelines for Involving Visual and Aesthetic Specialists in EIA Processes*, which lists the following categories of development:

Box 3: KEY TO CATEGORIES OF DEVELOPMENT

Category 1 Development: e.g. nature reserves, nature-related recreation, camping, picnicking, trails and minimal visitor facilities.

Category 2 Development: e.g. low-key recreation/resort/residential type development, small-scale agriculture/nurseries/narrow roads and small-scale infrastructure.

Category 3 Development: e.g. low density residential/resort type development, golf or polo estates, low to medium-scale infrastructure.

Category 4 Development: e.g. medium density residential development, sport facilities, small-scale commercial facilities/ office parks, one-stop petrol stations, light industry, medium-scale infrastructure.

Category 5 Development: e.g. high density township/residential development, retail and office complexes, industrial facilities, refineries, treatment plants, power stations, wind energy farms, power lines, freeways, toll roads, large-scale infrastructure generally. Large-scale development of agriculture land and commercial tree plantations. Quarrying and mining activities with related processing plants.

Based upon the above categorization and the assessment criteria provided in the *Guidelines for Involving Visual and Aesthetic Specialists in EIA Processes* it is expected that the visual impact of the proposed activity would be classified as ‘**moderate**’ (refer to the table below).

The objectives of the VIA described in this report is to:

- a) determine whether such broad impact categorisation is appropriate and if not, to determine an appropriate category of impact;
- b) formulate and implement measures or interventions that would mitigate any detrimental impacts to the extent that the activity will be acceptable.

Table 2: Categorization of expected visual impact (DEA&DP, 2005).

Type of environment	Type of development				
	Category 1	Category 2	Category 3	Category 4	Category 5
Protected/wild areas of international or	Moderate visual impact	High visual impact	High visual impact	Very high visual impact	Very high visual impact

regional significance	expected	expected	expected	expected	expected
Areas or routes of high scenic, cultural, historical significance	Minimal visual impact expected	Moderate visual impact expected	High visual impact expected	High visual impact expected	Very high visual impact expected
Areas or routes of medium scenic, cultural or historical significance	Little or no visual impact expected	Minimal visual impact expected	Moderate visual impact expected	High visual impact expected	High visual impact expected
Areas or routes of low scenic, cultural or historical significance/disturbed	Little or no visual impact expected. Possible benefits	Little or no visual impact expected	Minimal visual impact expected	Moderate visual impact expected	High visual impact expected
Disturbed or degraded sites / run-down urban areas / wasteland	Little or no visual impact expected. Possible benefits	Little or no visual impact expected. Possible benefits	Little or no visual impact expected	Minimal visual impact expected	Moderate visual impact expected

4 VIEWSHED ANALYSIS

4.1 Dominant View Corridors

As a first step of this VIA, a survey was undertaken to determine the existence of significant view corridors associated with the project site. A view corridor is defined as '*a linear geographic area, usually along movement routes, that is visible to users of the route*' (DEA&DP, 2005). Accordingly, five dominant *view corridors* were identified in the region, namely:

- a) **N3-** The eastern by-pass around Johannesburg en route to Pretoria.
- b) **N12-** The national road from Johannesburg to Emalahleni in the east.
- c) **R24-** The main road across the spine of Johannesburg from the OR Thambo International Airport in the east to Roodepoort in the west.
- c) **M40-** Club Street represents the most prominent dominant view corridor immediately adjacent to the project site.
- d) **R25-** Modderfontein Road coincides with the proposed BRT Bus route north and west of the project site.

When determining dominant view corridors, one has to take into consideration the class of the road, the dominance and nature of the town/settlement/neighbourhood/district in which direction it travels and the distance from the proposed activity. In this regard, all roads in the immediate vicinity of the project site represent either national, regional, district or local distributors within the Johannesburg Municipality.

4.2 Relevant Topographic and Physical Characteristics

A further key aspect affecting the potential visual impact of any proposed activity is the topography of the project site and the surrounding environment and the existence of prominent biophysical features from where the project site is visible. The topography and the major ridgelines of the area were subsequently determined and mapped by using a *Digital Elevation Model*².

As illustrated by the DEM below, the project site is located at a mean elevation of approximately 1586m above sea. The DEM shows that there are little prominent topographical manifestations in close proximity to the project site, from which the proposed activity is particularly visually exposed. As mentioned above, on a local scale and as a result of the undulating nature of the area, a secondary ridgeline is formed in the centre of the project site. It is therefore expected that the proposed activity will impact on the skyline in the immediate surroundings of the project site.



Figure 9: Digital Elevation Model illustrating major ridgelines and dominant view corridors in the sub-region.

² A Digital Elevation Model (DEM) is a geographic information system-based outcome generated from contours for a specific area. In this instance, 20m contour intervals for reference sheet no. 2628aa were used to calculate the DEM for the region.

The Joburg Regional Spatial Development Framework (2010) states that development on ridges should, in general, not be allowed, and if considered should be subject to conditions (i.e. ecological audit or an environmental impact study). Furthermore, a 200m buffer should be reserved between the foot of the ridge and the proposed development. The document goes further by stating that the majority of ridges in Region E have been partially or fully developed. There is however key ridges in Region E that warrant specific protection. This includes *inter alia* the Rietfontein Ridge (Sub Area 2).

In stark contrast to the above, the Regional SDF identifies the main ridges in the Witwatersrand Ridge Policy (see Figure 10 below). Notwithstanding the direct reference to the Rietfontein Ridge, the latter is not included or illustrated on the Witwatersrand Ridge Policy plan.

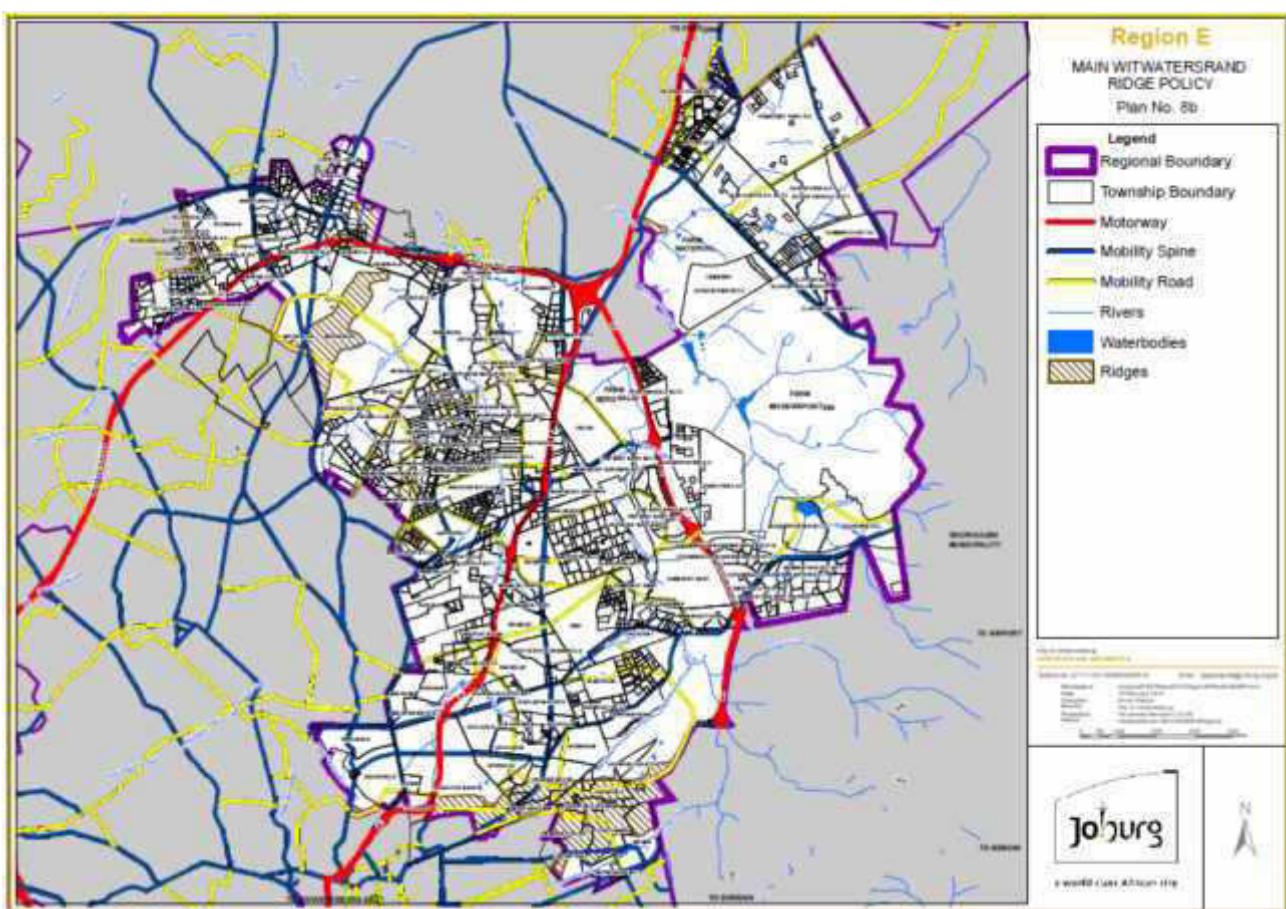


Figure 10: The main Witwatersrand Ridge Policy.

4.3 Photographic Study as Supplementary Component

In order to quantify and assess the visibility and potential impact of the proposed activity and to provide a basis for selecting appropriate observation points outside of the project site, a photographic study and analysis was undertaken in the vicinity of the project site. The analysis and ground-truthing identified several observation points with similar characteristics and assessments outcomes. A selection of Key Observation Points is therefore included under Annexure 2. The figure below illustrates the nature of the landscape of the project site.



Figure 11: Panoramic northerly view of the project site as taken from Club Street (Source: Google Earth Streetview).

5 DIGITAL VIEWSHED ANALYSIS

The photographic study summarised above was supplemented with a digital viewshed analysis based upon the Digital Elevation Model (refer to Figure 9). As stated previously, the purpose of these two steps was to provide a basis for the identification and selection of appropriate observation points outside the project site for the VIA.

The viewshed³ analysis was undertaken in accordance with the *Guideline Document for involving Visual Specialists in EIA Processes*. Geographic Information Systems (GIS) technology was used to analyse and map information in order to understand the relationships that exist between the observer and the observed view. Key aspects of the viewshed are as follows:

- It is based on a *single viewpoint* from the highest point of the project site.
- It is calculated at an assumed 24m above the natural ground level to reflect the highest point of the proposed infrastructure.
- It represents a '*broad-brush*' designation, which implies that the zone of visual influence may include portions that are located in a view of shadow and it is therefore not visible from the project site and *vice versa*. This may be as a result of landscape

³ A viewshed is defined as '*the outer boundary defining a view catchment area, usually along crests and ridgelines. Similar to a watershed*'. A Viewshed Analysis is therefore the study into the extent to which a defined area is visible to its surroundings.

- features such as vegetation, buildings and infrastructure not taken into consideration by the DEM.
- The viewshed generated from each of the selected observation points referred to in Annexure 2 is calculated at 1.7m above the natural ground level to reflect the average height of person either walking or sitting in a vehicle.

As illustrated by the generated viewsheds (refer to Figure 12 below), the *zone of visual influence*⁴ is located roughly in a circular band around the project site. The viewshed is primarily associated with the major topographical features of the area but due to the undulating nature of the region, the viewshed extends only approximately 10km from the project site. The viewshed coincide with the mentioned dominant view corridors, residential neighbourhoods, institutional facilities and industrial areas.

The GIS-generated viewshed illustrates a theoretical *zone of visual influence*. This does not mean that the proposed activity would be visible from all observation points in this area.

The distance radii indicating the various viewing distances from the project site are illustrated by Figure 12. Also illustrated by the figure are the view corridors, the N3 and N12 national roads.

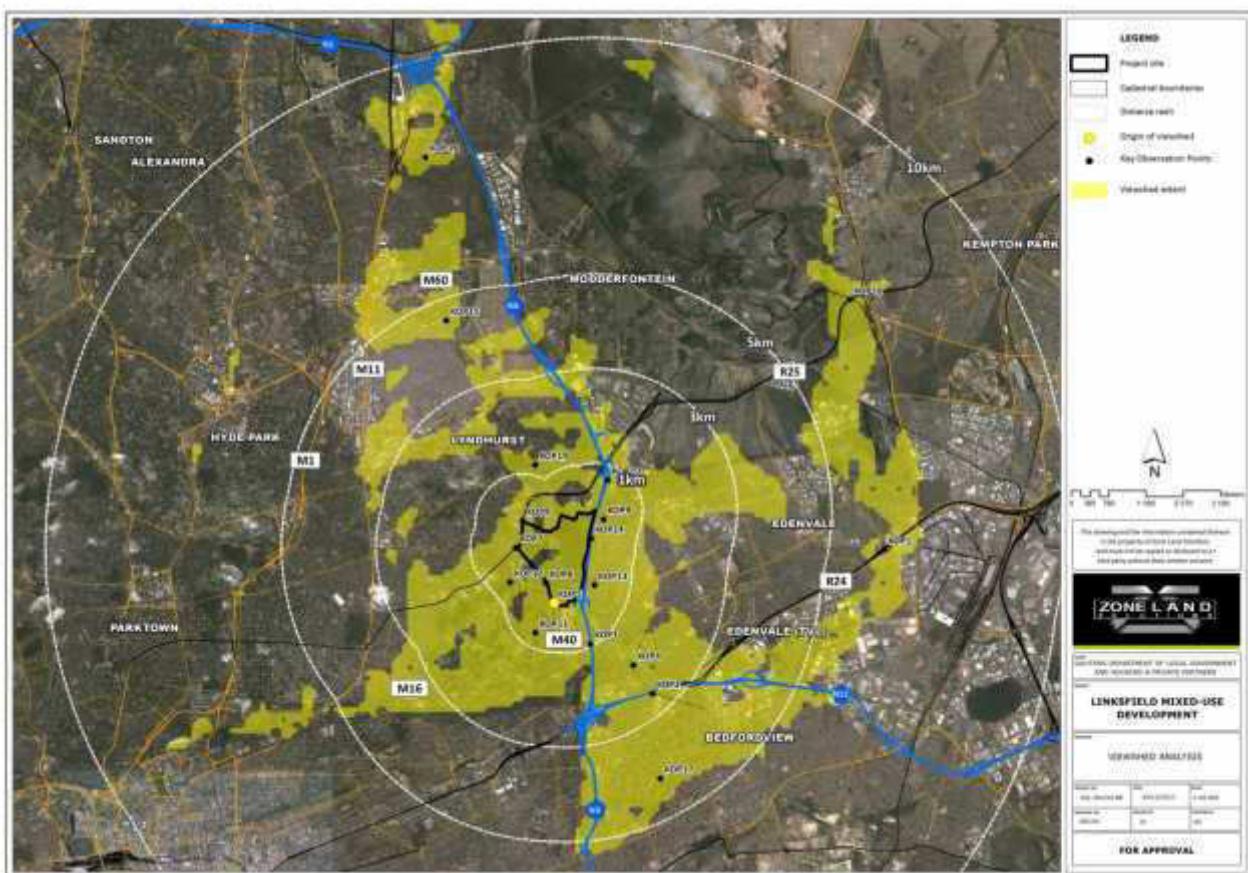


Figure 12: Viewshed generated from the highest point of the project site.

⁴ Zone of visual influence is defined as 'An area subject to the direct visual influence of a particular project'.

5.1 Key Aspects of the Viewshed

The distance between the observer and the observed activity is an important determinant of the magnitude of the visual impact. This is due to the visual impact of an activity diminishing as the distance between the viewer and the activity increases. Viewsheds are categorised into three broad categories of significance, namely:

- a) Foreground: The foreground is defined as the area within 1km from the observer within which details such as colour, texture, styles, forms and structure can be recognised. Objects in this zone are highly visible unless obscured by other landscape features, existing structures or vegetation.
- b) Middle ground: The middle ground is the area between 1km and 3km from the observer where the type of detail which is clearly visible in the foreground becomes indistinguishable. Objects in the middle ground can be classified as visible to moderately visible, unless obscured by other elements within the landscape.
- c) Background: the background stretches from approximately 3km onwards. Background views are only distinguishable by colour and lines, while structures, textures, styles and forms are often not visible (SRK Consulting, 2007).

6 VISUAL IMPACT ASSESSMENT

6.1 Selection of Observation Points

A total of 20 Key Observation Points (KOPs) were provisionally identified and selected within the defined viewshed for the visual assessment in accordance with the selection criteria stipulated in the Visual Guidelines. These KOPs correspond with movement routes, residential areas and general populated areas, commercial and institutional areas in the region. As a result of the similarity in the assessment results of the KOPs, the description and assessment of only a selected few KOPs are included in Annexure 2.

KOPs selected for the assessment are generally located at the intersection between the zone of visual influence and the defined view corridors (refer to Sections 4.1 and 5 above). The view corridors are those areas that are accessible to the general observer.

6.2 Assessment Process

The identified *observation points* were categorised and assessed as summarised in the table below.

Table 3: VIA methodology and process.

KEY	DESCRIPTION
NUMBER	Each observation point was allocated a reference number.
CO-ORDINATES	The co-ordinates of each of the observation points are provided.

ALTITUDE	The altitude of the observation point was provided in meters above sea level.
DESCRIPTION	A brief description where the observation point is located is provided.
TYPE	Each observation point is categorised according to its location and significance rating. These criteria include the following: <ul style="list-style-type: none"> • Tourist-related corridors, including linear geographical areas visible to users of a route or vantage points. • Residential areas. • Institutional areas. • Commercial areas.
PHOTOGRAPH	A photograph was taken from each observation point in the direction of the project site to verify the digitally-generated viewshed.
PROPERTY LOCATION	The location of the property was described a <i>foreground</i> , <i>middle ground</i> or <i>background</i> .
PROXIMITY	The distance between the observation point and the project site was provided in Kilometres.
VISUAL SENSITIVITY OF RECEPTORS	The visual impact considered acceptable is dependent on the type of receptors. A <i>high</i> (i.e. residential areas, nature reserves and scenic routes or trails), <i>moderate</i> (e.g. sporting or recreational areas, or places of work), or <i>low</i> sensitivity (e.g. industrial, mining or degraded areas) was awarded to each observation point.
VISUAL EXPOSURE	Exposure or visual impact tends to diminish exponentially with distance. A <i>high</i> (dominant or clearly visible), <i>moderate</i> (recognisable to the viewer) or <i>low</i> exposure (not particularly visible to the viewer) rating was allocated to each observation point.
VISUAL ABSORPTION CAPACITY (VAC)	The potential of the landscape to conceal the proposed activity was assessed. A rating of <i>high</i> (effective screening by topography and vegetation), <i>moderate</i> (partial screening) and <i>low</i> (little screening) was allocated to each observation point.
VISUAL INTRUSION	The potential of the activity to fit into the surrounding environment was determined. The visual intrusion relates to the context of the proposed activity while maintaining the integrity of the landscape. A rating of <i>high</i> (noticeable change), <i>moderate</i> (partially fits into the surroundings) or <i>low</i> (blends in well with the surroundings) was allocated.
DURATION	With regard to roads, the distance (in kilometres) and duration (in seconds) for which the property will be visible to the road user, were calculated for each observation point.

6.3 Summary of Assessment

Based on the viewshed analysis and the preceding sections, the envisaged visual impact of the proposed activity was assessed in accordance with the criteria for visual impact assessments (DEA&DP, 2005). The findings of the assessment from selected observation points are included under Annexure 2.

6.3.1 Assessment Criteria

It is stated in the DEA&DP's Visual Guidelines that to aid decision-making, the assessment and reporting of possible impacts requires consistency in the interpretation of impact assessment criteria. The criteria that specifically relate to VIAs were therefore described in Table 3 and Annexure 2.

The potential visual impact of the proposed activity was assessed against these criteria, with reference to the summary of criteria in Box 12 of the Visual Guidelines. Table 4 provides a description of the summary criteria used to determine the impact significance.

Table 4: Summary of criteria used to assess the potential impacts of the proposed activity.

CRITERIA	DESCRIPTION
NATURE OF THE IMPACT	The nature of the impact refers to the visual effect the proposed activity would have on the receiving environment. The nature of the development proposals are described in the preceding sections.
EXTENT	This category deals with the spatial or geographic area of influence and refers to the following levels: <ul style="list-style-type: none">• <i>Site-related</i> (extending only as far as the activity),• <i>Local</i> (limited to the immediate surroundings),• <i>Regional</i> (affecting a larger metropolitan or regional area),• <i>National</i> (affecting large parts of the country),• <i>International</i> (affecting areas across international boundaries). A value between 1 and 5 is assigned as appropriate (with 1 being low and 5 being high).
DURATION	Duration refers to the expected life-span of the visual impact. A rating of short term (during the construction phase) (assigned score of 1 or 2), <i>medium term</i> (duration for screening vegetation to mature) (assigned score of 3), <i>long term</i> (the lifespan of the project) (assigned score of 4), or <i>permanent</i> (where time will not mitigate the visual impact) (assigned score of 5) were applied.
MAGNITUDE	Magnitude refers to the magnitude of the impact on views, scenic or cultural resources. The following ratings were allocated to determine the intensity of the impact: <ul style="list-style-type: none">• <i>No effect</i> (assigned score of 0),• <i>Low</i> (visual and scenic resources not affected) (score of 2),• <i>Minor</i> (will not result in impact on processes) (score of 4),

	<ul style="list-style-type: none"> • <i>Medium</i> (affected to a limited scale) (assigned score of 6), • <i>High</i> (scenic and cultural resources are significantly affected) (assigned score of 8), • <i>Very high</i> (result in complete destruction of patterns) (score of 10).
PROBABILITY	This category refers to the degree of possibility of the visual impact occurring. A rating of <i>very improbable</i> (probably will not happen) (assigned score of 1), <i>improbable</i> (very low possibility of the impact occurring) (assigned score of 2), <i>probable</i> (distinct possibility that the impact will occur) (assigned score of 3), <i>highly probable</i> (most likely) (assigned score of 4), or <i>definite</i> (impact will occur regardless of any preventative measures) (assigned score of 5) were applied.
STATUS	Status will be described as positive, <i>negative</i> or <i>neutral</i> .
REVERSIBILITY	Degree to which the activity can be reversed. The following rating were allocated: <ul style="list-style-type: none"> • Reversible (assigned score of 1), • Recoverable (assigned score of 3), or • Irreversible (assigned score of 5).
SIGNIFICANCE	The significance is calculated by combining the criteria in the following formula: $S = (E + D + M)P$ <p>S = Significance E = Extent D = Duration M = Magnitude P = Probability</p> <p>The significance ratings for each potential impact are as follows:</p> <ul style="list-style-type: none"> • <i>Low</i> (where it will not have an influence on the decision) (< 30 points), • <i>Medium</i> (where it should have an influence on the decision unless it is mitigated) (30-60 points), or • <i>High</i> (where it would influence the decision regardless of any possible mitigation) (> 60 points).

6.4 Assessment of Impacts

6.4.1 Assessment of Impact on Sensitive Receptors in the Foreground

Several receptors are located in the *foreground* of the project site. The sensitive receptors in the *foreground* of the generated viewshed represent mostly users of the road networks and the adjacent golf course, schools and residential neighbourhoods. As illustrated by Figure 12 above and the results of the assessment included under Annexure 2, only those receptors

immediately adjacent to the project site will be visually impacted upon by the proposed activity.

Table 5: Impact table summarising the significance of visual impact on sensitive receptors in the *foreground*.

NATURE:	Potential visual impact on the sensitive receptors in the foreground.			
	Without Mitigation	Score	With Mitigation	Score
EXTENT	Regional	3	Site-related	1
DURATION	Long term	4	Long term	4
MAGNITUDE	Medium	6	Minor	4
PROBABILITY	Probable	3	Probable	3
SIGNIFICANCE	Medium	39	Low	27
STATUS	Negative		Neutral	
REVERSIBILITY	Recoverable	3	Recoverable	3
IRRPLACEABLE LOSS OF RESOURCE?	No		No	
CAN IMPACTS BE MITIGATED?	Yes			
MITIGATION:	<ul style="list-style-type: none"> • Keep disturbed areas to a minimum. • Determine the extent of the construction site in collaboration with the appointed freshwater specialist. Cordon-off all environmentally sensitive areas. • No clearing of land to take place outside the demarcated footprint. • Retain all large specimen trees along Club Street to preserve the natural characteristics of the area. Retain all other large trees on site, which does not necessitate removal. • Institute a rigorous planting regime along the ridge in the centre of the project site so that the skyline is not broken by buildings or structures. • Institute a vegetated buffer between the development components and the N3 to soften the expected visual impact on users of the N3. • Only indigenous plant species to be introduced and planted. Refer to section 2.2.1 and the botanical assessment report for suitable plant species. • Prepare a Landscaping Plan to serve as basis for all landscaping to be undertaken. • Buildings and similar structures must be in keeping with the principles of critical regionalism, namely sense of place, sense of history, sense of nature, sense of craft and sense of limits. • Buildings and structures must be set as low down as possible on their respective footprints. • Stepped terraces must be employed where necessary in response to sloping terrain. • Security fencing around the perimeter of the site must be permeable. 			
CUMULATIVE IMPACTS:	<p>It is expected that the cumulative impact of the proposed activity would be direct. The cumulative effect would also be synergistic (e.g. incremental urban development eventually results in the total loss of the rural character).</p>			

RESIDUAL IMPACTS:	The proposed infrastructure is of such a nature that it would not be possible to regain the status quo after decommissioning of the activity.
--------------------------	---

6.4.2 Assessment of Impact on Sense of Place

Sense of place and intrinsic values are closely related to one another. Sense of place refers to a unique experience of an environment by a user, based on his or her cognitive experience of the place. Visual criteria and specifically visual character of an area (informed by a combination of aspects, such as topography, level of development, vegetation, noteworthy features, cultural/historical features, etc.) play a significant role (MetroGIS, 2012).

A visual impact on the sense of place is one that alters the visual landscape to such an extent that the user experiences the environment differently, and more specifically, in a less appealing or less positive light (MetroGIS, 2012).

Although not well defined, the sense of place of the project site is very much one found in the natural landscape. The sense of place attributes and intrinsic values of the project site has, to a large degree, further been negatively impacted upon by the introduction of large-scale infrastructure in the region and the other competing land uses on the project site.

Table 6: Impact table summarising the significance of visual impact on the sense of place.

NATURE:	Potential visual impact on the intrinsic value and sense of place of the region.			
	Without Mitigation	Score	With Mitigation	Score
EXTENT	Regional	3	Local	2
DURATION	Long term	4	Long term	4
MAGNITUDE	Medium	6	Low	2
PROBABILITY	Probable	3	Probable	3
SIGNIFICANCE	Medium	36	Low	24
STATUS	Negative		Negative	
REVERSIBILITY	Irreversible	5	Irreversible	5
IRREPLACEABLE LOSS OF RESOURCE?	No		No	
CAN IMPACTS BE MITIGATED?	Yes			
MITIGATION:	<ul style="list-style-type: none"> • Keep disturbed areas to a minimum. • Determine the extent of the construction site in collaboration with the appointed freshwater specialist. Cordon-off all environmentally sensitive areas. • No clearing of land to take place outside the demarcated footprint. • Retain all large specimen trees along Club Street to preserve the natural characteristics of the area. Retain all other large trees on site, which does not necessitate removal. • Institute a rigorous planting regime along the ridge in the centre of the project site so that the skyline is not broken by buildings or structures. • Institute a vegetated buffer between the development components and 			

	<ul style="list-style-type: none"> the N3 to soften the expected visual impact on users of the N3. Only indigenous plant species to be introduced and planted. Refer to section 2.2.1 and the botanical assessment report for suitable plant species. Prepare a Landscaping Plan to serve as basis for all landscaping to be undertaken. Buildings and similar structures must be in keeping with the principles of critical regionalism, namely sense of place, sense of history, sense of nature, sense of craft and sense of limits. Buildings and structures must be set as low down as possible on their respective footprints. Stepped terraces must be employed where necessary in response to sloping terrain. Security fencing around the perimeter of the site must be permeable.
CUMULATIVE IMPACTS:	It is expected that the cumulative impact of the proposed activity would be direct . The cumulative effect would also be synergistic (e.g. incremental urban development eventually results in the total loss of the rural character).
RESIDUAL IMPACTS:	The proposed infrastructure is of such a nature that it would not be possible to regain the status quo after decommissioning of the activity.

6.4.3 Assessment of Impact of Artificial Lighting

The project site has a relatively low illumination factor. The occurrence of light sources on the site is strictly confined to the Sizwe Hospital and the traffic to and from this facility. A sky glow⁵ effect is however present in the wider area.

The project proposal will include a range of light sources. Structures and ground surfaces that are highly illuminated can be clearly visible for long distances, especially on clear nights. It is therefore expected that the proposed activity will contribute to the cumulative effects of sky glow or artificial lighting of the area.

A primary cause of light pollution is unshielded outdoor illumination fixtures. These fixtures produce large amounts of upward and horizontal spill. Light that shines upward is a direct waste and is the primary cause of light pollution. Horizontal light produces glare which might cause a degree of annoyance for viewers, especially at close proximity (MetroGIS, 2009).

Table 7: Impact table summarising the significance of visual impact of artificial lighting.

NATURE:	Potential visual impact of artificial lighting as a result of the activity.			
	Without Mitigation	Score	With Mitigation	Score
EXTENT	Regional	3	Local	2
DURATION	Long term	4	Long term	4

⁵ Sky glow refers to the illumination of the night sky or parts thereof. The most common cause of sky glow is artificial light that emits light pollution, which accumulates into a fast glow that can be seen from miles away.

MAGNITUDE	Medium	6	Minor	4
PROBABILITY	Probable	3	Probable	3
SIGNIFICANCE	Medium	33	Medium	30
STATUS	Negative		Negative	
REVERSIBILITY	Recoverable	3	Recoverable	3
IRREPLACEABLE LOSS OF RESOURCE?	No		No	
CAN IMPACTS BE MITIGATED?	Yes			
MITIGATION:	<ul style="list-style-type: none"> • Outdoor lighting must be strictly controlled so as to prevent light pollution. • Lighting must be installed at controlled angles. • Sources of light must as far as possible be shielded by physical barriers such as a planted trees and shrubs or built structures. • Consider the application of motion detectors in non critical areas to allow the application of lighting only where and when it is required. • The height of lampposts and masts determines how broadly the light is dispensed. If the lights are mounted at an appropriate height, they will provide maximum illumination while minimizing light pollution into the surrounding area. • The use of outdoor lighting fixtures high up on tall structures should be avoided. • The use of large neon advertising signs should be avoided. A uniform method of advertising and associated lighting must be developed for the proposed development and presented to the Johannesburg Metro Council for approval. • Alternative energy sources must be investigated to supply the proposed development with sufficient electricity. This will reduce the energy demand of the proposed development on the Municipality. 			
CUMULATIVE IMPACTS:	<p>The proposed activity will contribute to the cumulative lighting effect of the area.</p> <p>It is expected that the cumulative impact of artificial lighting caused by the proposed activity would be direct and additive.</p>			
RESIDUAL IMPACTS:	The proposed infrastructure is of such a nature that it would not be possible to regain the status quo after decommissioning of the activity.			



Figure 13: Artists' rendering of the proposed development at night.

6.4.4 Assessment of Impact of Pollution of Natural Systems

Nearly everything that can be found on land eventually makes its way to a stream. This is because every bit of ground on Earth is a part of some river's watershed. Water flows downhill. Whether the water comes from rain, a hose, or a pipe, whatever doesn't sink into the ground will flow into the nearest stream. That is a simplification, of course. In reality, much of the water that soaks down into aquifers also eventually finds its way to a stream.

Fertilizers, pesticides, and herbicides don't all come from farms, though. Most of them these days actually come from peoples' lawns and gardens. This is part of urban runoff. Water rushes over the many hard (impermeable) surfaces that humans create, over roadways and into gutters, and from there through pipes to the nearest stream. This type of pollution contributed by whole settlements of humans is called non-point-source pollution.

Urban runoff also contains a toxic soup of chemicals that are deposited by cars, buses, and trucks on roadways. Rainwater that runs off the road collects in ditches, which run alongside the road collecting more toxins until they finally empty into a stream (<http://chamisa.freeshell.org/pollution.htm>).

Table 8: Impact table summarising the significance of visual impact of pollution of the natural systems.

NATURE:	Potential visual impact of pollution of the natural systems.			
	Without Mitigation	Score	With Mitigation	Score
EXTENT	Local	2	Site related	1

DURATION	Long term	4	Long term	4
MAGNITUDE	Medium	6	Minor	4
PROBABILITY	Probable	3	Probable	3
SIGNIFICANCE	Medium	36	Low	27
STATUS	Negative		Neutral	
REVERSIBILITY	Recoverable	3	Recoverable	3
IRREPLACEABLE LOSS OF RESOURCE?	No		No	
CAN IMPACTS BE MITIGATED?	Yes			
MITIGATION:	<ul style="list-style-type: none"> Institute sustainable urban drainage systems (SUDS) as a method to effectively deal with drainage on the site scale. Consider implementing permeable paving as an alternative method to deal with urban storm water. Create sufficient buffer areas around the local streams and rivers and utilise these areas as community parks. Enforce the 1:50 and 1:100 year flood lines. Only allow natural fertilizers to be introduced in the community gardens. Institute a recycling programme at all residential units and commercial buildings. 			
CUMULATIVE IMPACTS:	<p>The proposed activity will contribute to the cumulative effect of pollution in the area.</p> <p>It is expected that the cumulative impact of artificial lighting caused by the proposed activity would be direct and additive.</p>			
RESIDUAL IMPACTS:	The proposed infrastructure is of such a nature that it would not be possible to regain the status quo after decommissioning of the activity.			

7 POLICY CONTEXT

The Joburg Regional Spatial Development Framework: Region E (2010) recognises that the project site is a large, relatively underutilised Sub Area and is one of the last remaining open tracts in the city. It further notes that it is the location of critical public health institutions.

The Sub Area is located within a Growth Management Strategy (GMS) Consolidation Area and, subsequently, the relevant GMS guidelines will apply (refer below).

In addition, the objective of the Rietfontein Farm area, as provided in the RSDF, is to *reinforce this area as an institutional node focusing on the medical field and to promote residential development*.

The following interventions and guidelines are also put forward in the RSDF.

INTERVENTIONS		GUIDELINES
1.1	Support low income residential development within the Sub Area	<ul style="list-style-type: none"> Implement the Alexandra Development Framework (2002). Support 70-200du/ha within the Sub Area.
1.2	Contain the neighbourhood nodes in the Sub Area	<ul style="list-style-type: none"> Contain the Linksfield Terrace Centre on Linksfield Road to its current development footprint.
1.3	Modderfontein Road has been identified as a Mobility Spine	<ul style="list-style-type: none"> Ensure easy access to the medical facilities. Provide sufficient public transport, pedestrian pathways and informal trading facilities in order to improve the accessibility of Edenvale Hospital.
1.4	Club Street, George Avenue, Linksfield Drive have been classified as Mobility Roads.	<ul style="list-style-type: none"> Limit direct access from these Mobility Roads.
1.5	Protect the quality and integrity of the environment.	<ul style="list-style-type: none"> Protect environmentally sensitive areas within the Sub Area from illegal dumping so that they may form part of the Johannesburg Open Space System. Protect the Jukskei River and its tributaries.

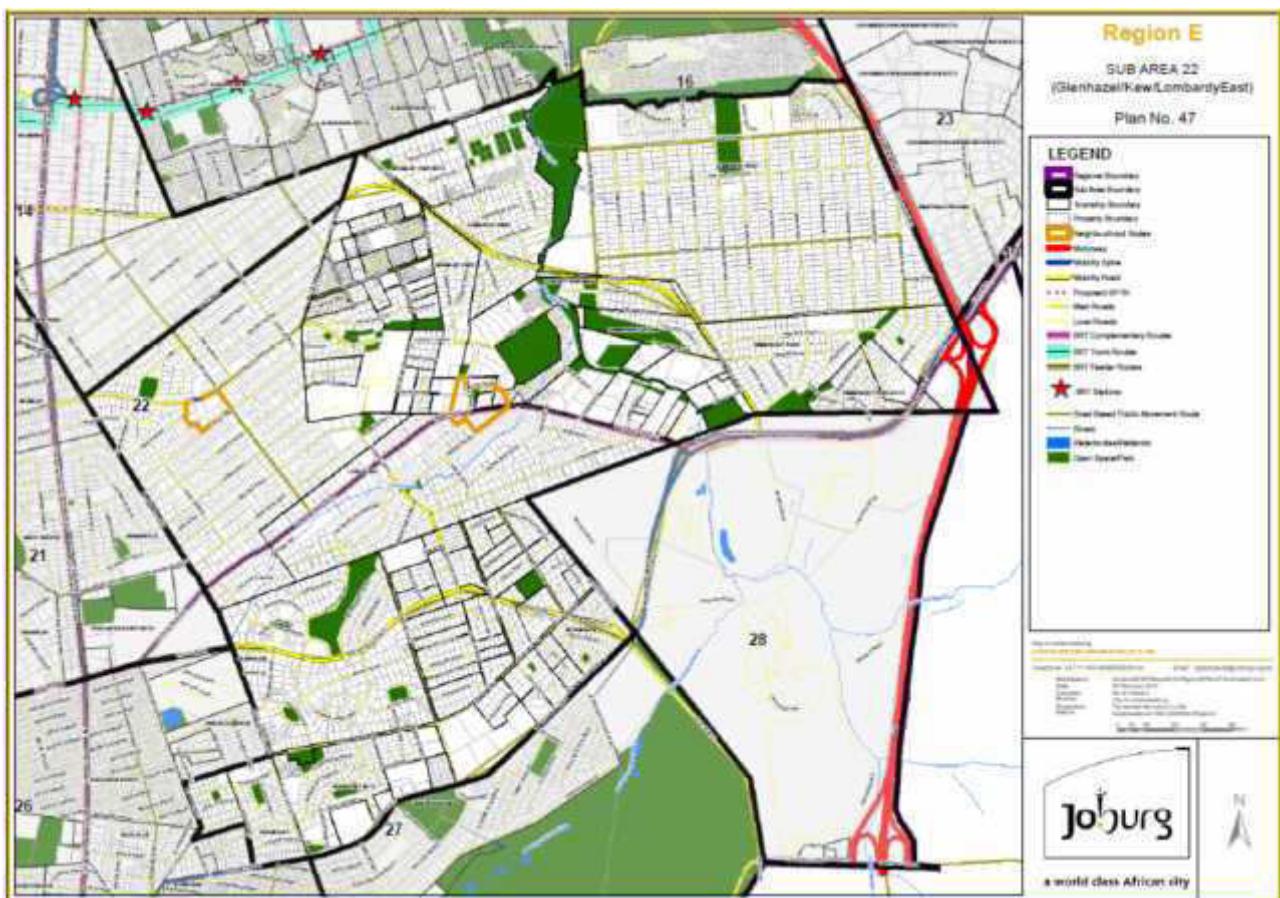


Figure 14: Spatial Plan for Sub Area 28.

7.1 Growth Management Strategy

The GMS prescribes where, and under what conditions, growth can be accommodated. The future growth of the City must ensure that population and economic growth is supported by complimentary services and infrastructure whilst also meeting spatial and socio-economic objectives. The two key objectives of the strategy are to:

- a) Determine priority areas for short-medium term investment and allocation of future development rights.
- b) Re-direct the respective capital investment programmes of the City's service providers to address the short-term hotspots and strategic priority areas.

The GMS sets high, medium and low priority areas across the City and describes specific interventions. The list below provides a summary of the other seven Development Strategies of the sub-region:

- Supporting an efficient movement system
- Ensuring strong viable nodes.
- Supporting sustainable environmental management.
- Initiating and implementing corridor development.
- Managing urban growth and delineating and urban development boundary.
- Increased densification of strategic locations.
- Facilitating sustainable housing environments in appropriate locations.

8 IMPACT STATEMENT

The on-site verification from the selected Key Observation Points and the viewsheds generated from the latter points indicated that the project site is not visible from observation points in the middle and background, but only from selected observation points in the foreground. To this end, the results of the viewshed analysis from defined Key Observation Points, together with a photograph indicating the actual view has been included under Annexure 2.

The results of the Visual Impact Assessment for the proposed Linksfield mixed-use development therefore found that the proposed activity will have a **low negative** impact from KOPs identified in the *foreground* (<1km), without mitigation, and a **low positive** impact if the mitigation measures are implemented.

8.1 Recommendations

Based on the above and the documentation attached under Annexure 2, it is herewith recommended that the proposed mitigation measures, in addition to those listed in the tables above, and the Environmental Management Programme described in section 9 below, be implemented, should the proposed activity be approved:

- a) A *Construction Phase and Operational Phase* Environmental Management Plan must be prepared which should guide and control all aspects of the development, including visual aspects.
- b) An Environmental Control Officer (ECO) must be appointed to oversee the construction process and ensure compliance with conditions of approval.
- c) An Environmental Management Specifications document must be prepared and adhered to.
- d) A Site Development Plan and Landscaping Plan must be prepared to serve as basis for all landscaping to be undertaken.
- e) An Urban Design, Architectural and Landscape Architectural Design Framework document must be prepared and adhered to with regard to the architectural styles, forms and layout of buildings and structures.
- f) Buildings and structures must be in keeping with regional policy documents, especially the principles of critical regionalism, which guide planning and design, namely Sense of Place, Sense of History, Sense of Craft, Sense of Nature and Sense of Limits.



Figure 15: Proposed recommendations.

9 ENVIRONMENTAL MANAGEMENT PROGRAMME

The management plan tables aim to summarise the key findings of the visual impact report and to suggest possible management actions in order to mitigate the potential visual impacts.

Table 9: Environmental Management Programme – Planning Phase

OBJECTIVE: To establish a facility that would have the least intrusive impact on the landscape and not create a detrimental visual impact.		
Project component/ s	All development components as listed in Chapter 3 above.	
Potential Impact	Potential visual intrusion in the area and damage to the natural environment.	
Activity/ risk source	Potential impact on sensitive receptors within the <i>foreground</i> .	
Mitigation: Target/ Objective	Diligent planning of the proposed facility to minimise the expected visual impact.	
Mitigation: Action/ control	Responsibility	Timeframe
Prepare an environmental constraints plan to establish the environmental sensitive areas and those areas upon which the development may occur.	Proponent	In the planning phase
Plan vegetated and landscaped areas along the N2 to minimise visual impacts onto the site.	Proponent / planners / landscape architect	In the planning phase
Plan park like areas along the ridge of the project site to prevent large buildings from breading the skyline.	Proponent / planners / landscape architect	In the planning phase
Design buildings to reflect the local architecture and sense of place of the region.	Proponent / contractor	Pre-construction
Performance Indicator	Well maintained development that has a small footprint on the environment. Natural processes continuing to occur unhindered. All actions to be measured against the Operational Phase Environmental Management Plan.	
Monitoring	N/A	

Table 10: Environmental Management Programme – Construction Phase

OBJECTIVE: Mitigate the possible visual impact associated with the construction phase.		
Project component/ s	Construction site	
Potential Impact	Visual impact of general construction activities and associated impacts.	
Activity/ risk source	Potential impact on sensitive receptors within the <i>foreground</i> .	
Mitigation: Target/ Objective	Minimal visual intrusion by construction activities and general acceptance and compliance with Environmental Specifications.	
Mitigation: Action/ control	Responsibility	Timeframe
An Environmental Control Officer (ECO) must be appointed to oversee the	Proponent	Pre-construction

construction process and ensure compliance with conditions of approval.		
Contractor to sign and undertake to comply with Environmental Specifications.	Contractor	Pre-construction
Demarcate sensitive areas and no-go areas with danger tape to prevent disturbance during construction.	Proponent / contractor	Pre-construction
Keep disturbed areas to a minimum.	Proponent / contractor	Throughout construction
Identify suitable areas within the construction site for administrative offices, storage, workshops, eating areas, ablution facilities and washing areas.	Proponent / contractor	Throughout construction
Institute a solid waste management programme to minimise waste generated on the construction site, and recycle where possible.	Proponent / contractor	Throughout construction
Reduce and control dust through the use of approved dust suspension techniques as and when required.	Proponent / contractor	Throughout construction
Institute a rigorous planting regime in collaboration with the appointed botanical specialist.	Proponent / contractor	Construction
Performance Indicator	Construction site is confined to the demarcated areas identified on a Development Plan. No transgression of the Environmental Specifications visible and natural processes occurring freely outside boundaries of the construction site.	
Monitoring	Monitoring to be undertaken by an appointed Environmental Control Officer who will enforce compliance with the Environmental Specifications.	

Table 11: Environmental Management Programme – Operational Phase

OBJECTIVE: Mitigate the possible visual impact associated with the operational phase.		
Project component/ s	Crusher plant and rock dumps and stockyards including ancillary infrastructure such as an electrical substation, weighbridge, workshops, storage building, and offices.	
Potential Impact	Potential visual intrusion in the area and damage to the natural environment.	
Activity/ risk source	Potential impact on sensitive receptors within the <i>foreground</i> .	
Mitigation: Target/ Objective	A development that fits in with the landscape, that is well maintained and managed.	
Mitigation: Action/ control	Responsibility	Timeframe
Maintain the general appearance of the development as a whole.	Proponent / contractor	Throughout operational phase
Monitor the streams and rivers to prevent pollution of freshwater systems.	Proponent / contractor	Throughout operational phase

Performance Indicator	Well managed development that has a small footprint on the environment. Natural processes continuing to occur unhindered. All actions to be measured against the Operational Phase Environmental Management Plan.
Monitoring	ECO to undertake monitoring functions for a year after construction has been completed to ensure compliance with mitigation measures. Management thereafter to be undertaken by the HOA.

10 REFERENCES

Administrative Region E. (2010). RSDF Region E

Chief Director of Surveys and Mapping, varying dates. *1:50 000 Topo-cadastral Maps and Data*.

City of Johannesburg. (2003). Joburg Regional Spatial Development Framework.

Johannesburg. 26°08'41.08" S and 28°07'24.87"E. Google Earth. 7 November 2013

Dennis Moss Partnership (2010). *Visual Impact Assessment for portions of the Farm Hartenbosch No. 217*.

MetroGIS (Pty) Ltd. (2009). *Visual Impact Assessment for the proposed Vele Colliery*.

Mucina and Rutherford (2006). *The vegetation map of South Africa, Lesotho and Swaziland*. SANBI, Pretoria.

Oberholzer, B. (2005). *Guideline for involving visual and aesthetic specialists in EIA processes*: Edition 1.

Rolston, H. (1994). *Conserving natural value: Perspectives in biological diversity series*. New York: Columbia University Press.

SRK Consulting. (2007). *Visual Impact Assessment Report for the Proposed Sibaya Precinct Development*. Report Prepared for Moreland (Pty) Ltd.

<http://chamisa.freeshell.org/pollution.htm>

http://www.saexplorer.co.za/south-africa/climate/johannesburg_climate.asp

ZONE LAND SOLUTIONS

7 NOVEMBER 2013

Declaration of Independence

I, Jacques Louis Volschenk, representing Zone Land Solutions (Pty) Ltd., hereby declares that I am an independent consultant appointed to provide specialist input for a VIA assessment. I confirm that I have no personal financial interest in the project other than remuneration for the VIA study itself, and neither I nor Zone Land Solutions (Pty) Ltd. will benefit in any other way from the outcomes of this VIA study. I further declare that opinions expressed in this report have been formulated in an objective manner without interference from any third party.

Jacques Volschenk

Print Name



Signature

11 November 2013

Date

Fauna and Flora reports

Annexure S

GALAGO ENVIRONMENTAL



Biodiversity & Aquatic Specialists

638 Turf Street
Wingate Park, 0181
Tel: 012-345 4891
Fax: 086 675 6136
Email: Vanessam@lantic.net

ADDENDUM

To the wetland assessment (site and soil survey) Draft Report, as compiled by J.H van der Waals (Terrasoil Science) for the Linksfield project.

December 2013

Compiled by: Mr Bertus Fourie (Cert. Sci. Nat: B. Tech Nat. Cons.)

1. Scope of work

Wetland delineation assessment was done for Portion 1 of the Farm Rietfontein 61 IR (Linksfield) by Terrasoil Science (Figure 1) as well as Galago Environmental (Figure 2). Some discrepancies were found between the two delineations of the wetlands occurring on site. These discrepancies are mainly due to the interpretation of aspects as found on site.

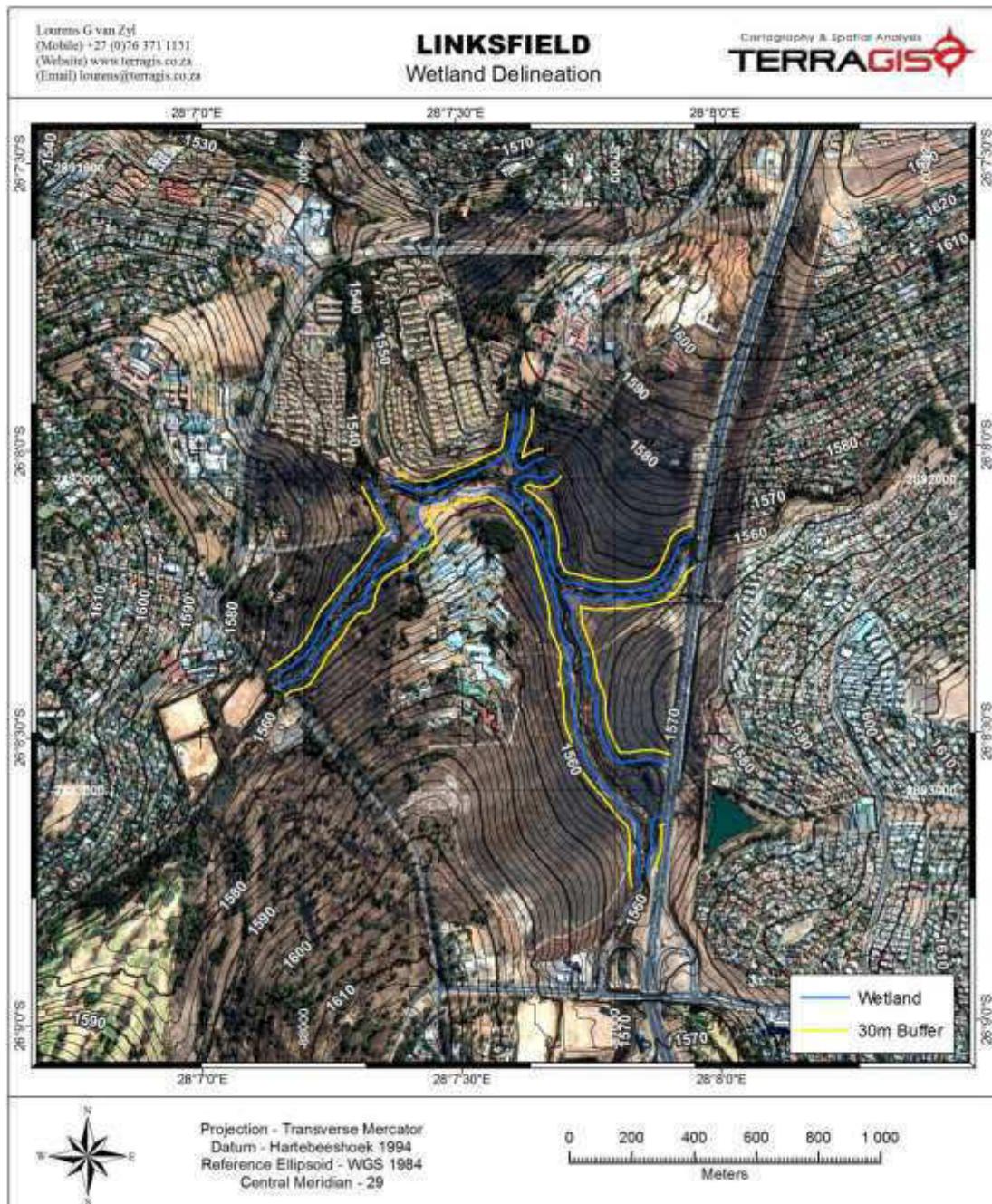


FIGURE 1: WETLAND DELINEATION MAP PROVIDED BY TERRASOIL SCIENCE.

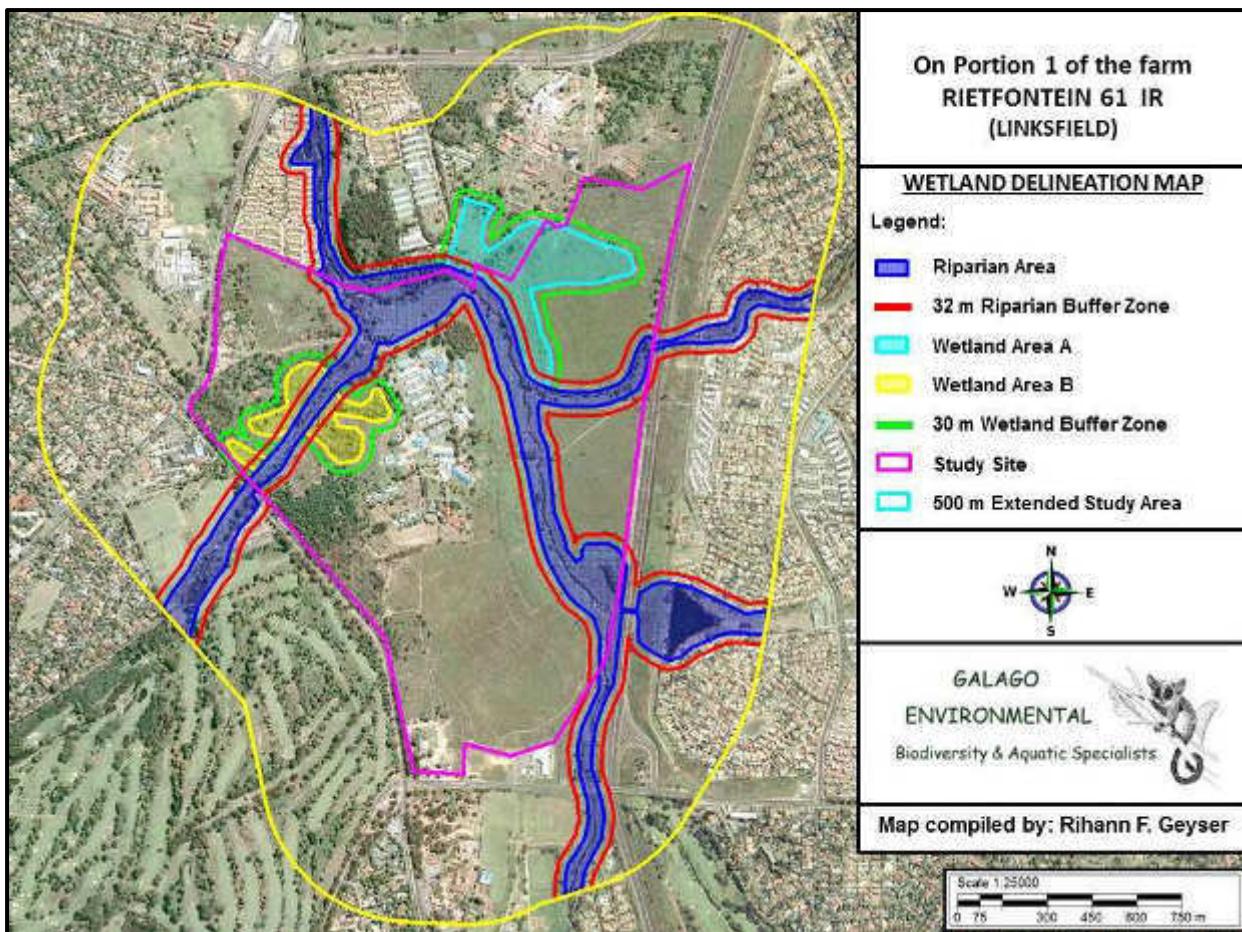


FIGURE 2: THE GALAGO ENVIRONMENTAL AQUATIC ECOSYSTEMS DELINEATION MAP OF THE STUDY SITE

2. Findings

The main area where discrepancies were found was at the wetland area B (should have been named drainage area) of the Galago Environmental map (this area is of concern to the author as the movement of water will be influenced by any developments here) as well as the wetland area A. Wetland area A does not have clear wetland indicators but *Trachyandra erythrorrhiza* a wetland associated red list plant was found here. This area was classified as wetland to specifically allow for the conservation of the *T. erythrorrhiza*.

2.1. *Trachyandra erythrorrhiza*¹

Trachyandra erythrorrhiza flowers from September to November. A plant specialist can identify the plant by its leaves and seed capsules outside the flowering time of the species. In addition, the roots of the plant, which are fleshy and red, can be examined by carefully digging alongside the plant to expose some of the roots without further disturbing the plant.

The plants grow in marshy areas in grassland, usually in black turf marshes, but have been recorded in other clayey marsh areas as well. It is often accompanied by wetland grass species such as *Imperata cylindrica* and *Leersia hexandra*.

The plant's global conservation status is "Near Threatened", and it is ranked A3 by the Gauteng provincial authorities, meaning it is endemic only in Gauteng and in two other provinces and occurs nowhere else in South Africa or the world.

All priority group A3 populations of Near Threatened plant taxa inside the urban edge must be protected with a buffer zone of 200 meters from the edge of a Red List Plant Species population and those outside the urban edge with a buffer zone of at least 400 (four hundred) meters from the edge of the Red List Plant Species population.

