

PROPOSED REALIGNMENT OF THE K54 ROAD - IRENE

ENVIRONMENTAL IMPACT ASSESSMENT For Public Review

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EXECUTIVE SUMMARY

1. Introduction

Eco Assessments CC, as independent environmental consultants, was appointed by Centurus (Pty) Ltd to carry out the required Environmental Scoping and Environmental Impact Assessment process for the proposed realignment of the K54 south of Irene in terms of the applicable legislation.

According to the Regulations that were promulgated in terms of the National Environmental Management Act (Act No. 107 of 1998) certain development activities require authorisation from the relevant authority to circumvent the possibility of potential detrimental environmental impacts. The construction of linear activities, and in this case the realignment of provincial road, is a listed activity requiring environmental authorisation.

For this reason the GDACE requires an Environmental Impact Assessment report be compiled for the project. This report must provide a brief description of the environmental aspects, and an evaluation of how the environment may be affected by the proposed development as well as details of the public participation process that was undertaken as part of the Environmental Impact Assessment Process.

2. Background

The original route determination of the Road K54 has been planned in various stages since 1976, stretching from