3. Recommendations

It is recommended that the wetland area A (Figure 3) be included in the draft wetland delineation report compiled by Terrasoil for the site. This will ensure the correct habitat is protected for the conservation of the *T. erythrorrhiza*.

¹ To be read with the Red List Plant Species Guidelines for Gauteng

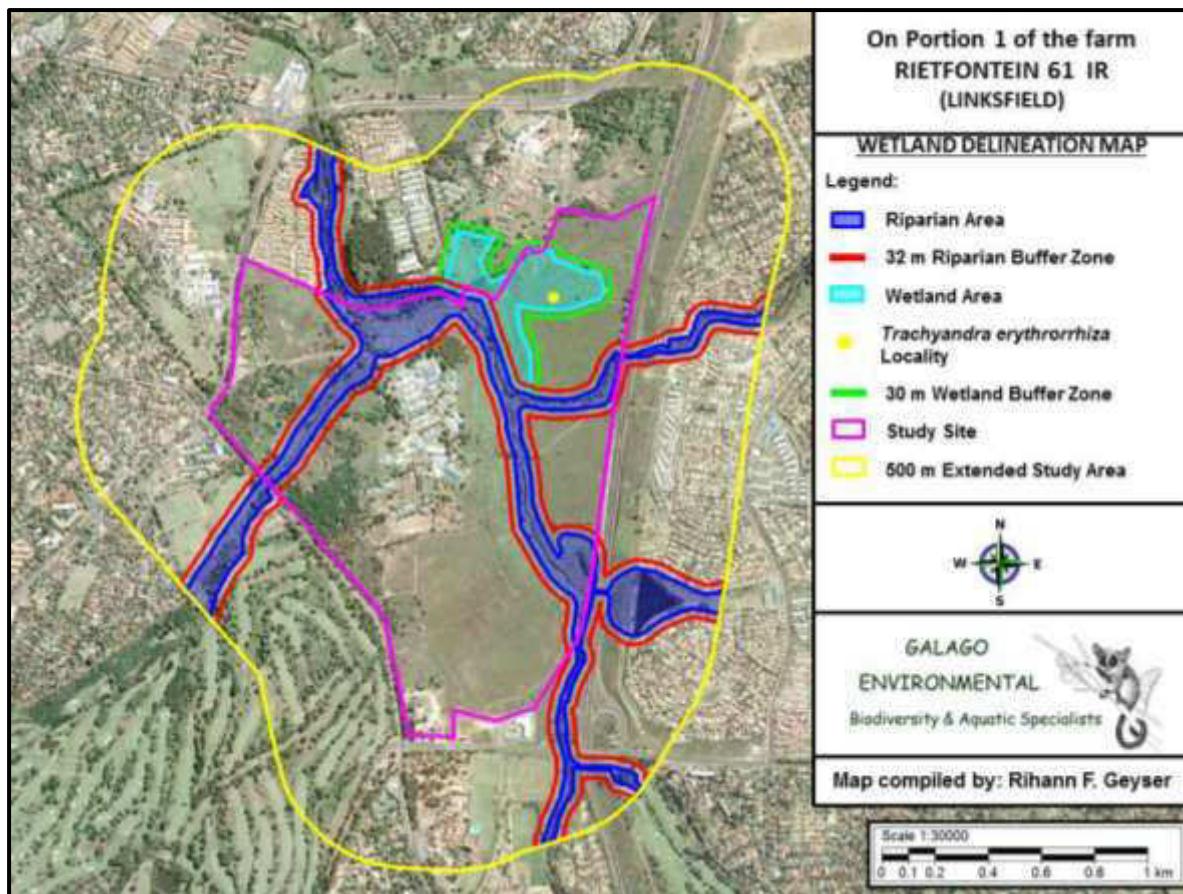


FIGURE 3: THE AREA OF WETLAND THAT MUST BE INCLUDED IN THE TERRASOIL SCIENTIFIC WETLAND DELINEATION MAP TO ENSURE THE CONSERVATION OF *T. ERYTHRORRHIZA*

GALAGO ENVIRONMENTAL

Biodiversity & Aquatic Specialists

638 Turf Street
Wingate Park, 0181

Tel: 012-345 4891

Fax: 086 675 6136

Email: Vanessam@lantic.net

Flora Assessment

of

Portion 1 of the farm Rietfontein 61-IR (LINKSFIELD)

December 2013

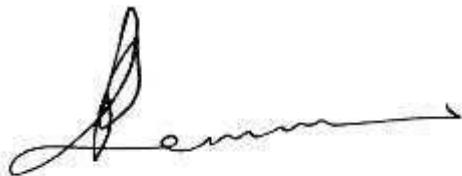
Report author: Mrs. P. Lemmer (Cert. Sci. Nat: B.Sc.)

Report verified/reviewed by: Dr. J.V. van Greuning (D.Sc.,Pr.Sci.Nat)

DECLARATION OF INDEPENDENCE

I, Petro Lemmer (440129 0025 085) declare that I:

- am committed to biodiversity conservation but concomitantly recognize the need for economic development. Whereas I appreciate the opportunity to also learn through the processes of constructive criticism and debate, I reserve the right to form and hold my own opinions and therefore will not willingly submit to the interests of other parties or change my statements to appease them
- abide by the Code of Ethics of the S.A. Council for Natural Scientific Professions
- act as an independent specialist consultant in the field of botany
- am subcontracted as specialist consultant by Galago Environmental CC for the proposed Linksfield development project described in this report
- have no financial interest in the proposed development other than remuneration for work performed
- have or will not have any vested or conflicting interests in the proposed development
- undertake to disclose to Galago Environmental CC and its client as well as the competent authority any material information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations, 2006.



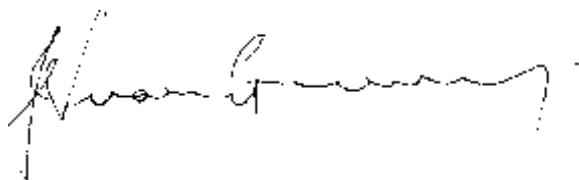
Petro Lemmer

VERIFICATION STATEMENT

Petro Lemmer is a Certified Natural Scientist with the S.A. Council for Natural Scientific Professions. This communication serves to verify that the flora report compiled by Petro Lemmer has been prepared under my supervision, and I have verified the contents thereof.

Declaration of Independence: I, Dr. J.V. van Greuning (400168/08) declare that I:

- am committed to biodiversity conservation but concomitantly recognize the need for economic development. Whereas I appreciate the opportunity to also learn through the processes of constructive criticism and debate, I reserve the right to form and hold my own opinions and therefore will not willingly submit to the interests of other parties or change my statements to appease them
- abide by the Code of Ethics of the S.A. Council for Natural Scientific Professions
- act as an independent specialist consultant in the field of botany
- am subcontracted as specialist consultant by Galago Environmental CC for the proposed Linksfield development project described in this report
- have no financial interest in the proposed development other than remuneration for work performed
- have or will not have any vested or conflicting interests in the proposed development
- undertake to disclose to Galago Environmental CC and its client as well as the competent authority any material information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations, 2006.



Dr. J.V. van Greuning

TABLE OF CONTENTS

1. INTRODUCTION	6
2. OBJECTIVES OF THE STUDY.....	6
3. SCOPE OF STUDY.....	6
4. STUDY AREA	6
4.1 Regional vegetation	6
4.2 The study site	7
5. METHOD	7
6. RESULTS.....	8
6.1 Vegetation study units	8
6.2 Medicinal plants.....	9
6.3 Alien plants.....	9
6.4 Orange List species on the study site.....	10
6.5 Red List species on the study site	10
6.6 Mixed alien and indigenous vegetation	10
6.7 Disturbed <i>Elionurus</i> – <i>Eragrostis</i> grassland	12
6.8 <i>Elionurus</i> – <i>Eragrostis</i> grassland.....	14
6.9 <i>Eragrostis</i> - <i>Senecio</i> Moist Grassland	18
6.10 Wetland vegetation.....	20
6.11 Pasture.....	21
6.12 <i>Hyparrhenia hirta</i> terraced grassland	22
7. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE	24
8. FINDINGS AND POTENTIAL IMPLICATIONS.....	24
9. RECOMMENDED MITIGATION MEASURES	24
10. CONCLUSION	26
11. LITERATURE SOURCES	26
 ANNEXURE A: Red- and Orange List* plants of the 2628AA q.d.s.....	29
ANNEXURE B: Red List plants for biodiversity studies required by GDARD	29
ANNEXURE C: Coordinates for the Red List species.....	30

FIGURES:

Figure 1: Locality map of the study area.....	7
Figure 2: Vegetation study units identified on the study site	8
Figure 3: Mixed alien and indigenous vegetation with grave stones between trees.	11
Figure 4: Disturbed <i>Elionurus</i> – <i>Eragrostis</i> grassland.....	13
Figure 5: <i>Elionurus</i> – <i>Eragrostis</i> grassland north of the drainage line	16
Figure 6: <i>Elionurus</i> – <i>Eragrostis</i> grassland south of the drainage line	16
Figure 7: Narrow strip of <i>Eragrostis</i> - <i>Senecio</i> Moist Grassland vegetation.....	19
Figure 8: One of the drainage lines in the Wetland vegetation study unit.....	21
Figure 9: Lucerne field in the Pasture study unit.....	22
Figure 10: <i>Hyparrhenia hirta</i> terraced grassland with concrete furrow.	23
Figure 11: Vegetation sensitivity map	26

Figure 12: Map showing the locality of the red listed plant and the recommended buffer area	30
---	----

TABLES:

Table 1: Number of medicinal species in the various study units	9
Table 2: Number of Alien species in each study unit	9
Table 3: Plants recorded in the Mixed alien and indigenous vegetation	11
Table 4: Plants recorded in the Disturbed <i>Elionurus – Eragrostis</i> grassland	13
Table 5: Plants recorded in the <i>Elionurus – Eragrostis</i> grassland	16
Table 6: Plants recorded in the <i>Eragrostis-Senecio</i> Moist Grassland vegetation	19
Table 7: Plants recorded in the Wetland vegetation	21
Table 8: Plants recorded in the Pasture study unit	22
Table 9: Plants recorded in the <i>Hyparrhenia hirta</i> terraced grassland.....	23

1. INTRODUCTION

Galago Environmental was appointed to conduct a vegetation survey on Portion 1 of the farm Rietfontein 61-IR (also known as Linksfield), scheduled for mixed use development. The objective was to determine which species might still occur on the site. Special attention had to be given to the habitat requirements of all the Red List species that may occur in the area. This survey focuses on the current status of threatened plant species occurring, or which are likely to occur on the study site, and a description of the available and sensitive habitats on the site and within 200 meters of the boundary of the site.

2. OBJECTIVES OF THE STUDY

- To assess the current status of the habitat component and current general conservation status of the area;
- To list the perceptible flora of the site and to recommend steps to be taken should threatened plant species, plant species of conservation concern and protected plant species be found;
- To highlight potential impacts of the development on the flora of the proposed site; and
- To provide management recommendations to mitigate negative and enhance positive impacts should the proposed development be approved.

3. SCOPE OF STUDY

This report:

- Pertains to the study site as described in subsection 4.2 and is not meant as a report of the general vegetation of the area (subsection 4.1).
- Lists the more noticeable trees, shrubs, herbs, geophytes and grasses observed during the study and offers recommendations about the protection of the sensitive areas on the study site;
- Indicates medicinal plants recorded and lists alien species;
- Comments on connectivity with natural vegetation on adjacent sites;
- Comments on ecological sensitive areas;
- Evaluates the conservation importance and significance of the site with special emphasis on the current status of resident threatened species; and
- Offers recommendations to reduce or minimise impacts, should the proposed development be approved

4. STUDY AREA

4.1 Regional vegetation

The study site lies in the quarter degree square 2627BB (Roodepoort). Mucina & Rutherford (2006) classified the area as Egoli Granite Grassland, with archaean granite and gneiss of the Halfway House Granite at the core of the Johannesburg Dome supporting leached, shallow, coarsely grained, sandy soil poor in nutrients. This grassland falls within a strongly seasonal summer-rainfall region and very dry winters with frequent frosts.

This vegetation unit is considered endangered. Its conservation target is 24%. Only about 3% of this vegetation unit is conserved in statutory reserves and a few private conservation areas. More than two-thirds of the unit has already undergone transformation, mostly by urbanization, cultivation and by building of roads. Current rates of transformation threaten most of the remaining unconserved areas.

4.2 The study site

The study site lies west of, and abuts, highway N3 on the arm Rietfontein 61-IR. Its western-southwestern boundary runs along Modderfontein Road and Club Street and its northern boundary runs along the grounds of the Rand Aid Association and Edenvale Hospital.

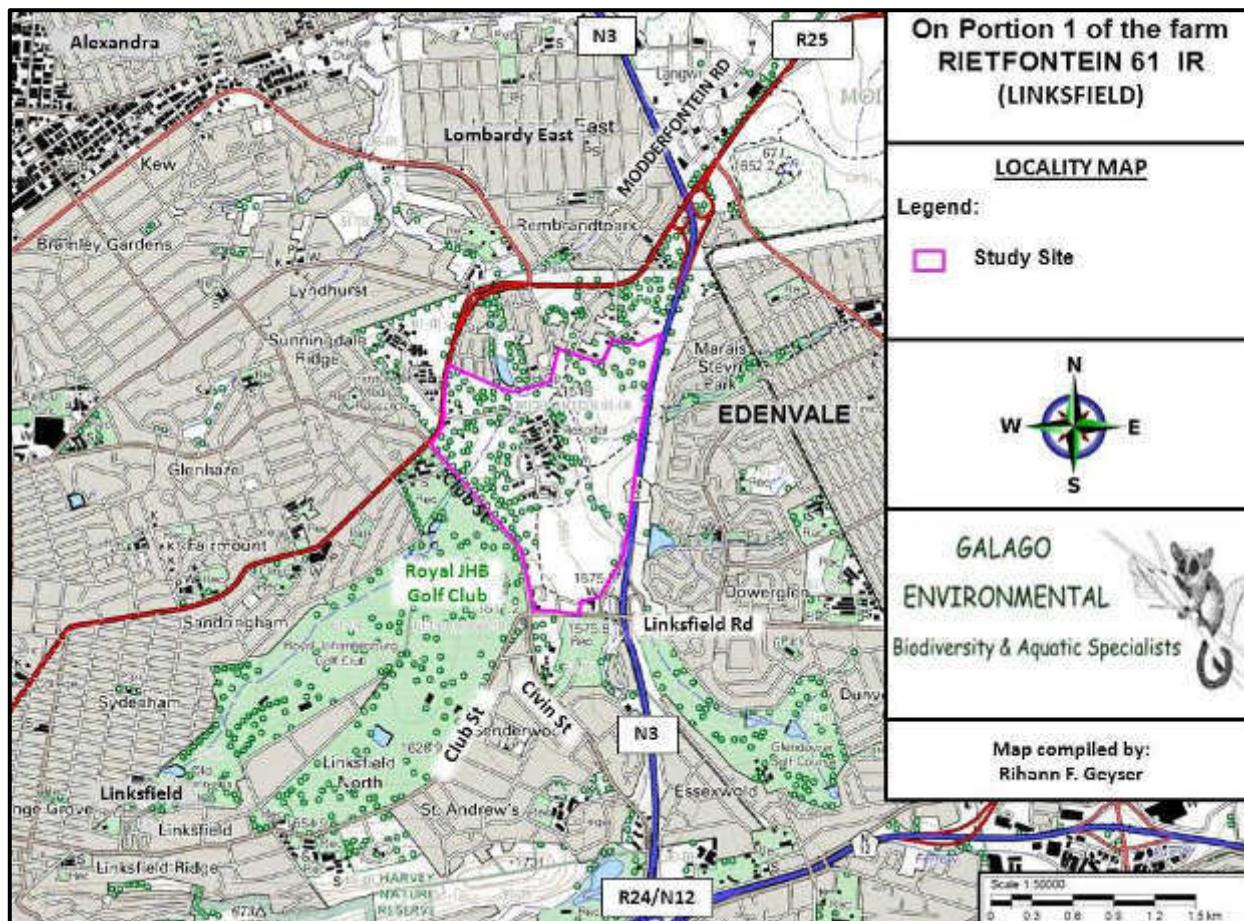


Figure 1: Locality map of the study area

5. METHOD

A desktop study of the habitats of the Red List and Orange List species known to occur in the area was done before the site visit. Information about the Red List and Orange List plant species that occur in the area was obtained from GDARD. Various Acts and Ordinances were consulted about the protected plant species and species of special concern that might occur on the site (Section 11). The Guidelines issued by GDARD to plant specialists as well as various publications (see Section 11) were consulted about the habitat preferences of the Red- and Orange List species concerned.

The list of plants recorded in the 2628AA quarter degree square was obtained from SANBI and consulted to verify the record of occurrence of the plant species seen on the site. The vegetation map published in Mucina and Rutherford (2006) was consulted about the composition of Egoli Granite Grassland.

The study site was visited on 19 October 2013 and again in November 2013 to determine whether suitable habitat for the Red List species known to occur in the quarter degree square, and for those for which biodiversity studies were required by GDARD, existed and to survey the flora present on the site.

The various study units were identified (Figure 2) and one or more plots, depending on the size and composition of the study unit, were selected at random from each study unit for detailed study. Each plot, which measured about 10m x 10m, was surveyed in a random crisscross fashion and the plants recorded. Areas where the habitat was suitable for the Red List species known to occur in the quarter degree square were examined in detail. The entire site was examined for the presence of protected tree species.

The suitability of the habitat for the presence of Red List species on the site and on an extended area within 200 meters of the boundaries of the site was evaluated.

Suitable habitat for Red List species on the neighbouring properties, where accessible, was examined to a distance of 200 m from the boundaries of the site for the presence of Red List plant species.

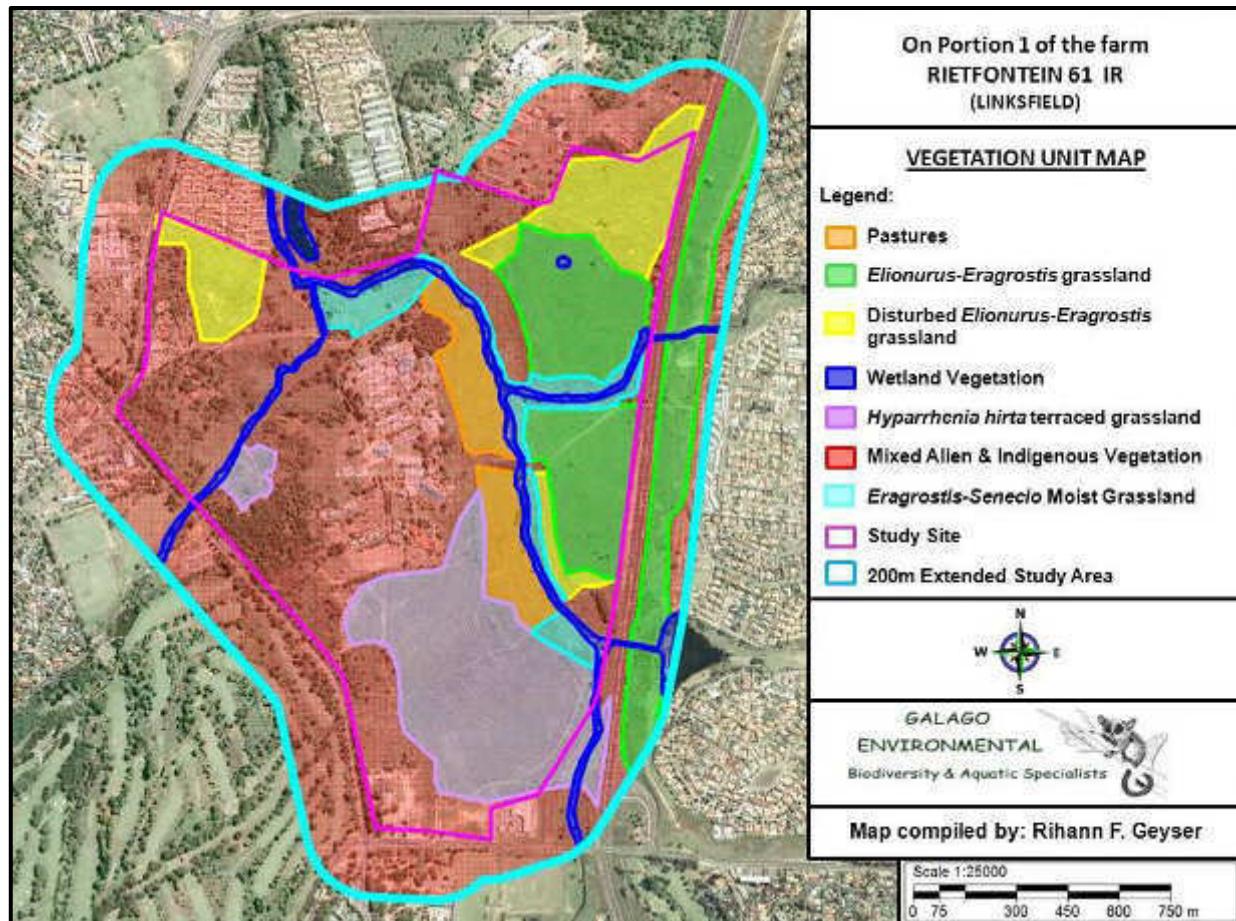


Figure 2: Vegetation study units identified on the study site

6. RESULTS

6.1 Vegetation study units

Seven vegetation study units were identified:

- Mixed alien and indigenous vegetation;
- Disturbed *Elionurus – Eragrostis* grassland;
- *Elionurus – Eragrostis* grassland;
- *Eragrostis-Senecio* Moist Grassland;
- Wetland vegetation;
- Pasture; and
- *Hyparrhenia hirta* terraced grassland.

Tables 3 to 9 list the trees, shrubs, geophytes, herbs and grasses found on each of the surveyed areas of the site.

6.2 Medicinal plants

The names of known medicinal plants are marked with numbers to footnotes in Tables 3 to 9 and the footnotes themselves appear at the end of the last table. Of the 168 plant species recorded on the site, 31 species with medicinal properties were found. Their distribution in the various study units is as follows:

Table 1: Number of medicinal species in the different study units

STUDY UNIT	TOTAL NO OF SPECIES IN STUDY UNIT	NO OF MEDICINAL SPECIES IN STUDY UNIT
Mixed alien and indigenous vegetation	58	8
Disturbed <i>Elionurus – Eragrostis</i> grassland	65	17
<i>Elionurus – Eragrostis</i> grassland	81	26
<i>Eragrostis-Senecio</i> Moist Grassland	43	6
Wetland vegetation	26	1
Pasture	5	0
<i>Hyparrhenia hirta</i> terraced grassland	28	7

6.3 Alien plants

Alien plants are not listed separately, but are included in the lists as they form part of each particular study unit. Their names are marked with an asterisk in Tables 3 to 9. Forty alien plant species, of which three species were Category 1 Declared weeds, eight were Category 2 Declared invaders and two were Category 3 Declared invaders, were recorded on the site. The number of alien species in each study unit is reflected in table 2.

Table 2: Number of Alien species in each study unit

STUDY UNIT	NO. OF ALIEN SPECIES	CAT 1	CAT 2	CAT 3	NOT DECLARED
Mixed alien and indigenous vegetation	29	2	5	2	20
Disturbed <i>Elionurus – Eragrostis</i> grassland	13	1	2	0	10
<i>Elionurus – Eragrostis</i> grassland	3	0	1	0	2
<i>Eragrostis-Senecio</i> Moist Grassland	9	0	2	0	7
Wetland vegetation	14	2	5	1	6
Pasture	3	0	0	0	3
<i>Hyparrhenia hirta</i> terraced grassland	4	0	0	0	4

The alien plant names printed in **bold** in the tables are those of Category 1 Declared Weeds and the removal of these plants is **compulsory** in terms of the regulations formulated under "The Conservation of Agricultural Resources Act" (Act No. 43 of 1983), as amended.

In terms of these regulations, Category 2 Declared invaders may not occur on any land other than a demarcated area and should likewise be removed.

Although the regulations under the above Act require that Category 3 Declared invader plants may not occur on any land or inland water surface other than in a biological control reserve, these provisions shall not apply in respect of category 3 plants already in existence at the time of the commencement of said regulations. If this is the case, a land user must take all reasonable steps to curtail the spreading of propagating material of Category 3 plants.

6.4 Orange List species on the study site

Suitable habitat existed for three of the four Orange List plant species known to occur in the 2628AA quarter degree square. Two of these species were found. (See details in Annexure A.)

6.5 Red List species on the study site

Eleven Red List plant species are known to occur in the 2628AA quarter degree square, two of these within 5 km of the site. However, the habitats on site were not suitable for these two species, but were suitable for two other species known to occur in the quarter degree square. (See Annexure A for a list of the Orange- and Red List species known to occur in the quarter degree square.)

GDARD required biodiversity studies for *Habenaria bicolor*, *Holothrix micrantha*, *Trachyandra erythrorrhiza* and *Gnaphalium nelsonii*. The habitats on site were not suitable for *Holothrix micrantha* or *Gnaphalium nelsonii*, but were suitable for the other two species. A few specimens of *Trachyandra erythrorrhiza* were found (see Annexure B)

6.6 Mixed alien and indigenous vegetation

6.6.1 Compositional aspects

This study unit comprised grassland severely invaded by alien tree species, especially Wattle and Eucalyptus. A large number of gravestones were observed and builders' rubble was dumped between and over the gravestones. Of the 168 plant species recorded on the site 58 were recorded in the Mixed alien and indigenous vegetation study unit. Of these, 29 were indigenous species. The following number of species in each life form was noted:

LIFE FORM	NUMBER OF SPECIES
Annual & perennial herbaceous species	32
Tree species	13
Shrubs and dwarf shrubs	2
Grasses	5
Geophytes	4
Succulents	2
Total No of species	58

6.6.2 Red and Orange List species on the study unit

The habitat of this study unit was not suitable for any of the Red List species or Orange List species known to occur in the quarter degree square.

6.6.3 Medicinal and alien species

Eight of the 31 medicinal species and 29 of the 40 alien species recorded on the site were found in the Mixed alien and indigenous vegetation study unit. Of the alien species two were Category 1 Declared weeds, five were Category 2 Declared invaders and two were Category 3 Declared invaders.

6.6.4 Sensitivity

From a vegetation point of view, this study unit was not considered sensitive. However, a heritage specialist should determine the extent of the grave sites.



Figure 3: Mixed alien and indigenous vegetation with grave stones between trees.

Table 3: Plants recorded in the Mixed alien and indigenous vegetation

SCIENTIFIC NAME	INV CAT	COMMON NAMES
<i>Acacia decurrens</i> *	2	Green wattle / Groenwattel
<i>Acacia karroo</i> ^{1,2}		Sweet thorn / Soetdoring
<i>Acacia melanoxylon</i> *		Australian blackwood
<i>Acalypha caperonioides</i> var. <i>caperonioides</i>		
<i>Agave americana</i> *	2	Century plant / Garingboom,
<i>Arundo donax</i>*	1	Spanish reed / Spaanse riet
<i>Bergia decumbens</i>		
<i>Berkheya radula</i>		Boesmanrietjie
<i>Celtis africana</i>		White stinkwood / Witstinkhout
<i>Cephalaria zeyheriana</i>		Mock scabious
<i>Cirsium vulgare</i>*	1	Scotch thistle / Skotse dissel
<i>Conyza albida</i> *		Tall fleabane / Vaalskraalhans
<i>Conyza podocephala</i>		
<i>Cymbopogon pospischilii</i> *		Turpentine grass / Terpentyngras
<i>Cynodon dactylon</i>		Couch grass / Kweek
<i>Delosperma herbeum</i>		
<i>Eucalyptus</i> sp*	2	Gum tree / Bloekom
<i>Fumaria muralis</i> subsp <i>muralis</i> *		
<i>Gleditsia triacanthos</i> *	2	Honey locust / Driedoring, soetpeul
<i>Gymnosporia buxifolia</i> ²		Spike-thorn / Pendoring
<i>Helichrysum nudifolium</i> var <i>nudifolium</i> ^{1,2}		Hottentot's tea / Hottentotstee
<i>Helichrysum rugulosum</i> ^{2,3}		
<i>Hermannia depressa</i> ^{2,3}		Creeping red Hermannia / Rooi-opslag
<i>Hilliardiella oligocephala</i> ^{1,2}		Cape vernonia / Blounaaldetree bossie
<i>Hypochaeris radicata</i> *		Hairy wild lettuce / Harige skaapslaai
<i>Hypoxis rigidula</i> var <i>rigidula</i>		Silver-leaved star flower / Wilde tulp
<i>Lactuca inermis</i>		Wild lettuce
<i>Lactuca serriola</i>		Wild lettuce / Wilde slaai
<i>Ledebouria ovatifolia</i>		
<i>Ledebouria revoluta</i> ³		Common ledebouria
<i>Ligustrum vulgare</i> *	3	Common privet / Gewone liguster
<i>Medicago sativa</i> *		Lucerne / Lusern
<i>Mellilotus indicus</i> *		Yellow sweet clover / Geelstinkklawer
<i>Morus alba</i> *	3	Common mulberry / Gewone moerbei

SCIENTIFIC NAME	INV CAT	COMMON NAMES
<i>Nemesia fruticans</i>		Wilde leeubekkie
<i>Oenothera rosea*</i>		Pink evening primrose / Pienk aandblom
<i>Ornithogalum tenuifolium</i> subsp <i>tenuifolium</i>		Bosui
<i>Pennisetum clandestinum*</i>		Kikuyu / Kikoejoe
<i>Pennisetum purpureum*</i>		Napier grass / Olifantsgras
<i>Physalis viscosa*</i>		
<i>Pinus</i> sp*	2	Pine / Den
<i>Populus deltoides</i> subsp <i>deltoides</i> *		Cottonwood / Vuurhoutjiepopulier
<i>Prunus persica*</i>		Peach / perske
<i>Rhynchosia monophylla</i>		
<i>Richardia brasiliensis*</i>		Tropical richardia / Tropiese richardia
<i>Rubus</i> sp*		Bramble / Braam
<i>Schkuhria pinnata*</i>		Dwarf marigold / Klein kakiebos
<i>Searsia pyroides</i> var <i>pyroides</i> ⁴		Common wild currant / Taaibos
<i>Senecio</i> sp		
<i>Seriphium plumosum</i>		Bankrupt bush / Bankrotbos
<i>Solanum panduriforme</i>		Poison apple / Gifappel
<i>Tagetes minuta*</i>		Tall khaki weed / Lang kakiebos
<i>Tephrosia semiglabra</i>		
<i>Trachyandra saltii</i> var <i>saltii</i>		
<i>Tragopogon porrifolius*</i>		Yellow goat's beard / Geel bokbaard
<i>Verbena aristigera*</i>		Fine-leaved verbena / Fynblaar verbena
<i>Verbena bonariensis*</i>		Purple top / Blouwaterbossie
<i>Vigna unguiculata</i> subsp <i>stenophylla</i>		

6.7 Disturbed *Elionurus – Eragrostis* grassland

6.7.1 Compositional aspects and Connectivity

This study unit comprised natural grassland disturbed by earthworks and dumped builders' rubble and with some alien trees evident. The Disturbed *Elionurus – Eragrostis* grassland that abuts highway N3 is connected with the natural grassland along the highway, but the smaller area in the west is enclosed by mixed alien and indigenous vegetation. Of the 168 plant species recorded on the site 65 were recorded in the Disturbed *Elionurus – Eragrostis* grassland study unit. Of these, 52 were indigenous species. The following number of species in each life form was noted:

LIFE FORM	NUMBER OF SPECIES
Annual & perennial herbaceous species	40
Tree species	5
Shrubs and dwarf shrubs	2
Grasses	7
Geophytes	10
Succulents	1
Total No of species	65

6.7.2 Red– and Orange List species on the study unit

The habitat of the Disturbed *Elionurus – Eragrostis* grassland study unit was not suitable for the Red List species known to occur in the quarter degree square, but a few specimens of the Orange List *Hypoxis hemerocallidea* were found in the study unit near Modderfontein Road.

6.7.3 Medicinal and alien species

Seventeen of the 31 medicinal species and 13 of the 40 alien species recorded on the site were found in this study unit. Of the alien species one was a Category 1 Declared weed and two were Category 2 Declared invaders.

6.7.4 Sensitivity

The vegetation of this study unit was not considered sensitive. *Hypoxis hemerocallidea* did not occur in sufficient numbers to make a relocation operation viable.



Figure 4: Disturbed *Elionurus – Eragrostis* grassland

Table 4: Plants recorded in the Disturbed *Elionurus – Eragrostis* grassland

SCIENTIFIC NAME	INV CAT	COMMON NAMES
<i>Acacia karroo</i> ^{1,2}		Sweet thorn Soetdoring
<i>Acalypha caperonioides</i> var. <i>caperonioides</i>		
<i>Afrosciadium magalismontanum</i> ²		Wild parsley / Wildepietersielie
<i>Albuca setosa</i>		Slymuntjie
<i>Aster harveyanus</i>		Bloublommetjie
<i>Celtis africana</i>		White stinkwood / Witstinkhout
<i>Cephalaria zeyheriana</i>		Mock scabious
<i>Chamaecrista comosa</i> var. <i>capricornia</i>		
<i>Cirsium vulgare</i> * ¹	1	Scotch thistle / Skotse dissel
<i>Convolvulus sagittatus</i>		
<i>Convolvulus</i> sp		
<i>Conyzza podocephala</i>		
<i>Cyanotis speciosa</i>		Doll's powder puff / Bloupoeierkwassie
<i>Cymbopogon pospischilii</i> *		Turpentine grass / Terpentyngras
<i>Cynodon dactylon</i>		Couch grass / Kweek
<i>Delosperma herbeum</i>		
<i>Elephantorrhiza elephantina</i> ^{1,2,3}		Elephant's root / Olifantswortel
<i>Elionurus muticus</i>		Wire grass / Draadgras
<i>Eragrostis chloromelas</i>		Curly leaf / Krulblaar
<i>Eucalyptus</i> sp*	2	Gum tree / Bloekom
<i>Felicia muricata</i> subsp. <i>muricata</i> ^{1,2,3}		White Felicia / Blouheuning karooblom
<i>Gleditsia triacanthos</i> *	2	Honey locust / Driedoring, soetpeul
<i>Graderia subintegra</i>		Wild penstemon

<i>Heliotropium amplexicaule</i> *	Blue heliotrope
<i>Hilliardiella aristata</i> ^{1,2}	Silver vernonia
<i>Hilliardiella oligocephala</i> ^{1,2}	Cape vernonia / Blounaaldetee bossie
<i>Hyparrhenia hirta</i>	Common thatching grass / Dekgras
<i>Hypochaeris radicata</i> *	Hairy wild lettuce / Harige skaapslaai
<i>Hypoxis argentea</i> var <i>argentea</i>	Small yellow star flower
<i>Hypoxis hemerocallidea</i> ^{1,2,3}	African potato / Gifbol
<i>Hypoxis rigidula</i> var <i>rigidula</i>	Silver-leaved star flower / Wilde tulip
<i>Indigostrum burkeanum</i>	
<i>Ipomoea crassipes</i> var <i>crassipes</i> ^{2,3}	Leafy-flowered Ipomoea / Wildewinde
<i>Ipomoea oblongata</i> ²	
<i>Justicia anagalloides</i>	
<i>Kohautia amatymbica</i> ²	Tremble tops
<i>Lactuca inermis</i>	Wild lettuce
<i>Lebedouria ovatifolia</i>	
<i>Lebedouria revoluta</i> ³	Common ledebouria
<i>Maclegium zeyheri</i> subsp <i>zeyheri</i> ^{2,3}	Doll's protea
<i>Nidorella hottentotica</i>	
<i>Ocimum obovatum</i> subsp <i>obovatum</i> var <i>obovatum</i> ^{2,3}	Cat's whiskers / Katsnor
<i>Ornithogalum tenuifolium</i> subsp <i>tenuifolium</i>	Bosui
<i>Pennisetum clandestinum</i> *	Kikuyu / Kikoejoe
<i>Pentanisia angustifolia</i>	Wild verbena / Sooibrandbossie
<i>Pentarrhinum insipidum</i>	Donkieperske
<i>Plantago lanceolata</i>	Buckhorn plantain / Small weëblaar
<i>Polygala amatymbica</i>	Dwarf polygala
<i>Raphionacme hirsuta</i> ²	Khadi root / Khadiwortel
<i>Rhynchosia monophylla</i>	
<i>Scabiosa columbaria</i> ^{1,2,3}	Wild scabiosa / Bitterbos
<i>Schkuhria pinnata</i> *	Dwarf marigold / Klein kakiebos
<i>Searsia pyroides</i> var <i>pyroides</i> ⁴	Common wild currant / Taaibos
<i>Sida rhombifolia</i> subsp <i>rhombifolia</i>	Arrow leaf Sida / Taaiman
<i>Solanum nigrum</i> *	Nastergal
<i>Tagetes minuta</i> *	Tall khaki weed / Lang kakiebos
<i>Tephrosia semiglabra</i>	
<i>Themeda triandra</i>	Red grass / Rooigras
<i>Tragopogon porrifolius</i> *	Yellow goat's beard / Geel bokbaard
<i>Tulbaghia acutiloba</i>	Wild garlic / Wildekoffel
<i>Verbena aristigera</i> *	Fine-leaved verbena / Fynblaar verbena
<i>Verbena bonariensis</i> *	Purple top / Blouwaterbossie
<i>Vernonia galpinii</i>	Perskwashbossie
<i>Vigna unguiculata</i> subsp <i>stenophylla</i>	
<i>Ziziphus zeyheriana</i> ²	Dwarf buffalo-thorn / Dwerg-blinkblaar-wag-'n-bietjie

6.8 *Elionurus – Eragrostis* grassland

6.8.1 Compositional aspects and Connectivity

This study unit comprised natural primary grassland that had been burned before the site visit and most of the grasses had not yet formed inflorescences. The part of the study unit north of the drainage line contained small rocky outcrops and the species diversity was slightly higher than that of the area south of the drainage line where the vegetation was somewhat trampled by grazing cattle. Connectivity with natural grassland was limited by the highway and by the developed area and secondary grassland to the west. The species diversity of this study unit was high with 48% of all species recorded on the site found in this unit. Of the 168 plant species recorded on the site 81 were recorded in the *Elionurus – Eragrostis* grassland study unit. Of these, 78 were indigenous species. The following number of species in each life form was noted:

LIFE FORM	NUMBER OF SPECIES
Annual & perennial herbaceous species	52
Tree species	2
Shrubs and dwarf shrubs	6
Grasses	6
Geophytes	13
Sedges	1
Succulents	1
Total No of species	81

6.8.2 Red- and Orange List species on the study unit

The habitat of the *Elionurus – Eragrostis* grassland study unit north of the drainage line was suitable for the Red List species *Habenaria bicolor* but as this species only flowers in March, none was observed during the present survey. The habitat was not suitable for the two species known to occur within 5 km of the study site. (See Annexure A for a list of the Orange- and Red List species known to occur in the quarter degree square.)

GDARD required biodiversity studies for *Habenaria bicolor*, *Holothrix micrantha*, *Trachyandra erythrorrhiza* and *Gnaphalium nelsonii*. The habitat of this study unit was not suitable for the last three species, but the study unit north of the drainage line should be examined during March when *Habenaria bicolor* flowers.

A few specimens of the Orange List plant species *Callilepis leptophylla* were found in the study unit but not in such quantities to make a relocation operation viable.

6.8.3 Medicinal and alien species

Twenty-six of the 31 medicinal species recorded on the site were found in this study unit. Three alien species, of which one was a Category 2 Declared invader, were recorded in this study unit.

6.8.4 Sensitivity

The vegetation of the *Elionurus – Eragrostis* grassland study unit north of the drainage line is considered sensitive, but because connectivity with natural grassland on neighbouring sites did not exist, its continued existence as a healthy vegetation unit is doubtful.

The vegetation of the *Elionurus – Eragrostis* grassland study unit south of the drainage line was of low sensitivity.



Figure 5: *Elionurus* – *Eragrostis* grassland north of the drainage line



Figure 6: *Elionurus* – *Eragrostis* grassland south of the drainage line

Table 5: Plants recorded in the *Elionurus* – *Eragrostis* grassland

SCIENTIFIC NAME	INV CAT	COMMON NAMES
<i>Acalypha caperonioides</i> var. <i>caperonioides</i>		
<i>Afrosciadium magalismontanum</i> ²		Wild parsley / Wildepietersielie
<i>Albuca pachychlamys</i>		Slymbol
<i>Albuca setosa</i>		Slymuintjie
<i>Aloe greatheadii</i> var. <i>davyana</i> ^{1,2}		Kleinaalwyn
<i>Asparagus africanus</i>		
<i>Aster harveyanus</i>		Bloubloemetjie

SCIENTIFIC NAME	INV CAT	COMMON NAMES
<i>Bergia decumbens</i>		
<i>Berkheya radula</i>		Boesmanrietjie
<i>Berkheya zeyheri</i> subsp <i>zeyheri</i>		
<i>Callilepis leptophylla</i> ²		Wild daisy / Bergbitterbossie
<i>Chaetacanthus costatus</i>		
<i>Chamaecrista comosa</i> var. <i>capricornia</i>		
<i>Cheilanthes hirta</i> ^{1,2}		Hairy lip fern / Harige lipvaring
<i>Clematis brachiata</i> ²		Traveler's joy / Klimop
<i>Convolvulus sagittatus</i>		
<i>Cyanotis speciosa</i>		Doll's powder puff / Bloupoeierkwassie
<i>Cymbopogon pospischilii</i> * ²		Turpentine grass / Terpentyngras
<i>Cyperus obtusiflorus</i> var. <i>obtusiflorus</i>		Witbiesie
<i>Drimia calcarata</i>		
<i>Drimia multisetosa</i>		
<i>Elephantorrhiza elephantina</i> ^{1,2,3}		Elephant's root / Olifantswortel
<i>Elionurus muticus</i>		Wire grass / Draadgras
<i>Eragrostis chloromelas</i>		Curly leaf / Krulblaar
<i>Eriosema burkei</i> var. <i>burkei</i>		
<i>Eulophia hians</i> var. <i>hians</i>		Ground orchid / Grondorgidee
<i>Felicia muricata</i> subsp <i>muricata</i> ^{1,2,3}		White Felicia / Blouheuning karooblom
<i>Gazania krebsiana</i> subsp <i>serrulata</i> ³		Common gazania / Botterblom
<i>Gerbera viridifolia</i>		Griekwateebossie
<i>Gladiolus woodii</i>		
<i>Gleditsia triacanthos</i> *	2	Honey locust / Driedoring, soetpeul
<i>Gnidia capitata</i> ^{1,2}		Kerrieblom
<i>Graderia subintegra</i>		Wild penstemon
<i>Gymnosporia buxifolia</i> ²		Spike-thorn / Pendoring
<i>Helichrysum nudifolium</i> var. <i>nudifolium</i> ^{1,2}		Hottentot's tea / Hottentottee
<i>Helichrysum rugulosum</i> ^{2,3}		
<i>Heliotropium amplexicaule</i> *		Blue heliotrope
<i>Hermannia depressa</i> ^{2,3}		Creeping red Hermannia / Rooi-opslag
<i>Hibiscus aethiopicus</i> var. <i>ovatus</i> ^{2,3}		Common dwarf Hibiscus
<i>Hilliardiella aristata</i> ^{1,2}		Silver vernonia
<i>Hilliardiella oligocephala</i> ^{1,2}		Cape vernonia / Blounaaldetee bossie
<i>Hyparrhenia tamba</i>		Blue thatching grass / Blou tamboekiegas
<i>Hypoxis galpinii</i>		
<i>Hypoxis rigidula</i> var. <i>rigidula</i>		Silver-leaved star flower / Wilde tulp
<i>Indigostrum burkeanum</i>		
<i>Indigofera heterotricha</i>		
<i>Indigofera hilaris</i> var. <i>hilaris</i>		Red indigo bush
<i>Ipomoea bathycolpos</i>		Veldsambreeltjies
<i>Ipomoea oblongata</i> ²		
<i>Jamesbrittenia aurantiaca</i>		Cape saffron / Saffraanbossie
<i>Justicia anagalloides</i>		
<i>Kohautia amatymbica</i> ²		Tremble tops
<i>Ledebouria ovatifolia</i>		
<i>Ledebouria revoluta</i> ³		Common ledebouria
<i>Macleum zeyheri</i> subsp <i>zeyheri</i> ^{2,3}		Doll's protea
<i>Melinis nerviglumis</i>		Bristle leaf red top / Steekblaarblinkgras
<i>Ocimum obovatum</i> subsp <i>obovatum</i> var. <i>obovatum</i> ^{2,3}		Cat's whiskers / Katsnor
<i>Ornithogalum tenuifolium</i> subsp <i>tenuifolium</i>		Bosui
<i>Parapodium costatum</i>		
<i>Pearsonia sessilifolia</i> subsp <i>sessilifolia</i>		Silwerertjettee
<i>Pellaea calomelanos</i> var. <i>calomelanos</i> ^{1,2}		Black cliff brake / Swart kransruigtevaring
<i>Pentanisia angustifolia</i>		Wild verbena / Sooibrandbossie
<i>Polygala amatymbica</i>		Dwarf polygala
<i>Polygala hottentotta</i> ^{2,3}		Small purple broom
<i>Rhynchosia monophylla</i>		

SCIENTIFIC NAME	INV CAT	COMMON NAMES
<i>Rhynchosia totta</i> var. <i>totta</i>		Yellow carpet bean / Tottabossie
<i>Scabiosa columbaria</i> ^{1,2,3}		Wild scabiosa / Bitterbos
<i>Searsia rigida</i>		Kliptaaibos
<i>Senecio affinis</i>		
<i>Senecio coronatus</i>		Sybossie
<i>Senecio scitus</i>		
<i>Seriphium plumosum</i>		Bankrupt bush / Bankrotbos
<i>Sisyranthus randii</i>		
<i>Solanum panduriforme</i>		Poison apple / Gifappel
<i>Themeda triandra</i>		Red grass / Rooigras
<i>Thesium sp 1</i>		
<i>Thesium sp2</i>		
<i>Trachyandra saltii</i> var. <i>saltii</i>		
<i>Tulbaghia acutiloba</i>		Wild garlic / Wildeknoffel
<i>Vernonia galpinii</i>		Perskwassbossie
<i>Ziziphus zeyheriana</i> ²		Dwarf buffalo-thorn / Dwerg-blinkblaar-wag-'n-bietjie

6.9 *Eragrostis-Senecio* Moist Grassland

6.9.1 Compositional aspects

This study unit consisted of low-lying natural grassland along the drainage lines. Most of the vegetation was burned during winter and most of the grasses had not yet formed inflorescences. Of the 168 plant species recorded on the site 43 were recorded in the *Eragrostis-Senecio* Moist grassland study unit. Of these, 34 were indigenous species. The following number of species in each life form was noted:

LIFE FORM	NUMBER OF SPECIES
Annual & perennial herbaceous species	30
Tree species	1
Shrubs and dwarf shrubs	2
Grasses	7
Geophytes	1
Sedges	1
Succulents	1
Total No of species	43

6.9.2 Red- and Orange List species on the study unit

The habitat of this study unit is not suitable for any of the Red List species, but was suitable for the Orange List *Hypoxis hemerocallidea*. None was, however, found.

6.9.3 Medicinal and alien species

Six medicinal species and 9 alien species were recorded in this study unit. Of the alien species, two were Category 2 Declared invaders.

6.9.4 Sensitivity

Because of its close proximity to the drainage line, the vegetation of this study unit was considered sensitive.



Figure 7: Narrow strip of *Eragrostis-Senecio* Moist Grassland vegetation

Table 6: Plants recorded in the *Eragrostis-Senecio* Moist Grassland vegetation

SCIENTIFIC NAME	INV CAT	COMMON NAMES
<i>Acacia karroo</i> ^{1,2}		Sweet thorn / Soetdoring
<i>Acalypha angustata</i>	2	Copper leaf / Katpisbossie
<i>Acalypha caperonioides</i> var. <i>caperonioides</i>		
<i>Agave americana</i> *	2	Century plant / Garingboom,
<i>Agrimonia procera</i> *		Agrimony / Geelklits
<i>Asparagus laricinus</i>		Wild asparagus / Katbos
<i>Bergia decumbens</i>		
<i>Berkheya radula</i>		Boesmanrietjie
<i>Bromus catharticus</i> *		Rescue grass / Reddingsgras
<i>Conyza podocephala</i>		
<i>Cynodon dactylon</i>		Couch grass / Kweek
<i>Epilobium hirsutum</i>		
<i>Eragrostis chloromelas</i>		Curly leaf / Krulblaar
<i>Erythrina zeyheri</i>		Plough-breaker / Ploegbreker
<i>Euphorbia striata</i> var. <i>striata</i>		Melkgas
<i>Fuirena pubescens</i>		
<i>Galium capense</i> subsp. <i>garipense</i>		
<i>Gazania krebsiana</i> subsp. <i>serrulata</i> ³		Common gazania / Botterblom
<i>Harpochloa falx</i>		Caterpillar grass / Ruspergras
<i>Helichrysum nudifolium</i> var. <i>nudifolium</i> ^{1,2}		Hottentot's tea / Hottentotstee
<i>Helichrysum rugulosum</i> ^{2,3}		
<i>Helictotrichon turgidulum</i>		Small oats grass / Klein hawergras
<i>Hermannia depressa</i> ^{2,3}		Creeping red Hermannia / Rooi-opslag
<i>Hilliardiella oligocephala</i> ^{1,2}		Cape vernonia / Blounaaldeetee bossie
<i>Hyparrhenia tamba</i>		Blue thatching grass / Blou tamboekiegrys
<i>Hypoxis argentea</i> var. <i>argentea</i>		Small yellow star flower
<i>Imperata cylindrica</i>		Cottonwool grass / Donsgras
<i>Jamesbrittenia aurantiaca</i>		Cape saffron / Saffraanbossie
<i>Medicago sativa</i> *		Lucerne / Lusern
<i>Mirabilis jalapa</i> *		Four o'clock / Vieruurtjie
<i>Nidorella anomala</i>		
<i>Oenothera rosea</i> *		Pink evening primrose / Pienk aandblom
<i>Oenothera stricta</i> subsp. <i>stricta</i> *		Yellow evening primrose / Geelaandblom
<i>Physalis viscosa</i> *		
<i>Plantago lanceolata</i>		Buckhorn plantain / Small weëblaar
<i>Raphanus raphanistrum</i>		Wild radish / Wilderadys
<i>Rhynchosia adenodes</i>		

<i>Senecio affinis</i>		
<i>Senecio erubescens</i> var. <i>crepidifolius</i>		
<i>Senecio isatideus</i>		Dan's cabbage / Blouvleibossie
<i>Tagetes minuta</i> *		Tall khaki weed / Lang kakiebos
<i>Themeda triandra</i>		Red grass / Rooigras
<i>Wahlenbergia denticulata</i> var. <i>transvaalensis</i>		

6.10 Wetland vegetation

6.10.1 Compositional aspects and Connectivity

This study unit comprised the vegetation of the drainage lines that was very disturbed by the presence of alien species such as *Nasturtium officinale*. A small natural wetland had formed as a result of seepage near the upper boundary of the *Elionurus – Eragrostis* grassland. The species diversity of this study unit was low. Of the 168 plant species recorded on the site 26 were recorded in the Wetland vegetation study unit. Of these, 11 were indigenous species. The following number of species in each life form was noted:

LIFE FORM	NUMBER OF SPECIES
Annual & perennial herbaceous species	6
Tree species	9
Shrubs and dwarf shrubs	3
Grasses	3
Geophytes	1
Sedges	4
Total No of species	26

6.10.2 Red– and Orange List species on the study unit

The habitat of the drainage lines in this study unit was not suitable for any of the Red List species, but about 15 specimens of the Red List *Trachyandra erythrorrhiza* was found in the the small wetland formed as a result of seepage near the upper boundary of the *Elionurus – Eragrostis* grassland (see Annexure C). The habitat was not suitable for *Gnaphalium nelsonii*.

6.10.3 Medicinal and alien species

Fourteen of the 40 alien species recorded on the site were found in the Wetland vegetation study unit. Of these, two were Category 1 Declared weeds, five were Category 2 Declared invaders and one was a Category 3 Declared invader. One medicinal species was found in this study unit.

6.10.4 Sensitivity

As wetlands form biological filters and drainage lines form corridors for the movement of species, which include pollinators of plant species, this study unit was considered sensitive and should be excluded from development. A buffer of 200 meters should be allowed around the Red List species.



Figure 8: One of the drainage lines in the Wetland vegetation study unit.

Table 7: Plants recorded in the Wetland vegetation

SCIENTIFIC NAME	INV CAT	COMMON NAMES
<i>Acacia decurrens</i> *	2	Green wattle / Groenwattel
<i>Arundo donax</i> *	1	Spanish reed / Spaanse riet
<i>Bromus catharticus</i> *		Rescue grass / Reddingsgras
<i>Carex glomerabilis</i>		
<i>Celtis africana</i>		White stinkwood / Witstinkhout
<i>Eleocharis dregeana</i>		Finger sedge
<i>Epilobium hirsutum</i>		
<i>Eucalyptus</i> sp*	2	Gum tree / Bloekom
<i>Fraxinus excelsior</i> *		Common ash
<i>Fuirena pubescens</i>		
<i>Gleditsia triacanthos</i> *	2	Honey locust / Driedoring, soetpeul
<i>Gomphostigma virgatum</i>		River stars / Otterbossie
<i>Imperata cylindrica</i>		Cottonwool grass / Donsgras
<i>Juncus effusus</i>		
<i>Morus alba</i> *	3	Common mulberry / Gewone moerbei
<i>Nasturtium officinale</i> *	2	Water cress / Bronkhors
<i>Populus deltoides</i> subsp <i>deltoides</i> *		Cottonwood / Vuurhoutjiepopulier
<i>Ranunculus multifidus</i>		Common buttercup / Geelbotterblom
<i>Raphanus raphanistrum</i>		Wild radish / Wilderadys
<i>Rubus</i> sp*		Bramble / Braam
<i>Rumex crispus</i> *		Curley dock / Krultongblaar
<i>Salix babylonica</i> var. <i>babylonica</i> *	2	Weeping willow / Treurwilg
<i>Sesbania punicea</i> *	1	Red sesbania / Rooisesbania
<i>Trachyandra erythrorrhiza</i>		
<i>Typha capensis</i> ^{1,2}		Bulrush / Papkuil
<i>Ulmus parvifolia</i> *		Chinese Elm / Fynblaarolm

6.11 Pasture

6.11.1 Compositional aspects and Connectivity

This study unit consisted of planted pasture dominated by *Medicago sativa* (lucern). The species diversity of this study unit was very low. Of the 168 plant species recorded on the site five were recorded in the pasture study unit. Of these three were herbaceous species and two were grasses.

6.11.2 Red– and Orange List species on the study unit

The habitat of this study unit was not suitable for any of the Red List or Orange List species known to occur in the quarter degree square.

6.11.3 Medicinal and alien species

No medicinal species were recorded in this study unit. Three alien species, none of which were declared invaders, were recorded in the Pasture study unit.

6.11.4 Sensitivity

The vegetation of this study unit was not considered sensitive.



Figure 9: Lucerne field in the Pasture study unit.

Table 8: Plants recorded in the Pasture study unit

SCIENTIFIC NAME	COMMON NAMES
<i>Hyparrhenia hirta</i>	Common thatching grass / Dekgras
<i>Medicago sativa*</i>	Lucerne / Lusern
<i>Melilotus indicus*</i>	Yellow sweet clover / Geelstinkklawer
<i>Pennisetum clandestinum*</i>	Kikuyu / Kikoejoe
<i>Senecio affinis</i>	

6.12 *Hyparrhenia hirta* terraced grassland

6.12.1 Compositional aspects

This study unit comprised secondary grassland that had in the past been graded into terraces. This vegetation unit had been burned during winter. A concrete furrow ran parallel to the terraces in the largest portion of this study unit. The species diversity of this study unit was low. Of the 168 plant species recorded on the site 28 were recorded in the *Hyparrhenia hirta* terraced grassland. Of these, 24 were indigenous species. The following number of species in each life form was noted:

LIFE FORM	NUMBER OF SPECIES
Annual & perennial herbaceous species	20
Shrubs and dwarf shrubs	1
Grasses	6
Geophytes	1
Total No of species	28

6.12.2 Red– and Orange List species on the study unit

The habitat of this study unit was not suitable for any of the Red List or Orange List species known to occur in the quarter degree square.

6.12.3 Medicinal and alien species

Seven medicinal were recorded in this study unit. Four alien species, none of which were declared invaders, were recorded in the *Hyparrhenia hirta* terraced grassland study unit.

6.12.4 Sensitivity

From a vegetation point of view this study unit was not considered sensitive. However, a heritage specialist should determine the extent of possible grave sites that exist in the *Hyparrhenia hirta* terraced grassland, according to local lore.



Figure 10: *Hyparrhenia hirta* terraced grassland with concrete furrow.

Table 9: Plants recorded in the *Hyparrhenia hirta* terraced grassland.

SCIENTIFIC NAME	COMMON NAMES
<i>Conyza albida</i> *	Tall fleabane / Vaalskraalhans
<i>Conyza podocephala</i>	
<i>Eragrostis chloromelas</i>	Curly leaf / Krulblaar
<i>Felicia muricata</i> subsp <i>muricata</i> ^{1,2,3}	White Felicia / Blouheuning karooblom
<i>Gomphocarpus fruticosus</i> subsp <i>fruticosus</i> ^{1,2}	Milkweed / Melkbos
<i>Helichrysum nudifolium</i> var <i>nudifolium</i> ^{1,2}	Hottentot's tea / Hottentotstee
<i>Helichrysum rugulosum</i> ^{2,3}	
<i>Hilliardiella oligocephala</i> ^{1,2}	Cape vernonia / Blounaaldetree bossie
<i>Hyparrhenia hirta</i>	Common thatching grass / Dekgras
<i>Lactuca inermis</i>	Wild lettuce
<i>Melinis nerviglumis</i>	Bristle leaf red top / Steekblaarblinkgras

SCIENTIFIC NAME	COMMON NAMES
<i>Melinis repens</i> subsp <i>repens</i>	Red top grass
<i>Nemesia fruticans</i>	Wilde leeubekkie
<i>Nidorella anomala</i>	
<i>Nidorella hottentotica</i>	
<i>Ornithogalum tenuifolium</i> subsp <i>tenuifolium</i>	Bosui
<i>Parapodium costatum</i>	
<i>Pennisetum purpureum</i> *	Napier grass / Olifantsgras
<i>Plantago lanceolata</i>	Buckhorn plantain / Small weëblaar
<i>Polygala hottentotta</i> ^{2,3}	Small purple broom
<i>Scabiosa columbaria</i> ^{1,2,3}	Wild scabiosa / Bitterbos
<i>Senecio affinis</i>	
<i>Tephrosia semiglabra</i>	
<i>Themeda triandra</i>	Red grass / Rooigras
<i>Verbena aristigera</i> *	Fine-leaved verbena / Fynblaar verbena
<i>Verbena bonariensis</i> *	Purple top / Blouwaterbossie
<i>Vigna unguiculata</i> subsp <i>stenophylla</i>	
<i>Wahlenbergia denticulata</i> var <i>transvaalensis</i>	

¹⁾ Van Wyk, B-E., Van Oudtshoorn, B. & Gericke, N. 2002.

²⁾ Watt, J.M. & Breyer-Brandwijk, M.G. 1962.

³⁾ Pooley, E. 1998.

⁴⁾ Van Wyk, B. & Van Wyk P. 1997.

7. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

The site was burned during winter and grasses have not yet developed inflorescences, impeding identification of these species. It is assumed that the species diversity of the grassland study units is much higher than that recorded in the survey.

8. FINDINGS AND POTENTIAL IMPLICATIONS

The *Elionurus – Eragrostis* grassland that abuts the N3 north of the drainage line was primary grassland and deemed sensitive. The habitat of this grassland was suitable for the orchid *Habenaria bicolor* that flowers in March. A small natural wetland, formed as a result of seepage, occurred near the northern boundary of the *Elionurus – Eragrostis* grassland. A Red List species, *Trachyandra erythrorrhiza* was recorded in this small wetland. Development within the recommended buffer zone might destroy the population of this species. A wetland specialist should determine the extent of the wetland and a heritage specialist the number and extent of the graves seen on the site.

No habitat for Red List plants existed on any of the surrounding plots to a distance of 200 m around the study site.

9. RECOMMENDED MITIGATION MEASURES

The following mitigation measures are proposed by the specialist:

- Dumping of builders' rubble and other waste in the areas earmarked for exclusion must be prevented, through fencing or other management measures. These areas must be properly managed throughout the lifespan of the project in terms of fire, eradication of exotics etc. to ensure continuous biodiversity.
- All Declared Weeds and invaders must be removed from the site.

The following mitigation measures were developed by GDARD 2012 (Department Of Agriculture And Rural Development, Directorate of Nature Conservation) and are applicable to the study site:

- An appropriate management authority (e.g. the body corporate) that must be contractually bound to implement the Environmental Management Plan (EMP) and Record of Decision (ROD) during the operational phase of the development should be identified and informed of their responsibilities in terms of the EMP and ROD.
- All areas designated as sensitive in a sensitivity mapping exercise should be incorporated into an open space system. Development should be located on the areas of lowest sensitivity.
- Development structures should be clustered as close as possible to existing development.
- The open space system should be managed in accordance with an Ecological Management Plan that complies with the *Minimum Requirements for Ecological Management Plans* and forms part of the EMP.
- The Ecological Management Plan should:
 - include a fire management programme to ensure persistence of grassland
 - include an ongoing monitoring and eradication programme for all non-indigenous species, with specific emphasis on invasive and weedy species
 - include a comprehensive surface runoff and storm water management plan, indicating how all surface runoff generated as a result of the development (during both the construction and operational phases) will be managed (e.g. artificial wetlands / storm water and flood retention ponds) prior to entering any natural drainage system or wetland and how surface runoff will be retained outside of any demarcated buffer/flood zones and subsequently released to simulate natural hydrological conditions
 - ensure the persistence of all Red and Orange List species
 - include a monitoring programme for all Red and Orange List species
 - facilitate/augment natural ecological processes
 - provide for the habitat and life history needs of important pollinators
 - minimize artificial edge effects (e.g. water runoff from developed areas & application of chemicals)
 - include a comprehensive plan for limited recreational development (trails, bird hides etc.) within the open space system
 - result in a report back to the Directorate of Nature Conservation on an annual basis
- The open space system should be fenced off prior to construction commencing (including site clearing and pegging). All construction-related impacts (including service roads, temporary housing, temporary ablution, disturbance of natural habitat, storing of equipment/building materials/vehicles or any other activity) should be excluded from the open space system. Access of vehicles to the open space system should be prevented and access of people should be controlled, both during the construction and operational phases. Movement of indigenous fauna should however be allowed (i.e. no solid walls, e.g. through the erection of palisade fencing).
- Information boards should be erected within the development to inform residents of the presence of Red / Orange List species, their identification, conservation status and importance, biology, habitat requirements and management requirements.
- Only indigenous plant species, preferably species that are indigenous to the natural vegetation of the area, should be used for landscaping in communal areas. As far as possible, plants naturally growing on the development site, but would otherwise be destroyed during clearing for development purposes, should be incorporated into landscaped areas. Forage and host plants required by pollinators should also be planted in landscaped areas.
- In order to minimize artificially generated surface stormwater runoff, total sealing of paved areas such as parking lots, driveways, pavements and walkways should be avoided. Permeable material should rather be utilized for these purposes.

- The crossing of natural drainage systems should be minimized and only constructed at the shortest possible route, perpendicular to the natural drainage system. Where possible, bridge crossings should span the entire stretch of the buffer zone.

10. CONCLUSION

To lessen the impact of the proposed development on the vegetation of the site, great care should be taken to group residences on smaller lots in certain areas, rather than spreading them out over large areas. Roads, footpaths, services etc should be constructed with great care.

The *Elionurus – Eragrostis* grassland that abuts the N3 highway north of the drainage line also includes a small natural wetland formed as a result of seepage. A Red List species, *Trachyandra erythrorrhiza* was recorded in this small wetland (Annexure C). The *Elionurus – Eragrostis* grassland, the Wetland vegetation and the *Eragrostis-Senecio* Moist grassland vegetation were deemed sensitive and should be excluded from the development and where possible, be connected to other natural grassland areas on the neighbouring properties to facilitate connectivity.

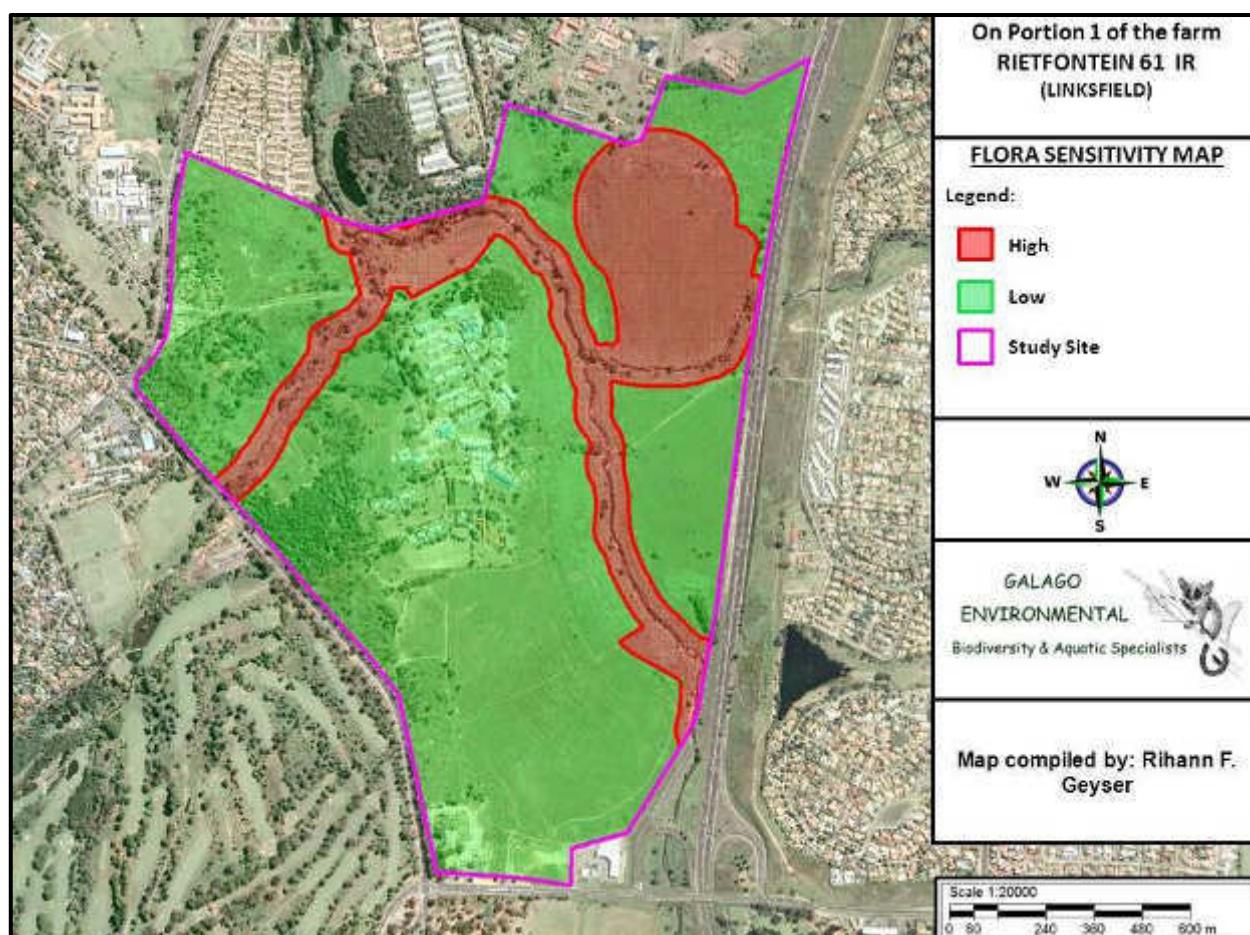


Figure 11: Vegetation sensitivity map

11. LITERATURE SOURCES

- Botha C. 2001. *Common weeds of crops and gardens in southern Africa*. ARC – Grain Crops Institute, Agricultural Research Council, Pretoria.
- Bothalia. 1962. Volume 7 part 4 (South African species of *Anthericum*, *Chlorophytum* and *Trachyandra*). Botanical Research Institute, Department of Agricultural Technical Services, Pretoria.
- Bromilow, C. 2001. *Problem plants of South Africa*. Briza Publications, Pretoria

- Chippindall, L.K.A. et. al. 1955. *The grasses and pastures of South Africa*. Central News Agency, Cape Times Limited, Parow.
- Crouch, N.R., Klopper, R.R., Burrows, J.E, & S.M., 2011. *Ferns of Southern Africa*. Struik Nature, Cape Town.
- Eardley, C. 2002. *Pollinators for Africa*. ARC – Plant Protection Research Institute, Department of Agriculture, Pretoria.
- Eardley, C.; Roth, D.; Clarke, J.; Buchmann, S. and Gemmill, B. 2006. *Pollinators and pollination: a resource book for policy and practice*. African Pollinator Initiative (API)
- Fabian, A. & Germishuizen, G. 1997. *Wild flowers of northern South Africa*. Fernwood Press, Cape Town.
- Flora of Southern Africa. 1985. Vol. 28,4 (Lamiaceae). Botanical Research Institute, Department of Agriculture & Water Supply, Pretoria
- Flowering plants of Africa. 2005. Vol. 59: Plate 2208/9 (*Habenaria bicolor* and *H. kraenzliniana*). South African National Biodiversity Institute, Pretoria.
- Gauteng Nature Conservation Act, 2013. Gauteng Provincial Legislature.
- GDARD, 2012. *Requirements for biodiversity assessments Version 2*. Directorate of Nature Conservation, Department of Agriculture and Rural development.
- GDARD, 2012. *Red List Plant Species Guidelines*. Compiled 26 June 2006 with minor edits in January 2012. Directorate of Nature Conservation, Department of Agriculture and Rural development.
- Germishuizen, G. & Clarke, B. 2003. *Illustrated guide to the Wildflowers of northern South Africa*. Briza Publications, Pretoria.
- Germishuizen, G. & Meyer, N.L. (eds) 2003. *Plants of southern Africa: an annotated checklist. Strelitzia 14*, National Botanical Institute, Pretoria.
- Gibbs Russell, G.E. et. al. 1990. *Grasses of southern Africa. Memoirs of the Botanical survey of South Africa No. 58*. National Botanic Gardens/Botanical Research Institute, South Africa.
- Government Gazette No. 19519. 27 November 1998. National Environmental management Act (NEMA), 1998. (Act 107 of 1998).
- Government Notice R151 Government Gazette No. 29657. 23 February 2007. National Environmental Management: Biodiversity Act, 2004 (Act 10 Of 2004): Publication Of Lists Of Critically Endangered, Endangered, Vulnerable And Protected Species.
- Henderson, L. 2001. *Alien weeds and invasive plants*. Plant Protection Research Institute, Agricultural Research Council, Pretoria.
- Leathart, S. 1977. *Trees of the world*. The Hamlyn Publishing Group, Limited, London.
- Linder, H.P. & Kurzweil, H. 1999. *Orchids of Southern Africa*. A.A. Balkema, Rotterdam.
- Mucina, L. & Rutherford, M.C. 2006. *The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19*. South African National Biodiversity Institute, Pretoria.
- National Environmental Management Act, 1998 (Act 107 of 1998).
- Pfab, M.F. 2002. *Priority ranking scheme for Red Data plants in Gauteng, South Africa*. South African Journal of Botany, Vol 68: 299 – 303.
- Pfab, M.F. & Victor, J.E. 2002. Threatened plants of Gauteng, South Africa. South African Journal of Botany, Vol 68: 370 – 375.
- Pooley, E. 1998. *A field guide to the wild flowers of Kwazulu-Natal and the eastern region*. Natal Flora Publications Trust, Durban.
- Raimondo, D., Von Staden. L., Foden, W., Victor, J.E., Helme, N.A., Turner R.C., Kamundi, D.A. & Manyama, P.A. (eds) 2009. *Red list of South African Plants 2009*. Strelitzia 25. South African National Biodiversity Institute, Pretoria.
- Retief, E. & Herman, P.P.J. 1997. *Plants of the northern provinces of South Africa: keys and diagnostic characters. Strelitzia 6: 1-681*, National Botanical Institute, Pretoria.
- Sheat, W.G. 1982. *The A-Z of gardening in South Africa*. C Struik Publishers, Cape Town.
- Smith, C.A. 1966. *Common names of South African plants*. Botanical Research Institute, Department of Agricultural Technical Services, Pretoria.
- Stewart, J. et. al. 1982. *Wild orchids of southern Africa*. Macmillan South Africa, Johannesburg.
- Van Ginkel, C.E., Glen, R.P., Gordon-Gray, K.D., Cilliers, C.J., Muasya, M. & Van Deventer, P.P. 2011. *Easy identification of some South African wetland plants*. WRC Report No TT 479/10. Water Research Commission, Pretoria.
- Van Oudshoorn, F.P. 2002. *Guide to grasses of southern Africa*. Briza Publications, Pretoria.

- Van Wyk, B. & Malan, S. 1998. *Field guide to the wild flowers of the Highveld*. Struik, Cape Town.
- Van Wyk, B. & Van Wyk P. 1997. *Field guide to trees of southern Africa*. Struik Publishers, Cape Town.
- Van Wyk, B-E., Van Oudtshoorn, B. & Gericke, N. 2002. *Medicinal plants of South Africa*. Briza Publications, Pretoria.
- Watt, J.M. & Breyer-Brandwijk, M.G. 1962. *The medicinal and poisonous plants of southern and eastern Africa*. 2nd edition. Livingstone, London.

ANNEXURE A: Red- and Orange List* plants of the 2628AA q.d.s.

Species	Flower season	Suitable habitat	Priority group	Conserv status	PRESENT ON SITE
<i>Adromischus umbraticola</i> subsp <i>umbraticola</i>	Sep-Jan	Rock crevices on rocky ridges, usually south-facing, or in shallow gravel on top of rocks, but often in shade of other vegetation.	A2	Near threatened ¹	Habitat not suitable
<i>Callilepis leptophylla</i>	Aug-Jan & May	Grassland or open woodland, often on rocky outcrops or rocky hillslopes.	N/A	Declining ²	FOUND
<i>Cineraria austrotransvaalensis</i>	Mar-Jun	Among rocks on steep slopes of hills and ridges as well as at the edge of thick bush or under trees.	A3	Near threatened ¹	Habitat not suitable
<i>Cineraria longipes</i>	Mar-May	Grassland, on koppies, amongst rocks and along seep lines exclusively on basalt on south-facing slopes.	A1	Vulnerable ¹	Habitat not suitable
<i>Delosperma purpureum</i>	Nov-Apr	South-facing slopes, grows in shallow soils among quartzitic rocks of crystalline or coglamorite type in open or broken shade, in grassland with some trees. .	A1	Endangered ¹	Habitat not suitable
<i>Eucomis autumnalis</i>	Nov-Apr	Damp open grassland and sheltered places.	N/A	Declining ²	Habitat suitable
<i>Gunnera perpensa</i>	Oct-Mar	In cold or cool continually moist localities, mainly along upland streambanks.	N/A	Declining ²	Habitat not suitable
<i>Habenaria bicolor</i>	Jan-Apr	Well-drained grassland, at about 1600m.	B	Near Threatened ²	Habitat suitable
<i>Habenaria mossii</i>	Mar-Apr	Open grassland on dolomite or in black sandy soil.	A1	Endangered ¹	Habitat not suitable
<i>Holothrix micrantha</i>	Oct	Terrestrial on grassy cliffs, recorded from 1500 to 1800m.	A1	Endangered ¹	Habitat not suitable
<i>Holothrix randii</i>	Sep-Jan	Grassy slopes & rock ledges, usually southern aspects.	B	Near Threatened ²	Habitat not suitable
<i>Hypoxis hemerocallidea</i>	Sep-Mar	Occurs in a wide range of habitats Grassland and mixed woodland.	N/A	Declining ²	FOUND
<i>Khadia beswickii</i>	Jul-Apr	Open areas on shallow surfaces over rocks in grassland.	A1	Vulnerable ¹	Habitat not suitable
<i>Stenostelma umbelliferum</i>	Sep-Mar	Deep black turf in open woodland mainly in the vicinity of drainage lines.	A3	Near threatened ¹	Habitat not suitable
<i>Trachyandra erythrorrhiza</i>	Sep-Nov	Marshy areas, grassland, usually in black turf marshes.	A3	Near Threatened ¹	FOUND

¹⁾ global status

²⁾ national status

* Orange listed plants have no priority grouping and are designated 'N/A'

▲ Has been recorded from the farm on which the study site is situated / within 5km of the study site. Should suitable habitat be present, it is highly likely that this species occur on the study site.

ANNEXURE B: Red List plants for which biodiversity studies were required by GDARD

Species	Flower season	Suitable habitat	Priority group	Conserv status	PRESENT ON SITE
<i>Gnaphalium nelsonii</i>	Oct-Dec	Seasonally wet grasslands	A2	Rare-sparse ¹	Habitat not suitable
<i>Habenaria bicolor</i>	Jan-Apr	Well-drained grassland, at about 1600m.	B	Near Threatened ²	Habitat suitable
<i>Holothrix micrantha</i>	Oct	Terrestrial on grassy cliffs, recorded from 1500 to 1800m.	A1	Endangered ¹	Habitat not suitable
<i>Trachyandra erythrorrhiza</i>	Sep-Nov	Marshy areas, grassland, usually in black turf marshes.	A3	Near Threatened ¹	FOUND

ANNEXURE C: Coordinates for the Red List species

Trachyandra erythrorrhiza:

S 26° 08' 02,5" / E 28° 07' 48,3"

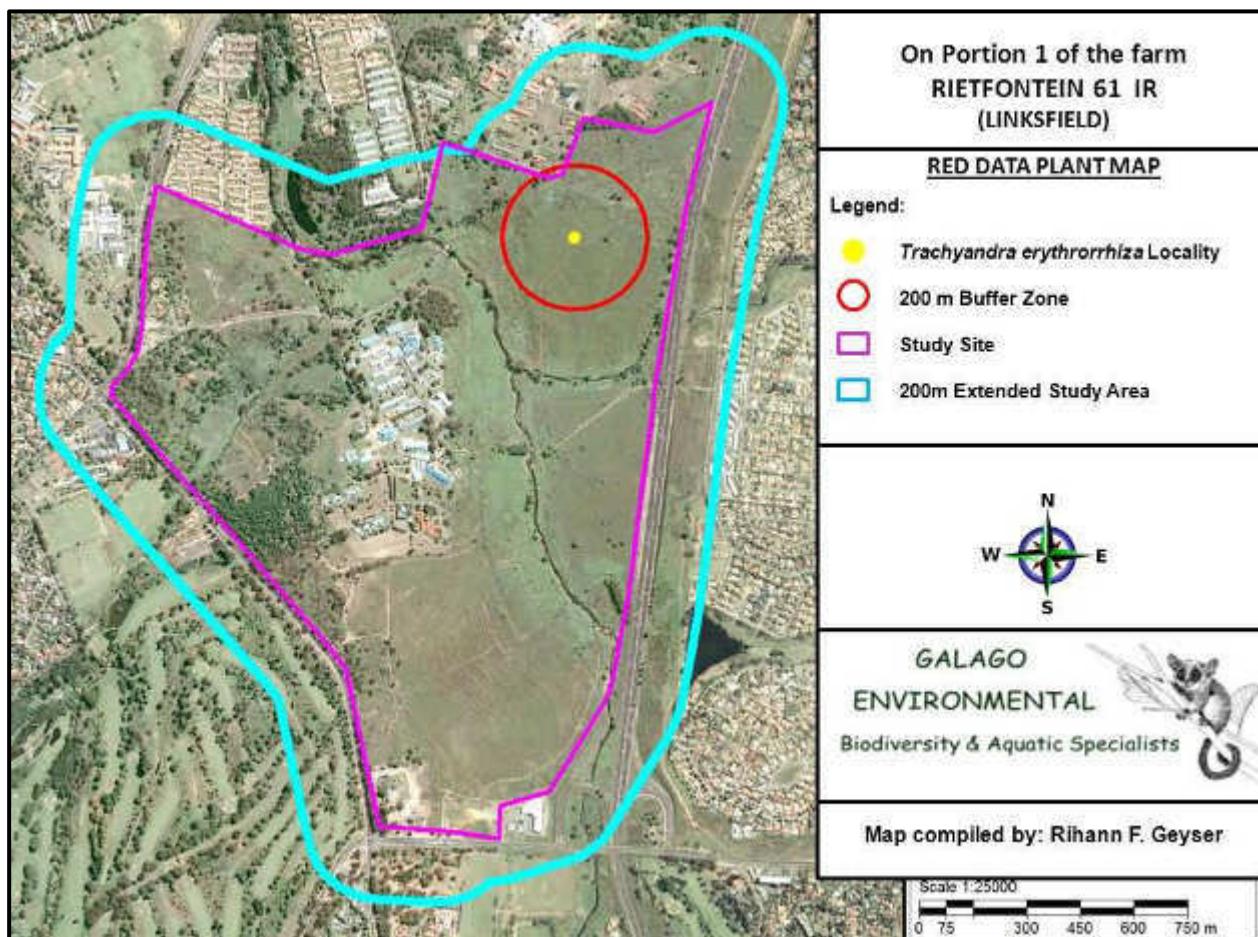


Figure 12: Map showing the locality of the red listed plant and the recommended buffer area

GALAGO ENVIRONMENTAL



Biodiversity & Aquatic Specialists

638 Turf Street
Wingate Park, 0181
Tel: 012-345 4891
Fax: 086 675 6136
Email: Vanessam@lantic.net

Mammal Species Richness and Habitat Assessment

of

Portion 1 of the farm Rietfontein 61-IR (LINKSFIELD)

December 2013

Report author: **Mr. J.C.P van Wyk** (Pri. Sci. Nat: M.Sc)

TABLE OF CONTENTS

1. INTRODUCTION.....	4
2. SCOPE AND OBJECTIVES OF THE HABITAT STUDY	4
3. STUDY AREA.....	4
4. METHOD	5
5. RESULTS	6
6. FINDINGS AND POTENTIAL IMPLICATIONS	13
7. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE.....	15
8. RECOMMENDED MITIGATION MEASURES	15
9. CONCLUSION.....	17
10. LITERATURE SOURCES.....	18

FIGURES:

Figure 1: Locality map of the study site.....	5
Figure 2: Moribund termitarium.	7
Figure 3: Altered terrestrial habitat in the form of old lucerne fields	7
Figure 4: Natural rupiculous habitat.	8
Figure 5: Note the sparse vegetation due to veld fires.....	8
Figure 6: The Jukskei River.	9
Figure 7: A view of the wetland with its aquatic vegetation.	9
Figure 8: Mammal habitat map	14
Figure 9: Mammal sensitivity map.....	18

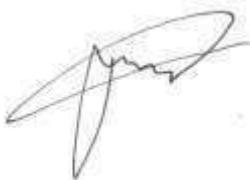
TABLES:

Table 1: Mammals species which were observed or deduced to occupy the site.....	11
Table 2: Mammal species positively confirmed from the study site	13

Declaration of Independence:

I, Jacobus Casparus Petrus van Wyk (68080450410845) declare that I:

- hold a MSc in the biological sciences, which allowed registration by SACNASP (SA Council for National Scientific Professions) as a Professional Zoologist and sanction me to function independently as a specialist scientific consultant
- declare that as per prerequisites of the Natural Scientific Professions Act No. 27 of 2003 this project was my work from inception and reflects exclusively my observations and unbiased scientific interpretations, and executed to the best of my ability
- abide by the Code of Ethics of the SACNASP
- am committed to biodiversity conservation but concomitantly recognize the need for economic development. Whereas I appreciate the opportunity to also learn through the processes of constructive criticism and debate, I reserve the right to form and hold my own opinions and therefore will not willingly submit to the interests of other parties or change my statements to appease them
- abide by the Code of Ethics of the S.A. Council for Natural Scientific Professions
- act as an independent specialist consultant in the field of zoology
- am subcontracted as specialist consultant by Galago Environmental CC for the project "Mammal species Richness and Habitat Assessment on Portion 1 of the Farm Rietfontein 61 IR" described in this report
- have no financial interest in the proposed development other than remuneration for work performed
- have or will not have any vested or conflicting interests in the proposed development
- undertake to disclose to the Galago Environmental CC and its client as well as the competent authority any material information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations 2006
- Our intellectual property in this report will only be transferred to the client (the party/ company that commissioned the work) on full payment of the contract fee. Upon transfer of the intellectual property, we recognise that written consent of the client will be required for release of any part of this report to third parties.



J.C.P. van Wyk

1. INTRODUCTION

Galago Environmental CC was appointed to undertake a mammal habitat survey for a Portion 1 of the Farm Rietfontein 61 IR (elsewhere referred to as the study site), scheduled for mixed use development known as Linksfield.

The objective was to determine which mammal species might still reside on the site. Special attention had to be given to the habitat requirements of all the Red Data species, which may occur in the area. This survey focuses on the current status of threatened mammal species occurring, or which are likely to occur on the proposed development site, and a description of the available and sensitive habitats on the site.

This assignment is in accordance with the 2010 EIA Regulations (No. R. 543-546, Department of Environmental Affairs and Tourism, 18 June 2010) emanating from Chapter 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

2. SCOPE AND OBJECTIVES OF THE HABITAT STUDY

- To qualitatively and quantitatively assess the significance of the mammal habitat components and current general conservation status of the property;
- Identify and comment on ecological sensitive areas;
- Comments on connectivity with natural vegetation and habitats on adjacent sites;
- To provide a list of mammal which occur or might occur, and to identify species of conservation importance;
- To highlight potential impacts of the proposed development on the mammal of the study site, and
- To provide management recommendations to mitigate negative and enhance positive impacts should the proposed development be approved.

3. STUDY AREA

This study site lies in the quarter degree grid cell 2628AA (Johannesburg). The site is located north-east of the Royal Johannesburg Golf Club and west of the N3 National Road. The Sizwe Tropical Disease Hospital forms part of the study site to the west. To the north and east of the study site lies the Modderfontein Road (R25). An important topographical feature of the study site is the Jukskei River which bisects the study site from south to north. Two small seasonal tributaries flow into the Jukskei River. A few wetlands occur along the Jukskei River. Aerial photographs show that the study site west of the Jukskei River used to consist of cultivated lands. To the east of the Jukskei River is a small ridge. Most of the study site slopes gently from both the east and west in the direction of the Jukskei River.

The study site lies inside the Egoli Granite Grassland vegetation type (Mucina & Rutherford, 2006). Exotic trees grow on the banks of the water courses and in some other areas of the study site. The substrate is mostly sandy soil, but near the streams the soil consists of clay. The study site was burnt during winter and new grass was growing at the time of the inspection.

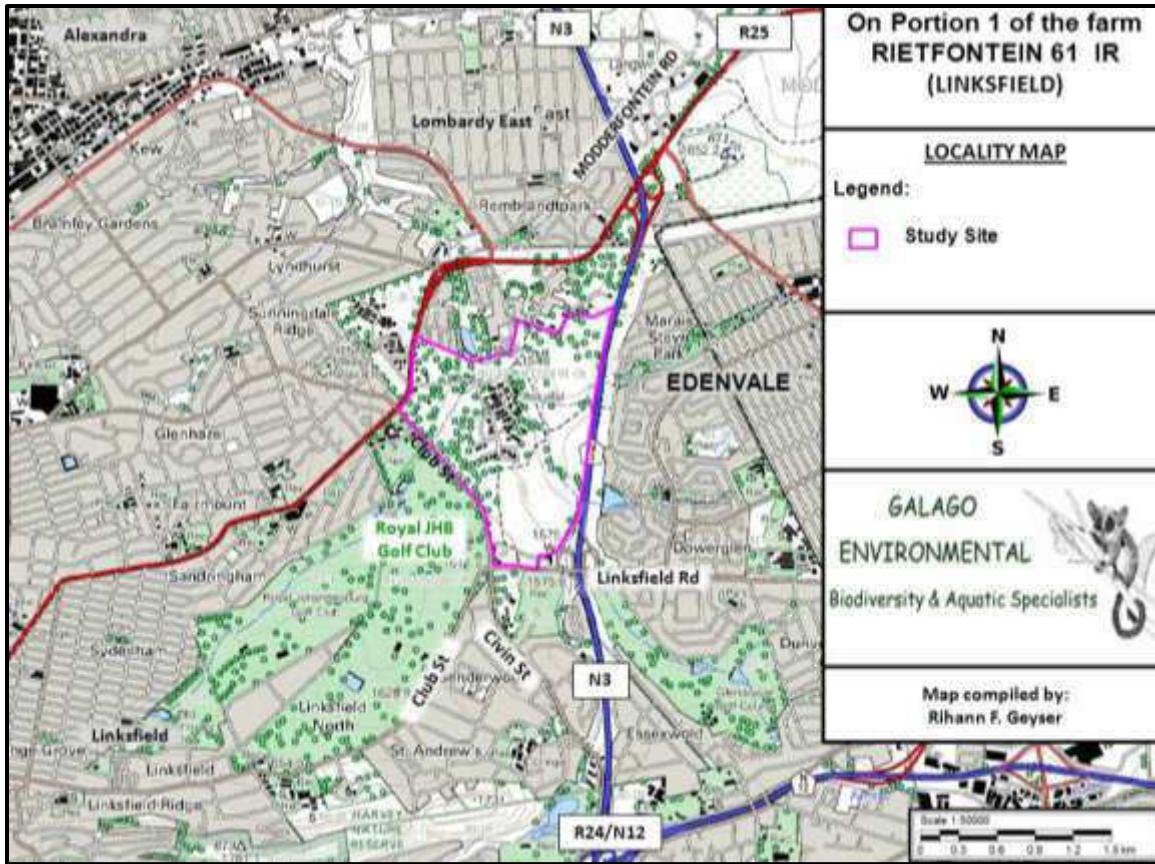


Figure 1: Locality map of the study site.

4. METHOD

An eight hour site visit was conducted on 19 October 2013. During this visit the observed and derived presence of mammals associated with the recognized habitat types of the study site, were recorded. This was done with due regard to the well recorded global distributions of Southern African mammals, coupled to the qualitative and quantitative nature of recognized habitats.

The 500 meters of adjoining properties was scanned for important faunal habitats.

4.1 Field Surveys

During the site visit mammals were identified by visual sightings through random transect walks. No trapping or mist netting was conducted, as the terms of reference did not require such intensive work. In addition, mammals were also identified by means of spoor, droppings, burrows or roosting sites. Locals were interviewed to confirm occurrences or absences of species.

Three criteria were used to gauge the probability of occurrence of mammals on the study site. These include known distribution range, habitat preference and the qualitative and quantitative presence of suitable habitat.

4.2 Desktop Surveys

As the majority of mammals are secretive, nocturnal, hibernators and/or seasonal, distributional ranges and the presence of suitable habitats were used to deduce the presence or absence of these species based on authoritative tomes, scientific literature, field guides, atlases and databases. This can be done irrespective of season. During the field work phase of the project, this derived list of occurrences is audited.

The probability of occurrences of **mammal** species was based on their respective geographical distributional ranges and the suitability of on-site habitat. In other words, *high* probability would be applicable to a species with a distributional range overlying the study site as well as the presence of prime habitat occurring on the study site. Another consideration for inclusion in this category is the inclination of a species to be common, i.e. normally occurring at high population densities.

Medium probability pertains to a mammal species with its distributional range peripherally overlapping the study site, or required habitat on the site being sub-optimal. The size of the site as it relates to its likelihood to sustain a viable breeding population, as well as its geographical isolation is also taken into consideration. Species categorised as *medium* normally do not occur at high population numbers, but cannot be deemed as rare. A *low* probability of occurrence will mean that the species' distributional range is peripheral to the study site and habitat is sub-optimal. Furthermore, some mammals categorised as *low* are generally deemed rare.

Based on the impressions gathered during the site visit, as well as publications, such as The Complete Book of Southern African Mammals (Mills & Hes, 1997), The Mammals of the Southern African Subregion (Skinner & Chimimba, 2005) and Smithers' Mammals of Southern Africa; A Field Guide (2012), a list of species which may occur on the site was compiled. The latest taxonomic nomenclature was used. The vegetation type was defined according to the standard handbook by Mucina and Rutherford (eds) (2006).

4.3 Specific Requirements

During the visit the site was surveyed and assessed for the potential occurrence of Red Data and/or wetland-associated species such as:

Juliana's golden mole (*Neamblosomus juliana*), Highveld golden mole (*Amblysomus septentrionalis*), Rough-haired golden mole (*Chrysospalax villosus*), African marsh rat (*Dasyurus incomitus*), Angoni vlei rat (*Otomys angoniensis*), Vlei rat (*Otomys irroratus*), White-tailed rat (*Mystromys albicaudatus*), a number of shrews such as the Forest shrew (*Myosorex varius*), Southern African hedgehog (*Atelerix frontalis*), a number of bats such as the Short-eared trident bat (*Cloeotis percivali*), African clawless otter (*Aonyx capensis*), Spotted-necked otter (*Lutra maculicollis*), Marsh mongoose (*Atilax paludinosus*), Brown hyena (*Parahyaena brunnea*), etc.

5. RESULTS

Mammal Habitat Assessment:

The local occurrences of mammals are closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupicolous (rock-dwelling) and wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of reptile and amphibian species by evaluating the habitat types within the

context of global distribution ranges. From a mammal habitat perspective, it was established that three of the four major habitats are naturally present on the study site, namely terrestrial, rupiculous and wetland-associated vegetation cover habitat.

Many manmade places of rupiculous habitat are present on the study site. Noticeable absentees from the study site are indigenous trees; and there are only a few termitaria. Moribund termitaria provide excellent retreats for small mammals (Figure 2).



Figure 2: Moribund termitarium.

The scattered trees present mostly along the drainage lines are all exotics, such as *Eucalyptus* sp., wattle, weeping willow, grey poplar, pine and mulberry. Due to the absence of indigenous trees and the presence of squatters on the study site, there are very few dead logs, which could have provided shelter and food for small mammals. Mammals narrowly reliant on an arboreal habitat are excluded from the species list.

Parts of the study site consist of transformed grassland. The natural grasslands were transformed into agricultural lands and are thus ecologically disturbed. It appears as if ploughing of former lucerne fields (Figure 3) has seriously diminished the presence of termitaria, especially moribund, which normally provide ideal retreats for small mammals. Accordingly, it is estimated that the mammal population density in that part of the study site is lower.



Figure 3: Altered terrestrial habitat in the form of old lucerne fields in the foreground and exotic trees in the background.

There are only a few natural rupiculous habitats on the study site in the form of a small ridge with scattered stones and rocks (Figure 4). Excellent manmade rupiculous habitat exists in a large number of building rubble piles and a few buildings.



Figure 4: Natural rupiculous habitat.

Despite the presence of old lucerne fields and new green grass there was no grazing by livestock. At the time of the site visit the basal cover was lush in a few places, especially along the Jukskei River and would provide adequate cover for small terrestrial mammals. However the site was largely burned and would not offer any vegetation cover protection for small mammals (Figure 5).



Figure 5: Note the sparse vegetation due to veld fires.

Permanent and temporary water sources occur on the study site. The Jukskei River (Figure 6) and two tributaries flow north of the study site. The one seasonal tributary flows from the south-western area into the Jukskei River and the second tributary flows from the east into the Jukskei River.



Figure 6: The Jukskei River.

A small wetland occurs on the banks of the Jukskei River near the entrance of the Sizwe Tropical Disease Hospital (Figure 7). In some places along the Jukskei River wetlands can be found due to overflowing of the riverbanks. All along the Jukskei River weirs and other manmade structures such as bridges have been built in the Jukskei River.



Figure 7: A view of the wetland with its aquatic vegetation.

These water sources provide water for water-dependent mammals. Although some wetlands are artificial, they are functional with several wetland plant species, and also wetland fauna. The semi-aquatic vegetation along the Jukskei River, its wetlands and temporary pans provide the ideal habitat for smaller mammals such as shrews, vlei rats and quite possibly the rough-haired golden mole. These water bodies are also likely to support insect populations which swarm over the water at dusk during summer, as such forming rich feeding patches for marauding bats.

All rivers, streams and wetlands are protected and are regarded as being sensitive.

The study site has no caves suitable for cave-dwelling bats, although some of the buildings may act as substitute daytime roosts. It is likely that common bats commute from roosting sites elsewhere to hawk for insects over the wetlands.

With the exception of the N3 on the easterly side of the study site and the R25 (Modderfontein Road), connectivity as a whole is good. Real opportunities for migration exist along the Jukskei River and its tributaries.

Expected and Observed Mammal Species Richness:

Of the 49 mammal species expected to occur on the study site (Table 1), three were confirmed during the site visit (Table 2). It should be noted that potential occurrences are interpreted as being possible over a period of time as a result of environmentally induced expansions and contractions of population densities and ranges which stimulate migration.

Table 1 lists the mammals which are deemed as probable residents on the study site and the 500 metres extended study area. All feral mammal species expected to occur on the study site (e.g. house mice, house rats, cattle, dogs and cats) were omitted from Table 1 since these species are normally associated with human settlements.

Most of the species of the resident diversity occurring in the near-vicinity of the study site are common and widespread. Scrub hares prefer short grass veld. The mole rat, four-striped grass mouse, multimammate mouse, Tete veld rat and Highveld gerbil are likewise robust and capable of persisting in ecologically disturbed conditions. The yellow and slender mongooses are taciturn small carnivores with a wide food preference.

The bats listed are mostly common on the Highveld wherever they can find daytime roosts in manmade structures. Many bat species commute over considerable distances in search of rich feeding patches, such as insects that are (or may eventually) swarm over wetlands at dusk.

Most of the adjoining areas are ecologically disturbed by invasive plants, overgrazing, and fires. Mega-mammals have long since been extirpated to favour agricultural and then urban interests. Persistent medium-sized mammals such as duiker and steenbok are deemed to be extinct.

The fairly low diversity is due to the disturbed ecological state of the study site and adjoining areas, the relative small size of the site and the quality of conservation.

Threatened and Red Listed Mammal Species

All Red Data species listed in Table 1 as Critically Endangered, Vulnerable, Near Threatened or Data Deficient are discerning species and became endangered as result of the deterioration of their preferred habitats.

It is amazing how many local mammals have never been studied in nature. As a result, the conservation status of the shrew species listed in Table 1 is unknown and they are ranked as "Data Deficient" as a precautionary measure. These include all shrew species.

Due to the presence of especially rupicolous (rock-dwelling) and wetland-associated vegetation cover the possibility of more Red listed mammal species increases dramatically. Protecting these habitat types would automatically protect many Red Data status species.

The White-tailed mouse is often found in rocky areas with good grass cover.

The wetland-associated vegetation cover along the Jukskei River creates an opportunity for species such as the Rough-haired golden mole and Spotted-necked otter to occur on the study site.

The Southern African hedgehog occurs in a wide variety of habitat types, but must have vegetation. The possibility exists that some individuals occur on the study site.

Due to their ability to fly and to cover large distances, the distribution information of some bat species is insufficient. This resulted in Red Data status for some bats species as a precautionary measurement.

No other Red Data or sensitive species are deemed present on the site, either since the site is too disturbed, falls outside the distributional ranges of some species, or does not offer suitable habitat(s).

Table 1: The mammals which were observed or deduced to occupy the site

	SCIENTIFIC NAME	ENGLISH NAME
	Class: MAMMALIA	Moles
	Order: AFROSORICIDA	
	Family: Chrysochloridae	Golden moles
?CE	<i>Chrysospalax villosus</i>	Rough-haired golden mole
	Order: MACROSCELIDEA	
	Family: Macroscelidiae	Elephant-shrews
?	<i>Elephantulus myurus</i>	Eastern rock elephant-shrew
	Order: LAGOMORPHA	
	Family: Leporidae	Hares, Rabbits and Rock Rabbits
✓	<i>Lepus saxatilis</i>	Scrub hare
?	<i>Pronolagus randensis</i>	Jameson's red rock rabbit
	Order: RODENTIA	
	Family: Bathyergidae	Mole-rats
✓	<i>Cryptomys hottentotus</i>	African mole rat
	Family: Hystricidae	Porcupines
*	<i>Hystrix africaeaustralis</i>	Cape porcupine
	Family: Thryonomyidae	Canerats
?	<i>Thryonomys swinderianus</i>	Greater canerat
	Family: Pedetidae	
?	<i>Pedetes capensis</i>	Springhare
	Family: Myoxidae	Dormice
?	<i>Graphiurus murinus</i>	Woodland dormouse
	Family: Muridae	Rats and Mice
✓	<i>Rhabdomys pumilio</i>	Four-striped grass mouse
?	<i>Mus indutus</i>	Desert pygmy mouse
✓	<i>Mastomys coucha</i>	Southern multimammate mouse
?	<i>Aethomys ineptus</i>	Tete veld rat
✓	<i>Micaelamys namaquensis</i>	Namaqua rock mouse
*	<i>Otomys angoniensis</i>	Angoni vlei rat
✓	<i>Tatera brantsii</i>	Highveld gerbil
?EN	<i>Mystromys albicaudatus</i>	White-tailed mouse
?	<i>Saccostomus campestris</i>	Pouched mouse
?	<i>Dendromus melanotis</i>	Grey pygmy climbing mouse
?	<i>Dendromus mystacalis</i>	Chestnut climbing mouse
	ORDER: EULIPOTYPHLA	
	Family: Soricidae	Shrews

	SCIENTIFIC NAME	ENGLISH NAME
?DD	<i>Myosorex varius</i>	Forest shrew
?DD	<i>Suncus varilla</i>	Lesser dwarf shrew
?DD	<i>Suncus infinitesimus</i>	Least dwarf shrew
?DD	<i>Crocidura mariquensis</i>	Swamp musk shrew
?DD	<i>Crocidura fuscomurina</i>	Tiny musk shrew
?DD	<i>Crocidura cyanea</i>	Reddish-grey musk shrew
?DD	<i>Crocidura silacea</i>	Lesser grey-brown musk shrew
?DD	<i>Crocidura hirta</i>	Lesser red musk shrew
	Family: Erinaceidae	Hedgehog
?NT	<i>Atelerix frontalis</i>	Southern African hedgehog
	ORDER: CHIROPTERA	Bats
	Family: Pteropodidae	Fruit-eating bats
?	<i>Eidolon helvum</i>	Straw-coloured fruit bat
	Family: Emballonuridae	Sheath-tailed bats
*	<i>Taphozous mauritianus</i>	Muaritian tomb bat
	Family: Molossidae	Free-tailed bats
✓	<i>Tadarida aegyptiaca</i>	Egyptian free-tailed bat
	Family: Vespertilionidae	Vesper bats
?NT	<i>Miniopterus natalensis</i>	Natal long-fingered bat
✓	<i>Neoromicia capensis</i>	Cape serotine bat
?NT	<i>Myotis welwitschii</i>	Welwitsch's hairy bat
?NT	<i>Myotis tricolor</i>	Temminck's hairy bat
	Family: Nycteridae	Slit-faced bats
*	<i>Nycteris thebaica</i>	Egyptian slit-faced bat
	Family: Rhinolophidae	Horseshoe bats
?NT	<i>Rhinolophus clivosus</i>	Geoffroy's horseshoe bat
?Vu	<i>Rhinolopus blasii</i>	Blasius's horseshoe bat
	ORDER: CARNIVORA	
	Family: Felidae	
?	<i>Felis silvestris</i>	African wild cat
	Family: Viverridae	Civets and genets
?	<i>Genetta genetta</i>	Small-spotted genet
	Family: Herpestidae	Suricates and Mongooses
?	<i>Suricata suricatta</i>	Suricate or Meerkat
*	<i>Cynictis penicillata</i>	Yellow mongoose
*	<i>Galerella sanguinea</i>	Slender mongoose
?	<i>Ichneumia albicauda</i>	White-tailed mongoose
✓	<i>Atilax paludinosus</i>	Marsh mongoose
	Family: Canidae	Foxes, Wild dogs and Jackals
?	<i>Canis mesomelas</i>	Black-backed jackal
	Family: Mustelidae	Otters, Honey Badger, Weasel and Polecat
?	<i>Aonyx capensis</i>	African clawless otter
?NT	<i>Lutra maculicollis</i>	Spotted-necked otter

(Systematics, taxonomy and Red Data status as proposed by Skinner and Chimimba [2005] and Apps [2012])

✓ Definitely there or have a *high* probability to occur;

*Medium probability to occur based on ecological and distributional parameters;

?Low probability to occur based on ecological and distributional parameters.

Red Data species rankings as defined in Friedmann and Daly's S.A. Red Data Book / IUCN (World Conservation Union) (2004) are indicated in the first column: CR= Critically Endangered, En = Endangered, Vu = Vulnerable, LR/cd = Lower risk conservation dependent, LR/nt = Lower Risk near threatened, DD = Data Deficient. All other species are deemed of Least Concern.

Table 2: Mammal species positively confirmed from the study site, observed indicators and habitat.

SCIENTIFIC NAME	ENGLISH NAME	OBSERVATION INDICATOR	HABITAT
<i>Cryptomys hottentotus</i>	African mole rat	Tunnel system	Universal/Terrestrial habitat
<i>Tatera brantsii</i>	Highveld gerbil	Lots of holes	Terrestrial habitat with sandy soil
<i>Atilax paludinosus</i>	Marsh mongoose	Scats	Along Jukskei River/aquatic habitat

The African mole rat has an exceptionally wide distribution range. Because of their subterranean lifestyle they are relatively immune to predation and prosecution, with the result that they occur at near-natural population densities, even in urban settings.

The Highveld gerbil is one of the most common rodent species in South Africa and has a wide distributional range.

The marsh mongoose has a wide distributional range and is associated with well-watered terrain where there is an adjacent cover of reed beds or dense stands of semi-aquatic grasses.

6. FINDINGS AND POTENTIAL IMPLICATIONS

The study site has important topographical features in the form of the Jukskei River, its tributaries and wetlands/temporary pans. On the study site, east of the Jukskei River, the small rocky ridge with termite mounds is also fairly pristine. The study site contains three mammal habitats, namely terrestrial, rupicolous and wetlands. The study site is ecologically disturbed in parts by formerly cultivated lucerne fields, building rubble, squatters, recreational motorbike riding and exotic plants. Water pollution by rubbish, eutrophication (algae bloom), squatters and invasive plants threatens the aquatic habitat.

Species richness: Due to the presence of three habitat types, especially all forms of aquatic types, the study site should have a fair number of species, but it must be emphasised that the species richness is for the general area and NOT for the study site itself.

Endangered species: The Endangered Species treat the site as part of their home ranges / territories. The possibility exist that 16 species of mammals with a Red Data status may occur on the study site. Most of these species include bats, which move over huge distances, and all possible shrew species. It is very difficult to confirm whether any of these species are present on any study site, but there is a possibility that some of these two groups of species occur on this particular study site.

In optimum conditions the possibility exists that the rough-haired golden mole, spotted-necked otter, Southern African hedgehog and white-tailed mouse may occur on the study site.

Sensitive species and/or areas (Conservation ranking): It is likely that sensitive species such as shrews and otters will migrate to aquatic and semi-aquatic conditions in and along the water bodies from time to time. The Jukskei River, its tributaries and wetlands are highly sensitive ecological systems. East of the Jukskei River, the small rocky ridge with termite mounds is medium sensitive. The study site falls in the Egoli Granite Grassland (Gm 10) vegetation type, which is considered endangered (Mucina and Rutherford, 2006).

Habitat(s) quality and extent: The terrestrial habitat quality has been jeopardised by ploughing of agricultural lands in the past. Water pollution by rubbish, eutrophication (algae bloom), squatters and invasive plants threatens the aquatic habitat.

Impact on species richness and conservation: The construction of the mixed development will have a significant and sometimes lasting effect on species richness and conservation, because of the construction of buildings and new roads carrying more vehicles. These buildings and roads will form an even larger barrier for mammal movement and it will result in a decrease in connectivity. The development will have a large and permanent footprint.

If the development should go ahead, a very important indirect effect would be the likely impact that the proposed development might have on the surface water runoff and water quality of both the Jukskei River and its tributaries and the wetlands. This could have a negative impact on the mammals.

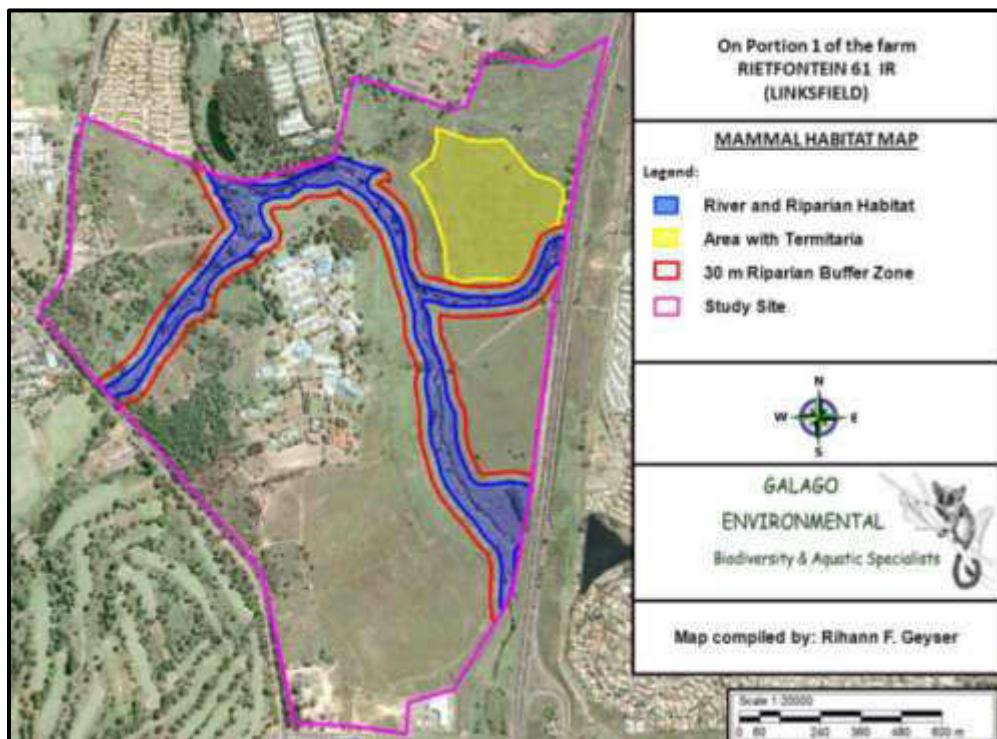


Figure 8: Mammal habitat map

Connectivity: Except for the N3 and Modderfontein Roads, connectivity is good. The Jukskei River and its tributaries are distribution corridors for many water-dependent mammals, which may also forage on the study site.

Management recommendation: Measures will have to be taken to stop water pollution of the wetlands, the Jukskei River and its tributaries by the mixed use development. The removal of exotic trees will increase the habitat of water-dependent mammals.

General: The integrity of the wetlands, the Jukskei River and its tributaries should not be jeopardised in any way by the proposed development.

7. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

Galago Environmental and its specialists are committed to the conservation of biodiversity but concomitantly recognise the need for economic development. Whereas we appreciate the opportunity to learn through the processes of constructive criticism and debate, we reserve the right to form and hold our own opinions and therefore will not willingly submit to the interest of other parties or change statements to appease them.

Even though every care is taken to ensure the accuracy of this report, environmental assessment studies are limited in scope, time and budget. To some extent discussions and proposed mitigations are made on reasonable and informed assumptions built on *bona fide* information sources, as well as deductive reasoning. Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions and migrations. Since environmental impact studies deal with dynamic natural systems, additional information may come to light at a later stage. Galago Biodiversity and Aquatic Specialists can therefore not accept responsibility for conclusions and mitigation measures made in good faith based on own databases or on the information provided at the time of the directive. This report should therefore be viewed and acted upon with these limitations in mind.

8. RECOMMENDED MITIGATION MEASURES

Protection of the wetlands, the Jukskei River and its tributaries:

- Every effort should be made to retain the linear integrity, flow dynamics and water quality of the Jukskei River and its tributaries. The same applies to temporary pans/dams, and all the water bodies associated with riparian vegetation.

The following mitigation measures are proposed by the specialist.

- Should any mammals (such as hedgehogs) be encountered during the construction phase of the development, these should be relocated to natural grassland areas in the vicinity.
- The contractor must ensure that no mammal species are disturbed, trapped, hunted or killed during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.
- Alien and invasive plants must be removed in a phased manner.

- During the construction phase there will be increased surface runoff and a decreased water quality (with increased silt load and pollution). Measures must be taken to mitigate erosion during this phase.

The following mitigation measures were developed by GDARD (Directorate of Nature Conservation, 2012) and are applicable to the study site.

- An appropriate management authority (e.g. the body corporate) that must be contractually bound to implement the Environmental Management Plan (EMP) and Record of Decision (ROD) during the operational phase of the development should be identified and informed of their responsibilities in terms of the EMP and ROD.
- All areas designated as sensitive in a sensitivity mapping exercise should be incorporated into an open space system. Development should be located on the areas of lowest sensitivity.
- The open space system should be managed in accordance with an Ecological Management Plan that complies with the *Minimum Requirements for Ecological Management Plans* and forms part of the EMP.
- The Ecological Management Plan should:
 - include a fire management programme to ensure persistence of grassland
 - include an ongoing monitoring and eradication programme for all non-indigenous species, with specific emphasis on invasive and weedy species
 - include a comprehensive surface runoff and storm water management plan, indicating how all surface runoff generated as a result of the development (during both the construction and operational phases) will be managed (e.g. artificial wetlands / storm water and flood retention ponds) prior to entering any natural drainage system or wetland and how surface runoff will be retained outside of any demarcated buffer/flood zones and subsequently released to simulate natural hydrological conditions
 - ensure the persistence of all Red List species
 - include a monitoring programme for all Red List species
 - facilitate/augment natural ecological processes
 - provide for the habitat and life history needs of important pollinators
 - minimise artificial edge effects (e.g. water runoff from developed areas & application of chemicals)
 - include a comprehensive plan for limited recreational development (trails, bird hides, etc.) within the open space system
 - include management recommendations for neighbouring land, especially where correct management on adjacent land is crucial for the long-term persistence of sensitive species present on the development site
 - result in a report back to the Directorate of Nature Conservation on an annual basis
 - investigate and advise on appropriate legislative tools (e.g. the NEMA: Protected Areas Act 57 of 2003) for formally protecting the area (as well as adjacent land where it is crucial for the long-term persistence of sensitive species present on the development site)
- The open space system should be fenced off prior to construction commencing (including site clearing and pegging). All construction-related impacts (including service roads, temporary housing, temporary ablution, disturbance of natural habitat, storing of equipment/building materials/vehicles or any other activity)

- should be excluded from the open space system. Access of vehicles to the open space system should be prevented and access of people should be controlled, both during the construction and operational phases. Movement of indigenous fauna should however be allowed (i.e. no solid walls, e.g. through the erection of palisade fencing).
- The appropriate agency should implement an ongoing monitoring and eradication program for all invasive and weedy plant species growing within the servitude.
 - Rehabilitation of natural vegetation should proceed in accordance with a rehabilitation plan compiled by a specialist registered in terms of the Natural Scientific Professions Act (No. 27 of 2003) in the field of Ecological Science.
 - Any post-development re-vegetation or landscaping exercise should use species indigenous to South Africa. Plant species locally indigenous to the area are preferred. As far as possible, indigenous plants naturally growing along the route, that would otherwise be destroyed during construction, should be used for re-vegetation / landscaping purposes

9. CONCLUSION

The Jukskei River and its tributaries with their buffer zones should be considered as ecologically highly sensitive. This will automatically protect some of the wetlands next to the Jukskei River. East of the Jukskei River, the small rocky ridge with termite mounds is medium sensitive. The study site falls in the Egoli Granite Grassland (Gm 10) vegetation type, which is considered endangered (Mucina and Rutherford, 2006).

The possibility exist that 16 species of mammals with a Red Data status may occur on the study site. Most of these species include bats, which move over huge distances, and all possible shrew species. It is very difficult to confirm whether any of these species are present on any study site, but there is a possibility that some of these two groups of species occurs on this particular study site.

In optimum conditions the possibility exist that rough-haired golden mole, spotted-necked otter, Southern African hedgehog and white-tailed mouse may occur on the study site.

The study site contains the Jukskei River, which in a pristine state has excellent habitat for the spotted-necked otter (*Lutra maculicollis*). Pollution of the water in the Jukskei River would affect prey, which would ultimately influence the occurrence of the spotted-necked otter.

Ecologically, the study site is in a downward spiral. The study site has been ecologically disturbed by encroaching urbanisation, veld fires, invasive plants, dumping, water pollution and squatters. These factors have a detrimental effect on mammal numbers and diversity.

If the development should go ahead, a very important indirect effect would be the likely impact that the proposed development might have on the surface water runoff and water quality of both the Jukskei River and its tributaries and the temporary pans. This could have a negative impact on the mammals. These impacts could be ameliorated by the construction of retention ponds, which would retard discharge into these water bodies and thus improve the water quality of the discharge.

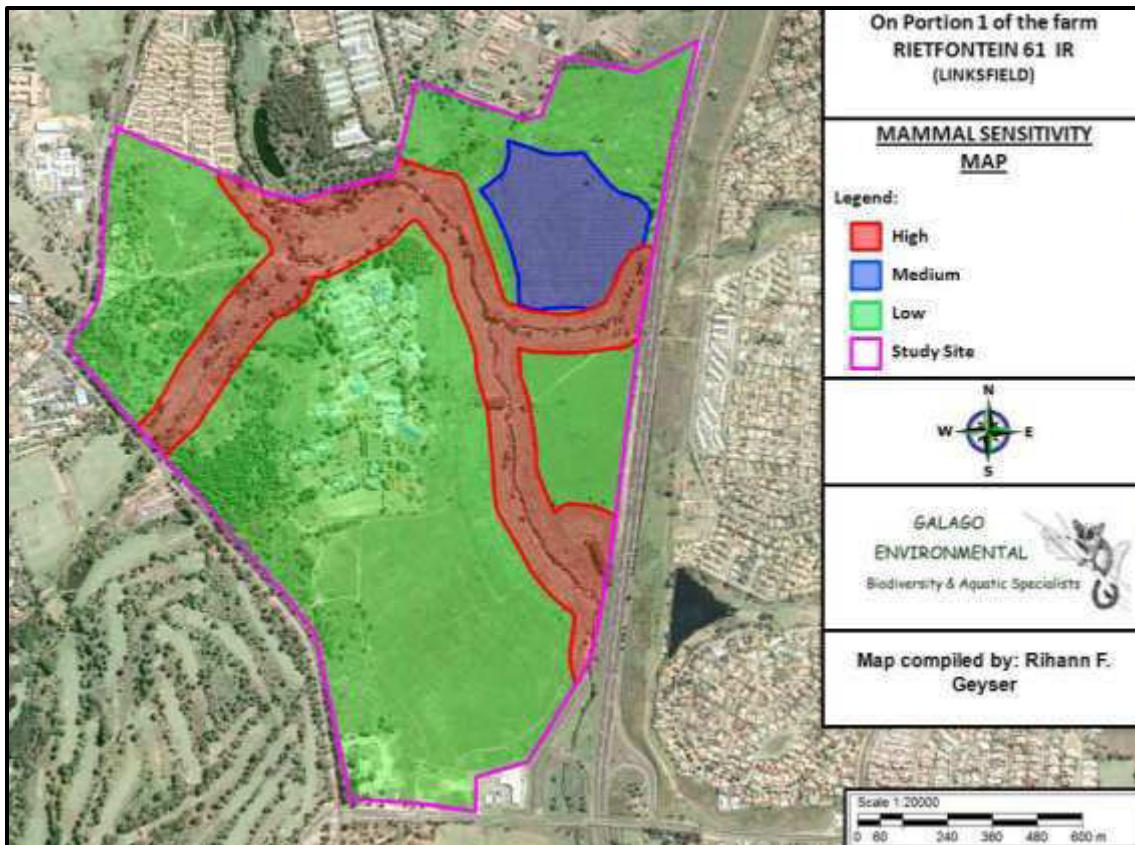


Figure 9: Mammal sensitivity map

10. LITERATURE SOURCES

- Acocks, J.P.H. 1988. Veld types of South Africa, 3rd ed. *Memoirs of the Botanical Survey of South Africa*.
- Apps, P. 2012. *Smithers Mammals of Southern Africa. A Field Guide*. Struik Nature, Cape Town.
- Department of Environmental Affairs and Tourism. 2007. National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004): Publication of Lists of Critically Endangered, Endangered, Vulnerable and Protected Species. Government Notices.
- Directorate of Nature Conservation, GDACE. 2009. GDACE Requirements for Biodiversity Assessments, Version 2. Gauteng Provincial Government.
- Directorate of Agriculture and Rural Development, GDARD. 2011. GDARD Gauteng Conservation Plan, Version 3.3. Gauteng Provincial Government.
- Friedman, Y. and Daly, B. (editors). 2004. *Red Data Book of the Mammals of South Africa: A Conservation Assessment*: CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust. South Africa.
- Low, A.B. & Rebelo, A.G. 1996. 'Vegetation Map of South Africa, Lesotho and Swaziland. Department of Environmental Affairs and Tourism, Pretoria.
- Low, A.E. & Rebelo, A.G. (eds). 1998. *Vegetation of South Africa, Lesotho and Swaziland*. A companion to the Vegetation Map of South Africa, Lesotho and Swaziland. Department of Environmental Affairs & Tourism, Pretoria.
- Meester, J.A.J., Rautenbach, I.L., Dippenaar, N.J. & Baker, C.M. 1986. *Classification of Southern African Mammals*. Transvaal Museum Monograph No. 5. Transvaal Museum, Pretoria, RSA.

- Mills, G. & Hes, L. 1997. The complete book of Southern African Mammals. Struik Winchester, Cape Town, RSA.
- Mucina, L. & Rutherford, M.C. 2006. *The vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. South African National Biodiversity Institute, Pretoria.
- Picker, M. & Griffiths, C. 2011. *Alien & Invasive Animals. A South African Perspective*. Struik Nature, Cape Town.
- Rautenbach, I.L. 1978. A numerical re-appraisal of the southern African biotic zones. Bulletin of the Carnegie Museum of Natural History 6:175-187.
- Rautenbach, I.L. 1982. Mammals of the Transvaal. Ecoplan Monograph No. 1. Pretoria, RSA.
- Skinner, J.D. & Chimimba, T.C. 2005. *The Mammals of the Southern African Subregion*. 3rd edition. Cambridge University Press.
- Skinner, J.D. & Smithers, R.H.N. 1990. *The Mammals of the Southern African Subregion*. 2nd edition. Pretoria: University of Pretoria.
- Smithers, R.H.N. 1983. *The Mammals of the Southern African Subregion*. Pretoria: University of Pretoria.
- Stuart, C. & Stuart, M. 2013. *A Field Guide to the Tracks & Signs of Southern, Central & East African Wildlife*. 4th edition. Struik Nature, Cape Town.
- The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)
- The Environmental Conservation Act, 1989 (Act No. 73 of 1989)
- The National Environment Management Act, 1998 (Act No. 107 of 1998)
- The National Environmental Management Biodiversity Act, 2004 (Act 10 of 2004). Government Gazette RSA Vol. 467, 26436, Cape Town, June 2004.
- The National Environmental Management Biodiversity Act, 2004 (Act 10 of 2004). Draft List of Threatened Ecosystems. Government Gazette RSA Vol. 1477, 32689, Cape Town, 6 Nov 2009.
- The National Forests Act, 2006 (Act 84 of 1998 as amended). Government Gazette RSA Vol. 897, 29062, Cape Town, 8 Sept 2006.
- The Natural Scientific Professions Act (Act 27 of 2003).

GALAGO ENVIRONMENTAL



Biodiversity & Aquatic Specialists

638 Turf Street
Wingate Park, 0181
Tel: 012-345 4891
Fax: 086 675 6136
Email: Vanessam@lantic.net

Avifaunal Habitat Assessment

of

PORTION 1 OF THE FARM RIETFONTEIN 61 IR

December 2013

Report author: Mr. R.F. Geyser

Report verified/reviewed by: Dr. A.C. Kemp (Ph.D., Pr.Sci.Nat. (Zoology & Ecology))

DECLARATION OF INDEPENDENCE:

I, Rihann F. Geyser (690304 5248 084), declare that I:

- am committed to biodiversity conservation but concomitantly recognize the need for economic development. Whereas I appreciate the opportunity to also learn through the processes of constructive criticism and debate, I reserve the right to form and hold my own opinions and therefore will not willingly submit to the interests of other parties or change my statements to appease them
- act as an independent specialist consultant in the field of ornithology
- am subcontracted as specialist consultant by Galago Environmental CC for the proposed Linksfield development on Portion 1 of the farm Rietfontein 61 IR described in this report
- have no financial interest in the proposed development other than remuneration for work performed
- neither have nor will have any vested or conflicting interests in the proposed development
- undertake to disclose to Galago Environmental CC and its client, and the competent authority, any material information that has or may have the potential to influence decisions by the competent authority as required in terms of the Environmental Impact Assessment Regulations 2006



Rihann F. Geyser

VERIFICATION STATEMENT

Mr R. Geyser is not registered as a Professional Natural Scientist with the S.A. Council for Natural Scientific Professions. This communication serves to verify that the bird report compiled by Mr R.F. Geyser has been prepared under my supervision, and I have verified the contents thereof.

Declaration of Independence: I, Alan Charles Kemp (4405075033081), declare that I:

- am committed to biodiversity conservation but concomitantly recognize the need for economic development. Whereas I appreciate the opportunity to also learn through the processes of constructive criticism and debate, I reserve the right to form and hold my own opinions and therefore will not willingly submit to the interests of other parties or change my statements to appease them
- abide by the Code of Ethics of the S.A. Council for Natural Scientific Professions
- act as an independent specialist consultant in the fields of zoology and ecology
- am subcontracted as specialist consultant by Galago Environmental CC for the proposed Linksfield development on Portion 1 of the farm Rietfontein 61 IR described in this report
- have no financial interest in the proposed development other than remuneration for work performed
- neither have nor will have any vested or conflicting interests in the proposed development
- undertake to disclose to Galago Environmental CC and its client, and the competent authority, any material information that has or may have the potential to influence decisions by the competent authority as required in terms of the Environmental Impact Assessment Regulations 2006



Dr. A.C. Kemp

TABLE OF CONTENTS

1. INTRODUCTION.....	5
2. SCOPE AND OBJECTIVES OF THE STUDY	5
3. STUDY AREA	5
4. METHODS	7
5. RESULTS	9
6. FINDINGS AND POTENTIAL IMPLICATIONS.....	23
7. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE.....	24
8. RECOMMENDED MITIGATION MEASURES.....	25
9. CONCLUSIONS	26
10. LITERATURE SOURCES	27

FIGURES:

Figure 1: Locality map of the study area	6
Figure 2: The 2628AA q.d.g.c.	8
Figure 3: Avifaunal species habitat systems identified in and the study area.....	9
Figure 4: Open river system with steep banks and scattered exotic trees	10
Figure 5: Open grassland east of the Jukskei River.....	11
Figure 6: Disturbed and Transformed area.	12
Figure 7: Habitat map for Half-collared King Fisher.	24
Figure 8: Avifaunal sensitivity map.....	26

TABLES:

Table 1: Avifaunal species observed within the study area.....	13
Table 2: Red Data avifaunal species recorded for the 2628AA q.d.g.c.	17
Table 3: Red Data avifaunal species assessment for the study area.....	18

1. INTRODUCTION

Galago Environmental CC. was appointed to undertake an avifaunal habitat survey for the Linksfield development on Portion 1 of the farm Rietfontein 61 IR (hereinafter referred to as the study site), which is scheduled for mixed use development. The study site and the 500 m extended study area are hereafter referred to as the study area. This is in accordance with the 2010 EIA Regulations (No. R. 543-546, Department of Environmental Affairs and Tourism, 18 June 2010) emanating from Chapter 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

The primary objective was to determine the presence of Red Data avifaunal species and to identify suitable habitat for these species. Direct observations and published data apart, qualitative and quantitative habitat assessments were used to derive the presence / absence of Red Data avifaunal species. A list of avifaunal species likely to be affected by the new development is compiled.

2. SCOPE AND OBJECTIVES OF THE STUDY

- To qualitatively and quantitatively assess the significance of the avifaunal habitat components, and current general conservation status of the property;
- To comment on ecologically sensitive areas;
- To comment on connectivity with natural vegetation and habitats on adjacent sites;
- To provide a list of avifauna that occur or that are likely to occur, and to identify species of conservation importance;
- To highlight potential impacts of the proposed development on the avifauna of the study site, and
- To provide management recommendations to mitigate negative and enhance positive impacts should the proposed development be approved.

3. STUDY AREA

3.1 Locality

The study site is situated within the 2628AA quarter degree grid cell (q.d.g.c.) and 2605_2805 pentad (SABAP2 protocol), within Gauteng Province, directly west of Edenvale and the N3 highway, which forms the eastern boundary of the study site. The study site is situated at an altitude of between 1 548 and 1 600 metres above sea level (m a.s.l.) sloping downwards to the Jukskei River that runs through the middle of the study site from the south-east to the north-west and represents the lowest area on site.

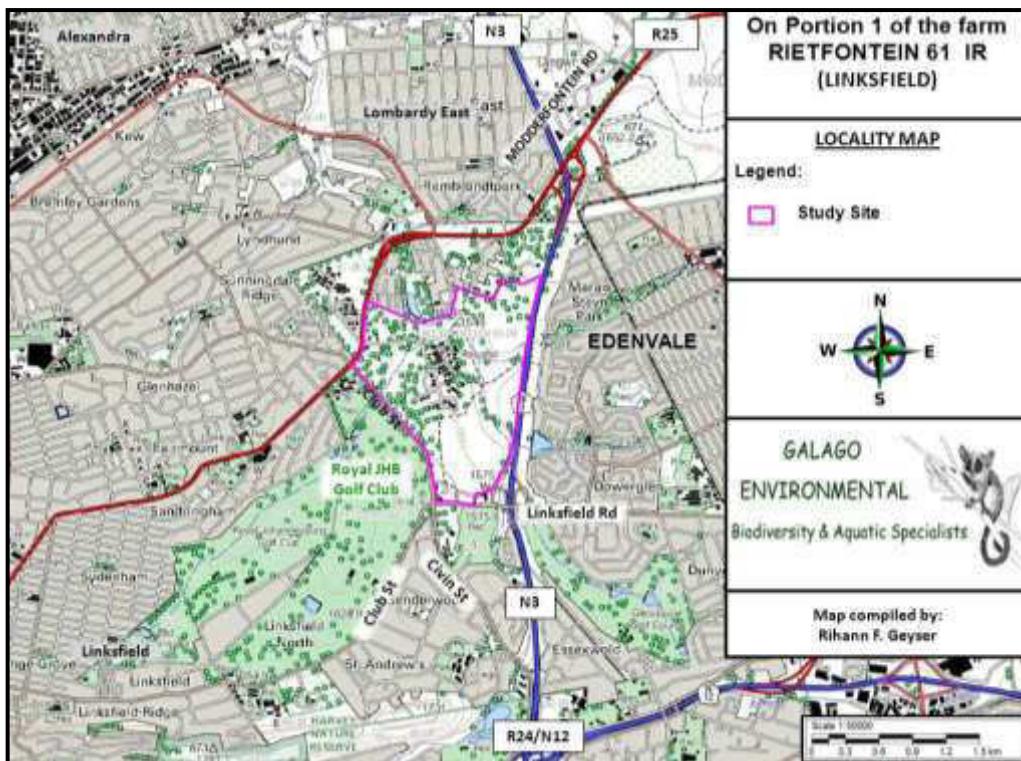


Figure 1: Locality map of the study area

3.2 Land Use

The largest portion of the study site consists of mainly disturbed grassland with the Jukskei River that runs through the middle of the study site. There is evidence of past agricultural activities, both crop farming and cattle grazing. Currently there is no obvious land use visible.

3.3 Biophysical Information

3.3.1 Vegetation type and landscape

The study site is situated within the Mesic Highveld Grassland Bioregion of the Grassland Biome and more specifically within the Egoli Granite Grassland (Gm 10) vegetation type according to Mucina and Rutherford (2006).

The landscape consists of moderately undulating plains and low hills supporting tall, usually *Hyparrhenia hirta* dominated grassland, with some woody species on rocky outcrops or rock sheets. The rocky habitat shows a high diversity of woody species, which occur in the form of scattered shrub groups or solitary small trees (Mucina and Rutherford, 2006).

3.3.2 Climate

The study site is situated in a strongly seasonal summer-rainfall region with between 620 to 800 mm of rainfall (average 680 mm) p/a. Winters are very dry with frequent frost especially in the south (northern Johannesburg).

3.3.4 Conservation status of habitat

This habitat type is considered endangered. More than two thirds of this vegetation type has undergone transformation mostly by urbanisation, cultivation or building of roads. The current rate of transformation is threatening most of the remaining unconserved areas.

4. METHODS

An eight-hour site visit was conducted on 19 October 2013 to record the presence of avifaunal species associated with the habitat systems on the study site and within study area and to identify possible sensitive areas. During this visit the observed and derived presence of avifaunal species associated with the recognized habitat types of the study site, were recorded. This was done with due regard to the well recorded global distributions of Southern African avifauna, coupled to the qualitative and quantitative nature of recognized habitats.

4.1 Field Surveys

Avifaunal species were identified visually, using 10X42 Bushnell Legend binoculars and a 20X-60X Pentax spotting scope, and by call, and where necessary were verified from Sasol Birds of Southern Africa (Sinclair *et al.*, 2011) and Southern African Bird Sounds (Gibbon, 1991).

The 500 m of adjoining properties or extended study area was scanned or surveyed for important avifaunal species and habitats.

During the site visit, avifaunal species were identified by visual sightings or aural records along random transect walks. No trapping or mist netting was conducted, since the terms of reference did not require such intensive work. In addition, avifaunal species were also identified by means of feathers, nests, signs, droppings, burrows or roosting sites. Locals were interviewed to confirm occurrences or absences of species.

4.2 Desktop Surveys

The presence of suitable habitats was used to deduce the likelihood of presence or absence of avifaunal species, based on authoritative tomes, scientific literature, field guides, atlases and databases. This can be done irrespective of season.

The likely occurrence of key avifaunal species was verified according to distribution records obtained during the Southern African Bird Atlas Project 1 (SABAP1) period from 1981 to 1993 (Harrison *et al.* 1997). Earlier records of only Red Data avifaunal species were obtained from the period between 1974 and 1987 according to Tarboton *et al.* (1987). The most recent avifaunal distribution data were obtained from the current SABAP2 project which commenced on 1 July 2007.

The occurrence and historic distribution of likely avifaunal species, especially all Red Data avifaunal species recorded for the q.d.g.c. 2628AA, were verified from SABAP1 (southern Africa Bird Atlas Project 1) data (Harrison *et al.* 1997), Tarboton *et al.* (1987) and the current SABAP2 project (SABAP2 data for the 2628AA q.d.g.c. and for the 2605_2805 pentad). The reporting rate for each avifaunal species likely to occur on the study site, based on Harrison *et al.* (1997), was scored between 0 – 100% and was calculated as follows: Total number of cards on which a species was reported during the Southern African Bird Atlas SABAP1 and, Red Data species only, the current SABAP2

project period X 100 ÷ total number of cards for the particular q.d.g.c. (Harrison *et al.*, 1997) and pentad(s) (SABAP2). It is important to note that a q.d.g.c. (SABAP1 Protocol) covers a large area: for example, q.d.g.c. 2628AA covers an area of $\pm 27 \times 25$ km (± 693 km 2) (15 minutes of latitude by 15 minutes of longitude, 15' x 15') and a pentad (SABAP2 Protocol) and area of $\pm 8 \times 7.6$ km (5 minutes of latitude by 5 minutes of longitude, 5' x 5') (Figure 2) and it is possible that suitable habitat will exist for a certain Red Data avifaunal species within this wider area surrounding the study site. However, the specific habitat(s) found on site may not suit the particular Red Data species, even though it has been recorded for the q.d.g.c. or pentad. For example, the Cape Vulture occurs along the Magaliesberg but will not favour the habitat found within the Pretoria CBD, both of which are in the same q.d.g.c. Red Data bird species were selected and categorised according to Barnes (2000).

2628AA		
2600_2800	2600_2805	2600_2810
2605_2800	2605_2805	2605_2810
2610_2800	2610_2805	2610_2810

Figure 2: The 2628AA q.d.g.c. (15 minutes of latitude by 15 minutes of longitude, 15' x 15') is divided in nine smaller grids (5 minutes of latitude by 5 minutes of longitude, 5' x 5') of which each represent a pentad. The pentad in red represents the pentad in which the study site is situated.

An avifaunal biodiversity index (ABI), which gives an indication of the habitat system on the study site that will hold the richest avifaunal species diversity, was calculated as the sum of the probability of occurrence of bird species within a specific habitat system on site. For each species and habitat, the probability of occurrence was ranked as: 5 = present on site, 4 = not observed on site but has a high probability of occurring there, 3 = medium probability, 2 = low probability, 1 = very low probability and 0 = not likely to occur.

4.3 Specific Requirements

During the site visit, the study site was surveyed visually and its habitats assessed for the potential occurrence of priority Red Data avifauna, according to GDARD's requirements for Biodiversity Assessments, Version 2 (June 2012) and C-Plan Version 3.3, as well as for any other Red Data avifaunal species: The priority Red Data avifaunal species for Gauteng are (in Roberts VII order and nomenclature, Hockey *et al.* 2005):

- Half-collared Kingfisher (*Alcedo semitorquata*)
- African Grass-Owl (*Tyto capensis*)
- White-bellied Korhaan (*Eupodotis senegalensis*)
- Blue Crane (*Anthropoides paradiseus*)
- African Finfoot (*Podica senegalensis*)
- Cape Vulture (*Gyps coprotheres*)

- African Marsh-Harrier (*Circus ranivorus*)
- Martial Eagle (*Polemaetus bellicosus*)
- Secretarybird (*Sagittarius serpentarius*)
- Lesser Kestrel (*Falco naumanni*)
- Greater Flamingo (*Phoenicopterus ruber*)
- Lesser Flamingo (*Phoenicopterus minor*)
- White-backed Night-Heron (*Gorsachius leuconotus*)
- Black Stork (*Ciconia nigra*)

No particular reference was made to the occurrence any Red Data avifaunal species on or surrounding the study site.

5. RESULTS

Avifaunal Habitat Assessment:

Three major avifaunal habitat systems were identified on the study site and within the study area. A short description of each habitat type follows, ranked from most to least important. Figure 3 illustrates the major habitat systems identified as likely to be used by bird species expected to occur on the study site.

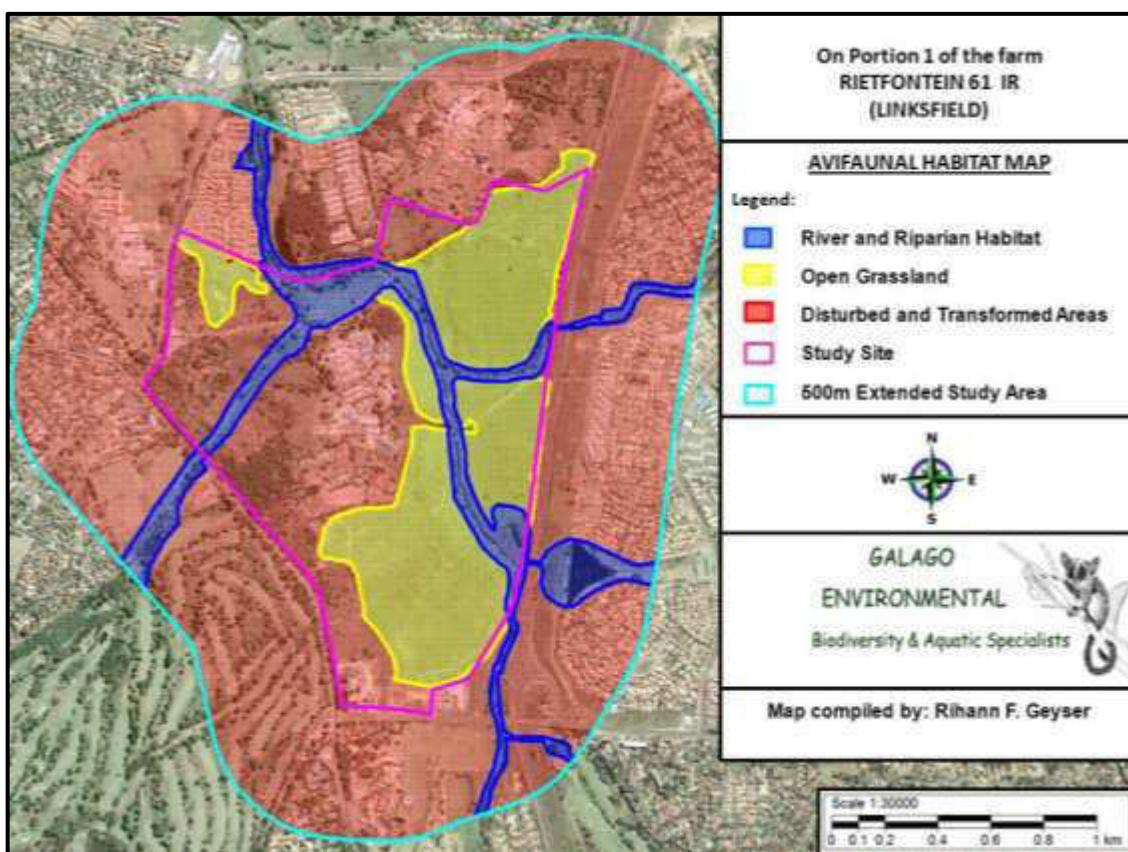


Figure 3: Avifaunal species habitat systems identified in and the study area.

River and riparian vegetation:

7% (± 43 ha) of the total surface area of the study area consists of the Jukskei River and its riparian zone. The Jukskei River originates 2.6 km south-east of the southern boundary of the study site at the Glendower Golf Course between the N3 and the Dowerglen, Dunvegan and Essexwold suburbs of Edenvale.

In general the river system consists of an open system with shallow and fast flowing water with steep vertical banks and scattered mainly exotic trees such as *Eucalyptus* sp, *Acacia decurrens* (Green Wattle) and *Salix babylonica* (Weeping willow) and weeds such as *Sesbania punicea* (Red Sesbania) that grow within the riparian zone (Figure 4). Above the river banks, floodplain areas have formed, which are mainly disturbed and over grown by weeds. Some the areas adjacent to the Jukskei River used to be under crop cultivation, such as *Medicago sativa* (lucerne) pastures (Figure 4). The river is subjected to flush floods during the high rainfall season in summer as a result of runoff water from roads and suburban areas upstream from the study area. Further to the north, before the river crosses Modderfontein Road (R25), denser vegetation grow on the river banks, dominated by exotic alien trees such as wattle and *Eucalyptus* sp. Isolated patches of reeds and bulrushes grow within the river and on its banks.



Figure 4: Open river system with steep banks and scattered exotic trees on its banks. Note the Lucerne field in the foreground.

The river system within the study area will only favour the more common avifaunal species associated with aquatic and semi-aquatic habitat. This floodplain area will mainly attract ground living avifaunal species that either breed on the ground or forages on the ground for food, such as plovers, lapwings, bishops and widowbirds. Avifaunal species such as bishops, weavers, cisticolas and warblers will breed in the reeds growing on the banks of the river and will forage on seeds and insects that grow and live within the reeds and semi-aquatic vegetation. Due to the nature of the spruit, fishes are likely to be found and it will thus attract avifaunal species that feed on them. Frogs and crabs are more likely to be found and will attract bird species that feed on them, such as Hadeda Ibis, herons and Hamerkop. One Red Data avifaunal species, the Half-collared Kingfisher (*Alcedo semitorquata*) could occur along the river system, especially in the northern area of the study area where there is denser riparian growth.

Open grassland:

16% (± 90 ha) of the total surface area of the study area consists of open grassland of which about 83% is disturbed (Figure 5).



Figure 5: Open grassland east of the Jukskei River

The largest portion of the study site consists of grassland that varies between patches with natural *Elionurus-Eragrostis* dominated grassland (17%) and areas where the natural grassland areas have been disturbed by past and present human activities. The southern area west of the river consists of disturbed terraced grassland dominated by *Hyparrhenia hirta* grass. The disturbed grassland areas take up the largest area of the grassland habitat and natural grassland areas are reduced to a small fragmented patch in the north-eastern portion of the study site. In the disturbed areas alien vegetation is dominated by species such as *Tagetes minuta* (Khaki weed), *Cirsium vulgare* (Scottish thistle) and *Verbena brasiliensis*. For purposes of this report the areas that consist of pastures and areas adjacent to the Jukskei River are grouped together as open grassland since the avifaunal species diversity will not differ significantly from these habitat systems.

Due to the highly fragmented state of the grassland (the study area is completely surrounded by disturbed and transformed areas) and its small extent only the more common grassland species are expected to occur within this habitat system. This was evident from the lack of typical Highveld grassland avifaunal species seen within the study area. The presence and abundance of avifaunal species in this habitat will vary from season to season - lush and green in summer after summer rains and dry, brown, frosted or burnt during winter. The habitat favours ground-living avifaunal species, such as lapwings, pipits, longclaws and larks. These birds hunt for insects and/or breed on the ground, in burrows in the ground, or between the grasses. Weavers and widowbirds make use of such habitat for feeding on ripe seeds during late summer and early winter when the grass is not burnt, and widowbirds and cisticolae will also breed in the tall grass during summer. Species such as weavers and bishops that breed in the riparian habitat during summer will also make use of the open grassland habitat for feeding during winter after the grasses have seeded. Aerial feeding birds such as martins, swifts and swallows will also hunt for insects over the grasslands.

Disturbed and Transformed Areas:

77% (± 582 ha) of the total surface area of the study area is disturbed and transformed by past and present human activities such as buildings surrounded by garden vegetation dominated by exotic plant species, roads, dumping of rubble, diggings and invasions by exotic and alien plant and tree species (Figure 6).



Figure 6: Disturbed and Transformed area.

Only the more common avifaunal species that are able to adapt to areas changed by man will make use of this habitat system. Most of these bird species are not habitat specific and, due to their high level of adaptability, are also not threatened.

Exotic vegetation and plantations such as dense stands of *Eucalyptus* sp. and wattle in general usually do not offer a large variation in plant communities and these trees are mostly unpalatable in their live stage for insect and game species. As a result, few insect-eating avifaunal species will occur within this vegetation type. A number of nectar feeding species, such as white-eyes and sunbirds, will feed on the nectar produced by the flowers of these trees, and a limited of avifaunal species also make nests in these trees.

A few species of bird of prey, which require tall trees for nest building, have increased their ranges due to the presence of *Eucalyptus* trees especially where they grow in dense forest patches. These include such species as Black and Ovambo Sparrowhawks.

No or little grass growth takes place on the ground where these exotic trees grow and seed-eating avifaunal species are few. The roots of these trees are known to extract large volumes of water daily and the surrounding ground is normally hard and dry.

The growth of wattle and *Eucalyptus* trees within the study area varies from single standing trees to dense woodland. In general, wattle trees create a sterile environment with low avifaunal biodiversity and are not utilised by many avifaunal species. Some of the most common species have however adapted to wattle plantations, such as Cape White-eye, White-bellied Sunbird, Southern Boubou, Neddicky, Black-crowned Tchagra and Cape Robin. These birds either make use of the flowers for nectar-feeding or the trees for nest building or shelter.

Rural and suburban gardens have created an evergreen habitat for many avifaunal species, where they can hide, breed and forage for food. Natural predators such as snakes and smaller wild-cat species, which largely are persecuted by man, have been driven out of these areas, making it a relatively safe environment for birds apart from domestic cats and dogs and hunting by man. Many avifaunal species have adapted to human-altered areas and these species are mainly the more common bird species found within southern Africa.

The ranges of some species have also increased and species not previously known to occur within Gauteng suburbs are now common, e.g. Grey Go-away-bird and Thick-billed Weaver. Some species, which are mainly alien species, are dependent on humans for survival such as the House Sparrow and Common Myna.

Observed and Expected Species Richness

Of the 335 avifaunal species recorded for the 2628AA q.d.g.c., 149 (44 %) are likely to occur within the study area and 71 (48 %) of these avifaunal species were actually observed within the study area.

The avifaunal biodiversity index (ABI) indicates that the largest avifaunal species diversity is likely to occur within the river and riparian vegetation habitat system, with an avifauna biodiversity index (ABI) of 452, followed by the disturbed and transformed areas (ABI 395) and open grassland (ABI 278).

The avifaunal species listed in Table 1 are in the species order according to *Roberts - Birds of Southern Africa* VIIth edition (Hockey *et al.*, 2005). These comprise the 149 species that are likely to occur within the specific habitat systems within the study area, with those actually observed in **bold**. This does not include overflying birds or rare vagrants. The reporting rate for each species is the percentage for the q.d.g.c. according to the SABAP1 atlas (Harrison *et al.* 1997). The habitat preference scores for each species are shown under the recognised habitat types on site: **RR = River and Riparian vegetation, OG = Open Grassland and DT = Disturbed and Transformed Areas** with their possibility of occurrence in these specific habitats rated as 5 = present, 4 = High, 3 = Medium, 2 = Low, 1 = Very low, and 0 = Not likely to occur.

Table 1: Avifaunal species observed and that are likely to occur within the study area.

SCIENTIFIC NAMES	COMMON NAMES	R rate (%)*	Habitat preference		
			RR	OG	DT
<i>Pternistis swainsonii</i>	Swainson's Spurfowl	25	2	3	0
<i>Numida meleagris</i>	Helmeted Guineafowl	48	5	5	4
<i>Dendrocygna viduata</i>	White-faced Duck	7	3	0	0
<i>Alopochen aegyptiaca</i>	Egyptian Goose	66	5	0	4
<i>Anas sparsa</i>	African Black Duck	32	5	0	0
<i>Anas undulata</i>	Yellow-billed Duck	42	5	0	0
<i>Anas erythrorhyncha</i>	Red-billed Teal	5	2	0	0
<i>Indicator indicator</i>	Greater Honeyguide	3	0	0	2
<i>Indicator minor</i>	Lesser Honeyguide	10	0	0	5
<i>Prodotiscus regulus</i>	Brown-backed Honeybird	4	0	0	3
<i>Jynx ruficollis</i>	Red-throated Wryneck	26	5	4	4
<i>Dendropicos fuscescens</i>	Cardinal Woodpecker	15	0	0	3
<i>Lybius torquatus</i>	Black-collared Barbet	69	3	0	5
<i>Trachyphonus vaillantii</i>	Crested Barbet	85	4	0	5
<i>Tockus nasutus</i>	African Grey Hornbill	<1	2	0	4
<i>Upupa africana</i>	African Hoopoe	61	3	2	4
<i>Phoeniculus purpureus</i>	Green Wood-Hoopoe	59	0	0	5
<i>Alcedo semitorquata</i>	Half-collared Kingfisher (NT)	<1	1	0	0
<i>Alcedo cristata</i>	Malachite Kingfisher	6	2	0	0
<i>Halcyon albiventris</i>	Brown-hooded Kingfisher	8	3	0	4
<i>Megaceryle maximus</i>	Giant Kingfisher	7	5	0	0
<i>Ceryle rudis</i>	Pied Kingfisher	14	3	0	0
<i>Merops bullockoides</i>	White-fronted Bee-eater	<1	1	1	0

SCIENTIFIC NAMES	COMMON NAMES	R rate (%)*	Habitat preference		
			RR	OG	DT
<i>Merops apiaster</i>	European Bee-eater	13	3	4	2
<i>Colius striatus</i>	Speckled Mousebird	80	4	0	4
<i>Urocolius indicus</i>	Red-faced Mousebird	53	4	2	5
<i>Cuculus solitarius</i>	Red-chested Cuckoo	19	2	0	4
<i>Chrysococcyx caprius</i>	Diderick Cuckoo	25	4	4	4
<i>Centropus burchellii</i>	Burchell's Coucal (N-END)	33	4	0	4
<i>Psittacula krameri</i>	Rose-ringed Parakeet	1	2	0	5
<i>Cypsiurus parvus</i>	African Palm-Swift	25	5	5	5
<i>Apus affinis</i>	Little Swift	42	5	5	5
<i>Apus caffer</i>	White-rumped Swift	32	5	5	5
<i>Corythaixoides concolor</i>	Grey Go-away-bird	59	2	0	5
<i>Tyto alba</i>	Barn Owl	7	2	3	3
<i>Bubo africanus</i>	Spotted Eagle-Owl	18	2	3	3
<i>Columba livia</i>	Rock Dove	62	3	2	5
<i>Columba guinea</i>	Speckled Pigeon	49	4	4	5
<i>Columba arquatrix</i>	African Olive-Pigeon	3	2	0	4
<i>Streptopelia senegalensis</i>	Laughing Dove	96	5	4	5
<i>Streptopelia capicola</i>	Cape Turtle-Dove	85	5	4	5
<i>Streptopelia semitorquata</i>	Red-eyed Dove	42	5	4	5
<i>Amaurornis flavirostris</i>	Black Crake	5	2	0	0
<i>Porphyrio madagascariensis</i>	African Purple Swamphen	14	1	0	0
<i>Gallinula chloropus</i>	Common Moorhen	36	5	0	0
<i>Fulica cristata</i>	Red-knobbed Coot	47	2	0	0
<i>Gallinago nigripennis</i>	African Snipe	3	2	0	0
<i>Tringa nebularia</i>	Common Greenshank	1	1	0	0
<i>Tringa glareola</i>	Wood Sandpiper	6	2	0	0
<i>Actitis hypoleucus</i>	Common Sandpiper	5	2	0	0
<i>Burhinus capensis</i>	Spotted Thick-knee	31	2	5	4
<i>Charadrius tricollaris</i>	Three-banded Plover	20	5	5	0
<i>Vanellus armatus</i>	Blacksmith Lapwing	55	5	4	4
<i>Vanellus senegallus</i>	African Wattled Lapwing	33	5	5	3
<i>Vanellus coronatus</i>	Crowned Lapwing	81	2	5	4
<i>Larus cirrocephalus</i>	Grey-headed Gull	33	5	0	2
<i>Elanus caeruleus</i>	Black-shouldered Kite	37	4	5	1
<i>Milvus migrans</i>	Black Kite	4	2	2	1
<i>Accipiter minullus</i>	Little Sparrowhawk	<1	0	0	2
<i>Accipiter ovampensis</i>	Ovambo Sparrowhawk	2	1	0	3
<i>Buteo vulpinus</i>	Steppe Buzzard	8	3	1	5
<i>Falco amurensis</i>	Amur Falcon	1	0	1	0
<i>Tachybaptus ruficollis</i>	Little Grebe	34	3	0	0
<i>Anhinga rufa</i>	African Darter	21	2	0	0
<i>Phalacrocorax africanus</i>	Reed Cormorant	51	5	0	0
<i>Phalacrocorax lucidus</i>	White-breasted Cormorant	22	2	0	0
<i>Egretta garzetta</i>	Little Egret	13	3	0	0
<i>Ardea cinerea</i>	Grey Heron	34	5	0	0
<i>Ardea melanocephala</i>	Black-headed Heron	54	5	5	2
<i>Ardea purpurea</i>	Purple Heron	11	5	0	0
<i>Bubulcus ibis</i>	Cattle Egret	66	5	5	2
<i>Butorides striata</i>	Green-backed Heron	2	2	0	0

SCIENTIFIC NAMES	COMMON NAMES	R rate (%)*	Habitat preference		
			RR	OG	DT
<i>Nycticorax nycticorax</i>	Black-crowned Night-Heron	6	1	0	0
<i>Scopus umbretta</i>	Hamerkop	17	3	0	0
<i>Plegadis falcinellus</i>	Glossy Ibis	19	5	0	0
<i>Bostrychia hagedash</i>	Hadeda Ibis	90	5	3	5
<i>Threskiornis aethiopicus</i>	African Sacred Ibis	54	5	0	0
<i>Oriolus larvatus</i>	Black-headed Oriole	3	2	0	2
<i>Dicrurus adsimilis</i>	Fork-tailed Drongo	4	1	0	3
<i>Terpsiphone viridis</i>	African Paradise-Flycatcher	11	4	0	4
<i>Dryoscopus cubla</i>	Black-backed Puffback	10	2	0	2
<i>Tchagra senegalus</i>	Black-crowned Tchagra	3	0	0	0
<i>Laniarius ferrugineus</i>	Southern Boubou (END)	6	3	0	4
<i>Telophorus zeylonus</i>	Bokmakierie (END)	56	2	3	2
<i>Corvus albus</i>	Pied Crow	71	4	5	5
<i>Lanius collaris</i>	Common Fiscal	87	5	5	5
<i>Riparia paludicola</i>	Brown-throated Martin	14	3	1	1
<i>Hirundo rustica</i>	Barn Swallow	34	5	5	5
<i>Hirundo albicularis</i>	White-throated Swallow	31	5	4	4
<i>Hirundo cucullata</i>	Greater Striped Swallow	31	5	5	5
<i>Hirundo abyssinica</i>	Lesser Striped Swallow	18	4	4	4
<i>Hirundo spilodera</i>	South African Cliff-Swallow (B-END)	5	2	3	2
<i>Hirundo fuligula</i>	Rock Martin	13	1	3	4
<i>Delichon urbicum</i>	Common House-Martin	7	4	5	3
<i>Pycnonotus tricolor</i>	Dark-capped Bulbul	88	5	0	5
<i>Sphenoecacus afer</i>	Cape Grassbird (END)	1	2	0	0
<i>Acrocephalus baeticatus</i>	African Reed-Warbler	5	5	0	0
<i>Acrocephalus palustris</i>	Marsh Warbler	2	2	0	2
<i>Acrocephalus arundinaceus</i>	Great Reed-Warbler	2	3	0	2
<i>Acrocephalus gracilirostris</i>	Lesser Swamp-Warbler	9	3	0	0
<i>Phylloscopus trochilus</i>	Willow Warbler	12	3	0	5
<i>Turdoidea jardineii</i>	Arrow-marked Babbler	<1	1	0	2
<i>Sylvia borin</i>	Garden Warbler	4	0	0	3
<i>Zosterops virens</i>	Cape White-eye (END)	79	5	0	5
<i>Cisticola lais</i>	Wailing Cisticola	4	0	2	0
<i>Cisticola tinniens</i>	Levaillant's Cisticola	25	5	1	0
<i>Cisticola fulvicapilla</i>	Neddicky	16	4	5	4
<i>Cisticola juncidis</i>	Zitting Cisticola	16	4	5	2
<i>Prinia subflava</i>	Tawny-flanked Prinia	25	5	4	4
<i>Prinia flavicans</i>	Black-chested Prinia	16	2	5	4
<i>Mirafra africana</i>	Rufous-naped Lark	12	0	5	2
<i>Psophocichla litsitsirupa</i>	Groundscraper Thrush	1	0	3	4
<i>Turdus libonyanus</i>	Kurrichane Thrush	2	0	0	4
<i>Turdus smithi</i>	Karoo Thrush (END)	86	3	0	5
<i>Sigelus silens</i>	Fiscal Flycatcher (END)	49	0	0	3
<i>Muscicapa striata</i>	Spotted Flycatcher	3	2	0	4
<i>Cossypha caffra</i>	Cape Robin-Chat	70	5	0	5
<i>Saxicola torquatus</i>	African Stonechat	18	4	5	2
<i>Onychognathus morio</i>	Red-winged Starling	2	1	0	3
<i>Lamprotornis nitens</i>	Cape Glossy Starling	57	3	4	5
<i>Spreo bicolor</i>	Pied Starling (END)	13	1	3	2

SCIENTIFIC NAMES	COMMON NAMES	R rate (%)*	Habitat preference		
			RR	OG	DT
<i>Creatophora cinerea</i>	Wattled Starling	<1	1	1	2
<i>Acridotheres tristis</i>	Common Myna (INT)	95	5	5	5
<i>Chalcomitra amethystina</i>	Amethyst Sunbird	31	3	2	4
<i>Cinnyris talatala</i>	White-bellied Sunbird	17	3	2	5
<i>Ploceus capensis</i>	Cape Weaver (END)	23	2	2	4
<i>Ploceus velatus</i>	Southern Masked-Weaver	92	5	5	5
<i>Quelea quelea</i>	Red-billed Quelea	3	4	4	3
<i>Euplectes afer</i>	Yellow-crowned Bishop	7	3	2	1
<i>Euplectes orix</i>	Southern Red Bishop	51	5	5	4
<i>Euplectes albonotatus</i>	White-winged Widowbird	1	3	3	2
<i>Euplectes ardens</i>	Red-collared Widowbird	6	4	3	1
<i>Euplectes progne</i>	Long-tailed Widowbird	16	3	4	0
<i>Amblyospiza albifrons</i>	Thick-billed Weaver	5	5	2	4
<i>Sporaeeginthus subflavus</i>	Orange-breasted Waxbill	7	3	1	0
<i>Ortygospiza atricollis</i>	African Quailfinch	6	3	3	0
<i>Amadina erythrocephala</i>	Red-headed Finch (N-END)	1	2	3	3
<i>Estrilda astrild</i>	Common Waxbill	14	5	2	4
<i>Lagonosticta rhodopareia</i>	Jameson's Firefinch	<1	2	0	3
<i>Spermestes cucullatus</i>	Bronze Mannikin	2	5	4	5
<i>Vidua macroura</i>	Pin-tailed Whydah	17	5	4	4
<i>Passer domesticus</i>	House Sparrow	68	0	0	4
<i>Passer melanurus</i>	Cape Sparrow (N-END)	94	4	5	5
<i>Passer diffusus</i>	Southern Grey-headed Sparrow	13	4	4	5
<i>Motacilla capensis</i>	Cape Wagtail	72	5	2	4
<i>Macronyx capensis</i>	Cape Longclaw (END)	20	4	4	0
<i>Anthus cinnamomeus</i>	African Pipit	15	2	5	3
<i>Crithagra mozambicus</i>	Yellow-fronted Canary	3	1	1	2
<i>Crithagra atrogularis</i>	Black-throated Canary	24	5	5	5
<i>Crithagra gularis</i>	Streaky-headed Seedeater	13	2	0	3
			Avifaunal Biodiversity Index	452	278
					395

*The reporting rate is calculated as follows: Total number of cards on which a species was reported X 100 ÷ total number of cards for a particular quarter degree grid cell. **INT** = Introduced or alien birds species to Southern Africa. **END** = Endemic species and **N-END** = near endemic species.

Red Data Species Categories for the birds (Barnes, 2000)

RE = Regionally extinct, **CR** = Critically Endangered **EN** = Endangered, **VU** = Vulnerable, **NT** = Near-threatened.

The Avifaunal biodiversity index gives an indication of which habitat will hold the richest avifaunal diversity on and within 500 m surrounding the study site. The likelihood of occurrence of each species in the specific habitat systems on the study site are as follow: 5 = present, 4 = High, 3 = Medium, 2 = Low, 1 = very low, and 0 = Not likely to occur.

Threatened and Red Listed Bird Species

The following Red Data avifaunal species were recorded for the 2628AA q.d.g.c. according the SABAP1 data (Harrison *et al.* 1997), the SABAP2 data for the 2628AA q.d.g.c. and more specifically the 2605_2805 pentad (Table 2).

Table 2: Red Data avifaunal species recorded for the 2628AA q.d.g.c.

SCIENTIFIC NAMES	ENGLISH NAMES	Reporting Rate (%)*		
		SABAP1	SABAP2	Pentad
<i>Alcedo semitorquata</i>	Half-collared Kingfisher (NT)	<1	0.3	0.3
<i>Tyto capensis</i>	African Grass-Owl (VU)	1	0.1	0
<i>Eupodotis senegalensis</i>	White-bellied Korhaan (VU)	2	0	0
<i>Anthropoides paradiseus</i>	Blue Crane (VU)	1	0.1	0
<i>Crex crex</i>	Corn Crake (VU)	<1	0	0
<i>Rostratula benghalensis</i>	Greater Painted-snipe (NT)	<1	inct	0
<i>Glareola nordmanni</i>	Black-winged Pratincole (NT)	<1	0	0
<i>Gyps coprotheres</i>	Cape Vulture (VU)(END)	1	0.1	0
<i>Circus ranivorus</i>	African Marsh-Harrier (VU)	<1	0	0
<i>Aquila ayresii</i>	Ayres's Hawk-Eagle (NT)	<1	0	0
<i>Polemaetus bellicosus</i>	Martial Eagle (VU)	<1	0	0
<i>Sagittarius serpentarius</i>	Secretarybird (NT)	1	0.1	0
<i>Falco naumanni</i>	Lesser Kestrel (VU)	<1	0.3	0
<i>Falco biarmicus</i>	Lanner Falcon (NT)	1	0.5	0.3
<i>Falco peregrinus</i>	Peregrine Falcon (NT)	0	1.1	0
<i>Phoenicopterus ruber</i>	Greater Flamingo (NT)	1	2.1	9.8
<i>Phoenicopterus minor</i>	Lesser Flamingo (NT)	<1	0.4	2.8
<i>Mycteria ibis</i>	Yellow-billed Stork (NT)	<1	0.1	0
<i>Ciconia nigra</i>	Black Stork (NT)	<1	0	0
<i>Leptoptilos crumeniferus</i>	Marabou Stork (NT)	<1	0	0
<i>Mirafra cheniana</i>	Melodious Lark (NT)	<1	0	0
TOTAL:		20	12	4

*The reporting rate of SABAP1 and SABAP2 is calculated as follows: Total number of cards on which a species was reported X 100 ÷ total number of cards for a particular quarter degree grid cell. The colour codes for each species are represented as follows: yellow = very low, light orange = low, dark orange = medium and red = high with reference to the specific habitat systems found on site. Inct = Incidental sighting.

Red Data Species Categories for the birds (Barnes, 2000)

RE = Regionally extinct, **CR** = Critically Endangered **EN** = Endangered, **VU** = Vulnerable, **NT** = Near-threatened. **END** = Endemic species

A total of 21 Red Data avifaunal species have been recorded within the 2628AA q.d.g.c (Table 2), 20 species during the SABAP1 period, 12 species for the entire 2628AA q.d.g.c. during the current SABAP2 period and more specifically, 4 species for the 2605_2805 pentad in which the study area is situated. Nine (9) Red Data avifaunal species recorded during the SABAP1 period were not recorded during the current SABAP2 period within the 2628AA q.d.g.c. These species have appeared to have disappeared from the area or were not recorded for this q.d.g.c. during the time of the SABAP2 period. This could be as a result of habitat loss through development.

Summary of the Red Data Avifaunal Species

Table 3 provides a list of the Red Data avifaunal species recorded for the 2628AA q.d.g.c. during the SABAP1 period according to Harrison *et al.* (1997) and the current SABAP2 period and an indication of their likelihood of occurrence on and within the study area based on actual sightings, habitat and food availability.

Table 3: Red Data avifaunal species assessment for the study area according to the SABAP1 and SABAP2 data for the 2628AA q.d.g.c.

SCIENTIFIC NAME	PRESENCE OF SUITABLE HABITAT AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE ON STUDY SITE
<i>Alcedo semitorquata*</i> (Half-collared Kingfisher) (NT)	Yes: Requires fast-flowing streams, rivers and estuaries, usually with dense marginal vegetation (Maclean, 1993), especially perennial streams and smaller rivers with overhanging riparian vegetation on their banks. Nests in sand/earth banks (Tarboton <i>et al.</i> 1987) and requires riverbanks in which to excavate nest tunnels (Harrison <i>et al.</i> 1997a). Most typically occurs along fast-flowing streams with clear water and well-wooded riparian growth, often near rapids. It most frequently favours broken escarpment terrain and requires at least 1 km up and downstream of undisturbed river and riparian vegetation while breeding. It occurs from sea-level to 2000 m a.s.l. in southern Africa. Usually perches low down on the banks of rivers and streams, often on exposed roots, as well as exposed rock and low overhanging tree branches.	Unlikely The river and riparian habitat system could offer ideal foraging and breeding habitat for this species under favourable conditions.
<i>Tyto capensis*</i> (African Grass-Owl) (VU)	None : Occurs predominately in rank grass, typically but not always at fairly high altitudes. Breeds mainly in permanent and seasonal vleis, which it vacates while hunting or during post-breeding although it will sometimes breed in any area of long grass, sedges or even weeds (Van Rooyen, pers comm.) and not necessarily associated with wetlands (Tarboton <i>et al.</i> 1987) although this is more the exception than the rule. Foraging mainly confined to tall grassland next to their wetland vegetation and rarely hunts in short grassland, wetlands or croplands nearby (Barnes, 2000). Mainly restricted to wet areas (marshes and vleis) where tall dense grass and/or sedges occur. Prefers permanent or seasonal vleis and vacates the latter when these dried up or are burnt. Roosts and breeds in vleis but often hunt elsewhere e.g. old lands and disturbed grassland although this is suboptimal habitat conditions (Tarboton <i>et al.</i> 1987). May rarely occur in sparse Acacia woodland where patches of dense grass cover are present (Harrison <i>et al.</i> 1997a).	Highly unlikely No suitable breeding, roosting and foraging habitat were identified on and surrounding the study site
<i>Eupodotis senegalensis*</i> (White-bellied Korhaan) (VU)	None: Occurs in fairly tall, dense grassland, especially sour and mixed grassland, in open or lightly wooded, undulating to hilly country. In winter, occasionally on modified pastures and burnt ground (Harrison <i>et al.</i> 1997a).	Highly unlikely Due to a lack of suitable habitat and the highly fragmented state of the grassland areas within the study area. Scarce in Gauteng and secretive resident; widespread (Marais & Peacock, 2008)

SCIENTIFIC NAME	PRESENCE OF SUITABLE HABITAT AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE ON STUDY SITE
<i>Anthropoides paradiseus*</i> (Blue Crane) (VU)	None: Midlands and highland grassland, edge of karoo, cultivated land and edges of vleis (Maclean, 1993). Nests in both moist situations in vleis which have short grass cover and in dry sites far from water, usually exposed places such as on hillsides; forages in grassland and cultivated and fallow lands; roosts communally in the shallow water of pans and dams (Tarboton <i>et al.</i> 1987). Short dry grassland, being more abundant and evenly disturbed in the eastern "sour" grassland, where natural grazing of livestock is the predominant land use. Prefers to nest in areas of open grassland (Barnes, 2000) In the fynbos biome it inhabit cereal croplands and cultivated pastures and avoids natural vegetation. By contrast, it is found in natural vegetation in the Karoo and grassland biomes, but it also feeds in crop fields (Harrison <i>et al.</i> 1997a).	<u>Highly unlikely</u> Due to a lack of suitable habitat. Localised but common in the south-eastern Gauteng (Marais & Peacock, 2008)
<i>Crex crex</i> (Corn Crake) (VU)	None: Rank grassland and savanna, dry grassland bordering marshes and streams, including long grass areas of seasonally flooded grassland and, occasionally, wet clay patches and soft mud fringing ponds. In Acacia savanna, occurs mostly where trees are small and scattered, and grass dense often tussocky, 0.7 – 1.5 m tall (Hockey <i>et al.</i> 2005).	<u>Highly unlikely</u> Due to a lack of suitable foraging habitat Rare summer visitor. Widespread but elusive (Marais & Peacock, 2008).
<i>Rostratula benghalensis</i> (Greater Painted-snipe) (NT)	None: Dams, pans and marshy river flood plains. Favours waterside habitat with substantial cover and receding water levels with exposed mud among vegetation, departing when water recedes beyond the fringes of vegetation. Rare in seasonally flooded grassland and palm savanna (Hockey <i>et al.</i> 2005).	<u>Highly unlikely</u> Due to a lack of suitable foraging habitat Uncommon visitor and resident (Marais & Peacock, 2008)
<i>Glareola nordmanni</i> (Black-winged Pratincole) (NT)	None: A non-breeding overland migrant to southern Africa. In southern Africa winter quarters, prefers open grassland, edges of pans and cultivated fields, but most common in seasonally wet grasslands and pan systems. Attracted to damp ground after rains, also to agricultural activities, including mowing and ploughing, and to newly flooded grassland (Hockey <i>et al.</i> 2005).	<u>Highly unlikely</u> Might only pass through the area on very rare occasions. Erratic summer migrant sometimes in large flocks (Marais & Peacock, 2008)
<i>Gyps coprotheres*</i> (Cape Vulture) (VU)	None: They mostly occur in mountainous country, or open country with inselbergs and escarpments; less commonly as visitors to savannah or desert (Maclean, 1993). Forage over open grassland, woodland and agricultural areas; usually roosts on cliffs, but will also roost on trees and pylons (Barnes, 2000). It is reliant on tall cliffs for breeding but it wanders widely away from these when foraging. It occurs and breeds from sea level to 3 100 m.a.s.l. Current distribution is closely associated with subsistence communal grazing areas characterised by high stock losses and low use of poisons and, to a lesser extent, with protected areas (Harrison <i>et al.</i> 1997a), but their presence is ultimately dependent on the availability of food.	<u>Highly unlikely</u> Due to a lack of suitable foraging and breeding habitat. Breeds in Magaliesberg; uncommon wanderer elsewhere; mostly SW & NW Gauteng (Marais & Peacock, 2008)

SCIENTIFIC NAME	PRESENCE OF SUITABLE HABITAT AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE ON STUDY SITE
<i>Circus ranivorus*</i> (African Marsh-Harrier) (VU)	None: Almost exclusively inland and coastal wetlands (Hockey <i>et al.</i> 2005). Wetland and surrounding grasslands. Most highveld wetlands > 100 ha support a breeding pair (Tarboton & Allan 1984). Nests in extensive reed beds often high above water. Forages over reeds, lake margins, floodplains and occasionally even woodland. Almost entirely absent from areas below 300 mm of rainfall (Harrison <i>et al.</i> , 1997a). Marsh, vlei, grassland (usually near water); may hunt over grassland, cultivated lands and open savanna (Maclean, 1993). Dependant on wetlands, particularly permanent wetlands for breeding, roosting and feeding. May utilise small wetlands 1-2 ha in extent for foraging, but larger wetlands are required for breeding (Barnes, 2000).	<u>Highly unlikely</u> There are no suitable foraging, breeding or roosting habitat for this species on the study site. Declining resident of large vleis, occurs mainly in south-eastern Gauteng (Marais & Peacock, 2008)
<i>Circus maurus</i> Black Harrier (NT)	Yes: Black Harriers hunts over dry and damp grasslands, fynbos and karoo. It also exploits cultivated lands. The known range of the Vlei Rat <i>Otomys irroratus</i> coincides accurately with its present distribution (Harrison <i>et al.</i> , 1997).	<u>Highly unlikely</u> Due to a lack of suitable foraging and breeding habitat.
<i>Aquila ayresii</i> (Ayres's Hawk-Eagle) (NT)	None: Non-breeding summer visitor to South Africa, favouring dense woodland and forest edge, often in hilly country. Regular in larger northern cities and towns (Johannesburg, Pretoria, Mokopane/Pietersburg), where it often roosts in <i>Eucalyptus</i> stands or other tall trees within its prime distribution range (Hockey <i>et al.</i> 2005).	<u>Highly unlikely</u> There is no suitable habitat for this species on the study site. Rare in Gauteng (Marais & Peacock, 2008)
<i>Polemaetus bellicosus*</i> (Martial Eagle) (VU)	None: Tolerates a wide range of vegetation types, being found in open grassland, scrub, Karoo, agricultural lands and woodland. It relies on large trees (or electricity pylons) to provide nest sites (Barnes, 2000) as well as windmills and even cliffs in treeless areas. It occurs mainly in flat country and is rarer in mountains, and it also avoids extreme desert, and densely wooded and forested areas (Harrison <i>et al.</i> 1997a & Barnes, 2000).	<u>Highly unlikely</u> Due to a lack of suitable habitat and disturbance cause by the large scale development surrounding the study site. Uncommon local resident (Marais & Peacock, 2008)
<i>Sagittarius serpentarius</i> (Secretarybird) (NT)	None: Open grassland with scattered trees, shrubland, open <i>Acacia</i> and <i>Combretum</i> savanna (Hockey <i>et al.</i> 2005). Restricted to large conservation areas in the region. Avoids densely wooded areas, rocky hills and mountainous areas (Hockey <i>et al.</i> 2005 & Barnes, 2000). Requires small to medium-sized trees with a flat crown for nesting, and often roosts in similar locations. Nesting density only about 150 km ² /pair (n = 4, Kemp, 1995).	<u>Highly unlikely</u> Due to a lack of suitable habitat. Uncommon in open areas within Gauteng (Marais & Peacock, 2008)
<i>Falco naumanni*</i> (Lesser Kestrel) (VU)	None: Non-breeding Palaearctic migrant. Forages preferentially in pristine open grassland but also hunts in converted grassland such as small scale pastures provided the conversion is not as total as in plantation forestry or in areas of consolidated agricultural monoculture (Barnes, 2000; Hockey <i>et</i>	<u>Highly unlikely</u> Due to a small and highly fragmented state of the grassland areas on the study site

SCIENTIFIC NAME	PRESENCE OF SUITABLE HABITAT AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE ON STUDY SITE
	<i>al.</i> 2005) such as maize, sorghum, peanuts, wheat, beans and other crops (Tarboton & Allan 1984) where they hunt for large insects and small rodents, but avoid wooded areas except on migration. They roost communally in tall trees, mainly <i>Eucalyptus</i> , in urban areas (Barnes, 2000), often in towns or villages, but also in farm lands (pers. obs). Favour a warm, dry, open or lightly wooded environment, and are concentrated in the grassy Karoo, western fringes of the grassland biome and southeast Kalahari. Generally avoids foraging in transformed habitats but occurs in some agricultural areas, including croplands, in fynbos and renosterveld of the Western Cape (Hockey <i>et al.</i> 2005). Large numbers congregate in sweet and mixed grasslands of the highveld regions.	Localised summer migrant (Marais & Peacock, 2008)
<i>Falco biarmicus*</i> (Lanner Falcon) (NT)	None: Most frequent in open grassland, open or cleared woodland, and agricultural areas. Breeding pairs generally favour habitats where cliffs are available as nest and roost sites, but will use alternative sites such as trees, electricity pylons and building ledges if cliffs are absent (Hockey <i>et al.</i> 2005). Mountains or open country, from semi desert to woodland and agricultural land, also cities (Maclean, 1993), even on forest-grassland ecotones. Generally a cliff nesting species and its wider distribution is closely associated with mountains with suitable cliffs. Able to breed on lower rock faces than Peregrine Falcon <i>Falco peregrinus</i> and also utilises the disused nests of other species, such as crows, other raptors and storks, on cliffs, in trees and on power pylons, and also quarry walls (Tarboton <i>et al.</i> 1987). Generally prefers open habitats e.g. alpine grassland and the Kalahari, but exploits a wide range of habitats – grassland, open savanna, agricultural lands, suburban and urban areas, rural settlements – in both flat and hilly or mountainous country. Also breeds in wooded and forested areas where cliffs occur (Harrison <i>et al.</i> 1997a).	<u>Highly unlikely</u> Due to a lack of suitable breeding habitat. Uncommon resident in open areas in Gauteng (Marais & Peacock, 2008)
<i>Falco peregrinus</i> (Peregrine Falcon) (NT)	None: Resident <i>F. p. minor</i> mostly restricted to mountainous riparian or coastal habitats, where high cliffs provides breeding and roosting sites. Breeding pairs prefer habitats that favour specialised, high speed, aerial hunting, e.g. high cliffs overhanging vegetation with raised and/or discontinuous canopy (e.g. forest, fynbos, woodland), or expanses of open water. Also uses quarries and dam walls, and frequents city centres, e.g. Cape Town, where tall buildings substitute for rock faces. Migrant <i>F. p. calidus</i> in more open country, often coastal, even roosting on ground on almost unvegetated salt flats.	<u>Highly unlikely</u> Due to a lack of suitable breeding habitat. Could move through the area or rare occasions. Uncommon resident and summer migrant in Gauteng (Marais & Peacock, 2008)
<i>Phoenicopterus ruber*</i> (Greater Flamingo) (NT)	None: Breeds at recently flooded, large, eutrophic wetlands (favoured foraging habitat), shallow salt pans; at other times, at coastal mudflats, inland dams, sewage treatments works, small ephemeral pans and river mouths (Hockey <i>et al.</i> 2005). Usually breeds colonially on mudflats in large pans (Harrison <i>et al.</i> 1997a). Shallow pans, especially saline pans when they have water; also occasionally on other bodies of shallow water such as dams and vleis	<u>Highly unlikely</u> Due to a lack of suitable foraging and breeding habitat. Mainly restricted to the south-eastern Gauteng (Marais & Peacock, 2008)

SCIENTIFIC NAME	PRESENCE OF SUITABLE HABITAT AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE ON STUDY SITE
	(Tarboton <i>et al.</i> 1987). Large bodies of shallow water, both inland and coastal; prefers saline and brackish water (Maclean 1993). Occasionally forages along sandy coasts.	
<i>Phoenicopterus minor*</i> (Lesser Flamingo) (NT)	None: Primarily open, shallow eutrophic, wetlands and coastal lagoons and may occur on water bodies which are more saline and more alkaline than those used by <i>Phoenicopterus ruber</i> (Greater Flamingo). Breeds on saline lakes, salt pans and mudflats far out in pans and lakes (Harrison <i>et al.</i> 1997a). Non-breeding birds aggregate at coastal mudflats, salt works and sewage treatment works where salinities are high. Small, ephemeral freshwater wetlands very important for birds dispersing from breeding grounds (Hockey <i>et al.</i> , 2005). Shallow pans, especially saline pans when they contain water (Tarboton <i>et al.</i> , 1987). Large brackish or saline inland and coastal waters (Maclean, 1993).	<u>Highly unlikely</u> Due to a lack of suitable foraging and breeding habitat. Mainly restricted to the south-western and south-eastern Gauteng (Marais & Peacock, 2008)
<i>Mycteria ibis</i> (Yellow-billed Stork) (NT)	None: Utilises diverse wetlands and permanent and seasonal habitats, including alkaline and freshwater lakes, river, dams, pans, flood plains, large marshes, swamps, estuaries, margins of lakes or rivers, flooded grassland and small pools or streams where there are areas of shallow water free of emergent vegetation (Tarboton <i>et al.</i> , 1987); less often marine mudflats and estuaries (Hockey <i>et al.</i> , 2005). Nests colonially on large trees adjacent to productive wetlands, but only locally and erratically during ideal conditions.	<u>Highly unlikely</u> Due to a lack of suitable habitat Common at large wetlands within Gauteng; erratic elsewhere (Marais & Peacock, 2008)
<i>Ciconia nigra*</i> (Black Stork) (NT)	None: Dams, pans, flood plains, shallows of rivers, pools in dry riverbeds, estuaries and sometimes on marshland and flooded grassland; uncommon at seasonal pans lacking fish. Associated with mountainous regions (Hockey <i>et al.</i> , 2005) where they nest (Maclean, 1993) on cliffs (Harrison <i>et al.</i> 1997a). Feeds in shallow water, but occasionally on dry land, in streams and rivers, marshes, floodplains, coastal estuaries and large and small dams; it is typically seen at pools in large rivers.	<u>Highly unlikely</u> Due to a lack of suitable breeding and foraging habitat
<i>Leptoptilos crumeniferus</i> (Marabou Stork) (NT)	None: Both aquatic and terrestrial habitats, favouring open and semi-arid areas; largely absent from forest areas and true desert ⁸ . Common at wetlands, including dams, pans and rivers, and in wildlife reserves and ranching areas.	<u>Highly unlikely</u> Due to a lack of suitable breeding and foraging habitat
<i>Buphagus erythrorhynchus</i> (Red-billed Oxpecker) (NT)	None: Open savanna, up to 3 000 m a.s.l. (Hockey <i>et al.</i> , 2005). Uses mammal feeding hosts in a variety of woodlands, all in rainfall zones of more than 400 mm/annum. Needs holes in trees for nesting and uses Ilala Palms, tree Aloes, reed beds and rarely larger game to roost on at night (Harrison <i>et al.</i> 1997a). Their presence is highly dependent on the availability of tick on large game species and cattle.	<u>Highly unlikely</u> Due to a lack of suitable habitat and the absence of large game species and livestock.
<i>Mirafra cheniana</i> (Melodious Lark) (NT)	None: Occurs in grassland dominated by <i>Themeda triandra</i> grass in South Africa. Occasionally in planted pastures of <i>Eragrostis curvula</i> and <i>E. tef</i> .	<u>Unlikely</u> Due to a lack of suitable grassland

SCIENTIFIC NAME	PRESENCE OF SUITABLE HABITAT AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE ON STUDY SITE
	Avoids wet lowlands, favouring fairly short grassland (< 0.5 m), with open spaces between tussocks, at 550 – 1 750 m.a.s.l. with annual rainfall of between 400 – 800 mm p/a (Hockey <i>et al.</i> , 2005).	habitat. Localised resident in Gauteng (Marais & Peacock, 2008) where suitable habitat occur

*Priority Red Data bird species according to GDARD.

6. FINDINGS AND POTENTIAL IMPLICATIONS

- 6.1 Red Data avifaunal species confirmed from the study site for which suitable foraging, breeding and roosting habitat was confirmed:

None

- 6.2 Red Data avifaunal species confirmed within the study area for which suitable foraging, breeding and roosting habitat was confirmed:

None

- 6.3 Red Data avifaunal species confirmed outside the study area for which suitable foraging, breeding and roosting habitat was confirmed:

None

- 6.4 Red Data avifaunal species for which suitable foraging and/or breeding habitat was confirmed from the study area:

Half-collared Kingfisher (*Alcedo semitorquata*):

Criteria for IUCN threatened category: Status: **Near-Threatened**

Breeding: Monogamous, solitary nester, territorial. Requires at least 1 km of river territory while breeding. Nests in burrows in vertical riverbanks usually 1.0-1.5 m (0.3-4.5m) high, with overhanging vegetation or roots providing screening. The nest is excavated by both sexes.

Habitat: Clear fast-flowing rivers fringed with riparian growth (Barnes, 2000). Clear, fast-flowing perennial streams, rivers and estuaries, usually narrow and secluded, with dense marginal vegetation; often near rapids. Also well-vegetated lake shores and coastal lagoons; fishes in salt water in E Cape (Hockey *et al.*, 2005).

Threat: Widespread degradation of its habitat by siltation, erosion, pollution, water extraction and clearing of riparian vegetation (Barnes, 2000), together with disturbance.

On site conclusion: The Half-collared Kingfisher has been observed along the Jukskei River (pers obs) in the past and is known to occur along this river system according to the SABAP2 data. The stretch of the Jukskei River on the study site represents the start of the river and here the river is still narrow and shallow and used to be a non-perennial river in the past but has probably changed to a perennial river system due to storm water runoff from roads and suburbia. There are only 5 records of this species from 1990 data cards (0.25%) for the entire 2628AA q.d.g.c. and 1 record from 287 data cards (0.3%) for the 2625_2805 pentad according to the SABAP2 data.

The SABAP1 data indicate a reporting rate of less than 1% for this species. Although the river system does not offer optimal conditions for Half-collared Kingfishers they are unlikely to occur along the Jukskei River within the study area. This is due to a lack of dense riparian growth in most areas along the river and the small extent of the river system. However, the possibility of this species occurring along this river stretch cannot be excluded. The northern river section within the study area with denser riparian growth is more favourable for this species even if the riparian vegetation consists of alien and exotic vegetation (per sobs) as long as there is sufficient vegetation cover. The presence of vertical sandbanks in the study area could offer suitable breeding habitat for this species. Habitat could be created to favour this species through the planting of preferably indigenous trees within the riparian area which could in time favour this species. In the past (Google image 28/1/2001) there used to be more riparian growth along the banks of the river which probably consisted of exotic and alien trees which has since been removed. The river and an area of 50 m riparian buffer zone should be left free from any sort of development and disturbance (Figure 7).

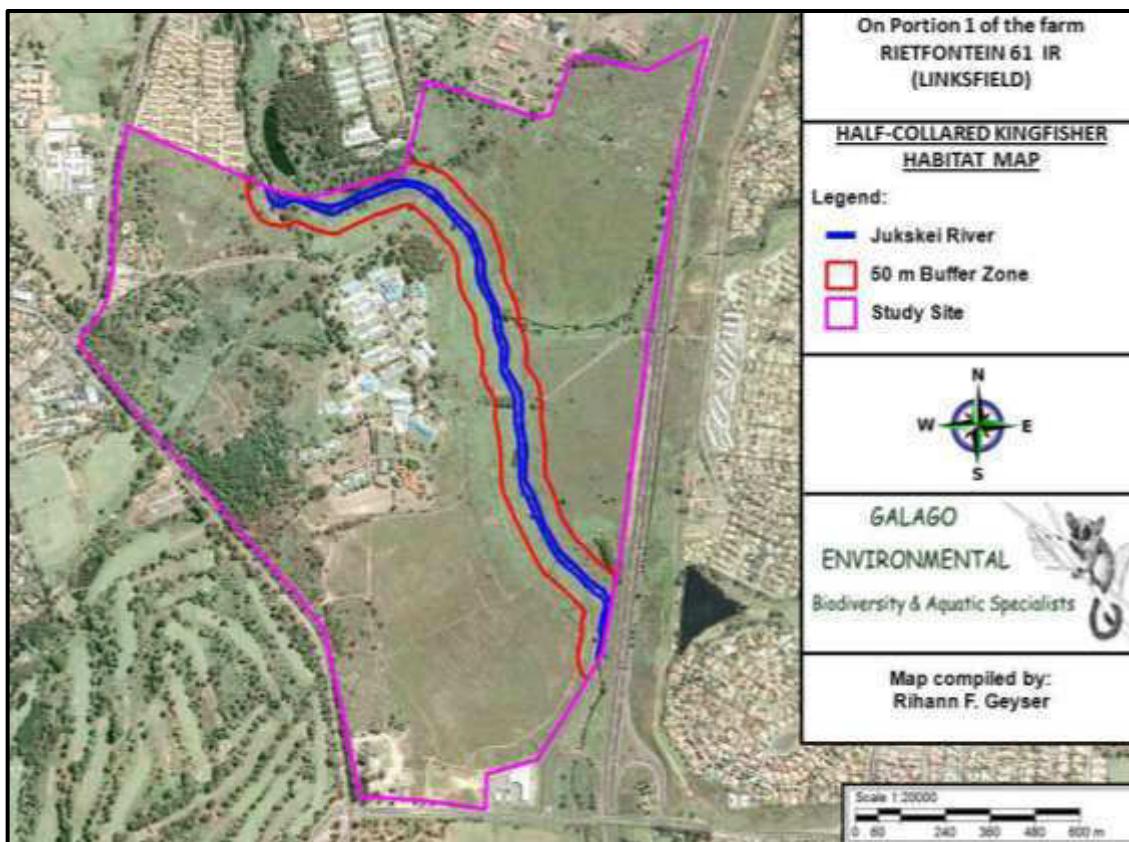


Figure 7: Habitat map for Half-collared King Fisher.

7. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

The Galago Environmental team has appropriate training and registration, as well as extensive practical experience and access to wide-ranging data bases to consider the derived species lists with high limits of accuracy. In this instance the biodiversity of all Alignments has to a greater or lesser extent been jeopardized, which renders the need for field surveys unnecessary. In instances where uncertainty exists regarding the presence of a species it is listed as a potential occupant, which renders the suggested mitigation measures and conclusions more robust.

Even though every care is taken to ensure the accuracy of this report, environmental assessment studies are limited in scope, time and budget. Discussions and proposed mitigations are to some extent made on reasonable and informed assumptions built on *bona fide* information sources, as well as deductive reasoning. Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions and migrations. Since environmental impact studies deal with dynamic natural systems additional information may come to light at a later stage. Galago Environmental can thus not accept responsibility for conclusions and mitigation measures made in good faith based on own databases or on the information provided at the time of the directive. This report should therefore be viewed and acted upon with these limitations in mind.

The general assessment of species rests mainly on the 1987 atlas for birds of the then-Transvaal (Tarboton *et al.* 1987) and comparison with the 1997 SABAP atlas (Harrison *et al.* 1997), so any limitations in either of those studies will by implication also affect this survey and conclusions.

The general assessment of species rests mainly on the 1997 SABAP1 atlas data (Harrison *et al.* 1997) for comparison with the current SABAP2 atlas, so any limitations in either of those studies will by implication also affect this survey and conclusions.

Furthermore the number of atlas cards received and the diversity of habitat systems surveyed for avifaunal species within a q.d.g.c. or pentad or lack thereof could also have an effect on the avifaunal diversity that could potentially occur on the study site. 2297 atlas cards were received for the 2628AA q.d.g.c. over the SABAP1 project period. To date of this report 1990 cards for the entire 2628AA q.d.g.c. over the current SABAP2 project period and 287 cards for the 2605_2805 pentad since 1 July 2007.

8. RECOMMENDED MITIGATION MEASURES

The following mitigation measures are proposed by the specialist:

- A monitoring plan should be implemented to confirm the presence of Half-collared Kingfisher within and surrounding the study area and to establish their population density.
- A 50 m buffer zone from the edge of the riparian area should be left undeveloped and undisturbed for Half-collared Kingfishers. This area should be regarded as highly sensitive.
- No development should be allowed within the 50 m buffer zone of the river system. Trees should be planted within the buffer zone area to create riparian habitat to create favourable riparian habitat for this species.
- Where possible, **work should be restricted to one area at a time**, as this will give the smaller birds, mammals and reptiles a chance to weather the disturbance in an undisturbed zone close to their natural territories.
- **No vehicles should be allowed to move in or across the wet areas or drainage lines and possibly get stuck.** This leaves visible scars and destroys habitat, and it is important to conserve areas where there are tall reeds or grass, or areas where there is short grass and mud.
- The contractor must ensure that no fauna is disturbed, trapped, hunted or killed during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.
- It is suggested that where work is to be done close to the drainage lines, these areas **be fenced off during construction**, to prevent heavy machines and trucks from trampling the plants, compacting the soil and dumping in the system.

- During the construction phase, noise must be kept to a minimum to reduce the impact of the development on the fauna residing on the site.
- Alien and invasive plants must be removed in a phased manner.

9. CONCLUSIONS

The river and riparian habitat as well as a buffer zone of 50 m from the edge of the river should be regarded as highly sensitive for Half-collared Kingfishers as well as other avifaunal species that breed, forage and roost along this river system. This will also ensure future avifaunal biodiversity for the study area. With exception of the Half-collared Kingfisher the proposed development will not have a negative effect on any of the other Red Data avifaunal species recorded for the 2628AA q.d.g.c. The rest of the study site is highly disturbed and only the more common avifaunal species associated with these habitat systems are likely to make use of these habitat systems.

The proposed development could increase populations of avifaunal species which are able to adapt to areas changed by man. Development of the grassland areas will however decrease the habitat for grassland avifaunal species within the direct vicinity of the study area and decrease the foraging habitat for avifaunal species that breed and forage along the river and within the rivers riparian zone. These species however are able to persist within disturbed grassland areas such as servitude areas under power lines and road reserves.

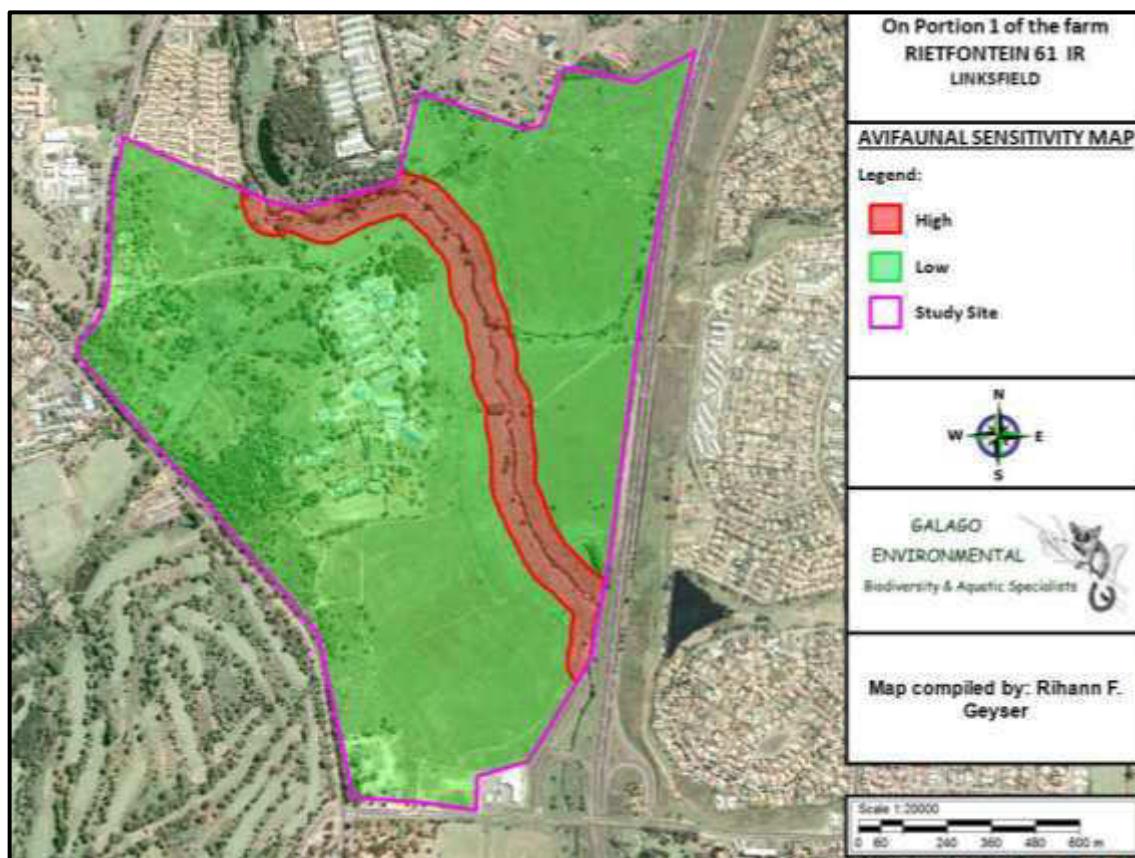


Figure 8: Avifaunal sensitivity map

10. LITERATURE SOURCES

- Barnes, K.N. (ed.). 1998. *The Important Bird Areas of southern Africa*. Johannesburg: BirdLife South Africa.
- Barnes, K.N. (ed.). 2000. *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland*. BirdLife South Africa, Johannesburg.
- Chittenden, H. 2007. *Roberts Bird Guide*. John Voelcker Bird Book Fund, Cape Town.
- GDARD, 2012. *Requirements for biodiversity assessments Version 2*. Directorate of Nature Conservation, Department of Agriculture and Rural development.
- Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V. & Brown, C.J. (eds.). 1997. *The Atlas of Southern African Birds*. Vol. 1 & 2. BirdLife South Africa, Johannesburg.
- Hockey, P.A.R., Dean, W.R.J. & Ryan, P.G. 2005. *Roberts Birds of Southern Africa VII th Edition*, The Trustees of the John Voelcker Bird Book Fund, Cape Town.
- Keith, S., Urban, E.K. & Fry, C.H. 1992. *The Birds of Africa*. Vol. 4. Academic Press, London.
- Kemp, A. C. 1995. Aspects of the breeding biology and behaviour of the Secretarybird *Sagittarius serpentarius* near Pretoria, South Africa. Ostrich 66: 61-68.
- Kemp, A.C. & Calburn, S. 1987. The owls of southern Africa. Cape Town: Struik Winchester.
- Maclean, G.L., 1990. *Ornithology for Africa*. University of Natal Press, Pietermaritzburg.
- Maclean, G.L., 1993. *Roberts' Birds of Southern Africa*. John Voelcker Bird Book Fund, Cape Town.
- Marais, M. & Peacock, F., 2008. *The Chamberlain guide to Birding Gauteng*, Mirafra Publishing, CTP Book Printers, Cape Town
- Mucina, L. & Rutherford, M.C. (eds) 2006. *The vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. South African National Biodiversity Institute, Pretoria.
- Peacock, F., 2006. Pipits of Southern Africa – a complete guide to Africa's ultimate LBJ's, Published by the author, Pretoria; www.pipits.co.za.
- Percy, W., & Pitman C.R.S., 1963 *Further notes on the African Finfoot, Podica senegalensis* (Vielott). Bull. Br. Ornithol. Club 83:127-132 .
- Sinclair, I., Hockey, P., Tarboton W & Ryan P. 2011. *Sasol Birds of Southern Africa*. 4th edition, Struik, Cape Town.
- Sinclair I., & Hockey P. 2005. *The Larger Illustrated Guide to Birds of Southern Africa*. Struik, Cape Town.
- Steyn, P. 1982. *Birds of prey of southern Africa*. Claremont, Cape Town: David Philip.
- Tarboton, W.R., Kemp, M.I., & Kemp, A.C. 1987. *Birds of the Transvaal*. Transvaal Museum, Pretoria.
- Tarboton, W., 2001. *A Guide to the Nests and Eggs of Southern African Birds*. Struik, Cape Town.
- Urban, E.K., Fry, C.H., & Keith, S., 1986. *Birds of Africa*. Vol. 2. Academic Press, London.
- Van Ginkel, C.E., Glen, R.P., Gordon-Gray, K.D., Cilliers, C.J., Muasya, M., & van Deventer, P.P. 2011. *Easy identification of some South African Wetland Plants (Grasses, Restios, Sedges, Rushes, Bulrushes, Eriocaulons and Yellow-eyed grasses)*, Water Research Commission, Gezina.
- Whittington-Jones, C. A., Lockwood, G., Pretorius, M. D. & Kemp, A. 2011. Monitoring of the African Grass-Owl *Tyto capensis* on the Suikerbosrand Nature Reserve northern extension, Gauteng, South Africa: 2010-2011. Gabar 22: 19-21.



Figure 33 Eroded bank of the Jukskei River exhibiting soils that formed under uneroded valley bottom conditions



Figure 34 Eroded bank of the Jukskei River exhibiting soils that formed under uneroded valley bottom conditions



Figure 35 Eroded bank of the Jukskei River exhibiting soils that formed under uneroded valley bottom conditions. Note the wetland vegetation on the remaining bank.



Figure 36 Eroded bank of the Jukskei River exhibiting soils that formed under uneroded valley bottom conditions



Figure 37 Eroded bank of the Jukskei River as a result of human activities



Figure 38 Eroded bank of the Jukskei River as a result of human activities



Figure 39 Eroded channel with several human structures and flood debris (massive tree trunk)



Figure 40 Eroded bank and compromised bridge (with signs of haphazard attempts at repair)



Figure 41 Eroded banks of the Jukskei River and a compromised weir



Figure 42 Eroded bank of the Jukskei River and collapsing gabion structures



Figure 43 Collapsing gabion structures and a silted-up weir



Figure 44 Eroded bank of the Jukskei River and collapsed concrete structures

7.4 ARTIFICIAL MODIFIERS

The physical historical artificial modifiers on the site were addressed in detail in the sections above. The driver of most of the modifications is the altered hydrology of and runoff from the urban structures in the catchment area.

The other modifier is water quality. A dedicated investigation into the water quality of the Jukskei River on the site was not conducted. However, it can be stated with a high degree of confidence that the water quality in the Jukskei River is severely compromised chemically and biologically. The reasons are:

1. A large section of the inner city of Johannesburg is characterised by dysfunctional buildings with leaking sewers. Raw sewage flows into the Bruma Lake with disastrous consequences. Bruma Lake's water flows into the Jukskei River and through the Linksfield site. From analysis conducted on the Bruma Lake water it is clear that the Jukskei River is afflicted with high levels of faecal pollutants and consequently the coliform levels are very high. It is assumed that there are many other chemical pollutants (of biological origin – microbial toxins) as well as pathogens present in high concentrations.
2. It is well known that many minibus taxis are serviced on the streets of Johannesburg. In this sense used oil is dumped into the storm water drains and these end up in Bruma Lake and consequently in the Jukskei River.
3. Many other sources of pollutants and litter exist in the catchment of the Jukskei River. The plastic pollution occurring within the catchment is evident in the presence of large volumes of plastic bottles, containers and bags within the organic detritus that accumulates in certain sections of the Jukskei River channel.

Due to the pollution of the river it is imperative that any activities within the river channel for the purposes of rehabilitation include the necessary precautions for the health and safety of workers.

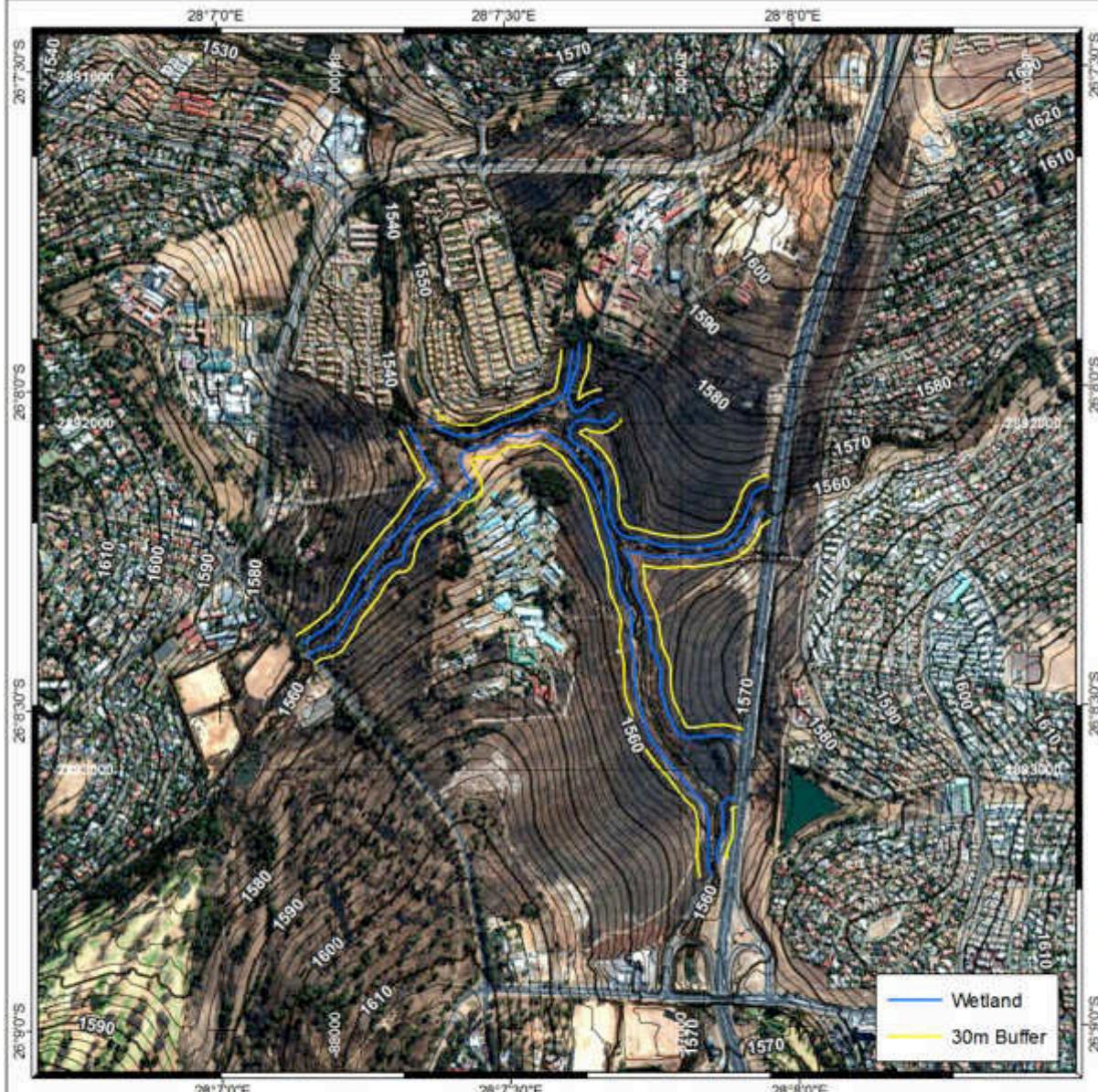
8. WETLAND ASSESSMENT

8.1 PROPOSED DELINEATION

The proposed delineation for the wetlands on the site, based on the information generated earlier in the report, is provided in **Figure 45**. A 30 m buffer is included on the map but this buffer is meaningless in the light of the modifications of the wetland / watercourse features.

8.2 WETLAND CLASSIFICATION / TYPES

Based on the information generated in this document and the fact that there aren't any distinct concave depressions with wet soil areas on the site the only wetlands present are **channelled (highly eroded) valley bottom wetlands** associated with the drainage channel and remaining floodplain of the Jukskei River. From a soil morphology, soil form and landscape indicator perspective no other wetland sites or types could be identified.



Projection - Transverse Mercator
Datum - Hartebeesthoek 1994
Reference Ellipsoid - WGS 1984
Central Meridian - 29

0 200 400 600 800 1 000
Meters

Figure 45 Proposed wetland delineation outcome for the site

8.3 WETLAND FUNCTIONALITY

The channelled and eroded valley bottom wetlands function as drainage features and water course channelling large volumes of water through the site. The contribution of wetland areas on the site in terms of seepage and overland flow to the volumes in the Jukskei River is negligible.

8.4 PRESENT ECOLOGICAL STATUS (PES) DETERMINATION

Hydrological Criteria:

- Flow modification: Large modification due to urban infrastructure in the catchment with significant erosion in the channel and on the banks. Score 1, Confidence 4.
- Permanent inundation: Permanent inundation not possible due to the extensive modification as well as the rainfall and catchment characteristics. Score 1, Confidence 4.

Water Quality Criteria

- Water quality modification: Score 1, Confidence 4
- Sediment load modification: Score 1, Confidence 4

Hydraulic / Geomorphic Criteria

- Canalisation: Score 1, Confidence 4
- Topographic Alteration: Score 2, Confidence 4

Biological Criteria

- Terrestrial encroachment: Score 2, Confidence 3
- Indigenous vegetation removal: Score 1, Confidence 4
- Invasive plant encroachment: Score 2, Confidence 3
- Alien fauna: Score 2, Confidence 3
- Overutilization of biota: Score 1, Confidence 4

Score

PES category E-F

8.5 IMPACT ASSESSMENT OF DEVELOPMENT ON WETLANDS

At the outset it must be stated that a final site layout was not available at the time of the generation of the report. However, general impacts of urban developments have been used in the assessment. Within the context of the drastic alteration of the Jukskei River channel and those of its tributaries it is concluded that the development on the site will not drastically alter the current status quo.

The impacts on the site, of development outside of the delineated wetland and buffer, will be limited to the following:

1. Storm water generation and alteration on site due to paving and sealing of surfaces (refer to section 5.8 for an explanation of the generalised impacts of sealing);
2. Increased storm water runoff and spikes in water flows leading to erosion within the drainage features as well as storm water channels (refer to section 5.9 for an explanation of the erodibility of the soils of the HHGD); and
3. Decreased infiltration of rainfall into the soils with decreased lateral flow volumes and recharge into groundwater. This decrease will not have significant effect on the site as there aren't any significant seepage wetlands on the mid or footslopes of the site.

Therefore, the impacts on the site will be limited to increased surface runoff in terms of volume and energy of the water. Through the adequate inclusion and design of storm water attenuation

structures on the site (outside of the drainage channels and wetland buffer) these impacts will be manageable. It is therefore recommended that adequate and effective storm water management structures be included throughout the site as part of the town planning and architectural designs.

8.6 MANAGEMENT REQUIREMENTS AND MITIGATION OF STORM WATER

The wetlands of the HHGD are stable against erosion under natural conditions where landscape runoff characteristics have not been altered by humans. As indicated earlier in the report, the HHGD soils are highly susceptible to erosion and as such even slight changes in storm water runoff intensity will cause increased erosion pressures on wetlands. **Important:** Opposite to the general notion that wetlands perform flood attenuation functions the HHGD wetlands cannot perform such as they are not stable against degradation once the runoff intensity increases.

It is therefore imperative that the wetlands (and other open soil areas on the site) be protected against increased erosion pressures through the implementation of the following:

1. Adequate storm water mitigation throughout the construction site (from start to completion) to prevent large pulses in storm water.
2. Sediment containment structures throughout the site to prevent sediment runoff and accumulation in the wetland area.

The storm water runoff from soils in the area under natural conditions will be barely perceivable as the soils act as a sponge with a gradual release of the water once it leaches out of the landscape through lateral seepage on the impervious subsoil layers. Only in events of exceptional rainfall will the overland flow increase to significant volumes. Once development and construction start on soils of the HHGD the infiltration characteristics of the soils change drastically with a consequent drastic change in runoff characteristics. Runoff changes lead to a distinct spike in the hydrograph as elucidated through modelling and calculations. These spikes are the main drivers of accelerated degradation of watercourses in the area. Please refer to sections 5.7, 5.8 and 5.9 for an explanation of the implications of the above in terms of the wetland delineation guidelines, urban developments and soil erosion in the HHGD area.

It is not the purpose of this document to provide detailed designs for mitigation measures as these should be generated by a suitably qualified engineer in conjunction a suitably qualified wetland soil specialist. There are a few general pointers though that should be adhered to namely:

1. Subsurface lateral flow of water leads to the interception of such water once foundations are sunk into the soils and weathered rock / hard plinthite. Adequate drainage structures should be constructed to prevent damp problems in structures arising within the soil profiles and landscape start filling with water once rainfall increased during summer months. This aspect is already a major problem in large developments of housing such as Cosmo City.
2. In many areas it has been found that the water moving downslope in the fractured rock is under positive pressure (due to gravity) with a consequent squirting out from severed preferential flow structures. This implies that in some areas water ingress into foundations and basements can occur from below (leading to the expression of a “wet basement syndrome” as mentioned under section 5.8). Structures constructed in areas with such risks should have additional water removal mechanisms implemented at the structure / ground

- interface. These can include dedicated containment and drainage features. Where cut and fill operations take place with a consequent large volume of “overburden” material over the soil a specific capillary break layer with associated drainage should suffice.
3. Surface sealing of the landscape through roads, parking areas, roof covered areas and general soil compaction leads to accelerated and increased surface water runoff. In order to mitigate the potential large volumes over a large area numerous small containment structures with choked outflows should be constructed throughout a site. The fewer these structures are the larger other structures have to be to contain the said water. As a minimum requirement these structures should be adequate and enough to contain the standard storm water runoff from a site before it reaches the wetland /drainage feature area.
 4. Several soft engineering approaches exist for the successful mitigation of storm water. If these are incorporated into the design and layout of development sites impacts on the wetlands and drainage features of the HHGD can be successfully mitigated.
 5. In terms of both the NWA (National Water Act) and NEMA (National Environmental Management Act) land owners have a duty to protect water resources, water courses and wetlands. In addition, CARA (Conservation of Agricultural Resources Act) and the municipal bylaws address storm water aspects that are of importance to land owners and managers. Insufficient attention to storm water related impacts during the design phase of a development can lead to administrative and criminal liabilities for the developer / land owner post development.
 6. Important: In the absence of adequate management of storm water, wetland impacts in terms of erosion will be inevitable therefore exposing the relevant entities involved with the development to unacceptable punitive administrative action or even criminal prosecution.

9. CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are drawn from the investigation:

1. The wetlands on the site are limited to the area associated with a distinct drainage features / water courses;
2. The wetland and surrounding landscape have been impacted by a number of human activities that range from agriculture to infrastructure development;
3. The wetlands, water courses and soils on the general site are all severely prone to erosion. Adequate storm water management measures should be implemented to address this risk.
4. The integrity of the wetlands on the site have been compromised by historical human activities. Extensive rehabilitation of the drainage feature and management of storm water runoff and erosion is needed to manage water emanating from this site in terms of quantity and quality.
5. Wetland delineation on the HHGD is not an auditable process as different workers interpret the wetland delineation guidelines and soil indicators differently. Whatever the outcome of the delineation exercise the most important aspect of the exercise is the provision of context of the wetland and management measures to protect the wetland once land use changes are authorised.

REFERENCES

- Boehner, J., Koethe, R. Conrad, O., Gross, J., Ringeler, A., Selige, T. 2002: Soil Regionalisation by Means of Terrain Analysis and Process Parameterisation. In: Micheli, E., Nachtergaele, F., Montanarella, L. [Ed.]: Soil Classification 2001. European Soil Bureau, Research Report No. 7, EUR 20398 EN, Luxembourg. pp. 213-222.
- Brady, N.C. and Weil, R.P. 1999. *The Nature and Properties of Soils*. Twelfth edition. Upper Saddle River, New Jersey: Prentice Hall.
- Department of Water Affairs and Forestry (DWAF). 2005. A practical field procedure for identification and delineation of wetland and riparian areas. DWAF, Pretoria.
- Hillel, D. 1982. Introduction to soil physics. Academic Press, INC. Harcourt Brace Javonovich, Publishers.
- Jenny, H. 1941. Factors of soil formation. New York, NY, USA: McGraw-Hill Book Company, p 281
- Land Type Survey Staff. (1972 – 2006). *Land Types of South Africa: Digital map (1:250 000 scale) and soil inventory databases*. ARC-Institute for Soil, Climate and Water, Pretoria.
- MacVicar, C.N. et al. 1977. *Soil Classification. A binomial system for South Africa*. Sci. Bull. 390. Dep. Agric. Tech. Serv., Repub. S. Afr., Pretoria.
- Soil Classification Working Group. 1991. Soil Classification. A taxonomic system for South Africa. *Mem. Agric. Nat. Resour. S.Afr.* No.15. Pretoria.
- Wischmeier, W.H., C.B. Johnson and B.V. Cross. 1971. A Soil Erodibility Nomograph for Farm Land and Construction Sites. *J. Soil Water Conserv.* 26: 189 – 193.

GALAGO ENVIRONMENTAL



Biodiversity & Aquatic Specialists

638 Turf Street
Wingate Park, 0181
Tel: 012-345 4891
Fax: 086 675 6136
Email: Vanessam@lantic.net

Herpetofauna **Habitat Assessment**

of

Portion 1 of the farm Rietfontein 61-IR (LINKSFIELD)

December 2013

Report author: **Mr. J.C.P van Wyk** (Pri.Sci.Nat: M.Sc)

TABLE OF CONTENTS

1.	INTRODUCTION.....	4
2.	SCOPE AND OBJECTIVES OF THE HABITAT STUDY	4
3.	STUDY AREA	4
4.	METHOD	5
5.	RESULTS	6
6.	FINDINGS AND POTENTIAL IMPLICATIONS	13
7.	LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE	15
8.	RECOMMENDED MITIGATION MEASURES	16
9.	CONCLUSION	17
10.	LITERATURE SOURCES	18

FIGURES:

Figure 1: Locality map of the study site.....	5
Figure 2: South-easterly view of the study site with termitaria in the foreground. .	7
Figure 3: Altered terrestrial habitat in the form of old lucerne fields	7
Figure 4: Natural rupiculous habitat.	8
Figure 5: Note the sparse vegetation due to veld fires.....	8
Figure 6: The Jukskei River.	9
Figure 7: A view of the wetland with its aquatic vegetation.	9
Figure 8: Herpetofauna habitat map	15
Figure 9: Herpetofaunal Sensitivity map	18

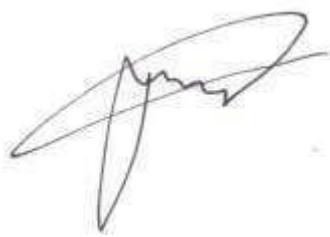
TABLES:

Table 1: The Reptile and Amphibian species observed on the site.....	11
Table 2: Reptile and Amphibian species positively confirmed on the study site .	13

Declaration of Independence:

I, Jacobus Casparus Petrus van Wyk (68080450410845) declare that I:

- hold a MSc in the biological sciences, which allowed registration by SACNASP (SA Council for National Scientific Professions) as a Professional Zoologist and sanction me to function independently as a specialist scientific consultant
- declare that as per prerequisites of the Natural Scientific Professions Act No. 27 of 2003 this project was my work from inception and reflects exclusively my observations and unbiased scientific interpretations, and executed to the best of my ability
- abide by the Code of Ethics of the SACNASP
- am committed to biodiversity conservation but concomitantly recognize the need for economic development. Whereas I appreciate the opportunity to also learn through the processes of constructive criticism and debate, I reserve the right to form and hold my own opinions and therefore will not willingly submit to the interests of other parties or change my statements to appease them
- abide by the Code of Ethics of the S.A. Council for Natural Scientific Professions
- act as an independent specialist consultant in the field of zoology
- am subcontracted as specialist consultant by Galago Environmental CC for the project "Herpetofauna Habitat Assessment on a Portion 1 of the Farm Rietfontein 61 IR" described in this report
- have no financial interest in the proposed development other than remuneration for work performed
- have or will not have any vested or conflicting interests in the proposed development
- undertake to disclose to the Galago Environmental CC and its client as well as the competent authority any material information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations 2006
- Our intellectual property in this report will only be transferred to the client (the party/ company that commissioned the work) on full payment of the contract fee. Upon transfer of the intellectual property, we recognise that written consent of the client will be required for release of any part of this report to third parties.



J.C.P. van Wyk

1. INTRODUCTION

Galago Environmental CC was appointed to undertake a Herpetofauna (reptile and amphibian) habitat survey for a Portion 1 of the Farm Rietfontein 61 IR (elsewhere referred to as the study site), scheduled for mixed use development known as Linksfield.

The objective was to determine which herpetofauna species might still reside on the site. Special attention had to be given to the habitat requirements of all the Red Data species, which may occur in the area. This survey focuses on the current status of threatened herpetofauna species occurring, or which are likely to occur on the proposed development site, and a description of the available and sensitive habitats on the site.

This assignment is in accordance with the 2010 EIA Regulations (No. R. 543-546, Department of Environmental Affairs and Tourism, 18 June 2010) emanating from Chapter 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

2. SCOPE AND OBJECTIVES OF THE HABITAT STUDY

- To qualitatively and quantitatively assess the significance of the herpetofaunal habitat components and current general conservation status of the property;
- Identify and comment on ecological sensitive areas;
- Comments on connectivity with natural vegetation and habitats on adjacent sites;
- To provide a list of herpetofauna which occur or might occur, and to identify species of conservation importance;
- To highlight potential impacts of the proposed development on the herpetofauna of the study site, and
- To provide management recommendations to mitigate negative and enhance positive impacts should the proposed development be approved.

3. STUDY AREA

This study site lies in the quarter degree grid cell 2628AA (Johannesburg). The site is located north-east of the Royal Johannesburg Golf Club and west of the N3 National Road. The Sizwe Tropical Disease Hospital forms part of the study site to the west. To the north and east of the study site lies the Modderfontein Road (R25). An important topographical feature of the study site is the Jukskei River which bisects the study site from south to north. Two small seasonal tributaries flow into the Jukskei River. A few wetlands occur along the Jukskei River. Aerial photographs show that the study site west of the Jukskei River used to consist of cultivated lands. To the east of the Jukskei River is a small ridge. Most of the study site slopes gently from both the east and west in the direction of the Jukskei River.

The study site lies inside the Egoli Granite Grassland vegetation type (Mucina & Rutherford, 2006). Exotic trees grow on the banks of the water courses and in some other areas of the study site. The substrate is mostly sandy soil, but near the streams the soil consists of clay. The study site was burnt during winter and new grass was growing at the time of the inspection.

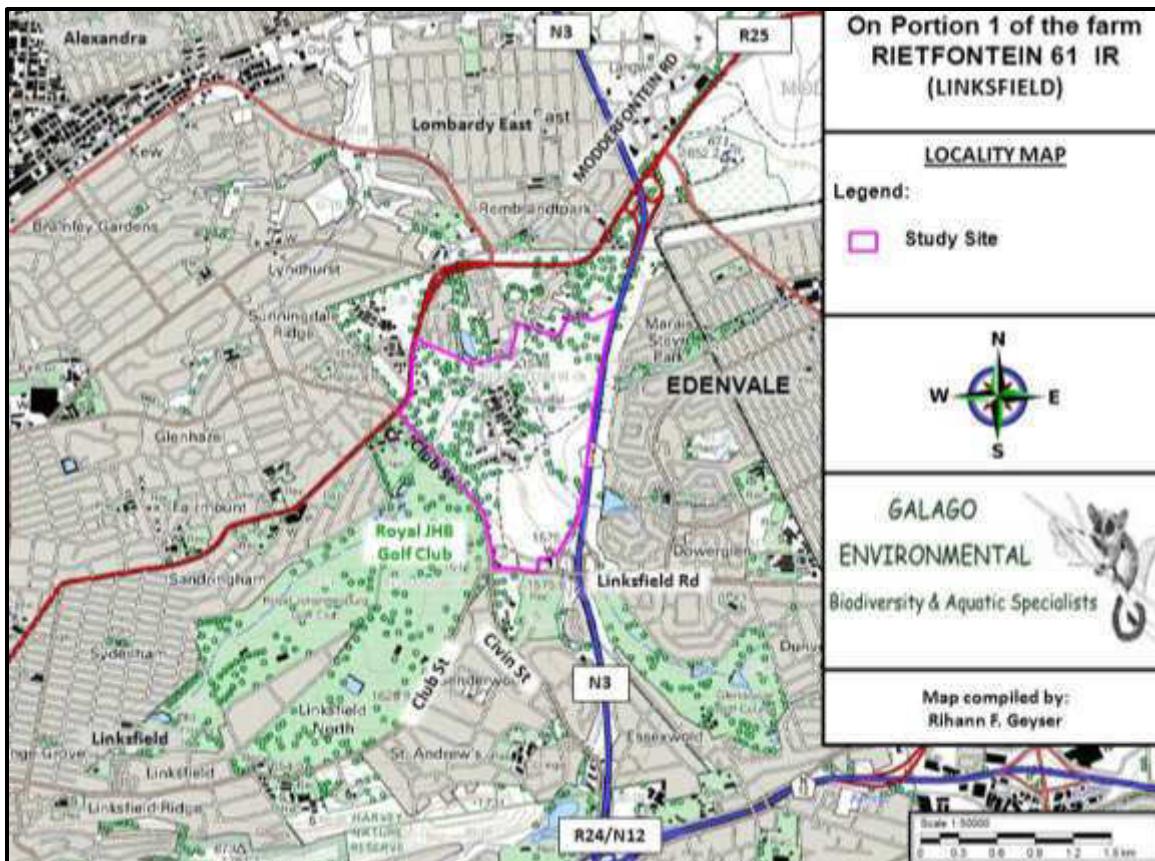


Figure 1: Locality map of the study site.

4. METHOD

An eight hour site visit was conducted on 19 October 2013. During this visit the observed and derived presence of reptiles and amphibians associated with the recognised habitat types of the study site were recorded. This was done with due regard to the well-recorded global distributions of Southern African herpetofauna, coupled with the qualitative and quantitative nature of recognised habitats.

The 500 meters of adjoining properties were scanned for important fauna habitats.

4.1 Field Surveys

During the site visits, reptiles and amphibians were identified by visual sightings through random transect walks. Amphibian diversity was also established by means of acoustic identification. No trapping was conducted, as the terms of reference did not require such intensive work.

4.2 Desktop Surveys

As the majority of reptiles and amphibians are secretive, nocturnal and/or poikilothermic or seasonal, distributional ranges and the presence of suitable habitats were used to deduce the presence or absence of these species based on authoritative tomes, scientific literature, field guides, atlases and databases. This can be done irrespective of season.

The probability of the occurrence of reptile and amphibian species was based on their respective geographical distributional ranges and the suitability of on-site habitats. In other words, high probability would be applicable to a species with a distributional range overlying the study site as well as the presence of prime habitat occurring on the study site. Another consideration for inclusion in this category is the inclination of a species to be common to the area, i.e. normally occurring at high population densities.

Medium probability pertains to a herpetofaunal species with its distributional range peripherally overlapping the study site, or required habitat on the site being sub-optimal. The size of the site as it relates to its likelihood to sustain a viable breeding population, as well as its geographical isolation is taken into consideration. Species categorised as *medium* normally do not occur at high population numbers, but cannot be deemed as rare.

A low probability of occurrence would imply that the species' distributional range is peripheral to the study site and habitat is sub-optimal. Furthermore, some reptiles and amphibians categorised as low are generally deemed to be rare.

Based on the impressions gathered during the site visit, as well as publications, such as FitzSimons' Snakes of Southern Africa (Broadley, 1990), Field Guide to Snakes and other Reptiles of Southern Africa (Branch, 1998), A Guide to the Reptiles of Southern Africa (Alexander and Marais, 2007), Amphibians of Central and Southern Africa (Channing 2001), Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland (Minter, et al, 2004) and A Complete Guide to the Frogs of Southern Africa (Du Preez & Carruthers, 2009), a list of species which may occur on the site was compiled. The latest taxonomic nomenclature was used and the vegetation type was defined according to the standard handbook by Mucina and Rutherford (eds) (2006).

4.3 Specific Requirements

During the visit the site was surveyed and assessed for the potential occurrence of Red Data species in Gauteng (Alexander and Marais, 2007; Minter, et al, 2004 and Du Preez & Carruthers, 2009), such as:

- Giant Bullfrogs (*Pyxicephalus adspersus*);
- Striped Harlequin Snake (*Homoroselaps dorsalis*);
- The Southern African Python (*Python natalensis*).

5. RESULTS

The vegetation types of the site were analysed according to Mucina and Rutherford (2006).

Herpetofaunal Habitat Assessment:

The local occurrences of reptiles and amphibians are closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupicolous (rock-dwelling) and wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of reptile and amphibian species by evaluating the habitat types within the context of global distribution ranges. From a herpetological habitat perspective, it was established that three of the four major habitats are naturally present

on the study site, namely terrestrial, rupicolous and wetland-associated vegetation cover habitat. Many manmade places of rupicolous habitat are present on the study site.

Noticeable absentees from the study site are indigenous trees; and there are a few termitaria (Figure 2).



Figure 2: A south-easterly view of the study site with termitaria in the foreground.

The scattered trees present mostly along the drainage lines are all exotics, such as *Eucalyptus sp.*, wattle, weeping willow, grey poplar, pine and mulberry. Due to the absence of indigenous trees and the presence of squatters on the study site, there are very few dead logs, which could have provided shelter and food for some herpetofauna.

Parts of the study site consist of transformed grassland. The natural grasslands were transformed into agricultural lands and are thus ecologically disturbed. It appears as if ploughing of former lucerne (Figure 3) fields has seriously diminished the presence of termitaria, especially dead termitaria, which normally provide ideal retreats for reptiles and amphibians. Accordingly, it is estimated that the reptile and amphibian population density in that part of the study site is lower.



Figure 3: Altered terrestrial habitat in the form of old lucerne fields in the foreground.

There are only a few natural rupicolous habitats on the study site in the form of a small ridge with scattered stones and rocks (Figure 4). Excellent manmade rupicolous habitat exists in a large number of building rubble piles and a few buildings.



Figure 4: Natural rupicolous habitat.

Despite the presence of old lucerne fields and new green grass there was no grazing by livestock. At the time of the site visit the basal cover was lush in a few places, especially along the Jukskei River and would provide adequate cover for small terrestrial herpetofauna. However the site was largely burned and would not offer any vegetative cover protection for small herpetofauna (Figure 5).



Figure 5: Note the sparse vegetation due to veld fires.

Permanent and temporary water sources occur on the study site. The Jukskei River (Figure 6) and two tributaries flow north of the study site.



Figure 6: The Jukskei River.

The one seasonal tributary flows from the south-western area into the Jukskei River and the second tributary flows from the east into the Jukskei River.

A small wetland occurs on the banks of the Jukskei River near the entrance of the Sizwe Tropical Disease Hospital (Figure 7). In some places along the Jukskei River wetlands can be found due to overflowing of the riverbanks. All along the Jukskei River weirs and other manmade structures such as bridges have been built in the Jukskei River.



Figure 7: A view of the wetland with its aquatic vegetation.

These water sources provide water for water-dependent herpetofauna. Although some wetlands are artificial, they are functional with several wetland plant species, and also wetland fauna. All rivers, streams and wetlands are protected and are regarded as being sensitive.

With the exception of the N3 on the easterly side of the study site and the R25 (Modderfontein Road), connectivity as a whole is good. Real opportunities for migration exist along the Jukskei River and its tributaries.

Threatened and Red listed Reptile and Amphibian Species

The study site falls outside the natural range of the Southern African python and this species should not occur on the study site.

The striped harlequin snake has been recorded in this quarter degree square (TVL Museum Records or Ditsong Museum of Natural History) and a few moribund termitaria, where this species are most likely to be found, are present on the study site. It is very difficult to confirm whether this cryptic snake is present on any study site, but a small possibility exists that it occurs on this particular study site.

The study site is unsuitable for any Red Data reptile species or falls outside their natural distribution range.

The study site contains a few wetlands with temporary water, which are potential breeding places for giant bullfrogs. Many of these breeding sites are temporary, which bullfrogs prefer in order to avoid predation from fish. Some of these wetlands also have gentle slopes. A gentle slope allows for shallow water (less than 9cm deep), which enables the female bullfrog to stand when she lays her eggs outside the water for the male to fertilise. Many areas of the study site consist of sandy soil and are very suitable as a dispersal area, which combines feeding and aestivation. It is essential that the soil be suitable for burrowing on a daily basis during the short activity period at the beginning of the rainy season and for deeper retreats during the resting periods.

Although the Jukskei River runs through the study site, the river is not suitable for giant bullfrogs due to the presence of fish in the stream. The water of the Jukskei River and its tributaries is also fast flowing and too cold for giant bullfrogs to breed in. They prefer warm, stagnant water, which giant bullfrog tadpoles need for rapid development (Van Wyk, Kok & Du Preez, 1992).

It is important to note that in the latest literature (Measey (ed.) 2011 and Carruthers & Du Preez, 2011); the giant bullfrog's status has changed officially from Near Threatened (Minter *et al*, 2004) to Least Concern in South Africa.

Expected and Observed Herpetofauna Species Richness:

Of the 44 reptile species which may occur on the study site (Table 1), four were confirmed during the site visit and of the possible 14 amphibian species which may occur on the study site (Table 1); two were confirmed during the site visit.

The American red-eared terrapin (*Trachemys scripta elegans*) and the Brahminy blind snake (*Ramphotyphlops braminus*) are the only two feral reptile or amphibian species known to occur in South Africa (De Moor and Bruton, 1988; Picker and Griffiths, 2011), but with only a few populations, they are not expected to occur on this particular site.

The species assemblage is typical of what can be expected of habitat that is severely disturbed, but with sufficient habitat to sustain populations. Most of the species of the resident diversity (Table 1) are fairly common and widespread (viz. the marsh terrapin, brown house snake, mole snake, montane speckled skink, Transvaal gecko, water monitor, guttural toad, raucous toad, common platanna and the common river frog).

The species richness is fair due to the three habitat types occurring on the study site.

Table 1: The Reptile and Amphibian species observed on or deduced to occupy the site.

	SCIENTIFIC NAME	ENGLISH NAME
	CLASS: REPTILIA	REPTILES
	Order: TESTUDINES	TORTOISES & TERRAPINS
	Family: Pelomedusidae	Side-necked Terrapins
✓	<i>Pelomedusa subrufa</i>	Marsh or Helmeted Terrapin
	Order: SQUAMATA	SCALE-BEARING REPTILES
	Suborder:LACERTILIA	LIZARDS
	Family: Gekkonidae	Geckos
✓	<i>Pachydactylus affinis</i>	Transvaal Thick-toed or Transvaal Gecko
*	<i>Pachydactylus capensis</i>	Cape Thick-toed or Cape Gecko
	Family: Agamidae	Agamas
✓	<i>Agama aculeata</i>	Ground Agama
?	<i>Agama atra</i>	Southern Rock Agama
	Family: Scincidae	Skinks
✓	<i>Trachylepis capensis</i>	Cape Skink
✓	<i>Trachylepis punctatissima</i>	Montane Speckled Skink
✓	<i>Trachylepis varia</i>	Variable Skink
*	<i>Panaspis wahlbergii</i>	Wahlberg's Snake-eyed Skink
?	<i>Acontias gracilicauda</i>	Thin-tailed Legless Skink
	Family:Lacertidae	Old World Lizards or Lacertids
?	<i>Pedioplanis lineoocellata</i>	Spotted Sand Lizard
?	<i>Ichnotropis squamuosa</i>	Common Rough-scaled Lizard
✓	<i>Nucras ornata</i>	Ornate Sandveld Lizard
	Family: Gerrhosauridae	Plated Lizards
*	<i>Gerhosaurus flavigularis</i>	Yellow-throated Plated Lizard
	Family: Cordyidae	
?	<i>Cordylus vittifer</i>	Transvaal Girdled Lizard
	Family: Varanidae	Monitors
✓	<i>Varanus niloticus</i>	Water Monitor
	Suborder: SERPENTES	SNAKES
	Family: Typhlopidae	Blind Snakes
?	<i>Typhlops bibronii</i>	Bibron's Blind Snake
?	<i>Rhinotyphlops lalandei</i>	Delalande's Beaked Blind Snake
	Family: Leptotyphlopidae	Thread Snakes
*	<i>Leptotyphlops conjunctus</i>	Cape Thread or Worm Snake
*	<i>Leptotyphlops scutifrons</i>	Peter's Thread or Worm Snake
	Family: Atractaspididae	African burrowing Snakes
?	<i>Atractaspis bibronii</i>	Southern Stiletto Snake
*	<i>Aparallactus capensis</i>	Cape or Black-headed Centipede Eater
?	<i>Homoroselaps lacteus</i>	Spotted Harlequin Snake
NT?	<i>Homoroselaps dorsalis</i>	Striped harlequin Snake
	Family: Colubridae	Typical Snakes
✓	<i>Lycodonomorphus rufulus</i>	Common Brown Water Snake
✓	<i>Boaedon capensis</i>	Brown House Snake
?	<i>Lamprophis aurora</i>	Aurora House Snake
?	<i>Lamprophis inornatus</i>	Olive House Snake

	SCIENTIFIC NAME	ENGLISH NAME
?	<i>Lycophidion capense</i>	Cape or Common Wolf Snake
*	<i>Mehelya capensis</i>	Southern or Cape File Snake
?	<i>Duberria lutrix</i>	Common Slug Eater
✓	<i>Pseudaspis cana</i>	Mole Snake
?	<i>Prosymna sundevallii</i>	Sundevall's Shovel-snout
*	<i>Psammophylax rhombeatus</i>	Spotted Skaapsteker
?	<i>Psammophylax tritaeniatus</i>	Striped Skaapsteker
✓	<i>Psammophis brevirostris</i>	Short-snouted Grass or Sand Snake
✓	<i>Psammophis crucifer</i>	Crossed Whip Snake
?	<i>Philothamnus hoplogaster</i>	Green Water Snake
✓	<i>Dasypeltis scabra</i>	Common or Rhombic Egg Eater
*	<i>Crotaphopeltis hotamboeia</i>	Herald Snake
Family: Elapidae		Cobras, Mambas and Others
?	<i>Elapoidea sunderwallii</i>	Sundevall's Garter Snake
✓	<i>Hemachatus haemachatus</i>	Rinkhals
Family: Viperidae		Adders
*	<i>Causus rhombeatus</i>	Rhombic Night Adder
✓	<i>Brits arietans</i>	Puff Adder
CLASS: AMPHIBIA		AMPHIBIANS
Order: ANURA		FROGS
Family: Pipidae		Clawed Frogs
✓	<i>Xenopus laevis</i>	Common Platanna
Family: Bufonidae		Toads
✓	<i>Amietiaophryalus gutturalis</i>	Guttural Toad
?	<i>Amietiaophryalus poweri</i>	Western Olive toad
*	<i>Amietiaophryalus rangeri</i>	Raucous Toad
✓	<i>Schismaderma carens</i>	Red Toad
Family: Hyperoliidae		Reed Frogs
✓	<i>Kassina senegalesis</i>	Bubbling Kassina
Family Phrynobatrachidae		Puddle Frog
*	<i>Phrynobatrachus natalensis</i>	Snoring Puddle Frog
Family: Pyxicephalidae		
✓	<i>Amietia angolensis</i>	Common River Frog
*	<i>Amietia fuscigula</i>	Cape River Frog
?	<i>Strongylopus fasciatus</i>	Striped Stream Frog
✓	<i>Cocosternum boettgeri</i>	Boettger's Caco or Common Caco
NT?	<i>Pyxicephalus adspersus</i>	Giant Bullfrog
✓	<i>Tomopterna cryptotis</i>	Tremolo Sand Frog
✓	<i>Tomopterna natalensis</i>	Natal Sand Frog

Systematic arrangement and nomenclature according to Branch (1998), Alexander and Marais (2007), Minter, et.al (2004) & Du Preez and Carruthers (2009).

✓ Definitely there or have a *high* probability of occurring;

* *Medium* probability of occurring based on ecological and distributional parameters;

? *Low* probability of occurring based on ecological and distributional parameters.

Red Data species rankings as defined in Branch, The Conservation Status of South Africa's threatened Reptiles': 89 – 103..In:- G.H.Verdoorn & J. le Roux (editors), 'The State of Southern Africa's Species (2002) and Minter, et.al, Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland (2004) are indicated in the first

column: CR= Critically Endangered, En = Endangered, Vu = Vulnerable, NT = Near Threatened, DD = Data Deficient. All other species are deemed of Least Concern.

Table 2: Reptile and Amphibian species positively confirmed on the study site, observed indicators and habitat.

SCIENTIFIC NAME	ENGLISH NAME	OBSERVATION INDICATOR	HABITAT
<i>Boaedon capensis</i>	Brown House Snake	Skin	Terrestrial habitat
<i>Trachylepis punctatissima</i>	Montane Speckled Skink	Sight record	On bridge near Sizwe Tropical Disease hospital
<i>Pachydactylus affinis</i>	Transvaal Thick-toed or Transvaal Gecko	Sight record	Under rock in terrestrial/rupicolous habitat
<i>Nucras ornata</i>	Ornate Sandveld Lizard	Sight record	In terrestrial habitat, under piece of rubble in short grassveld
<i>Amietia angolensis</i>	Common River Frog	Sight record	In and on the banks of Jukskei River and its tributaries.
<i>Amietophryne gutturalis</i>	Guttural Toad	Sight record of tadpoles (Gosner 28-36 stages) [Gosner, 1960]	In a pool in the Jukskei River

All six species listed in Table 2, should be abundant on the study site and elsewhere in its range.

6. FINDINGS AND POTENTIAL IMPLICATIONS

The study site has important topographical features in the form of the Jukskei River, its tributaries and wetlands. On the study site, east of the Jukskei River, the small rocky ridge with termite mounds is also fairly pristine. The study site contains three herpetofaunal habitats, namely terrestrial, rupicolous and wetlands. The study site is ecologically disturbed in parts by formerly cultivated lucerne fields, building rubble, squatters, recreational motorbike riding and exotic plants. Water pollution by rubbish, eutrophication (algae bloom), squatters and invasive plants threatens the aquatic habitat.

Species richness: Due to the presence of three habitat types, especially all forms of aquatic types, the study site should have a fair number of species, but it must be emphasised that the species richness is for the general area and NOT for the study site itself.

Endangered species: The possibility exists that the giant bullfrog may occur on the study site. There are potential breeding sites for giant bullfrogs and the possibility exists that at least some individuals may use the study site for feeding and aestivation. A small possibility exists that the striped harlequin snake may occur on the study.

Sensitive species and/or areas (Conservation ranking): The Jukskei River, its tributaries and wetlands are highly sensitive ecological systems. East of the Jukskei River, the small rocky ridge with termite mounds is medium sensitive. The study site falls in the Egoli Granite Grassland (Gm 10) vegetation type, which is considered endangered (Mucina and Rutherford, 2006).

Habitat(s) quality and extent: The terrestrial habitat quality has been jeopardised by ploughing of agricultural lands in the past. Water pollution by rubbish, eutrophication (algae bloom), squatters and invasive plants threatens the aquatic habitat.

Impact on species richness and conservation: The construction of the mixed use development will have a significant and sometimes lasting effect on species richness and conservation, because of the construction of buildings and new roads carrying more vehicles. These buildings and roads will form an even larger barrier for herpetofaunal movement and it will result in a decrease in connectivity. The proposed development will have a large and permanent footprint.

If the development should go ahead, a very important indirect effect would be the likely impact that the proposed development might have on the surface water runoff and water quality of both the Jukskei River and its tributaries and the wetlands. This could have a negative impact on the herpetofauna.

Connectivity: Except for the N3 and Modderfontein Roads, connectivity is good. The Jukskei River and its tributaries are distribution corridors for many water-dependent herpetofauna, which may also forage on the study site.

Management recommendation: Measures will have to be taken to stop water pollution of the wetlands, the Jukskei River and its tributaries from the mixed development. The removal of exotic trees will increase the habitat of water-dependent herpetofauna.

General: The integrity of the wetlands, the Jukskei River and its tributaries should not be jeopardised in any way by the development.

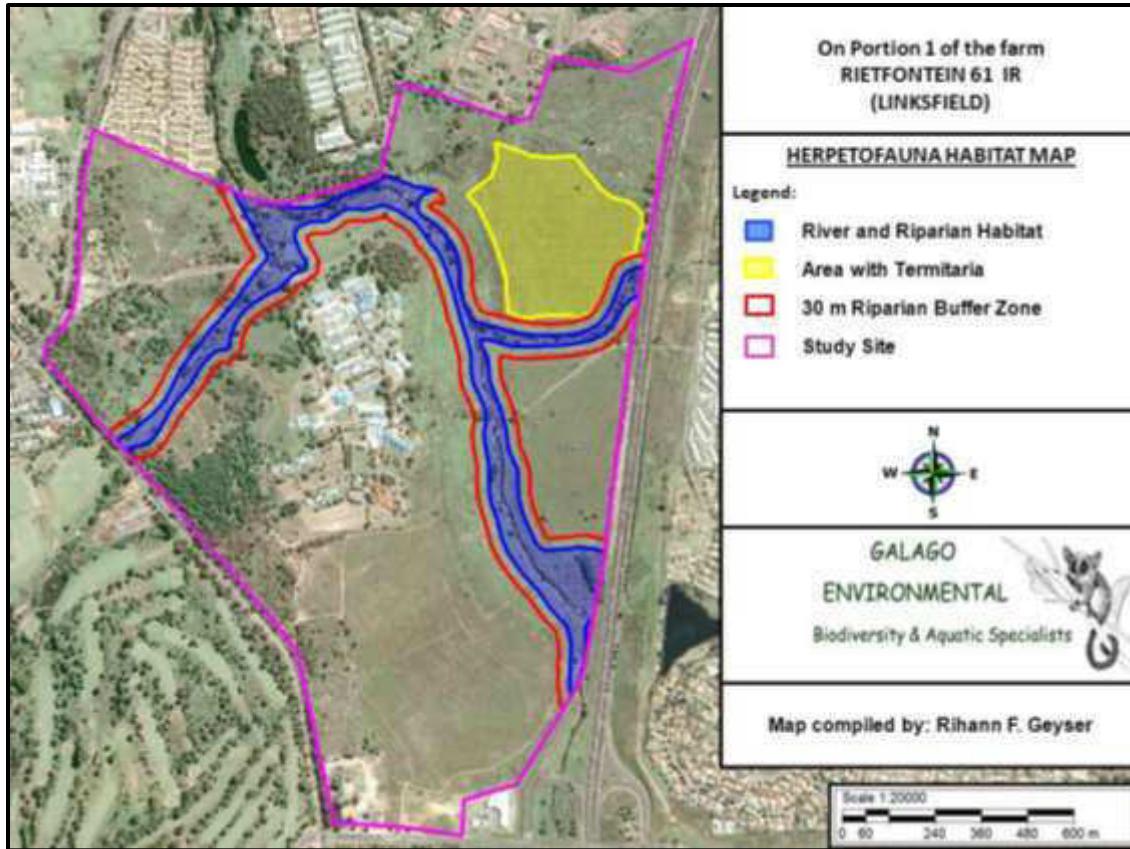


Figure 8: Herpetofauna habitat map

7. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

Galago Environmental and its Specialists are committed to the conservation of biodiversity but concomitantly recognise the need for economic development. Whereas we appreciate the opportunity to learn through the processes of constructive criticism and debate, we reserve the right to form and hold our own opinions and therefore will not willingly submit to the interest of other parties or change statements to appease them.

Even though every care is taken to ensure the accuracy of this report, environmental assessment studies are limited in scope, time and budget. To some extent discussions and proposed mitigations are made on reasonable and informed assumptions built on *bona fide* information sources, as well as deductive reasoning. Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions and migrations. Since environmental impact studies deal with dynamic natural systems, additional information may come to light at a later stage. Galago Biodiversity and Aquatic Specialists can therefore not accept responsibility for conclusions and mitigation measures made in good faith based on own databases or on the information provided at the time of the directive. This report should therefore be viewed and acted upon with these limitations in mind.

8. RECOMMENDED MITIGATION MEASURES

Protection of the wetlands/pans, the Jukskei River and its tributaries:

- Every effort should be made to retain the linear integrity, flow dynamics and water quality of the Jukskei River Stream and its tributaries. The same applies to wetlands, and all the water bodies associated with riparian vegetation.

The following mitigation measures are proposed by the specialist.

- If the Giant Bullfrog or any herpetological species are encountered or exposed during the construction phase, they should be removed and relocated to natural areas in the vicinity. This remedial action requires the employment of a herpetologist to oversee the removal of any herpetofauna during the initial ground clearing phase of construction (i.e. initial ground-breaking by earthmoving equipment). The contractor must ensure that no herpetofauna species are disturbed, trapped, hunted or killed during the construction phase. Any herpetofauna that are inadvertently killed during earthmoving operations should be preserved as museum voucher specimens. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.
- Alien and invasive plants must be removed in a phase manner.

The following mitigation measures were developed by GDARD (Directorate of Nature Conservation, 2012) and are applicable to the study site.

- An appropriate management authority (e.g. the body corporate) that must be contractually bound to implement the Environmental Management Plan (EMP) and Record of Decision (ROD) during the operational phase of the development should be identified and informed of their responsibilities in terms of the EMP and ROD.
- All areas designated as sensitive in a sensitivity mapping exercise should be incorporated into an open space system. Development should be located on the areas of lowest sensitivity.
- The open space system (the water ways) should be managed in accordance with an Ecological Management Plan that complies with the *Minimum Requirements for Ecological Management Plans* and forms part of the EMP.
- The Ecological Management Plan should:
 - include a fire management programme to ensure persistence of grassland
 - include an ongoing monitoring and eradication programme for all non-indigenous species, with specific emphasis on invasive and weedy species
 - include a comprehensive surface runoff and storm water management plan, indicating how all surface runoff generated as a result of the development (during both the construction and operational phases) will be managed (e.g. artificial wetlands / storm water and flood retention ponds) prior to entering any natural drainage system or wetland and how surface runoff will be retained outside of any demarcated buffer/flood zones and subsequently released to simulate natural hydrological conditions
 - ensure the persistence of all Red List species
 - include a monitoring programme for all Red List species
 - facilitate/augment natural ecological processes

- provide for the habitat and life history needs of important pollinators
 - minimise artificial edge effects (e.g. water runoff from developed areas & application of chemicals)
 - include a comprehensive plan for limited recreational development (trails, bird hides, etc.) within the open space system
 - include management recommendations for neighbouring land, especially where correct management on adjacent land is crucial for the long-term persistence of sensitive species present on the development site
 - result in a report back to the Directorate of Nature Conservation on an annual basis
 - investigate and advise on appropriate legislative tools (e.g. the NEMA: Protected Areas Act 57 of 2003) for formally protecting the area (as well as adjacent land where it is crucial for the long-term persistence of sensitive species present on the development site)
- The open space system should be fenced off prior to construction commencing (including site clearing and pegging). All construction-related impacts (including service roads, temporary housing, temporary ablution, disturbance of natural habitat, storing of equipment/building materials/vehicles or any other activity) should be excluded from the open space system. Access of vehicles to the open space system should be prevented and access of people should be controlled, both during the construction and operational phases. Movement of indigenous fauna should however be allowed (i.e. no solid walls, e.g. through the erection of palisade fencing).
- The appropriate agency should implement an ongoing monitoring and eradication program for all invasive and weedy plant species growing within the servitude.
- Rehabilitation of natural vegetation should proceed in accordance with a rehabilitation plan compiled by a specialist registered in terms of the Natural Scientific Professions Act (No. 27 of 2003) in the field of Ecological Science.
- Any post-development re-vegetation or landscaping exercise should use species indigenous to South Africa. Plant species locally indigenous to the area are preferred. As far as possible, indigenous plants naturally growing along the route, that would otherwise be destroyed during construction, should be used for re-vegetation / landscaping purposes

9. CONCLUSION

The Jukskei River and its tributaries and their buffer zones should be considered as ecologically highly sensitive. The normal 32 metres buffer zone inside the urban edge for riparian zones applies. This will automatically protect some of the wetlands next to the Jukskei River. East of the Jukskei River, the small rocky ridge with termite mounds is medium sensitive.

The study site contains a wetland, which is a potential breeding place for the giant bullfrog.

The striped harlequin snake has been recorded on this quarter degree square (TVL Museum Records or Ditsong Museum of Natural History) and a few moribund termitaria, where this species are most likely to be found, are present on the study site. It is very difficult to confirm whether this cryptic snake is present on any study site, but a small possibility exists that it occurs on this particular study site.

If the development should go ahead, a very important indirect effect would be the likely impact that the proposed development might have on the surface water runoff and water quality of both the Jukskei River and its tributaries and the temporary pans. This could have a negative impact on the herpetofauna. These effects could be ameliorated by the construction of retention ponds, which would retard discharge into these water bodies and thus improve the water quality of the discharge.

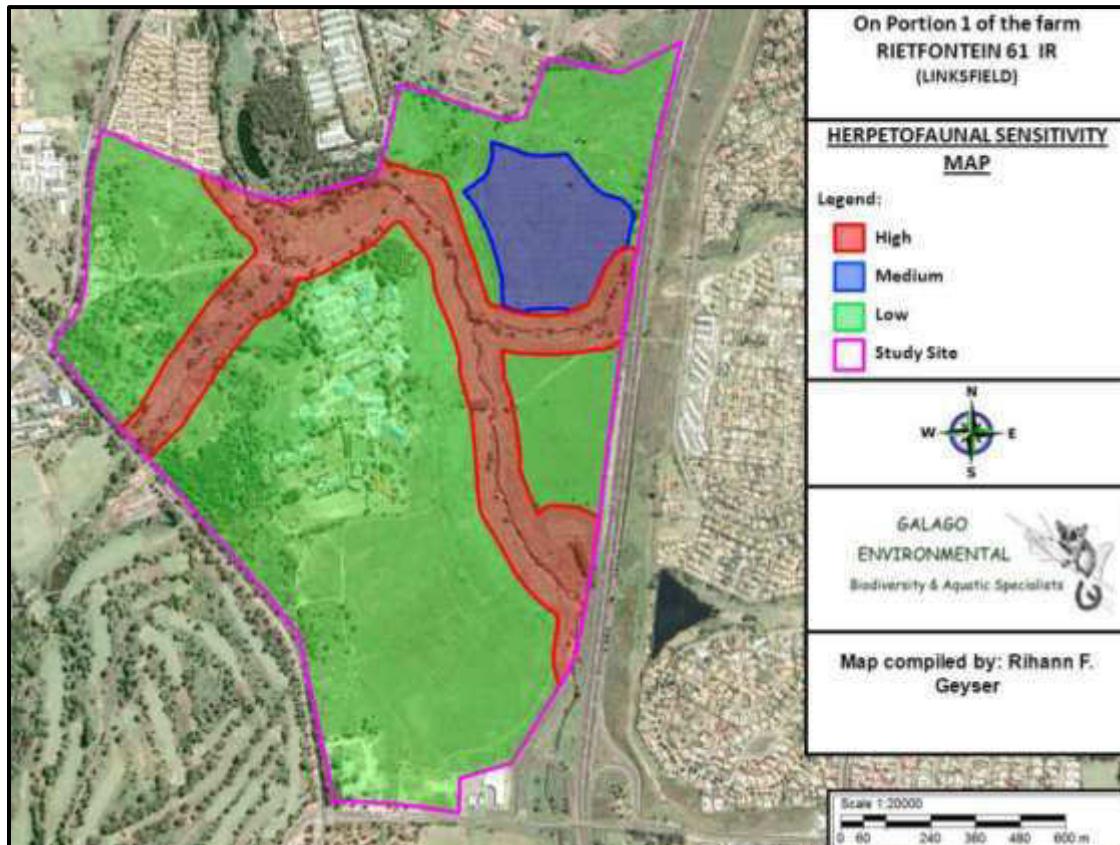


Figure 9: Herpetofaunal Sensitivity map

10. LITERATURE SOURCES

- Alexander, G. & Marais J. 2007. *A Guide to the Reptiles of Southern Africa*. Struik Publishers, Cape Town 408pp.
- Branch, W.R. (Editor), August 1988. *South African Red Data Book – Reptiles and Amphibians*. S.A. National Scientific Programmes, Report No. 151, 244 pp.
- Branch, W.R. 1998. *Field Guide to the Snakes and other Reptiles of Southern Africa*. 3rd edition. Struik Publishers, Cape Town. 399 pp., maps, 112 plates.
- Branch, W.R. 2002. 'The Conservation Status of South Africa's threatened Reptiles': 89 – 103..In:- G.H. Verdoorn & J. le Roux (editors), 'The State of Southern Africa's Species', Proceedings of a conference held at the Rosebank Hotel, 4 – 7 September 2001. World Wildlife Fund.
- Broadley, D.G. 1990. *FitzSimons' Snakes of Southern Africa*. Jonathan Ball & Ad Donker Publishers. 387pp.
- Carruthers, V. & Du Preez L. 2011. *Frogs & Frogging*. Struik Nature, Cape Town. p108.
- Channing, A. 2001. *Amphibians of Central and Southern Africa*. Protea Bookhouse Pretoria. 470pp.

- De Moor I.J. & Bruton M.N. 1988. *Atlas of alien and translocated indigenous aquatic animals in southern Africa*. S.A. National Scientific Programmes, Report No. 144, 310pp.
- Department of Environmental Affairs and Tourism. 2007. National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004): Publication of Lists of Critically Endangered, Endangered, Vulnerable and Protected Species. Government Notices.
- Directorate of Nature Conservation, GDACE. 2008 and revised on February 2009. GDACE requirements for Biodiversity Assessments, Version 2. Gauteng Provincial Government
- Du Preez L. & Carruthers V. 2009. *A Complete Guide to the Frogs of Southern Africa*. Struik Publishers, Cape Town. 488 pp.
- Gosner, K.L. 1960. A simplified table for staging Anuran embryos and larvae with notes on identification. *Herpetology*. 16:183 -190.
- Measey, G.J. (ed.) 2011. Ensuring a future for South Africa's frogs: a strategy for conservation research. SANBI Biodiversity Series 19. South African National Biodiversity Institute, Pretoria. 84pp
- Minter, L.R., Burger, M., Harrison, J.A., Braack, H.H., Bishop, P.J. and Kloepfer, D. eds. 2004. *Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland*. SI/MAB Series #9. Smithsonian Institution, Washington, DC.
- Mucina, L. & Rutherford, M.C. 2006. *The vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. South African National Biodiversity Institute, Pretoria.
- Picker M. & Griffiths C. 2011. *Alien & Invasive Animals. A South African Perspective*. Struik Nature, Cape Town. P240.
- Van Wyk, J.C.P., Kok, D.J. & Du Preez L.H. 1992. Growth and behaviour of tadpoles and juveniles of the African Bullfrog, *Pyxicephalus adspersus* Tschudi 1838. *J Herp. Assoc. Afr.* 40:56.
- The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)
- The Environmental Conservation Act, 1989 (Act No. 73 of 1989)
- The National Environment Management Act, 1998 (Act No. 107 of 1998)
- The National Environmental Management Biodiversity Act, 2004 (Act 10 of 2004). Government Gazette RSA Vol. 467, 26436, Cape Town, June 2004.
- The National Environmental Management Biodiversity Act, 2004 (Act 10 of 2004). Draft List of Threatened Ecosystems. Government Gazette RSA Vol. 1477, 32689, Cape Town, 6 Nov 2009.
- The National Forests Act, 2006 (Act 84 of 1998 as amended). Government Gazette RSA Vol. 897, 29062, Cape Town, 8 Sept 2006.
- The Natural Scientific Professions Act (Act 27 of 2003).

Correspondence with Ate Berga

Annexure Si

Alfred

From: Bokamoso <lizelleg@mweb.co.za>
Sent: 02 October 2014 01:43 PM
To: user2@bokamoso.net
Cc: user1@bokamoso.net
Subject: FW: Trachyandra erythrorrhiza
Attachments: image001.jpg

From: Ate Berga [mailto:ateberga41@gmail.com]

Sent: 02 October 2014 01:34 PM

To: Bokamoso

Subject: Re: Trachyandra erythrorrhiza

Dear Mary Lee

Whilst I was working at the University of Pretoria (2000 - 2005) as an unpaid, greenhouse assistant, I was given permission to collect seed by GDACE at a site in Pretoria East. (*Trachyandra erythrorrhiza* >1000 individuals).

The seed germination was >90%.

I planted 20% in the Botanical Gardens of UP.

The remaining plants were to be planted in a reserve in Gauteng. This never materialized, and when I moved my operations from UP, I planted them on our property. One was planted in the garden (shade, extra water) grew and multiplied aggressively. The specimens in the drainage line has been less successful due to the habitat (drought, wrong soil type). That has not stop them from surviving, and flowering every year, producing seed. I looked this morning, and found one with a inflorescence.

I have not relocated any plants of this species, many others though. The rescued plants are planted on our property, awaiting relocation. The inspectors have been here to investigate my progress.

Conclusion:

The species is extremely easy to propagate, raise and to plant, even where conditions are not ideal. As *T. erythrorrhiza* has a creeping rhizome, with fleshy roots, I can only conclude that transplanting would be easy.

Kind regards

Ate Berga

On Thu, Oct 2, 2014 at 10:35 AM, Bokamoso <lizelleg@mweb.co.za> wrote:

Good morning Ate,

Our telephonic conversation earlier this morning regarding the plant species, *Trachyandra erythrorrhiza*, has reference.

We understood that you grew *Trachyandra erythrorrhiza* species both from seeds and plants and that it is a major success. In our conversation you mentioned that your success rate is more than 90% and you experienced the species to grow very easily. You have previously conducted relocation of the *T. erythrorrhiza* species for projects. You have planted some of the species in your garden as well as other individuals in a drainage line which was a success.

Could you kindly confirm our telephonic conversation and give your opinion on the relocation of *T. erythrorrhiza*.

Thank you for the insight into this species and sharing your knowledge.

Kind Regards,

Mary-Lee van Zyl

Senior Environmental Assessment Practitioner



**Landscape Architects &
Environmental Consultants cc**

T: (+27)12 346 3810 | F: (+27) 86 570 5659 | E: lizelleg@mweb.co.za | www.bokamoso.biz

36 Lebombo Street, Ashlea Gardens, Pretoria | P.O. Box 11375 Maroelana 0161

Please consider the environment before printing this email



This email is free from viruses and malware because [avast! Antivirus](#) protection is active.

Wetland Report

Annexure T



REPORT

HYDROPEDOLOGY WETLAND IMPACT ASSESSMENT AND MANAGEMENT REPORT:

PROPOSED LINKSFIELD DEVELOPMENT SITE, GAUTENG PROVINCE

10th August, 2014

**Compiled by:
J.H. van der Waals
(PhD Soil Science, Pr.Sci.Nat.)**

Member of:
Soil Science Society of South Africa (SSSSA)

Accredited member of:
South African Soil Surveyors Organisation (SASSO)

Registered with:
The South African Council for Natural Scientific Professions
Registration number: 400106/08

Declaration

I, Johan Hilgard van der Waals, declare that:

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing
 - any decision to be taken with respect to the application by the competent authority; and
 - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.



**J.H. VAN DER WAALS
TERRA SOIL SCIENCE**

TABLE OF CONTENTS

1. INTRODUCTION	1
1.1 Terms of Reference	1
1.2 Aim of this Report.....	1
1.3 Disclaimer	1
1.4 Methodology.....	2
2. SITE LOCALITY AND DESCRIPTION	2
2.1 Survey Area Boundary	2
2.2 Land Type Data.....	2
2.3 Topography	5
3. PROBLEM STATEMENT.....	8
4. STATUTORY CONTEXT	8
4.1 Wetland Definition	8
4.2 Watercourse Definition.....	8
4.3 The Wetland Delineation Guidelines.....	8
4.4 The Resource Directed Measures for Protection of Water Resources	9
4.4.1 The Resource Directed Measures for Protection of Water Resources: Volume 4: Wetland Ecosystems.	10
4.4.2 The Resource Directed Measures for Protection of Water Resources: Generic Section "A" for Specialist Manuals – Water Resource Protection Policy Implementation Process.....	10
4.4.3 The Resource Directed Measures for Protection of Water Resources: Appendix W1 (Ecoregional Typing for Wetland Ecosystems)	10
4.4.4 The Resource Directed Measures for Protection of Water Resources: Appendix W4 IER (Floodplain Wetlands) Present Ecological Status (PES) Method	11
4.4.5 The Resource Directed Measures for Protection of Water Resources: Appendix W5 IER (Floodplain Wetlands) Determining the Ecological Importance and Sensitivity (EIS) and the Ecological Management Class (EMC)	15
4.5 Summary and Proposed Approach	16
5 CHALLENGES REGARDING WETLAND DELINEATION ON THE HALFWAY HOUSE GRANITE DOME	17
5.1 Pedogenesis	17
5.2 Water Movement in the Soil Profile.....	17
5.3 Water Movement in the Landscape	20
5.4 The Catena Concept.....	23
5.5 The Halfway House Granite Dome Catena	24
5.6 Convex Versus Concave Landscapes in the Halfway House Granite Catena.....	25
5.7 Implications for Wetland Delineation and Application of the Guidelines	27
5.8 Implications for Wetland Conservation in Urban Environments	27
5.9 Soil Erosion on the Halfway House Granite Dome	30
5.10 Detailed Soil Characteristics – Summarising Conclusions.....	32
5.11 Recommended Assessment Approach – Hydropedology Investigation	33
5.11.1 Hydropedology Background	33

5.11.2	Hydropedology – Proposed Approach	33
6.	METHOD OF SITE INVESTIGATION.....	34
6.1	Wetland Context Determination	34
6.2.	Aerial Photograph Interpretation	34
6.3	Terrain Unit Indicator.....	34
6.4	Soil Form and Soil Wetness Indicators	35
6.5	Vegetation Indicator	35
6.6	Artificial Modifiers	35
7.	SITE SURVEY RESULTS AND DISCUSSION	35
7.1	Wetland Context.....	35
7.2	Aerial Photograph Interpretation	36
7.2.1	Current Images.....	36
7.2.2	Historical Images.....	36
7.2	Terrain Unit Indicator.....	43
7.3	Soil Form and Soil Wetness Indicators (and Vegetation).....	45
7.3.1	Red Coloured Granite/Serpentine Derived Soils.....	45
7.3.2	Light Coloured Granite/Serpentine Derived Soils	45
7.3.3	Shallow and Rocky Granite/Serpentine Derived Soils	49
7.3.4	Shallow and Rocky Serpentine Derived Soils	49
7.3.5	Structured Floodplain Soils	50
7.3.6	Eroded and Alluvial Soils.....	50
7.4	Artificial Modifiers	58
8.	WETLAND ASSESSMENT.....	58
8.1	Proposed Delineation.....	58
8.2	Wetland Classification / Types	58
8.3	Wetland Functionality.....	59
8.4	Present Ecological Status (PES) Determination	60
8.5	Impact Assessment of Development on Wetlands.....	60
8.6	Management Requirements and Mitigation of Storm Water	61
9.	CONCLUSIONS AND RECOMMENDATIONS	62
	REFERENCES	63

HYDROPODOLOGY WETLAND IMPACT ASSESSMENT AND MANAGEMENT REPORT: LINKSFIELD DEVELOPMENT SITE, GAUTENG PROVINCE

1. INTRODUCTION

1.1 TERMS OF REFERENCE

Terra Soil Science was appointed by **Bokamoso** to conduct a hydropedology based wetland delineation, status and functional assessment of the wetlands on the proposed Linksfield development site. The focus of the investigation is to address aspects that include wetland distribution and functioning, landscape hydropedology and impacts of the proposed urban development on the hydrological functioning of the wetlands.

1.2 AIM OF THIS REPORT

The aim of this report is to provide a perspective on the distribution, status and functioning of the wetlands on the Linksfield development site, provide a description of the hydropedology of the site and to provide specific management recommendations regarding the hydrology of the wetland and site post development. In conclusion the aim of this report is to provide dedicated recommendations regarding the management of the soils on the site in terms of the above aspects as well as the management and mitigation of erosion. This is to be done in the context of the broader problems and challenges faced on the Halfway House Granite Dome (HHGD) in terms of wetland impacts of current and future land uses.

1.3 DISCLAIMER

This report was generated under the regulations of NEMA (National Environmental Management Act) that guides the appointment of specialists. The essence of the regulations is 1) independence, 2) specialisation and 3) duty to the regulator. The independent specialist has, in accordance with the regulations, a duty to the competent authority to disclose all matters related to the specific investigation should he be requested to do such (refer to declaration above).

It is accepted that this report can be submitted for peer review (as the regulations also allow for such). However, the intention of this report is not to function as one of several attempts by applicants to obtain favourable delineation outcomes. Rather, the report is aimed at addressing specific site conditions in the context of current legislation, guidelines and best practice with the ultimate aim of ensuring the conservation and adequate management of the water resource on the specific site.

Due to the specific legal liabilities wetland specialists face when conducting wetland delineations and assessments this author reserves the right to, in the event that this report becomes part of a delineation comparison exercise between specialists, submit the report to the competent authorities, without entering into protracted correspondence with the client, as an independent report.

1.4 METHODOLOGY

The report was generated through:

1. The collection and presentation of baseline land type and topographic data for the site;
2. The thorough consideration of the statutory context of wetlands and the process of wetland delineation as well as agricultural potential;
3. The identification of water related landscape parameters (conceptual and real) for the site;
4. Aerial photograph interpretation of the site;
5. Assessment of historical impacts and changes on the site through the accessing of various historical aerial photographs and topographic maps;
6. Focused soil and site survey in terms of soil properties as well as drainage feature properties;
7. Assessment of the functioning, status and hydromorphy of the wetlands on the site; and
8. Presentation of the findings of the various components of the investigation.

2. SITE LOCALITY AND DESCRIPTION

2.1 SURVEY AREA BOUNDARY

The site lies between $26^{\circ} 07' 46''$ and $26^{\circ} 08' 59''$ south and $28^{\circ} 07' 05''$ and $28^{\circ} 08' 04''$ east in Linksfield in the Gauteng Province (**Figure 1**).

2.2 LAND TYPE DATA

Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC). The land type data is presented at a scale of 1:250 000 and entails the division of land into land types, typical terrain cross sections for the land type and the presentation of dominant soil types for each of the identified terrain units (in the cross section). The soil data is classified according to the Binomial System (MacVicar et al., 1977). The soil data was interpreted and re-classified according to the Taxonomic System (Soil Classification Working Group, 1991).

The site falls into the **Bb1** land type with a section of the eastern edge of the site falling into the **Ab11** land type (Land Type Survey Staff, 1972 - 2006). **Figure 2** provides the land type distribution around the site. The **Bb1** land type is restricted to the Halfway House Granite Dome with the typical bleached sandy soils and the **Ab11** land type is dominated by serpentine (greenstone), schist and gneiss with subsequent finer textured soils. The implications of the mixed nature of the geology will be described later in the report.

LINKSFIELD

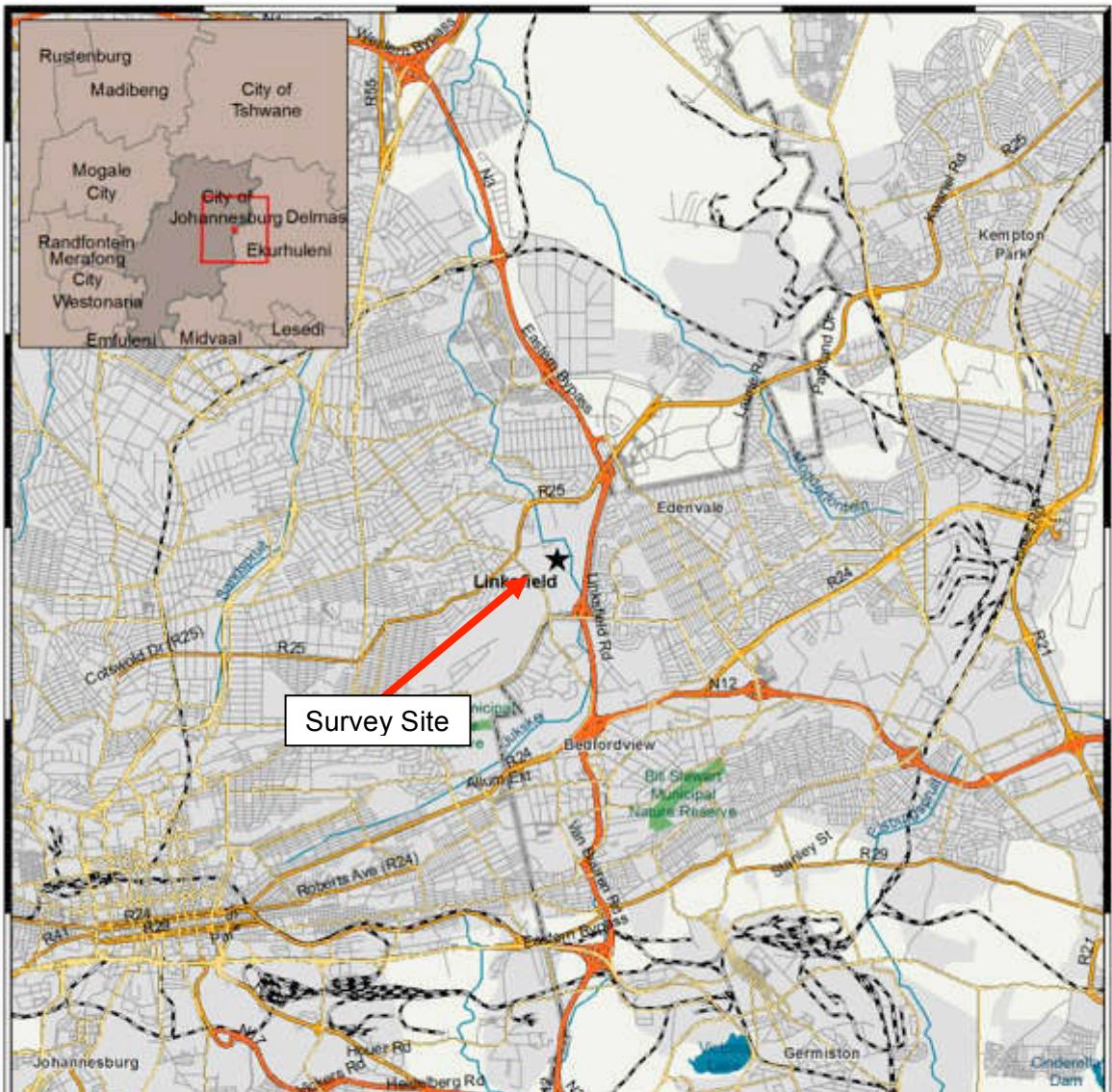


Figure 1 Locality of the survey site

Lourens G van Zyl
(Mobile) +27 (0)76 371 1151
(Website) www.terragis.co.za
(Email) lourens@terragis.co.za

LINKSFIELD
Land Types Map

Cartography & Spatial Analysis
TERRAGIS

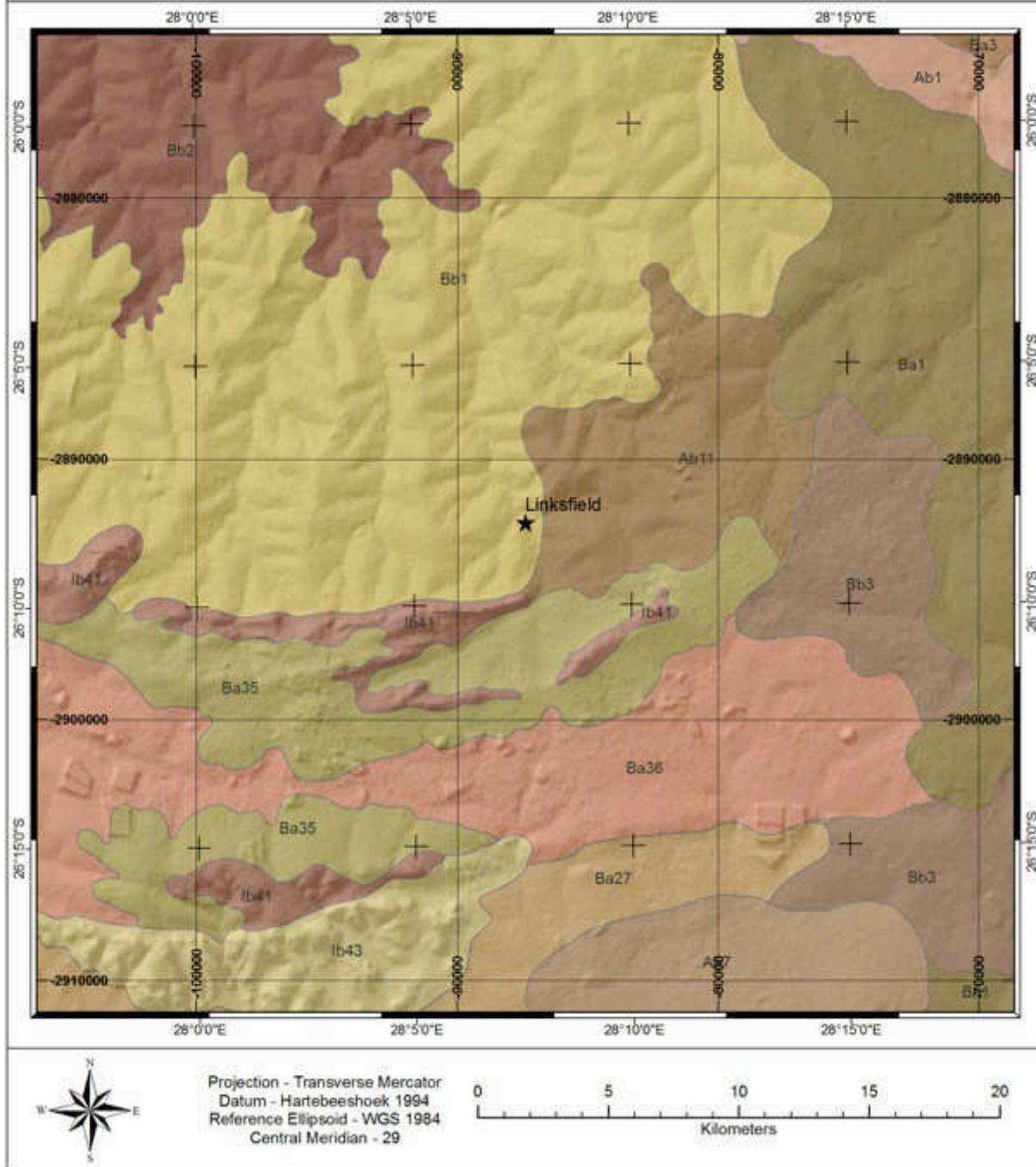


Figure 2 Land type map of the survey site and surrounding area

2.3 TOPOGRAPHY

The topography of the site is undulating with incised and often eroded stream channels throughout. The contour map for the site is provided in **Figure 3**. From the contour data a digital elevation model (DEM) (**Figure 4**) and slope map (**Figure 5**) were generated.



Figure 3 Contours of the survey area superimposed on an aerial photograph

Lourens G van Zyl
(Mobile) +27 (0)76 371 1151
(Website) www.terragis.co.za
(Email) lourens@terragis.co.za

LINKSFIELD
Digital Elevation Model

Cartography & Spatial Analysis
TERRAGIS

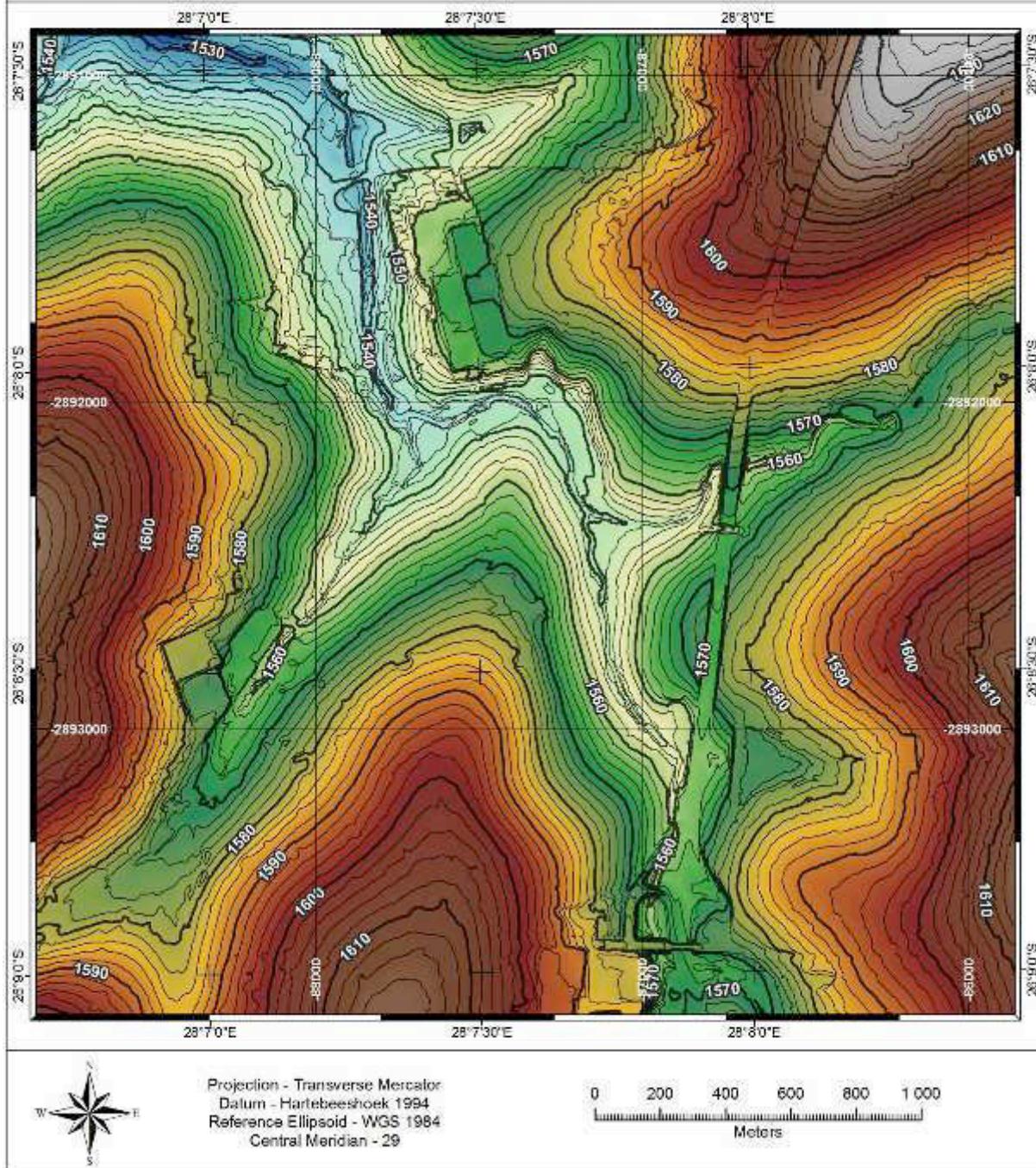


Figure 4 DEM of the survey site

Lourens G van Zyl
(Mobile) +27 (0)76 371 1151
(Website) www.terragis.co.za
(Email) lourens@terragis.co.za

LINKSFIELD Slope Map

Cartography & Spatial Analysis
TERRAGIS

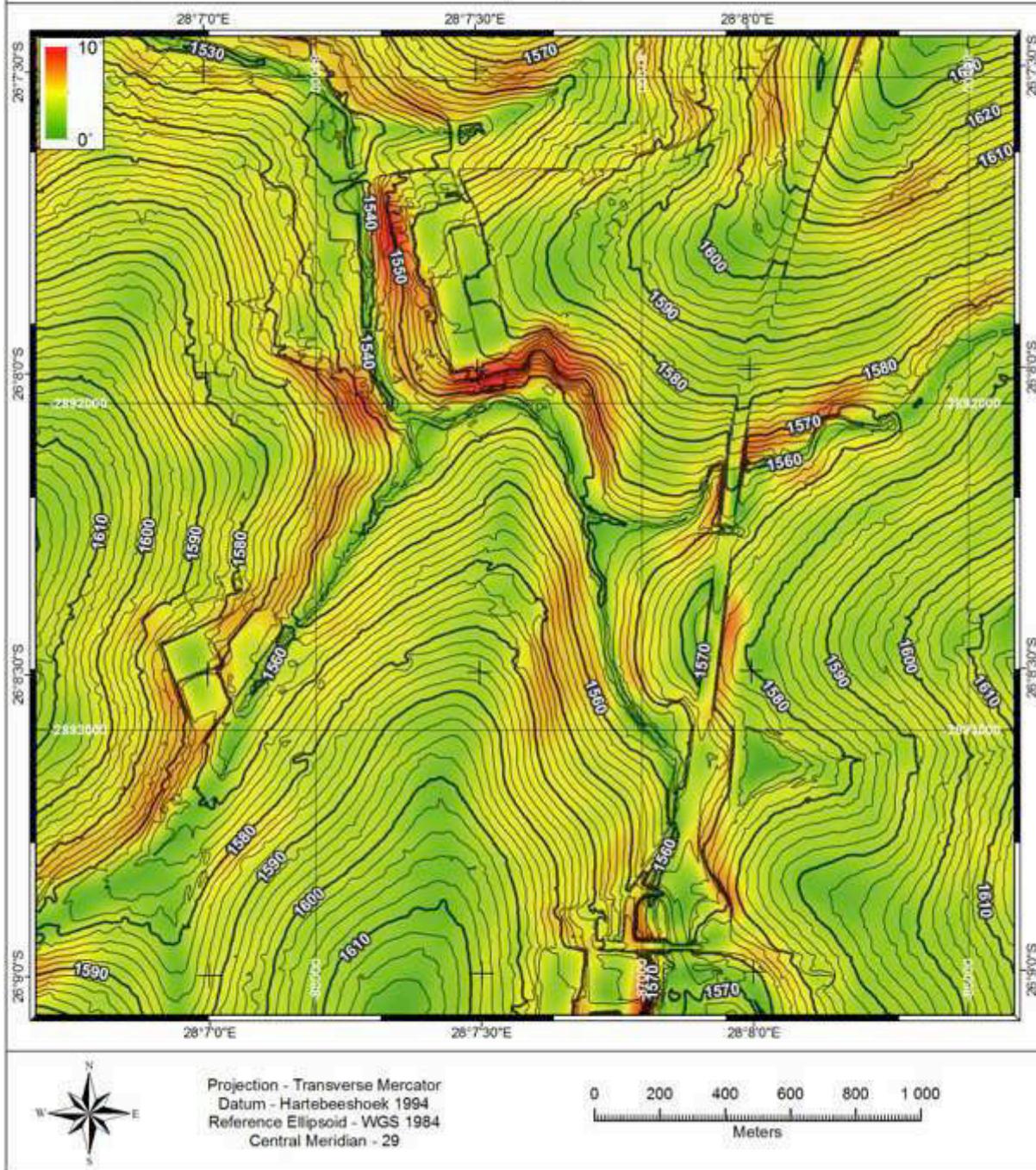


Figure 5 Slope map of the survey site

3. PROBLEM STATEMENT

The Halfway House Granite Dome (HHGD) is particularly problematic regarding the expression of morphological signs of wetness in soils as well as erodibility of soils in hydrologically altered environments. This investigation will focus on the delineation of the wetland features based on soil hydromorphy and landscape hydrology as well as address the causes and results of erosion through a dedicated assessment and elucidation of hydromedical processes experienced in the catchment and on the site.

4. STATUTORY CONTEXT

4.1 WETLAND DEFINITION

Wetlands are defined, in terms of the National Water Act (Act no 36 of 1998) (NWA), as:

“Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.”

4.2 WATERCOURSE DEFINITION

“Catchment” is defined, in terms of the National Water Act (Act no 36 of 1998) (NWA), as:

“..., in relation to a watercourse or watercourses or part of a watercourse, means the area from which any rainfall will drain into the watercourse or watercourses or part of a watercourse, through surface flow to a common point or common points;”

“Watercourse” is defined, in terms of the National Water Act (Act no 36 of 1998) (NWA), as:

“(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows; and
(d) any collection of water which the Minister may, by notice in the *Gazette*, declare to be a water course,
and a reference to a watercourse includes, where relevant, its bed and banks;”

4.3 THE WETLAND DELINEATION GUIDELINES

In 2005 the Department of Water Affairs and Forestry published a manual entitled “A practical field procedure for identification and delineation of wetland and riparian areas” (DWAF, 2005). The “...manual describes field indicators and methods for determining whether an area is a wetland or riparian area, and for finding its boundaries.” The definition of a wetland in the guidelines is that of the NWA and it states that wetlands must have one or more of the following attributes:

- **“Wetland (hydromorphic) soils** that display characteristics resulting from prolonged saturation”

- “The presence, at least occasionally, of **water loving plants (hydrophytes)**”
- “A **high water table** that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil.”

The guidelines further list four indicators to be used for the finding of the outer edge of a wetland. These are:

- Terrain Unit Indicator. The terrain unit indicator does not only identify valley bottom wetlands but also wetlands on steep and mild slopes in crest, midslope and footslope positions.
- Soil Form Indicator. A number of soil forms (as defined by MacVicar et al., 1991) are listed as indicative of permanent, seasonal and temporary wetland zones.
- Soil Wetness Indicator. Certain soil colours and mottles are indicated as colours of wet soils. The guidelines stipulate that this is the primary indicator for wetland soils. (Refer to the guidelines for a detailed description of the colour indicators.) In essence, the reduction and removal of Fe in the form of “bleaching” and the accumulation of Fe in the form of mottles are the two main criteria for the identification of soils that are periodically or permanently wet.
- Vegetation Indicator. This is a key component of the definition of a wetland in the NWA. It often happens though that vegetation is disturbed and the guidelines therefore place greater emphasis on the soil form and soil wetness indicators as these are more permanent whereas vegetation communities are dynamic and react rapidly to external factors such as climate and human activities.

The main emphasis of the guidelines is therefore the use soils (soil form and wetness) as the criteria for the delineation of wetlands. The applicability of these guidelines in the context of the survey site will be discussed in further detail later in the report.

Due to numerous problems with the delineation of wetlands there are a plethora of courses being presented to teach wetland practitioners and laymen the required techniques. Most of the courses and practitioners focus on ecological or vegetation characteristics of landscapes and soil characteristics are often interpreted incorrectly due to a lacking soil science background of these practitioners. As such this author regularly presents, in conjunction with a colleague (Prof. Cornie van Huysteen) from the University of the Free State, a course on the aspects related to soil classification and wetland delineation.

4.4 THE RESOURCE DIRECTED MEASURES FOR PROTECTION OF WATER RESOURCES

The following are specific quotes from the different sections of the “Resource Directed Measures for Protection of Water Resources.” as published by DWAF (1999).

4.4.1 The Resource Directed Measures for Protection of Water Resources: Volume 4: Wetland Ecosystems.

From the Introduction:

"This set of documents on Resource Directed Measures (RDM) for protection of water resources, issued in September 1999 in Version 1.0, presents the procedures to be followed in undertaking **preliminary determinations of the class, Reserve and resource quality objectives for water resources**, as specified in sections 14 and 17 of the South African National Water Act (Act 36 of 1998).

The development of procedures to determine RDM was initiated by the Department of Water Affairs and Forestry in July 1997. Phase 3 of this project will end in March 2000. Additional refinement and development of the procedures, and development of the full water resource classification system, will continue in Phase 4, until such time as the detailed procedures and full classification system are ready for publication in the Government Gazette.

It should be noted that until the final RDM procedures are published in the Gazette, and prescribed according to section 12 of the National Water Act, all determinations of RDM, whether at the rapid, the intermediate or the comprehensive level, will be considered to be preliminary determinations."

4.4.2 The Resource Directed Measures for Protection of Water Resources: Generic Section "A" for Specialist Manuals – Water Resource Protection Policy Implementation Process

"Step 3: Determine the reference conditions of each resource unit"

"What are reference conditions?"

"The determination of reference conditions is a very important aspect of the overall Reserve determination methodology. Reference conditions describe the natural unimpacted characteristics of a water resource. Reference conditions quantitatively describe the ecoregional type, specific to a particular water resource."

4.4.3 The Resource Directed Measures for Protection of Water Resources: Appendix W1 (Ecoregional Typing for Wetland Ecosystems)

Artificial modifiers are explained namely:

"Many wetlands are man-made, while others have been modified from a natural state to some degree by the activities of humans. Since the nature of these alterations often greatly influences the character of such habitats, the inclusion of modifying terms to accommodate human influence is important. In addition, many human modifications, such as dam walls and drainage ditches, are visible in aerial photographs and can be easily mapped. The following

Artificial Modifiers are defined and can be used singly or in combination wherever they apply to wetlands:

Farmed: the soil surface has been physically altered for crop production, but hydrophytes will become re-established if farming is discontinued

Artificial: substrates placed by humans, using either natural materials such as dredge spoils or synthetic materials such as concrete. Jetties and breakwaters are examples of Non-vegetated Artificial habitats

Excavated: habitat lies within an excavated basin or channel

Diked/Impounded: created or modified by an artificial barrier which obstructs the inflow or outflow of water

Partially Drained: the water level has been artificially lowered, usually by means of ditches, but the area is still classified as wetland because soil moisture is sufficient to support hydrophytes.“

4.4.4 The Resource Directed Measures for Protection of Water Resources: Appendix W4 IER (Floodplain Wetlands) Present Ecological Status (PES) Method

In Appendix W4 the methodology is provided for the determination of the present ecological status (PES) of a palustrine wetland.

The present ecological state (PES) of the wetland was determined according to the method described in “APPENDIX W4: IER (FLOODPLAIN WETLANDS) PRESENT ECOLOGICAL STATUS (PES) METHOD” of the “Resource Directed Measures for Protection of Water Resources. Volume 4: Wetland Ecosystems” as published by DWAF (1999). However, the PES methodology already forms an adaptation from the methodology to assess palustrine wetlands. Hillslope seepage wetlands have a range of different drivers and as such some modification of the criteria has been made by this author to accommodate the specific hydopedology drivers of hillslope seepage wetlands.

The criteria as described in Appendix 4 is provided below with the relevant modification or comment provided as well.

The summarised tasks in the PES methodology are (for detailed descriptions refer to the relevant documentation):

1. Conduct a literature review (review of available literature and maps) on the following:
 - a. Determine types of development and land use (in the catchment in question).
 - b. Gather hydrological data to determine the degree to which the flow regime has been modified (with the “virgin flow regime” as baseline). The emphasis is predominantly on surface hydrology and hydrology of surface water features as well as the land uses, such as agriculture and forestry, that lead to flow modifications. Important Note: The hydopedology of landscapes is not explicitly mentioned in the RDM documentation and this author will make a case for its consideration as probably the most important component of investigating headwater systems and seepage wetlands and areas.

- c. Assessment of the water quality as is documented in catchment study reports and water quality databases.
 - d. Investigate erosion and sedimentation parameters that address aspects such as bank erosion and bed modification. Important Note: The emphasis in the RDM documentation is again on river and stream systems with little mention of erosion of headwater and seepage zone systems. Again a case will be made for the emphasis of such information generation.
 - e. Description of exotic species (flora and fauna) in the specific catchment in question.
2. Conduct and aerial photographic assessment in terms of the parameters listed above.
 3. Conduct a site visit and make use of local knowledge.
 4. Assess the criteria and generate preliminary PES scores.
 5. Generation of report.

Table 1 presents the scoresheet with criteria for the assessment of habitat integrity of palustrine wetlands (as provided in the RDM documentation).

Table 1 “Table W4-1: Scoresheet with criteria for assessing Habitat Integrity of Palustrine Wetlands (adapted from Kleynhans 1996)”

Criteria and attributes	Relevance	Score	Confidence
Hydrologic			
Flow modification	Consequence of abstraction, regulation by impoundments or increased runoff from human settlements or agricultural land. Changes in flow regime (timing, duration, frequency), volumes, velocity which affect inundation of wetland habitats resulting in floristic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland.		
Permanent Inundation	Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.		
Water Quality			
Water Quality Modification	From point or diffuse sources. Measure directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland		
Sediment load modification	Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.		
Hydraulic/Geomorphic			
Canalisation	Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. River diversions or drainage.		
Topographic Alteration	Consequence of infilling, ploughing, dykes, trampling, bridges, roads, railwaylines and other substrate disruptive activities which reduces or changes wetland habitat directly or through changes in inundation patterns.		
Biota			
Terrestrial Encroachment	Consequence of desiccation of wetland and		

	encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.		
Indigenous Vegetation Removal	Direct destruction of habitat through farming activities, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and increases potential for erosion.		
Invasive plant encroachment	Affect habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).		
Alien fauna	Presence of alien fauna affecting faunal community structure.		
Overutilization of biota	Overgrazing, Over-fishing, etc.		
TOTAL MEAN			

Scoring guidelines per attribute:

natural, unmodified = 5; Largely natural = 4, Moderately modified = 3; largely modified = 2; seriously modified = 1; Critically modified = 0.

Relative confidence of score:

Very high confidence = 4; High confidence = 3; Moderate confidence = 2; Marginal/low confidence = 1.

Important Note: The present ecological state (PES) determination is, as discussed earlier in the report, based on criteria originally generated for palustrine and floodplain wetlands. Seepage wetlands very rarely have the same degree of saturation or free water and consequently often do not have permanent wetland zones. These wetlands are therefore often characterised by seasonal or temporary properties and as such a standard PES approach is flawed. The existing criteria is provided below as is a comment on the applicability as well as proposed improvements.

Criteria

Hydrological Criteria

- “Flow modification: Consequence of abstraction, regulation by impoundments or increased runoff from human settlements or agricultural land. Changes in flow regime (timing, duration, frequency), volumes, velocity which affect inundation of wetland habitats resulting in floristic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland.” Comment: Although the description is wide it is very evident that seepage or hillslope wetlands do not become inundated but rather are fed by hillslope return flow processes. The main criterion should therefore be the surface and subsurface hydrological linkages expressed as a degree of alteration in terms of the surface, hydromediation and groundwater hydrology.

- “Permanent inundation: Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.” Comment: Mostly not applicable to hillslope seepage wetlands.

Water Quality Criteria

- “Water quality modification: From point or diffuse sources. Measure directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland.” Comment: Water quality in this context applies generally but cognisance should be taken of seepage water quality that can be natural but significantly different to exposed water bodies. The main reason for this being the highly complex nature of many redox processes within the hillslope.
- “Sediment load modification: Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.” Comment: This is a very relevant concept but on hillslopes should be linked to erosivity of the soils as well as the specific land use influences.

Hydraulic / Geomorphic Criteria

- “Canalisation: Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. River diversions or drainage.” Comment: Again this is a very relevant concept but on hillslopes should be linked to erosivity of the soils as well as the specific land use influences. This concept does however not address the influences on the hydropedology of the hillslope. These aspects should be elucidated and contextualised.
- “Topographic Alteration: Consequence of infilling, ploughing, dykes, trampling, bridges, roads, railwaylines and other substrate disruptive activities which reduces or changes wetland habitat directly or through changes in inundation patterns.” Comment: Again this is a very relevant concept but on hillslopes should be linked to erosivity of the soils as well as the specific land use influences. This concept does however not address the influences on the hydropedology of the hillslope. These aspects should be elucidated and contextualised.

Biological Criteria

- “Terrestrial encroachment: Consequence of desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.” Comment: Again this is a very relevant concept but on hillslopes should be linked to erosivity of the soils as well as the specific land use influences. This concept does however not address the influences on the hydropedology of the hillslope. These aspects should be elucidated and contextualised.
- “Indigenous vegetation removal: Direct destruction of habitat through farming activities, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and increases potential for erosion.”
- “Invasive plant encroachment: Affect habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).”
- “Alien fauna: Presence of alien fauna affecting faunal community structure.”
- “Overutilization of biota: Overgrazing, Over-fishing, etc.”

Scoring Guidelines

Scoring guidelines per attribute:

Natural, unmodified = 5

Largely natural = 4

Moderately modified = 3

Largely modified = 2

Seriously modified = 1

Critically modified = 0

Relative confidence of score:

Very high confidence = 4

High confidence = 3

Moderate confidence = 2

Marginal/low confidence = 1

4.4.5 The Resource Directed Measures for Protection of Water Resources: Appendix W5 IER (Floodplain Wetlands) Determining the Ecological Importance and Sensitivity (EIS) and the Ecological Management Class (EMC)

In Appendix W5 the methodology is provided for the determination of the ecological importance and sensitivity (EIS) and ecological management class (EMC) of floodplain wetlands.

"Ecological importance" of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. "Ecological sensitivity" refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The Ecological Importance and sensitivity (EIS) provides a guideline for determination of the Ecological Management Class (EMC)." Please refer to the specific document for more detailed information.

The following primary determinants are listed as determining the EIS:

1. Rare and endangered species
2. Populations of unique species
3. Species / taxon richness
4. Diversity of habitat types or features
5. Migration route / breeding and feeding site for wetland species
6. Sensitivity to changes in the natural hydrological regime
7. Sensitivity to water quality changes
8. Flood storage, energy dissipation and particulate / element removal

The following modifying determinants are listed as determining the EIS:

1. Protected status
2. Ecological integrity

4.5 SUMMARY AND PROPOSED APPROACH

When working in environments where the landscape and land use changes are significant (such as urban and mining environments) it is important to answer the following critical questions regarding the assessment and management planning for wetlands:

1. What is the reference condition?
2. What is the difference between the reference condition and the current condition and how big is this difference from a hydrological driver perspective?
3. What are the hydrological drivers (as a function of geology, topography, rainfall and soils) and what are the relative contributions of these drivers to the functioning of the wetland system?
4. What is the intended or planned land use in the wetland as well as terrestrial area and how will these developments impact on the hydrology of the landscape and wetlands?
5. How can the intended land use be plied to secure the best possible hydrological functioning of the landscape in terms of storm water attenuation, erosion mitigation and water quality?

The key to the generation of adequate information lies in the approach that is to be followed. In the next section an explanation about and motivation in favour of will be provided for a hydropedology assessment approach. Due to the detailed nature of the information that can be generated through such an approach it is motivated that all wetland assessments be conducted with the requirements of criminal law in mind. The main reason for this is the fact that many well-meaning administrative exercises often yield not tangible results due to the gap in terms of information that is required should there be a compliance process followed.

To Summarise:

During wetland assessments and delineations it is important to provide a perspective on assessment tools, the original or reference state of the wetland, the assessment process and outcome as well as the intended or possible state of the wetland and site post development. Urban and mining developments are good examples of cases where surrounding developments and land use changes have significant effects on wetland integrity and water quality emanating from the site.

5 CHALLENGES REGARDING WETLAND DELINEATION ON THE HALFWAY HOUSE GRANITE DOME

Disclaimer: The following section represents a discussion that I use as standard in describing the challenges regarding wetland delineation and management in the Halfway House Granite Dome (HHGD) area. This implies that the section is verbatim the same as in other reports provided to clients and the authorities. Copyright is strictly reserved.

In order to discuss the procedures followed and the results of the wetland identification exercise it is necessary at the outset to provide some theoretical background on soil forming processes, soil wetness indicators, water movement in soils and topographical sequences of soil forms (catena).

5.1 PEDOGENESIS

Pedogenesis is the process of soil formation. Soil formation is a function of five (5) factors namely (Jenny, 1941):

- Parent material;
- Climate;
- Topography;
- Living Organisms; and
- Time.

These factors interact to lead to a range of different soil forming processes that ultimately determine the specific soil formed in a specific location. Central to all soil forming processes is water and all the reactions (physical and chemical) associated with it. The physical processes include water movement onto, into, through and out of a soil unit. The movement can be vertically downwards, lateral or vertically upwards through capillary forces and evapotranspiration. The chemical processes are numerous and include dissolution, precipitation (of salts or other elements) and alteration through pH and reduction and oxidation (redox) changes. In many cases the reactions are promoted through the presence of organic material that is broken down through aerobic or anaerobic respiration by microorganisms. Both these processes alter the redox conditions of the soil and influence the oxidation state of elements such as Fe and Mn. Under reducing conditions Fe and Mn are reduced and become more mobile in the soil environment. Oxidizing conditions, in turn, lead to the precipitation of Fe and Mn and therefore lead to their immobilization. The dynamics of Fe and Mn in soil, their zones of depletion through mobilization and accumulation through precipitation, play an important role in the identification of the dominant water regime of a soil and could therefore be used to identify wetlands and wetland conditions.

5.2 WATER MOVEMENT IN THE SOIL PROFILE

In a specific soil profile, water can move upwards (through capillary movement), horizontally (owing to matric suction) and downwards under the influence of gravity.

The following needs to be highlighted in order to discuss water movement in soil:

- Capillary rise refers to the process where water rises from a deeper lying section of the soil profile to the soil surface or to a section closer to the soil surface. Soil pores can be

regarded as miniature tubes. Water rises into these tubes owing to the adhesion (adsorption) of water molecules onto solid mineral surfaces and the surface tension of water.

The height of the rise is inversely proportional to the radius of the soil pore and the density of the liquid (water). It is also directly proportional to the liquid's surface tension and the degree of its adhesive attraction. In a soil-water system the following simplified equation can be used to calculate this rise:

$$\text{Height} = 0.15/\text{radius}$$

Usually the eventual height of rise is greater in fine textured soil, but the rate of flow may be slower (Brady and Weil, 1999; Hillel, 1983).

- Matric potential or suction refers to the attraction of water to solid surfaces. Matric potential is operational in unsaturated soil above the water table while pressure potential refers to water in saturated soil or below the water table. Matric potential is always expressed as a negative value and pressure potential as a positive value.

Matric potential influences soil moisture retention and soil water movement. Differences in the matric potential of adjoining zones of a soil results in the movement of water from the moist zone (high state of energy) to the dry zone (low state of energy) or from large pores to small pores.

The maximum amount of water that a soil profile can hold before leaching occurs is called the field capacity of the soil. At a point of water saturation, a soil exhibits an energy state of 0 J.kg^{-1} . Field capacity usually falls within a range of -15 to -30 J.kg^{-1} with fine textured soils storing larger amounts of water (Brady and Weil, 1999; Hillel, 1983).

- Gravity acts on water in the soil profile in the same way as it acts on any other body; it attracts towards earth's centre. The gravitational potential of soil water can be expressed as:

$$\text{Gravitational potential} = \text{Gravity} \times \text{Height}$$

Following heavy rainfall, gravity plays an important part in the removal of excess water from the upper horizons of the soil profile and recharging groundwater sources below.

Excess water, or water subject to leaching, is the amount of water that falls between soil saturation (0 J.kg^{-1}) or oversaturation ($> 0 \text{ J.kg}^{-1}$), in the case of heavy rainfall resulting in a pressure potential, and field capacity (-15 to -30 J.kg^{-1}). This amount of water differs according to soil type, structure and texture (Brady and Weil, 1999; Hillel, 1983).

- Under some conditions, at least part of the soil profile may be saturated with water, resulting in so-called saturated flow of water. The lower portions of poorly drained soils are often saturated, as are well-drained soils above stratified (layers differing in soil texture) or impermeable layers after rainfall.

The quantity of water that flows through a saturated column of soil can be calculated using Darcy's law:

$$Q = K_{\text{sat}} \cdot A \cdot \Delta P / L$$

Where Q represents the quantity of water per unit time, K_{sat} is the saturated hydraulic conductivity, A is the cross sectional area of the column through which the water flows, ΔP is the hydrostatic pressure difference from the top to the bottom of the column, and L is the length of the column.

Saturated flow of water does not only occur downwards, but also horizontally and upwards. Horizontal and upward flows are not quite as rapid as downward flow. The latter is aided by gravity (Brady and Weil, 1999; Hillel, 1983).

- Mostly, water movement in soil is ascribed to the unsaturated flow of water. This is a much more complex scenario than water flow under saturated conditions. Under unsaturated conditions only the fine micropores are filled with water whereas the macropores are filled with air. The water content, and the force with which water molecules are held by soil surfaces, can also vary considerably. The latter makes it difficult to assess the rate and direction of water flow. The driving force behind unsaturated water flow is matric potential. Water movement will be from a moist to a drier zone (Brady and Weil, 1999; Hillel, 1983).

The following processes influence the amount of water to be leached from a soil profile:

- Infiltration is the process by which water enters the soil pores and becomes soil water. The rate at which water can enter the soil is termed infiltration tempo and is calculated as follows:

$$I = Q/A \cdot t$$

Where I represents infiltration tempo (m.s^{-1}), Q is the volume quantity of infiltrating water (m^3), A is the area of the soil surface exposed to infiltration (m^2), and t is time (s).

If the soil is quite dry when exposed to water, the macropores will be open to conduct water into the soil profile. Soils that exhibit a high 2:1 clay content (swelling-shrinking clays) will exhibit a high rate of infiltration initially. However, as infiltration proceeds, the macropores will become saturated and cracks, caused by dried out 2:1 clay, will swell and close, thus leading to a decline in infiltration (Brady and Weil, 1999; Hillel, 1983).

- Percolation is the process by which water moves downward in the soil profile. Saturated and unsaturated water flow is involved in the process of percolation, while the rate of percolation is determined by the hydraulic conductivity of the soil.

During a rain storm, especially the down pouring of heavy rain, water movement near the soil surface mainly occurs in the form of saturated flow in response to gravity. A sharp boundary, referred to as the wetting front, usually appears between the wet soil and the underlying dry soil. At the wetting front, water is moving into the underlying soil in response to both matric and gravitational potential. During light rain, water movement at the soil surface may be ascribed to unsaturated flow (Brady and Weil, 1999; Hillel, 1983).

The fact that water percolates through the soil profile by unsaturated flow has certain ramifications when an abrupt change in soil texture occurs (Brady and Weil, 1999; Hillel, 1983). A layer of coarse sand, underlying a fine textured soil, will impede downward movement of water. The macropores of the coarse textured sand offer less attraction to the water molecules than the macropores of the fine textured soil. When the unsaturated wetting front reaches the coarse sand, the matric potential is lower in the sand than in the overlying material. Water always moves from a higher to a lower state of energy. The water can, therefore, not move into the coarse textured sand. Eventually, the downward moving water will accumulate above the sand layer and nearly saturate the fine textured soil. Once this occurs, the water will be held so loosely that gravitational forces will be able to drag the water into the sand layer (Brady and Weil, 1999; Hillel, 1983).

A coarse layer of sand in an otherwise fine textured soil profile will also inhibit the rise of water by capillary movement (Brady and Weil, 1999; Hillel, 1983).

Field observations and laboratory-based analysis can aid in assessing the soil-water relations of an area. The South African soil classification system (Soil Classification Working Group, 1991.) comments on certain field observable characteristics that shed light on water movement in soil. The more important of these are:

- Soil horizons that show clear signs of leaching such as the E-horizon – an horizon where predominantly lateral water movement has led to the mobilisation and transport of sesquioxide minerals and the removal of clay material;
- Soil horizons that show clear signs of a fluctuating water table where Fe and Mn mottles, amongst other characteristics, indicate alternating conditions of reduction and oxidation (soft plinthic B-horizon);
- Soil horizons where grey colouration (Fe reduction and redox depletion), in an otherwise yellowish or reddish matrix, indicate saturated (or close to saturated) water flow for at least three months of the year (Unconsolidated/Unspecified material with signs of wetness);
- Soil horizons that are uniform in colouration and indicative of well-drained and aerated (oxidising) conditions (e.g. yellow brown apedal B-horizon).

5.3 WATER MOVEMENT IN THE LANDSCAPE

Water movement in a landscape is a combination of the different flow paths in the soils and geological materials. The movement of water in these materials is dominantly subject to gravity and as such it will follow the path of least resistance towards the lowest point. In the landscape there are a number of factors determining the paths along which this water moves. **Figure 6** provides a simplified schematic representation of an idealised landscape (in “profile curvature”). The total precipitation (rainfall) on the landscape from the crest to the lowest part or valley bottom is taken as 100 %. Most geohydrologists agree that total recharge, the water that seeps into the underlying geological strata, is less than 4 % of total precipitation for most geological settings. Surface runoff varies considerably according to rainfall intensity and distribution, plant cover and soil characteristics but is taken as a realistic 6 % of total precipitation for our idealised landscape. The total for surface runoff and recharge is therefore calculated as 10 % of total precipitation. If evapotranspiration (from plants as well as the soil surface) is taken as a very high 30 % of total precipitation it leaves 60 % of the total that has to move through the soil and/or geological strata from higher lying to lower lying areas. In the event of an average rainfall of 750 mm per year it

results in 450 mm per year having to move laterally through the soil and geological strata. In a landscape there is an accumulation of water down the slope as water from higher lying areas flow to lower lying areas.

To illustrate: If the assumption is made that the area of interest is 100 m wide it follows that the first 100 m from the crest downwards has $4\ 500\ m^3$ (or $4\ 500\ 000$ litres) of water moving laterally through the soil ($100\ m \times 100\ m \times 0.45\ m$) per rain season. The next section of 100 m down the slope has its own $4\ 500\ m^3$ of water as well as the added $4\ 500\ m^3$ from the upslope section to contend with, therefore $9\ 000\ m^3$. The next section has $13\ 500\ m^3$ to contend with and the following one $18\ 000\ m^3$. It is therefore clear that, the longer the slope, the larger the volume of water that will move laterally through the soil profile.

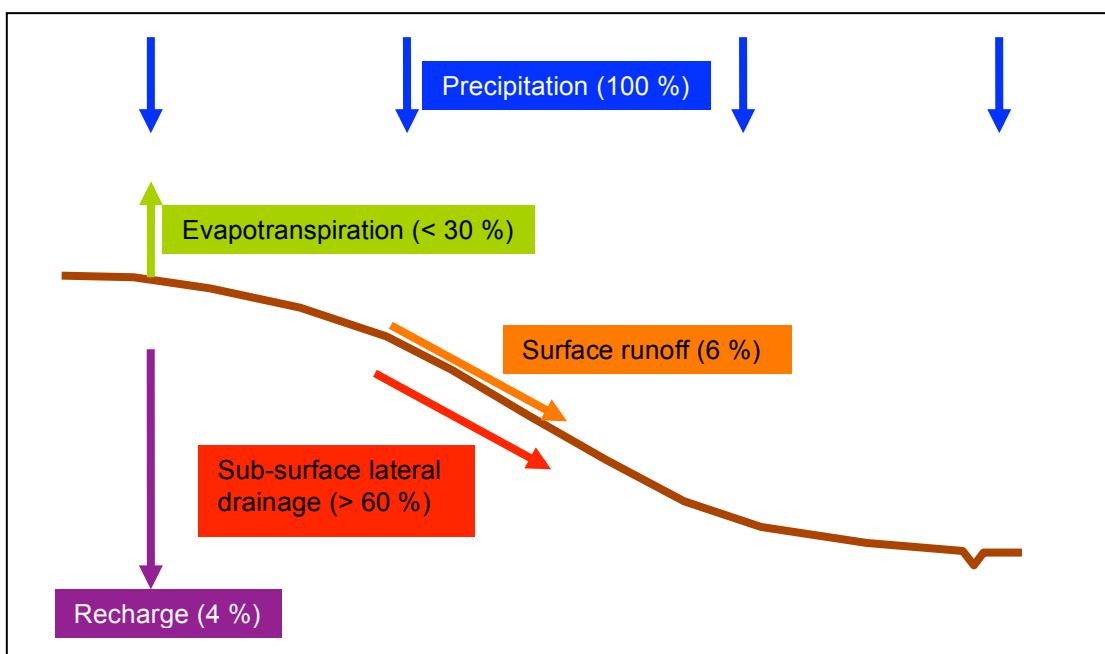


Figure 6 Idealised landscape with assumed quantities of water moving through the landscape expressed as a percentage of total precipitation (100 %).

Flow paths through soil and geological strata, referred to as “interflow” or “hillslope water”, are very varied and often complex due to difficulty in measurement and identification. The difficulty in identification stems more from the challenges related to the physical determination of these in soil profile pits, soil auger samples and core drilling samples for geological strata. The identification of the morphological signs of water movement in permeable materials or along planes of weakness (cracks and seams) is a well-established science and the expression is mostly referred to as “redox morphology”. In terms of the flow paths of water large variation exists but these can be grouped into a few simple categories. **Figure 7** provides a schematic representation of the different flow regimes that are usually encountered. The main types of water flow can be grouped as 1) recharge (vertically downwards) of groundwater; 2) lateral flow of water through the landscape along the hillslope (interflow or hillslope water); 3) return flow water that intercepts the soil/landscape surface; and 4) surface runoff. Significant variation exists with these flow paths and numerous combinations are often found. The main wetland types associated with the flow paths are: a) valley bottom wetlands (fed by groundwater, hillslope processes, surface runoff, and/or in-

stream water); b) hillslope seepage wetlands (fed by interflow water and/or return flow water); and wetlands associated with surface runoff, ponding and surface ingress of water anywhere in the landscape.

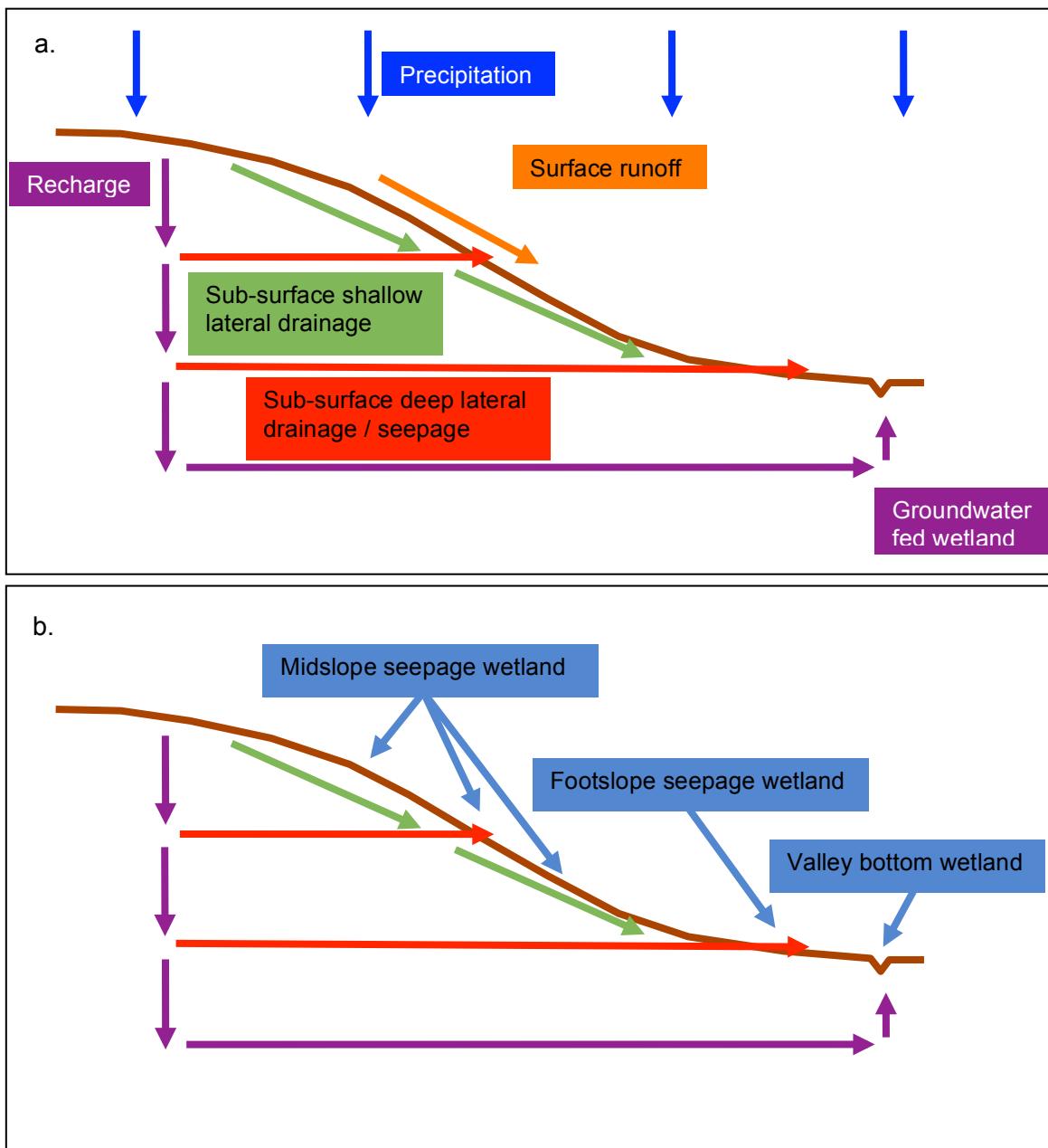


Figure 7 Different flow paths of water through a landscape (a) and typical wetland types associated with the water regime (b)

Amongst other factors, the thickness of the soil profile at a specific point will influence the intensity of the physical and chemical reactions taking place in that soil. **Figure 8** illustrates the difference between a dominantly thick and a dominantly thin soil profile. If all factors are kept the same except for the soil profile thickness it can be assumed with confidence that the chemical and physical reactions associated with water in the landscape will be much more intense for the thin soil profile than for the thick soil profile. Stated differently: The volume of water moving through the soil per surface area of an imaginary plane perpendicular to the direction of water flow is much higher for

the thin soil profile than for the thick soil profile. This aspect has a significant influence on the expression of redox morphology in different landscapes of varying soil/geology/climate composition.

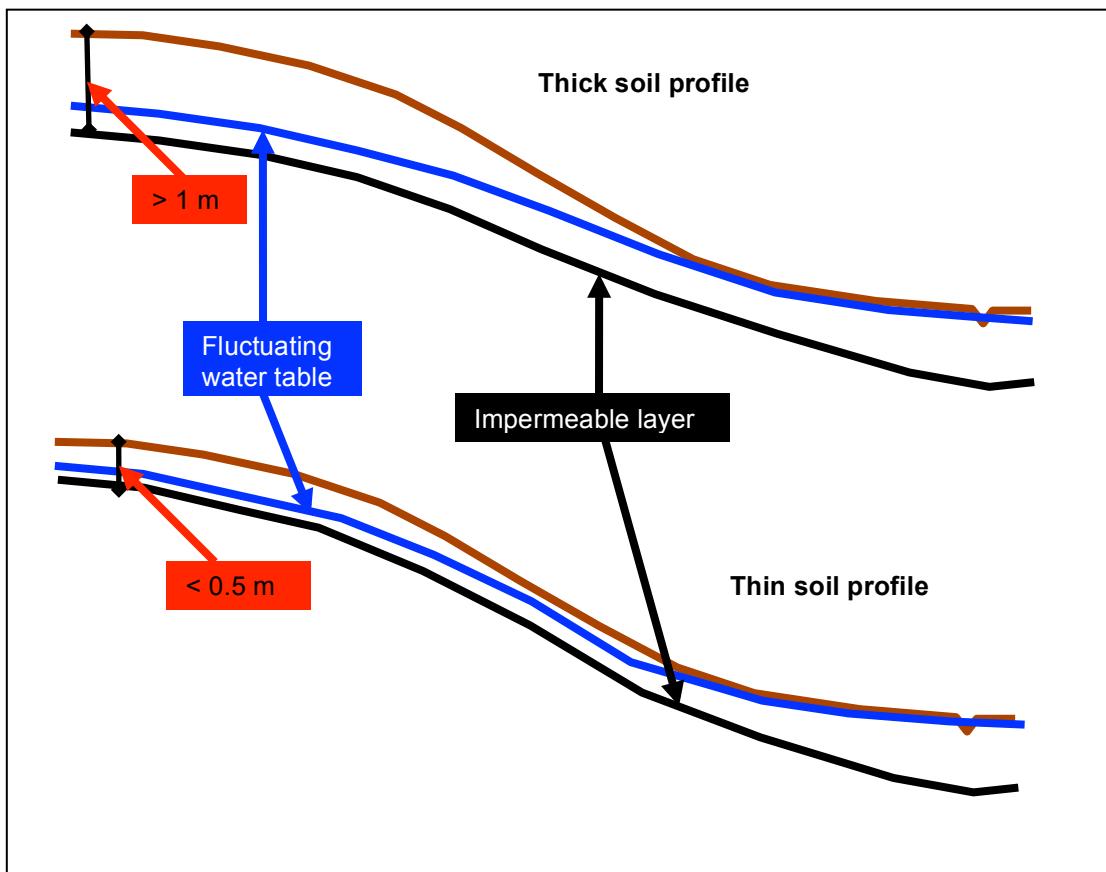


Figure 8 The difference in water flow between a dominantly thick and dominantly thin soil profile.

5.4 THE CATENA CONCEPT

Here it is important to take note of the “catena” concept. This concept is one of a topographic sequence of soils in a homogenous geological setting where the water movement and presence in the soils determine the specific characteristics of the soils from the top to the bottom of the topography. **Figure 9** illustrates an idealised topographical sequence of soils in a catena for a quartz rich parent material. Soils at the top of the topographical sequence are typically red in colour (Hutton and Bainsvlei soil forms) and systematically grade to yellow further down the slope (Avalon soil form). As the volume of water that moves through the soil increases, typically in midslope areas, periodic saturated conditions are experienced and consequently Fe is reduced and removed in the laterally flowing water. In the event that the soils in the midslope positions are relatively sandy the resultant soil colour will be bleached or white due to the colour dominance of the sand quartz particles. The soils in these positions are typically of the Longlands and Kroonstad forms. Further down the slope there is an accumulation of clays and leaching products from higher lying soils and this leads to typical illuvial and clay rich horizons. Due to the regular presence of water the dominant conditions are anaerobic and reducing and the soils exhibit grey colours often with bright yellow and grey mottles (Katspruit soil form). In the event that there is a large depositional environment with prolonged saturation soils of the Champagne form may develop (typical peat

land). Variations on this sequence (as is often found on the Mpumalanga Highveld) may include the presence of hard plinthic materials instead of soft plinthite with a consequent increase in the occurrence of bleached soil profiles. Extreme examples of such landscapes are discussed below.

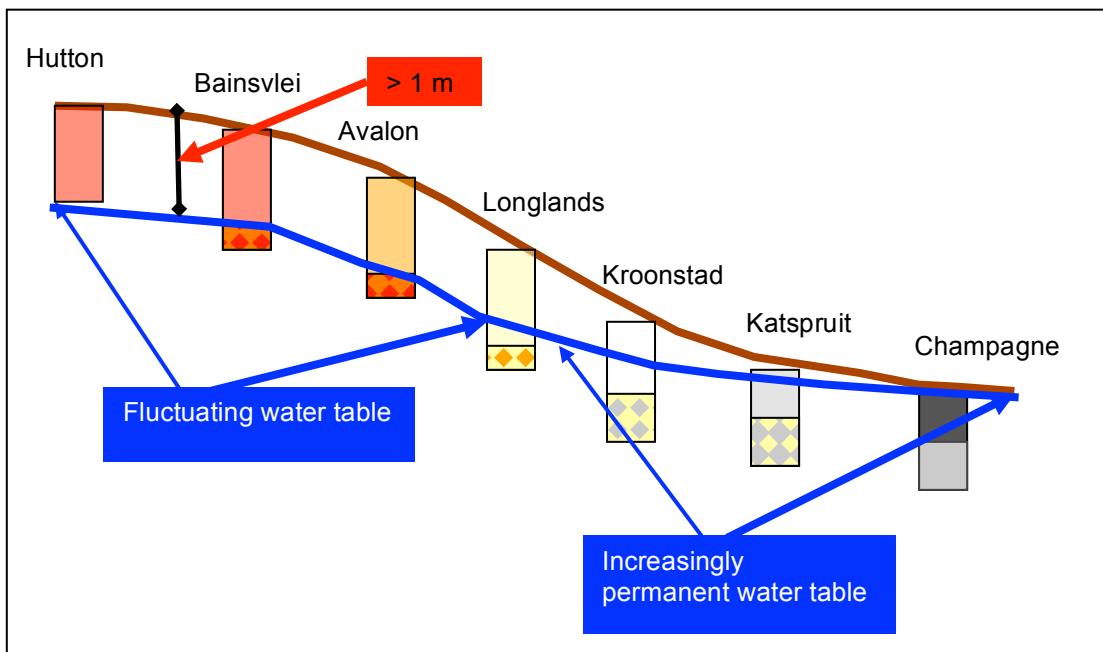


Figure 9 Idealised catena on a quartz rich parent material.

5.5 THE HALFWAY HOUSE GRANITE DOME CATENA

The Halfway House Granite Catena is a well-studied example of a quartz dominated Bb catena. As a result of the elucidation of the wetland delineation parameters and challenges in the specialist testimony in the matter between The State versus 1. Stefan Frylinck and 2. Mpofu Environmental Solutions CC (Case Number 14/1740/2010) it will be discussed in further detail here.

The typical catena that forms on the Halfway House granite differs from the idealised one discussed above in that the landscape is an old stable one, often with extensive subsoil ferricrete (or hard plinthic) layers where perched water tables occur. The parent material is relatively hard and the ferricrete layer is especially resistant to weathering. The quartz rich parent materials have a very low Fe content/"reserve", and together with the age of the material leads to the dominance of bleached sandy soils. The implication is that the whole catena is dominated by bleached sandy soils with a distinct and shallow zone of water fluctuation. This zone is often comprised of a high frequency of Fe/Mn concretions and sometimes exhibits feint mottles. In lower lying areas the soils tend to be deeper due to colluvial accumulation of sandy soil material but then exhibit more distinct signs of wetness (and pedogenesis). **Figure 10** provides a schematic representation of the catena.

The essence of this catena is that the soils are predominantly less than 50 cm thick and as such have a fluctuating water table (mimicking rainfall events) within 50 cm of the soil surface. One of the main criteria used during wetland delineation exercises as stipulated by the guidelines (DWAF, 2005) is the presence of mottles within 50 cm of the soil surface (temporary and seasonal wetland zones). Even from a theoretical point of view the guidelines cannot be applied to the above-

described catena as soils at the crest of the landscape would already qualify as temporary wetland zone soils (upon request many such examples can be supplied). The practical implication of this statement as well as practical examples will be discussed in the next section.

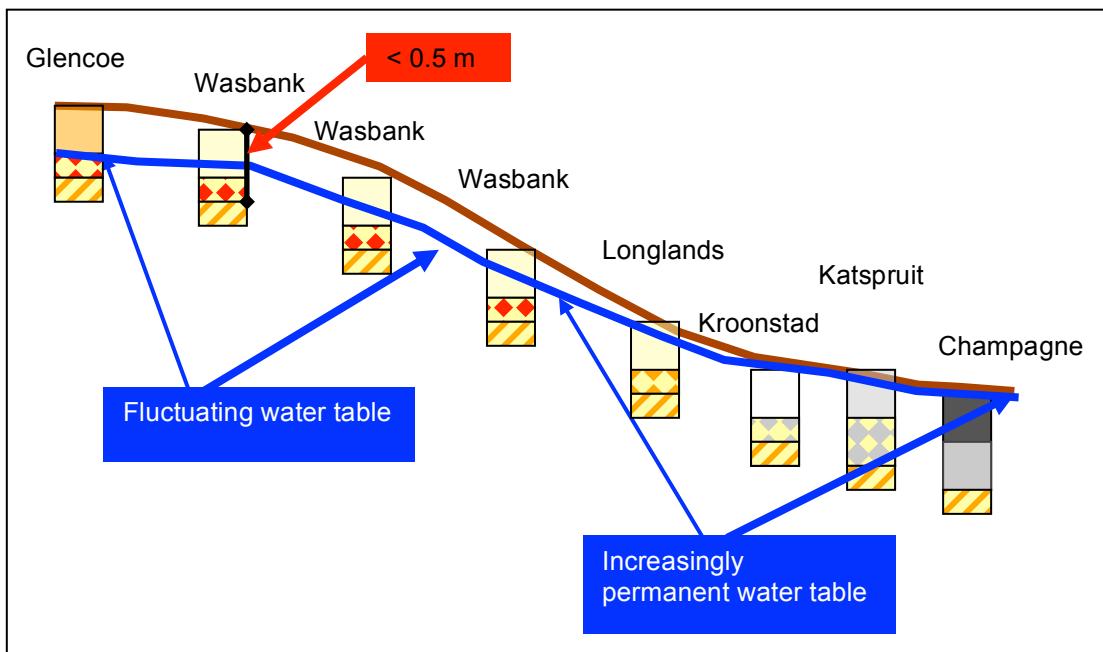


Figure 10 Schematic representation of a Halfway House Granite catena.

5.6 CONVEX VERSUS CONCAVE LANDSCAPES IN THE HALFWAY HOUSE GRANITE CATENA

An additional factor of variation in all landscapes is the shape of the landscape along contours (referred to as "plan curvature"). Landscapes can be either concave or convex, or flat. The main difference between these landscapes lies in the fact that a convex landscape is essentially a watershed with water flowing in diverging directions with a subsequent occurrence of "dryer" soil conditions. In a concave landscape water flows in converging directions and soils often exhibit the wetter conditions of "signs of wetness" such as grey colours, organic matter and subsurface clay accumulation. **Figure 11** presents the difference between these landscapes in terms of typical soil forms encountered on the Halfway House granites. In the convex landscape the subsurface flow of water removes clays and other weathering products (including Fe) in such a way that the midslope position soils exhibit an increasing degree of bleaching and relative accumulation of quartz (E-horizons). In the concave landscapes clays and weathering products are transported through the soils into a zone of accumulation where soils start exhibiting properties of clay and Fe accumulation. In addition, coarse sandy soils in convex environments tend to be thinner due to the removal of sand particles through erosion and soils in concave environments tend to be thicker due to colluvial accumulation of material transported from upslope positions. Similar patterns are observed for other geological areas with the variation being consistent with the soil variation in the catena.

Often these concave and convex topographical environments occur in close proximity or in one topographical sequence of soils. This is often found where a convex upslope area changes into a

concave environment as a drainage depression is reached (**Figure 11**). The processes in this landscape are the same as those described for the convex and concave landscapes above.

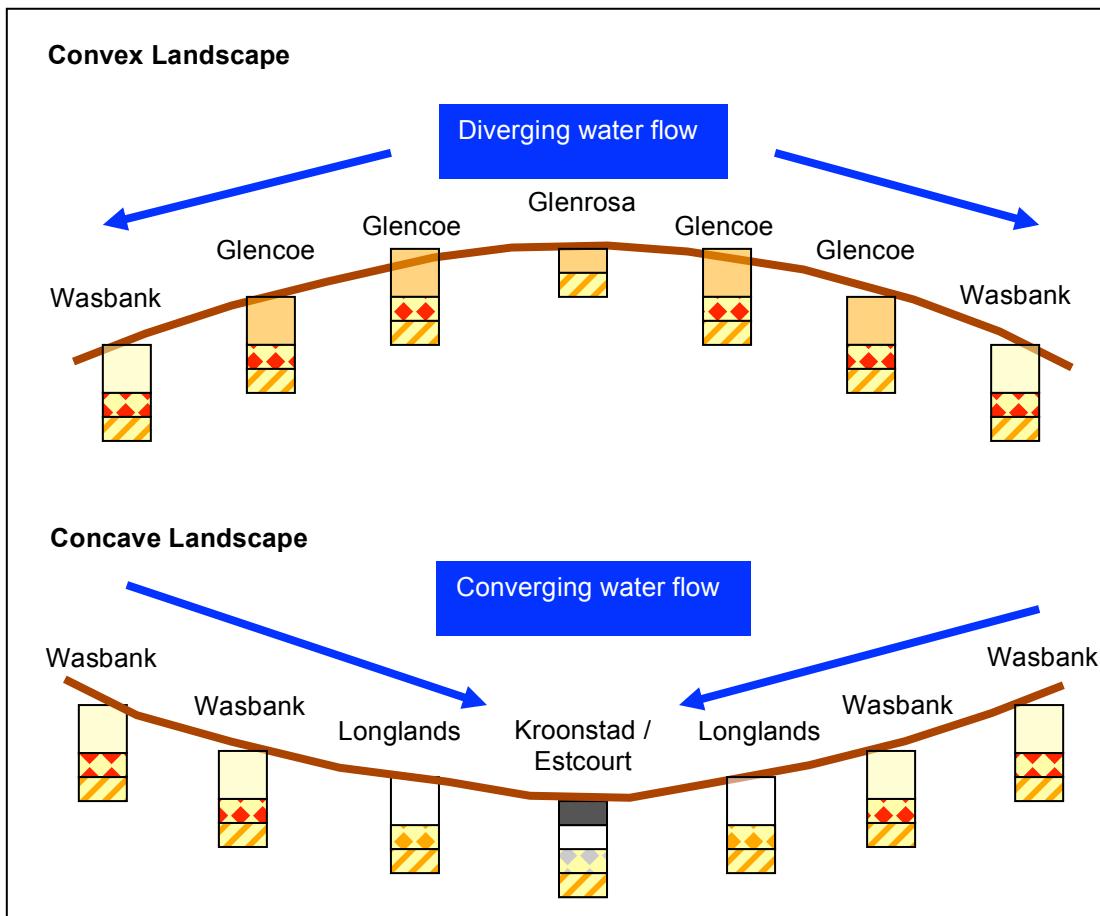


Figure 11 Schematic representation of the soils in convex and concave landscapes in the Halfway House Granite catena.

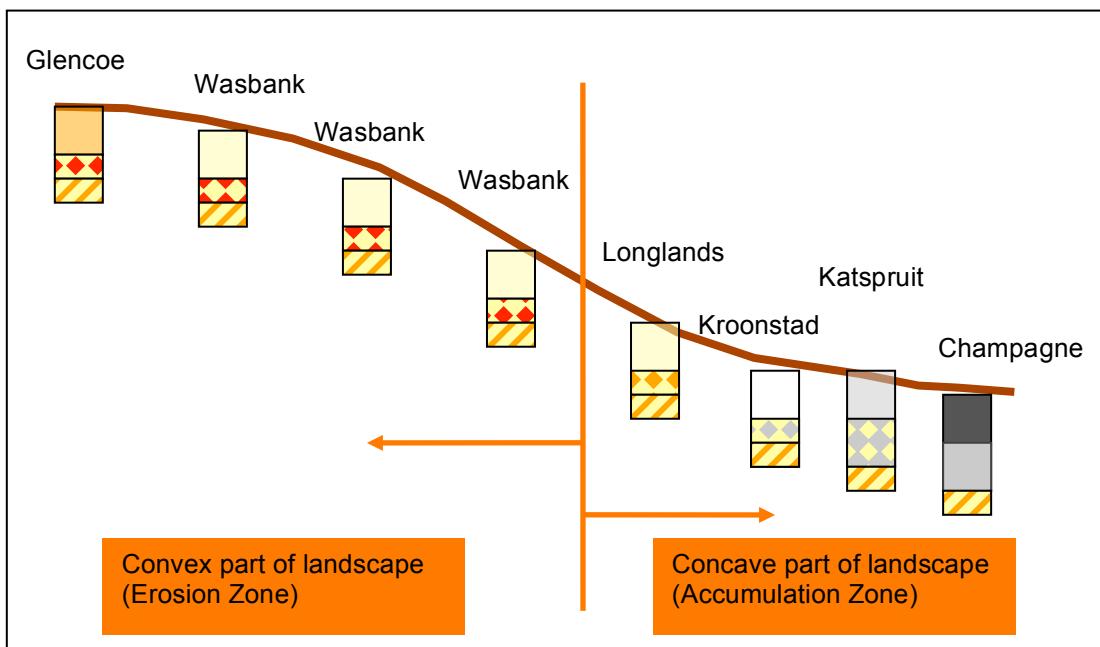


Figure 12 Schematic representation of the soils in a combined convex and concave landscape in the Halfway House Granite catena.

5.7 IMPLICATIONS FOR WETLAND DELINEATION AND APPLICATION OF THE GUIDELINES

When the 50 cm criterion is used to delineate wetlands in the HHGD environment, the soils in convex positions often “qualify” as temporary wetland soils due to their relatively thin profile and the presence of concretions (often weathering to yield “mottles”) within this zone. In conjunction with a low Fe content in the soils and subsequent bleached colours (as defined for E-horizons) in the matrix a very large proportion of the landscape “qualifies” as temporary wetland zones. On the other hand, the soils in the concave environments, especially in the centre of the drainage depression, tend to be thicker and the 50 cm criterion sometimes does not flag these soils as being wetland soils due to the depth of the signs of wetness (mottles) often occurring only at depths greater than 80 cm. Invariably these areas are always included in wetland delineations due to the terrain unit indicator flagging it as a wetland area and drainage feature.

The strict application of the wetland delineation guidelines in the Halfway House Granite area often leads to the identification of 70 % or more of a landscape as being part of a wetland. For this reason a more pragmatic approach is often followed in that the 50 cm criterion is not applied religiously. Rather, distinctly wet horizons and zones of clay accumulation within drainage depressions are identified as distinct wetland soils. The areas surrounding these are assigned to extensive seepage areas that are difficult to delineate and on which it is difficult to assign a realistic buffer area. The probable best practice is to assign a large buffer zone in which subsurface water flow is encouraged and conserved to lead to a steady but slow recharge of the wetland area, especially following rainfall events. In the case where development is to take place within this large buffer area it is preferred that a “functional buffer” approach be followed. This implies that development can take place within the buffer area but then only within strict guidelines regarding storm water management and mitigation as well as erosion prevention in order to minimise sediment transport into stream and drainage channels and depressions.

5.8 IMPLICATIONS FOR WETLAND CONSERVATION IN URBAN ENVIRONMENTS

Whether an area is designated a wetland or not loses some of its relevance once drastic influences on landscape hydrology are considered. If wetlands are merely the expression of water in a landscape due to proximity to the land surface (viz. the 50 cm mottle criterion in the delineation guidelines) it follows that potentially large proportions of the water moving in the landscape could fall outside of this sphere – as discussed in detail above. **Figures 13** and **14** provide schematic representations (as contrasted with **Figure 7**) of water dynamics in urban environments with distinct excavations and surface sealing activities respectively.

Through the excavation of pits (**Figure 13**) for the construction of foundations for infrastructure or basements for buildings the shallow lateral flow paths in the landscape are severed. As discussed above these flow paths can account for up to 60 % of the volume of water entering the landscape in the form of precipitation. These severed flow paths often lead to the ponding of water upslope from the structure with a subsequent damp problem developing in buildings. Euphemistically we have coined the term “wet basement syndrome” (WBS) to describe the type of problem experienced extensively on the HHGD. A different impact is experienced once the surface of the land is sealed through paving (roads and parking areas) and the construction of buildings (in this case the roof provides the seal) (**Figure 14**). In this case the recharge of water into the soil and

weathered rock experienced naturally is altered to an accumulation and concentration of water on the surface with a subsequent rapid flowing downslope. The current approach is to channel this water into storm water structures and to release it in the nearest low-lying position in the landscape. These positions invariable correlate with drainage features and the result is accelerated erosion of such features due to a drastically altered peak flow regime.

The result of the above changes in landscape hydrology is the drastic alteration of flow dynamics and water volume spikes through wetlands. This leads to wetlands that become wetter and that experience vastly increased erosion pressures. The next section provides a perspective on the erodibility of the soils of the HHGD. It is important to note the correlation between increasing wetness, perching of water and erodibility.

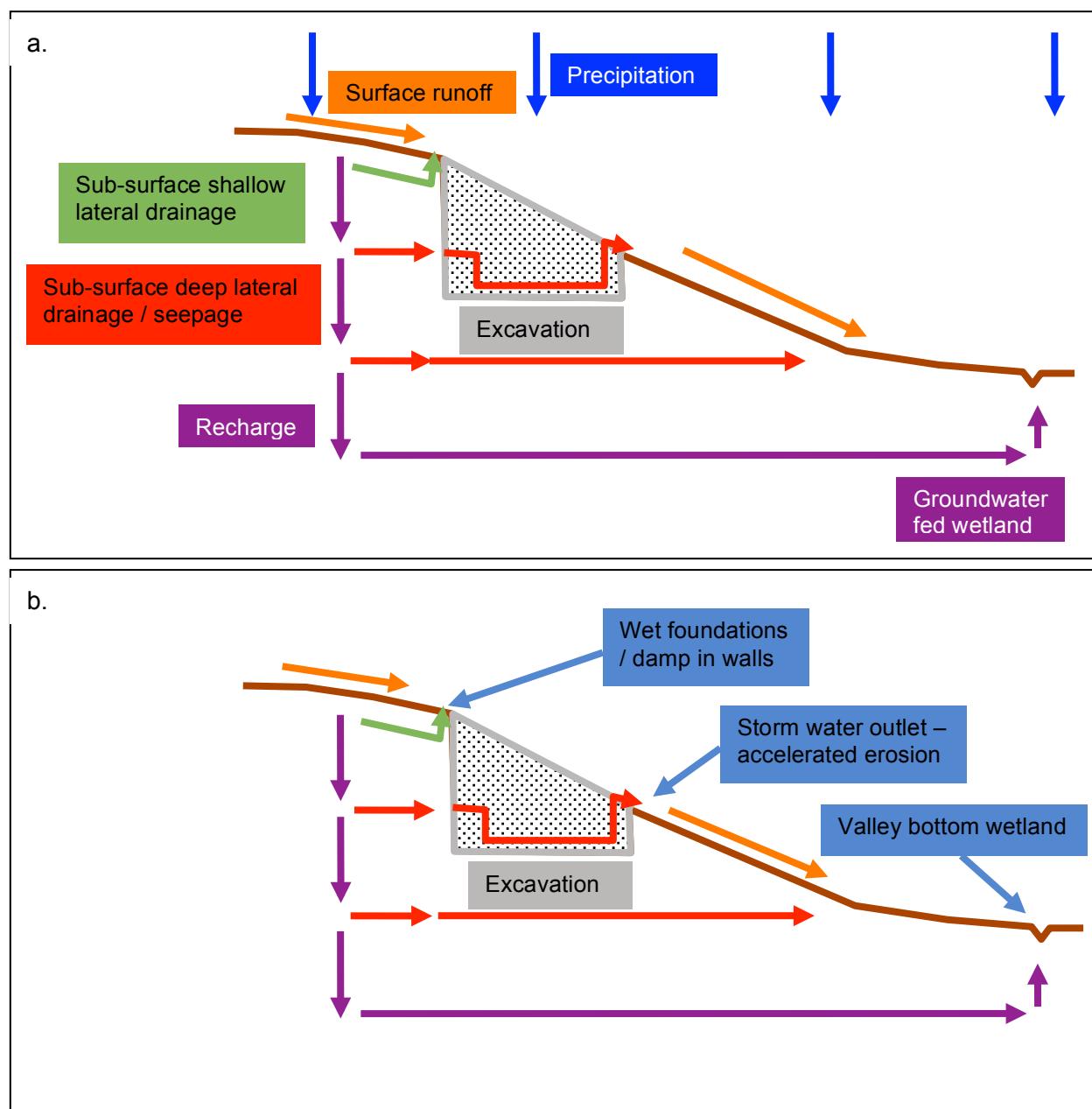


Figure 13 Different flow paths of water through a landscape with an excavated foundation (a) and typical wetland types associated with the altered water regime (b)

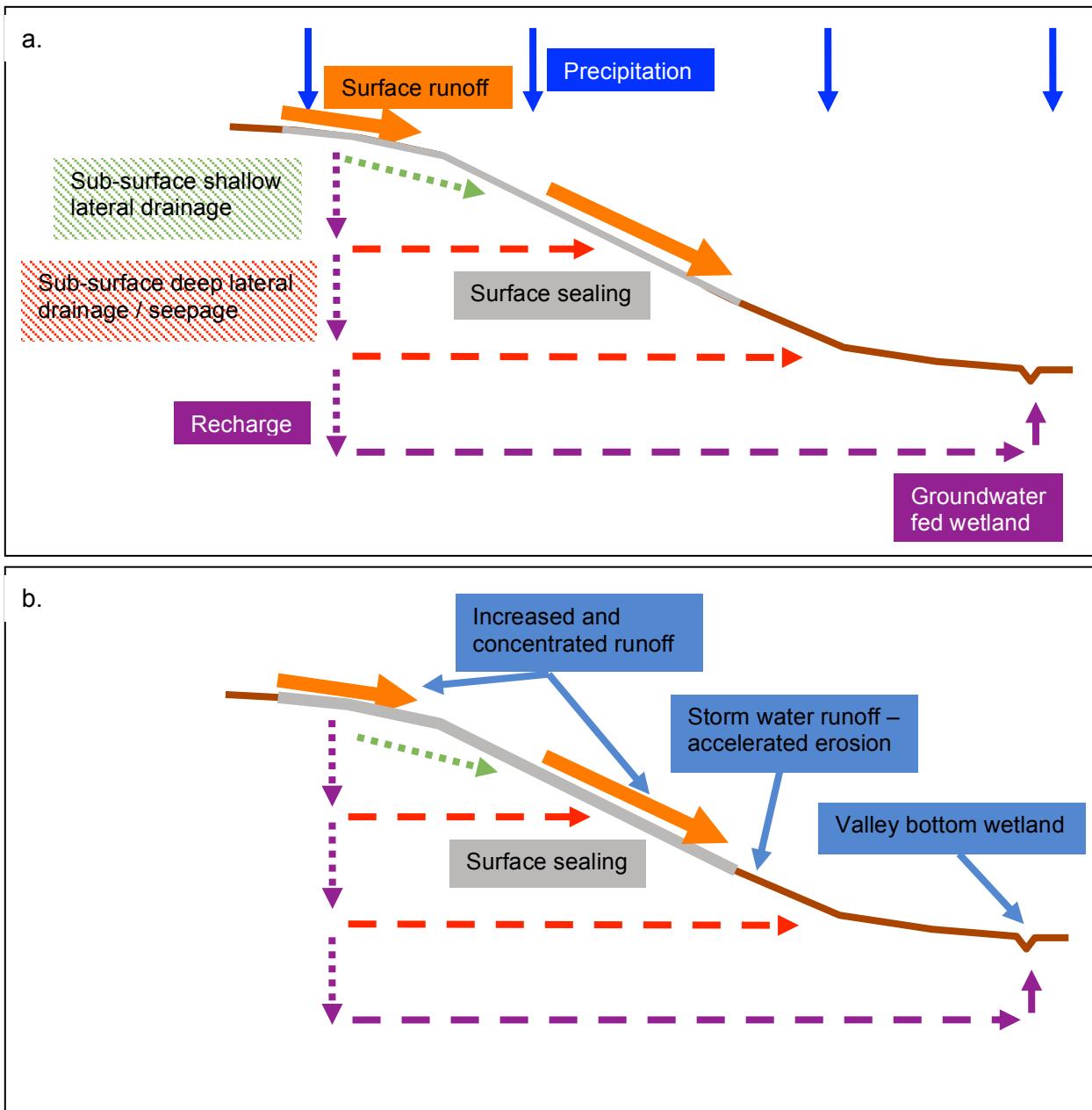


Figure 14 Different flow paths of water through a landscape with surface sealing (buildings and paving) (a) and typical wetland types associated with the altered water regime (b)

5.9 SOIL EROSION ON THE HALFWAY HOUSE GRANITE DOME

Infiltration of water into a soil profile and the percolation rate of water in the soil are dependent on a number of factors with the dominant one being the soil's texture (**Table 2**). Permeability and the percolation of water through the soil profile are governed by the least permeable layer in the soil profile. The implication of this is that soil horizons that overlie horizons of low permeability (i.e. hard rock, hard plinthite, G-horizon) are likely to become saturated with water relatively quickly - particularly if the soil profile is shallow and a large amount of water is added. Another impermeable layer is one that is saturated with water and such a layer acts the same way as the ones mentioned earlier. In cases where internal drainage is hampered by an impermeable layer such as hard rock (the Dresden or Wasbank soil forms) evaporation and lateral water movement are the only processes that will drain the soil profile of water.

Infiltration of water into a soil profile is dependent on the factors leading to the downward movement of water. In cases where impermeable layers exist water will infiltrate into the profile until it is saturated. Once this point is reached water infiltration will cease and surface runoff will become the dominant water flow mechanism. A similar situation will develop if a soil has a slow infiltration rate of water due to fine texture, hardened or compacted layers and low hydraulic conductivity. When these soils are subjected to large volumes and rates of rainfall the rate of infiltration will be exceeded and excess water will flow downslope on the soil surface.

Table 2 Infiltration/permeability rates for soil textural classes (Wischmeier, Johnson & Cross 1971)

Texture class	Texture	Permeability Rate (mm/hour)	Permeability Class
Coarse	Gravel, coarse sand	>508	Very rapid
	Sand, loamy sand	152 – 508	Rapid
Moderately coarse	Coarse sandy loam	51 - 152	Moderately rapid
	Sandy loam		
	Fine sandy loam		
Medium	Very fine sandy loam	15 – 51	Moderate
	Loam		
	Silt loam		
	Silt		
Moderately fine	Clay loam	5.1 – 15.2	Moderately slow
	Sandy clay loam		
	Silty clay loam		
Fine	Sandy clay	1.5 – 5.1	Slow
	Silty clay		
	Clay (>60%)		
Very fine	Clay (>60%)	< 1.5	Very slow
	Clay pan		

The texture, permeability and presence of impeding layers are some of the main determinants of soil erosion. Wischmeier, Johnson and Cross (1971) compiled a soil erodibility nomograph from soil analytical data (**Figure 15**). The nomograph uses the following parameters that are regarded as having a major effect on soil erodibility:

- The mass percentage of the fraction between 0.1 and 0.002 mm (very fine sand plus silt) of the topsoil.
- The mass percentage of the fraction between 0.1 and 2.0 mm diameter of the topsoil.
- Organic matter content of the topsoil. This “content” is obtained by multiplying the organic carbon content (in g/100 g soil – Walkley Black method) by a factor of 1.724.
- A numerical index of soil structure.
- A numerical index of the soil permeability of the soil profile. The least permeable horizon is regarded as horizon that governs permeability.

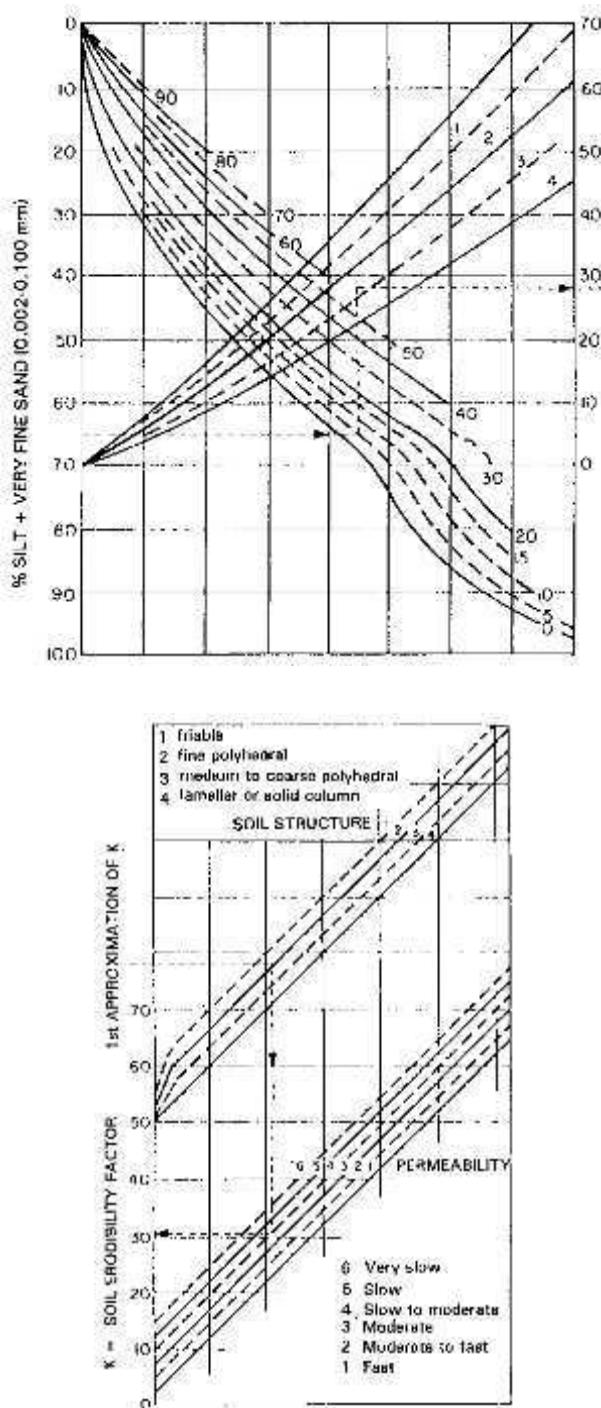


Figure 15 The nomograph by Wischmeier, Johnson and Cross (1971) that allows a quick assessment of the K factor of soil erodibility

Box 1 describes the procedure to use the nomograph.

As part of a different study 45 soil samples were collected from 19 points on the HHGD. The samples were described in terms of soil form and analysed with respect to texture (6 fractions) and organic carbon content of the A-horizons (data not presented here but available upon request). The erodibility index and maximum stable slope were calculated for each horizon (according to the method discussed above) in both an unsaturated and saturated soil matrix (data not presented here but available upon request).

The erosion risk is based on the product of the slope (in percentage) and the K-value of erodibility (determined from the Wischmeier, Johnson and Cross (1971) nomograph). This product should not exceed a value of 2.0 in which case soil erosion becomes a major concern. The K-value allows for a “hard” rainfall event but is actually based on scheduled irrigation that allows for infiltration and percolation rates and so-called “normal” rainfall intensity. Soil erosion potential increases with an increase in the very fine sand plus silt fraction, a decrease in the organic matter content, an increase in the structure index and a decrease in permeability. Water quality is assumed not to be a problem for the purposes of the erosion hazard calculations.

Box 1: Using the nomograph by Wischmeier, Johnson and Cross (1971)

In examining the analysis of appropriate surface samples, enter on the left of the graph and plot the percentage of silt (0.002 to 0.1 mm), then of sand (0.10 to 2 mm), then of organic matter, structure and permeability in the direction indicated by the arrows. Interpolate between the drawn curves if necessary. The broken arrowed line indicates the procedure for a sample having 65% silt + very fine sand, 5% sand, 2.8% organic matter, 2 of structure and 4 of permeability. Erodibility factor K = 0.31.

Note: The erodibility factor increase due to saturation was also calculated. These results indicated an increase in erodibility of a factor predominantly between 3 and 4 for saturated soil conditions.

5.10 DETAILED SOIL CHARACTERISTICS – SUMMARISING CONCLUSIONS

The following general conclusions can be made regarding the soil characteristics of the HHGD (and the catchment):

1. The site (and catchment) is dominated by shallow to moderately deep sandy soils with deep soils occurring in the drainage features only ;
2. The soils are dominantly coarse sandy in texture;
3. On the bulk of the site the soils are underlain by a hard plinthic layer (ferricrete) that acts as an aquoclude under natural conditions;
4. The bulk of the water movement on the site occurs within 50 cm of the soil surface on top of the ferricrete layer in the absence of human impacts;
5. Wetland delineation is a challenging exercise on the HHGD; and
6. The soils of the HHGD, as those of the site, are highly erodible, especially when saturated with water.

5.11 RECOMMENDED ASSESSMENT APPROACH – HYDROPEDOLOGY INVESTIGATION

5.11.1 Hydropedology Background

The identification and delineation of wetlands rest on several parameters that include topographic, vegetation and soil indicators. Apart from the inherent flaws in the wetland delineation process, as discussed earlier in this report, the concept of wetland delineation implies an emphasis on the wetlands themselves and very little consideration of the processes driving the functioning and presence of the wetlands. One discipline that encompasses a number of tools to elucidate landscape hydrological processes is “hydropedology” (Lin, 2012). The crux of the understanding of hydropedology lies in the fact that pedology is the description and classification of soil on the basis of morphology that is the result of soil and landscape hydrological, physical and chemical processes. But, the soils of which the morphology are described, also take part in and intimately influence the hydrology of the landscape. Soil is therefore both an indicator as well as a participant in the processes that require elucidation.

Wetlands are merely those areas in a landscape where the morphological indicators point to prolonged or intensive saturation near the surface to influence the distribution of wetland vegetation. Wetlands therefore form part of a larger hydrological entity that they cannot be separated from.

5.11.2 Hydropedology – Proposed Approach

In order to provide detailed pedohydrological information both detailed soil surveys and hydrological investigations are needed. In practice these intensive surveys are expensive and very seldom conducted. However, with the understanding of soil morphology, pedology and basic soil physics parameters as well as the collection and interpretation of existing soil survey information, assessments at different levels of detail and confidence can be conducted. In this sense four levels of investigation are proposed namely:

1. Level 1 Assessment: This level includes the collection and generation of all applicable remote sensing, topographic and land type parameters to provide a “desktop” product. This level of investigation rests on adequate experience in conducting such information collection and interpretation exercises and will provide a broad overview of dominant hydropedological parameters of a site. Within this context the presence, distribution and functioning of wetlands will be better understood than without such information.
2. Level 2 Assessment: This level of assessment will make use of the data generated during the Level 1 assessment and will include a reconnaissance soil and site survey to verify the information as well as elucidate many of the unknowns identified during the Level 1 assessment.
3. Level 3 Assessment: This level of assessment will build on the Level 1 and 2 assessments and will consist of a detailed soil survey with sampling and analysis of representative soils. The parameters to be analysed include soil physical, chemical and mineralogical

parameters that elucidate and confirm the morphological parameters identified during the field survey.

4. Level 4 Assessment: This level of assessment will make use of the data generated during the previous three levels and will include the installation of adequate monitoring equipment and measurement of soil and landscape hydrological parameters for an adequate time period. The data generated can be used for the building of detailed hydrological models (in conjunction with groundwater and surface hydrologists) for the detailed water management on specific sites.

For most wetland delineation exercises a Level 2 or Level 3 assessment should be adequate. For this investigation a Level 3 assessment was conducted with extensive field work. Analysis of soils was conducted but data from other sites with highly similar soils was also used to illustrate the challenges faced on the site and in the broader area.

The process of the hydrometeorology assessment entails the aspects listed in the methodology description below. These items also correspond with the proposed PES assessment methodology discussed in section 4.4.4. The results of the assessment will therefore be structured under the headings as provided below.

6. METHOD OF SITE INVESTIGATION

6.1 WETLAND CONTEXT DETERMINATION

For the purposes of the wetland assessment the context of the specific wetland was determined. This was done through the thorough consideration of the geological, topographical, climatic, hydrometeorological and catchment context of the site. In this sense the relative contribution of water flow from the catchment upstream was compared to the contribution from the slopes on the specific site. The motivation being that the larger the contribution of the catchment upstream the smaller the impacts of the proposed developments on the site would be in terms of modification of the wetland. The elements of context are described in more detail below.

6.2 AERIAL PHOTOGRAPH INTERPRETATION

An aerial photograph interpretation exercise was conducted through the use of Google Earth images and historical aerial photographs of the site. This data was used to obtain an indication of the extent of the wetlands on the site as well as to provide an indication of the artificial modifiers evident on the site and in the catchment.

6.3 TERRAIN UNIT INDICATOR

Detailed contours of the site (filtered to 5 m intervals for the purpose of map production) were used to provide an indication of drainage depression and drainage line. From this data the terrain unit indicator was deduced.

6.4 SOIL FORM AND SOIL WETNESS INDICATORS

The soil form and wetness indicators were assessed on the site through a dedicated soil survey within the context of the description of the HHGD as provided in sections 5.5 to 5.7. During the soil survey areas of significance were identified and soil auger profile description activities conducted for the specific areas.

Historical impacts were identified as the impacts on the soils are very distinct. Soil characteristics could therefore be used to provide a good indication of the historical impacts on the grounds of a forensic approach. In areas where soil impacts are limited the standard approach in terms of identification of soil form and soil wetness indicators was used.

6.5 VEGETATION INDICATOR

Due to the extent of the historical impacts as well as the timing of the investigation a dedicated vegetation survey for the purpose of wetland delineation was not conducted. These parameters were generated in a wetland report by different workers and will not be repeated here as this report focuses primarily on hydrometeorology and soil indicators. Relevant vegetation parameters were noted and these are addressed in the report where applicable.

6.6 ARTIFICIAL MODIFIERS

Artificial modifiers of the landscape and wetland area were identified during the different components of the investigation and are addressed in the context of the wetland management plan.

7. SITE SURVEY RESULTS AND DISCUSSION

7.1 WETLAND CONTEXT

The land type, topography and geological setting of the site have been elucidated in section 2 of this document. The main wetland features on the site are limited to the Jukskei River channel and that of two small tributaries. Both the Jukskei River and the two tributaries drain large areas outside of the site leading to the conclusion that the contribution of water runoff from the site is insignificant. As such the land use alteration of the site will have little impact on the quantity of water exiting the site at the lowest point. However, land use changes on the site may impact on the water quantity and quality in the form of sediment generation and erosion of the river / stream banks.

7.2 AERIAL PHOTOGRAPH INTERPRETATION

7.2.1 Current Images

A detailed aerial photograph interpretation exercise was conducted to identify potential wetland areas on the site. For this purpose a range of Google Earth images of the site were used in order for the difference in wetland signature through seasons to be accentuated. From the interpretation it was clear that the site had undergone several anthropogenic impacts – especially in the watercourses (Figure X). On the basis of this observation it was decided to conduct a detailed assessment of the historical impacts.

7.2.2 Historical Images

The historical data collected for the site include aerial photographs of 1937, 1948, 1952, 1968, 1976, 1985 and 1992. Following on these Google Earth images were used dating from 2004 to the present. In addition, topographic maps for the site were obtained and these are from 1939, 1954, 1975, 1983 and 2002. Due to the large number of images and maps only a selection will be provided below in order to emphasize the changes in land use and drainage line characteristics over the past 80 years.

7.2.2.1 Alteration of Alignment of the Jukskei River

From topographic maps dating from 1939 (Figure 9), 1975 (Figure 10) and 2002 (Figure 11) it is very clear that significant alteration of the flow channel of the Jukskei River has taken place in the area of the off/on ramp on Linksfield Road. This impact has, with others, led to a significant degradation of the flow channel as well as accelerated erosion of the downstream channel of the river.

7.2.2.2 Historical Agricultural Activities on the Banks of the Jukskei River

From aerial photographs dating from 1937 (Figure 12) and 1948 (Figure 13) it is clear that extensive crop production activities took place on the banks (floodplain) of the Jukskei River. Although the link between crop production and degradation of the channel in terms of erosion is not easily established it is the comparison with present day conditions that provide a stark contrasting perspective of the state of the river channel. From the 1937 aerial photograph it is very evident that the Jukskei River barely exhibited any significant erosion. In fact, the channel seems to be very shallow and some areas appear to have no channelling at all. Later in this report specific reference will be made to the current state of the same river's channel.

Lourens G van Zyl
(Mobile) +27 (0)76 371 1151
(Website) www.terragis.co.za
(Email) lourens@terragis.co.za

LINKSFIELD
Satellite Image

Cartography & Spatial Analysis
TERRAGIS



Figure 16 Satellite image of the Linksfield site

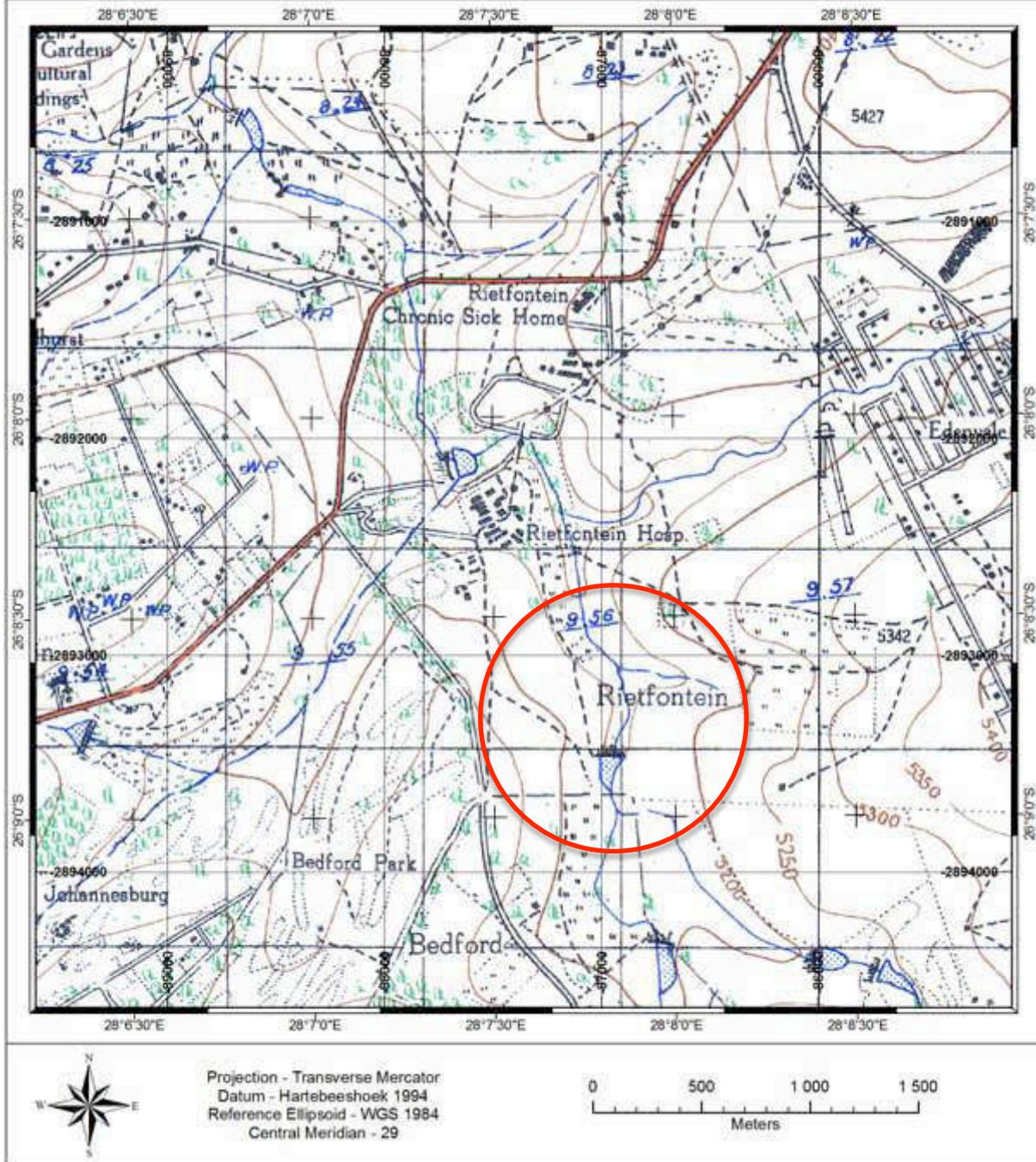


Figure 17 Topographic map dated 1939 with the original alignment of and dam on the Jukskei River

Lourens G van Zyl
(Mobile) +27 (0)76 371 1151
(Website) www.terragis.co.za
(Email) lourens@terragis.co.za

LINKSFIELD
NGI Topo 1975

Cartography & Spatial Analysis
TERRAGIS

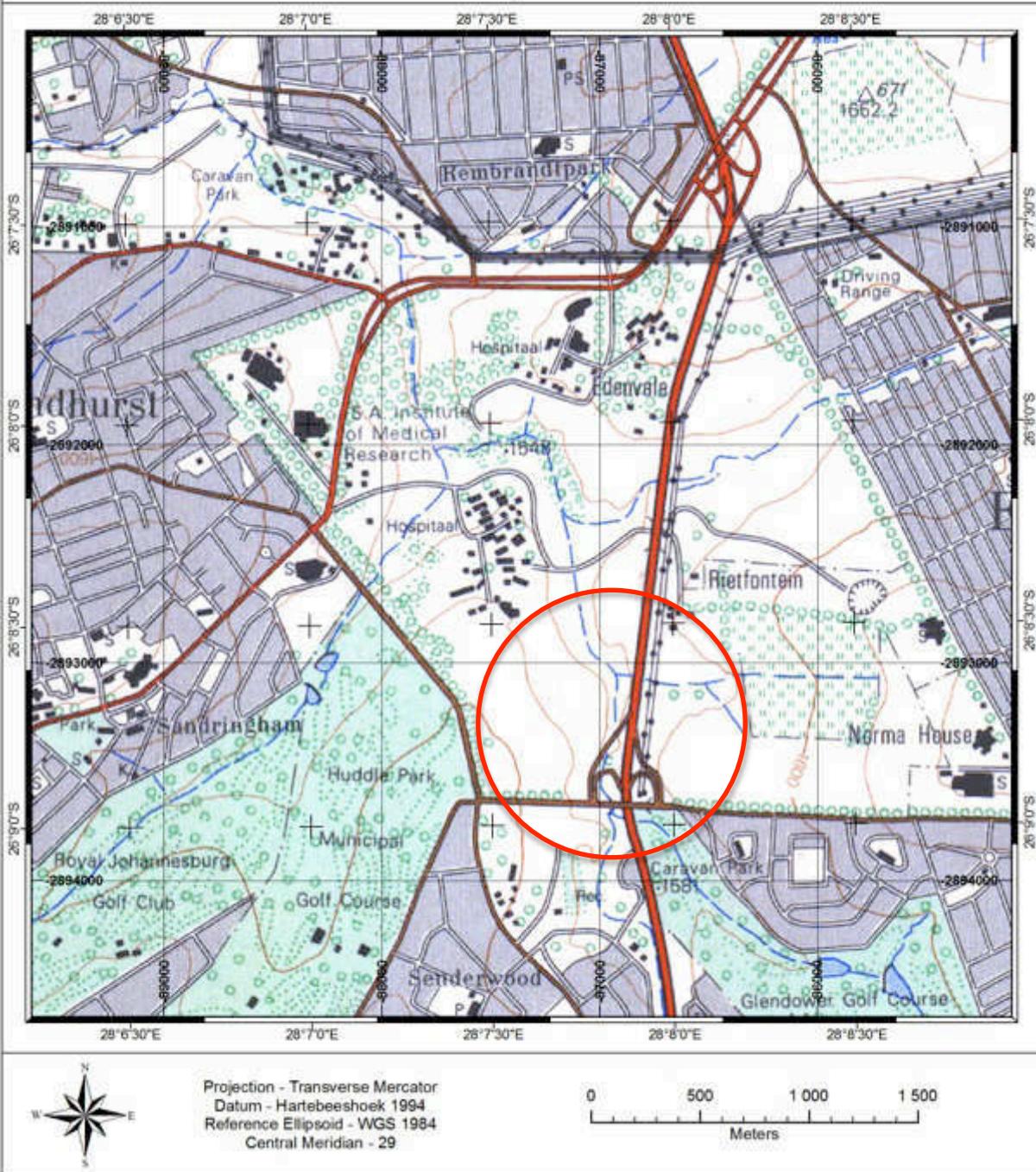


Figure 18 Topographic map dated 1975 with the altered alignment of the Jukskei River due to road construction

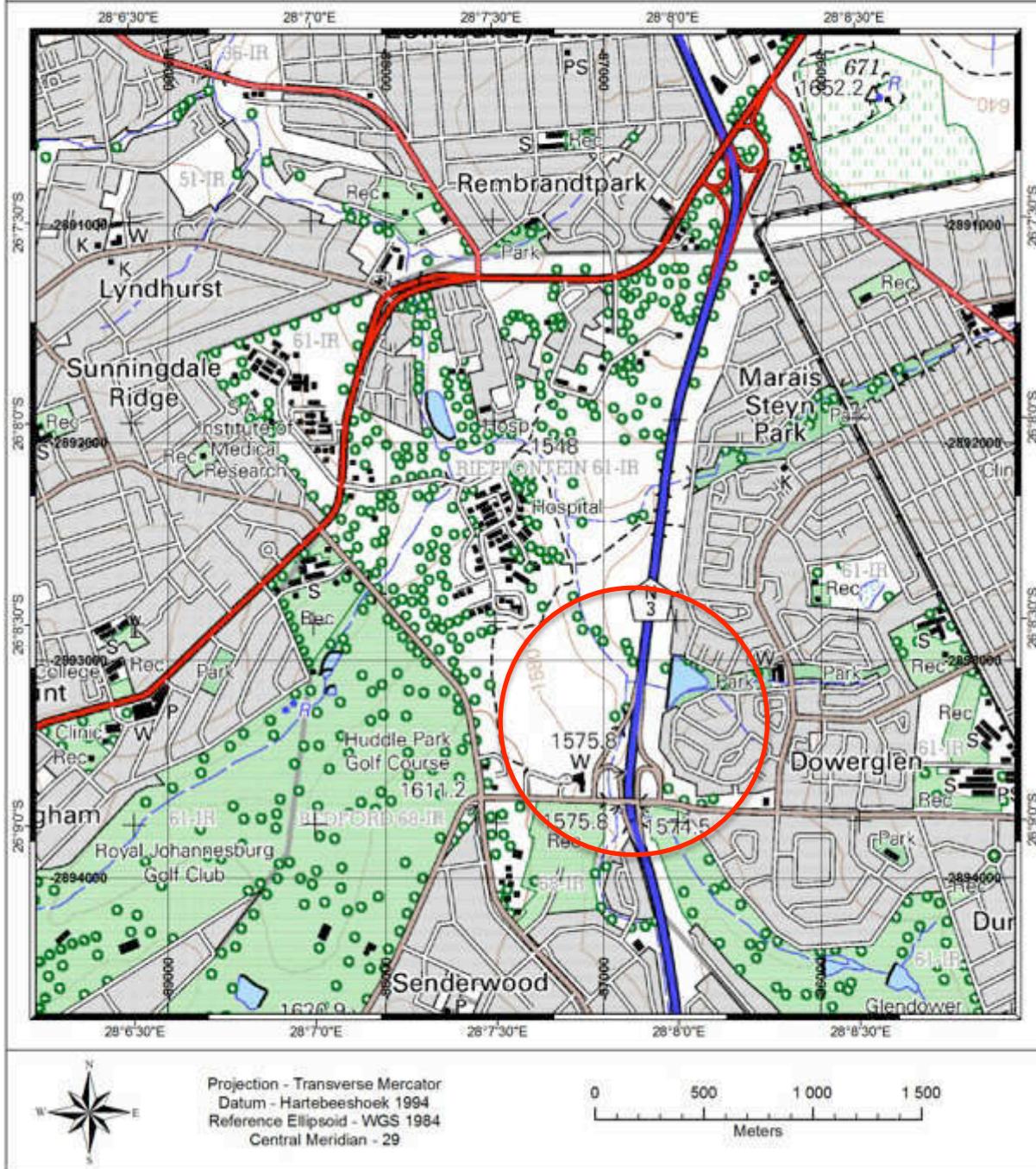


Figure 19 Topographic map dated 2002 with the altered alignment of the Jukskei River due to road construction as well as new dam in the 2 o'clock position of the red circle



Figure 20 Extract from an aerial photograph dated 1937 indicating significant crop production activities (red arrows) on the banks of the Jukskei River

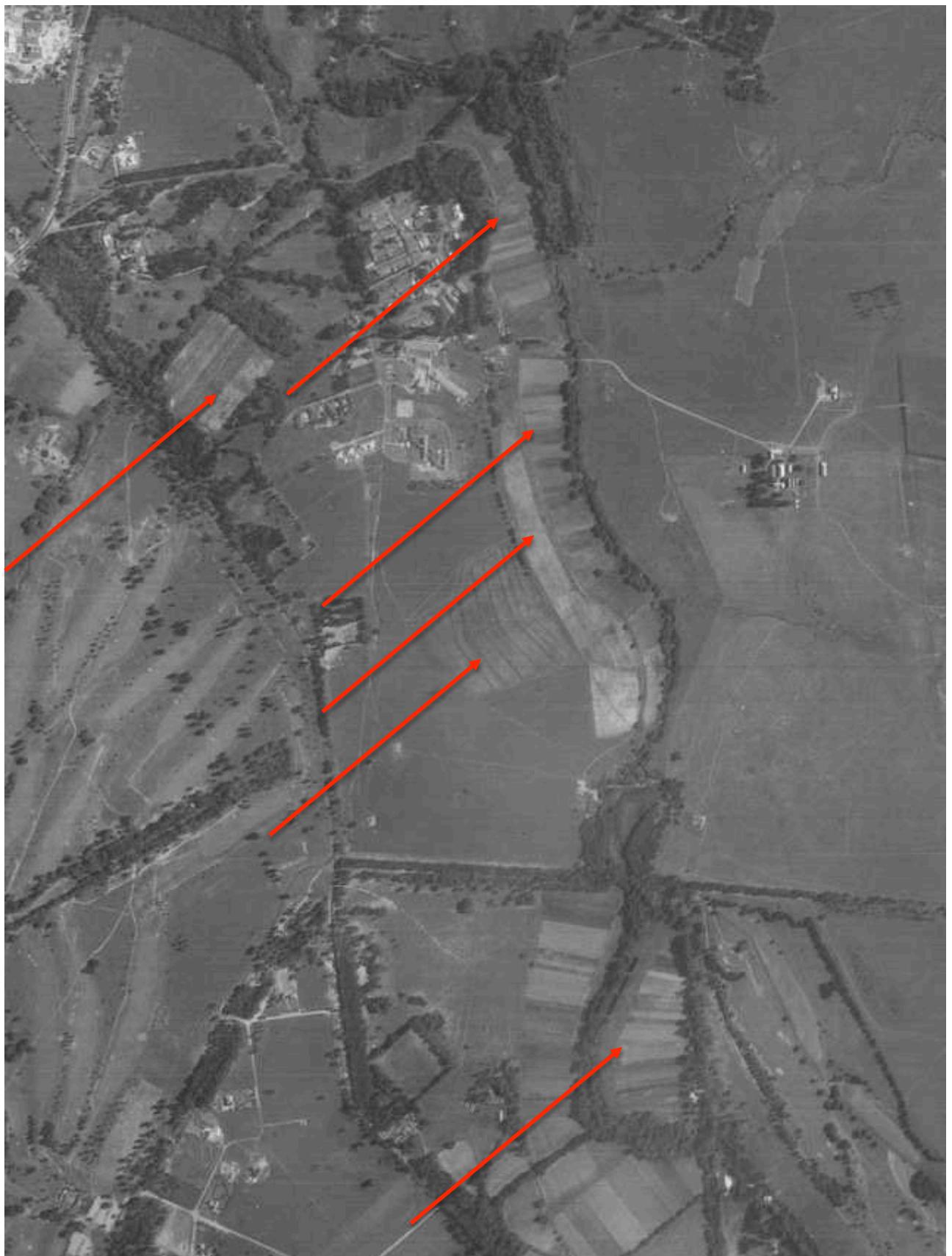


Figure 21 Extract from an aerial photograph dated 1948 indicating further expansion of significant crop production activities (red arrows) on the banks of the Jukskei River and its tributary

7.2 Terrain Unit Indicator

From the contour data a topographic wetness index (TWI) (**Figure 22**) was generated for the site.

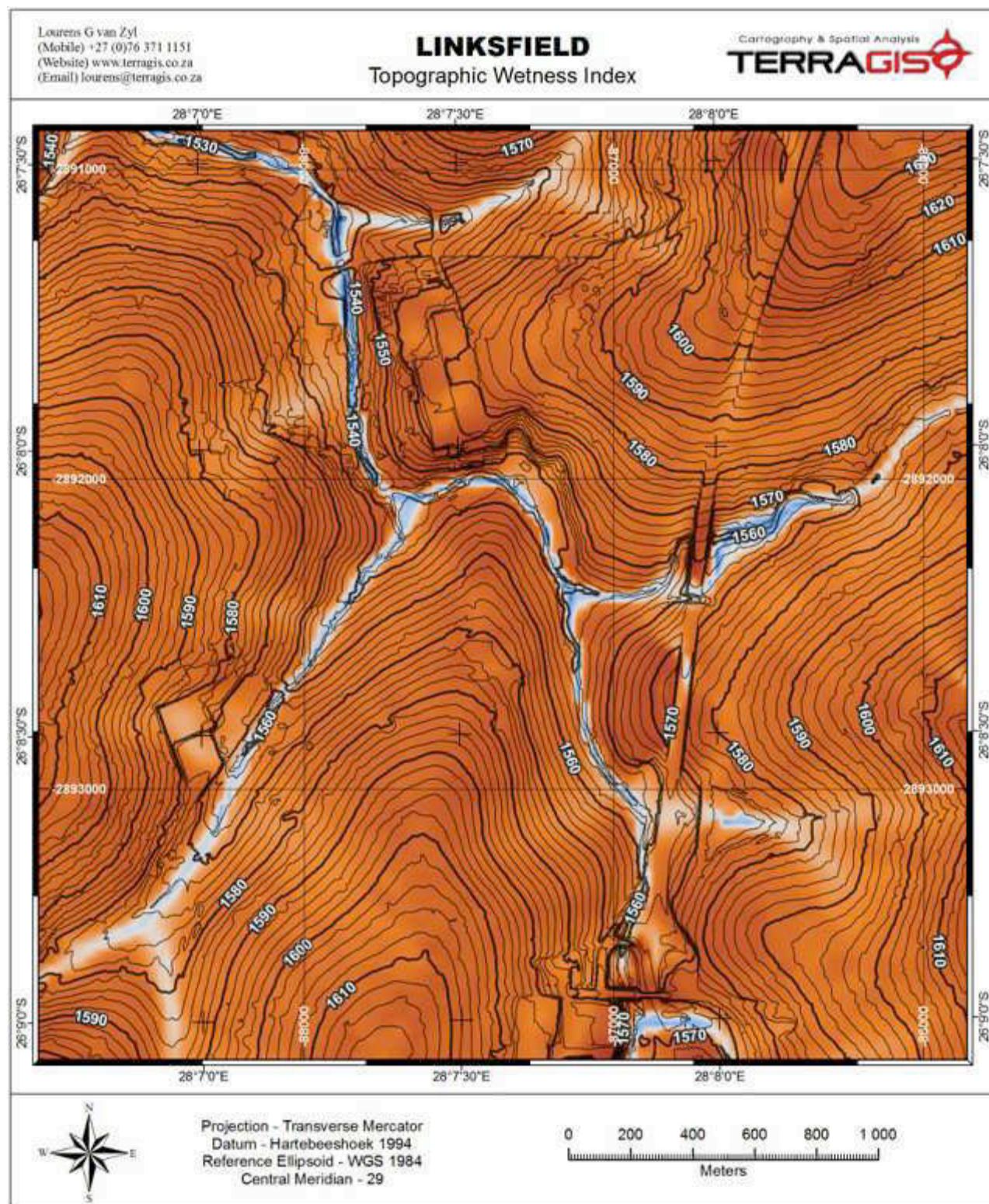


Figure 22 Topographic wetness index (TWI) of the survey site

The SAGA Wetness Index (SWI) is provided in **Figure 23**.

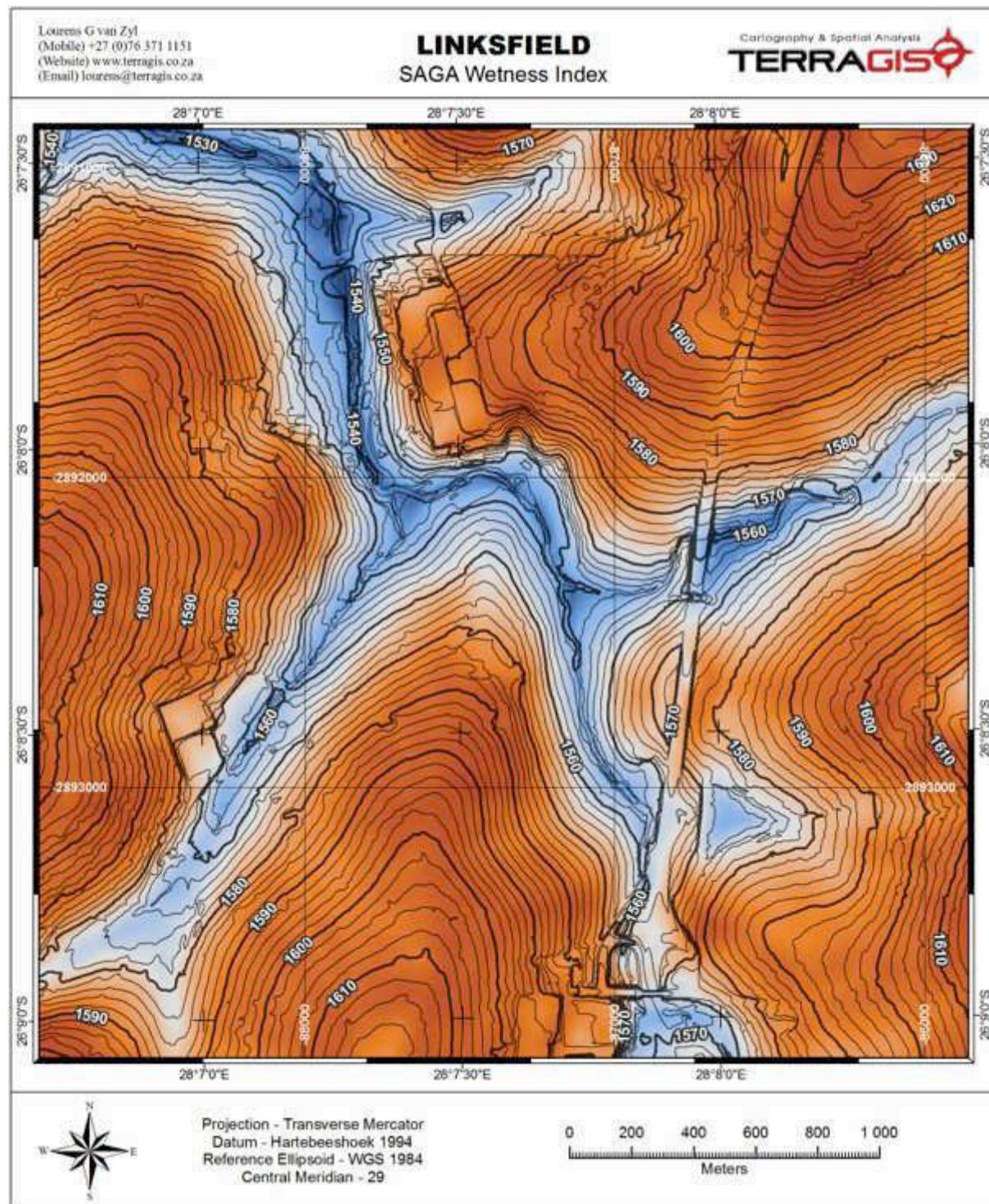


Figure 23 SAGA wetness index (SWI) of the survey site

From extensive experience on the HHGD it is evident that the TWI provides a very accurate indication of water flow paths and areas of water accumulation that are often correlated with wetlands. This is a function of the topography of the site and ties in with the dominant water flow regime in the soils and the landscape (refer to previous section where the concept of these flows was elucidated). Areas in blue indicate concentration of water in flow paths with lighter shades of blue indicating areas of regular water flows in the soils and on the surface of the wetland / terrestrial zone interface. The difference between the TWI and the SWI is provided by a quote from Boehner et. al. (2002) "The 'SAGA Wetness Index' is, as the name says, similar to the 'Topographic Wetness Index' (TWI), but it is based on a modified catchment area calculation ('Modified Catchment Area'), which does not think of the flow as very thin film. As result it predicts for cells situated in valley floors with a small vertical distance to a channel a more realistic, higher potential soil moisture compared to the standard TWI calculation."

The terrain unit indicator confirms the presence of the wetland features identified during the aerial photograph interpretation phase. This index does not indicate any other areas of potential wetlands in the form of concave topography. The above mentioned features were investigated in more detail during the field and soil survey and will therefore be addressed in the sections to follow.

7.3 SOIL FORM AND SOIL WETNESS INDICATORS (AND VEGETATION)

A dedicated field verification exercise was conducted through the mapping of the soils on the site. In addition, the geotechnical report as produced by J Louis van Rooy (2014) was used to ascertain subsoil conditions as well as the presence of potential seepage areas. The resultant generalised soil map of the site is provided in **Figure 24**. The soils can be divided (for reporting purposes) into the following sections described below.

7.3.1 Red Coloured Granite/Serpentine Derived Soils

This area is dominated by red soils of varying depth and stone content (**Figure 25**). The dominant soils are of the Hutton (Orthic A horizon / Red Apedal B horizon / Unspecified – weathering serpentine in this case) form. Shallower soils of the Glenrosa (Orthic A horizon / Lithocutanic B horizon) also occur throughout. These soils show no morphological signs of wetness or any other wetland indicator as they are uniformly red. The red colour and slightly higher clay content than the median granite derived soil on the Halfway House Granite Dome is presumed to be inherited from a serpentine geology influence (as is evident on other parts of the site) (**Figure 26**).

7.3.2 Light Coloured Granite/Serpentine Derived Soils

This area is dominated by soils with coarse sandy A horizons (derived from colluvial granitic material) with bleached colours overlying serpentine material with varying degrees of weathering. Consequently the soils vary from Glenrosa (Orthic A horizon / Lithocutanic B horizon) soils with coarse sandy topsoils on the crest (**Figure 27**), to Cartref (Orthic A horizon / E horizon / Lithocutanic B horizon = serpentine derived) forms on the mid and footslope areas to Glenrosa

forms on the footslopes again. The footslopes soils show a larger degree of chemical weathering of the lithocutanic B horizon material. The midslope positions have, as the valley bottom part of the landscape, been used for crop production in the past as is evident by distinct contours and swales (**Figure 28**). The valley bottom areas are severely eroded and the soils in the drainage channel areas are therefore severely altered and impacted. In the valley bottom position these soils link up with the eroded and alluvial soils discussed under point 7.3.6 below. Wetland soils are found in the valley bottom position.

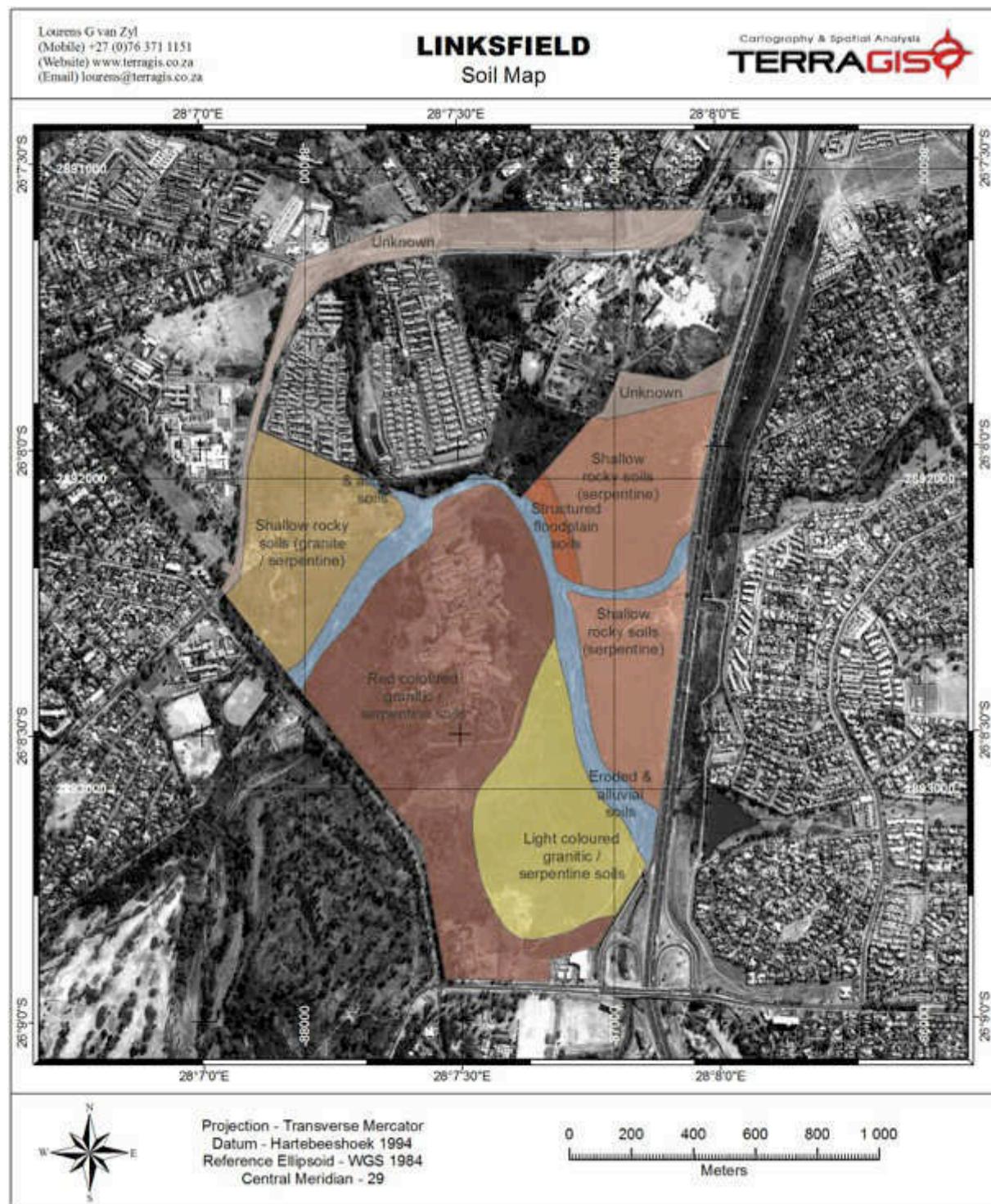


Figure 24 Generalised soil map of the Linksfield site



Figure 25 Exposed profiles (presumably due to cable theft) of the Hutton form (rocky) on the site



Figure 26 Serpentine rock (greenstone) within the granite dominated survey area



Figure 27 Bleached and light coloured soils on the crest of the granite dominated landscape



Figure 28 Contour/swale in the midslope position with dominantly Cartref and Wasbank soils

7.3.3 Shallow and Rocky Granite/Serpentine Derived Soils

This area is dominated by shallow sandy soil material (derived from granite) overlying weathering serpentine material. The soils exhibit copious amounts of quartz pebbles on the surface (**Figure 29**) – an artefact of the presence of a stone line indicating the boundary between granite and serpentine material with subsequent surface disturbance by humans as well as intense mole activity. The dominant soil form is Glenrosa. The only wetland soils are found on the edge of the drainage feature and these are discussed under point 7.3.6 below.



Figure 29 Granite derived shallow and rocky soils with copious amounts of quartz pebbles on the surface due to mole activity

7.3.4 Shallow and Rocky Serpentine Derived Soils

The eastern section of the site is dominated by shallow and structured rocky soils with rock outcrops occurring throughout (**Figure 30**). The dominant soil forms are Mispah (Orthic A horizon / Hard Rock) and Glenrosa. Small areas of wetland or poorly drained soils occur on the edge of the Juskei River. These soils are variable but dominantly of high clay content and structured with some degree of swelling properties. The dominant A horizon therefore varies between Melanic and Vertic.



Figure 30 Rock outcrops (serpentine) and shallow soils

7.3.5 Structured Floodplain Soils

A small section of the site on the eastern bank of the Jukskei River consists of structured soils having formed on the floodplain. These soils are dark coloured and structured with a degree of swelling (**Figures 31 and 32**). The dominant soils are therefore of the Willowbrook (Melanic A horizon / G horizon) and Rensburg (Vertic A horizon / G horizon) forms.

7.3.6 Eroded and Alluvial Soils

The soils along the banks of the Jukskei River and its tributary have been cultivated since the 1930s. As was shown in the historical aerial photographs earlier in this report it was quite evident that the drainage features on the site exhibited very little and small scale erosion. In comparison the field survey revealed that most of the soils associated with the banks of the rivers have been eroded significantly (**Figures 33 to 36**). Most of the erosion and impacts are associated with increased storm water runoff on sites in the catchment of the Jukskei. However, many impacts on the site are associated with in-situ human impacts and failed interventions (**Figures 37 to 44**).



Figure 31 Structured soil in the floodplain of the Jukskei River



Figure 32 Structured soil in the floodplain of the Jukskei River with swelling properties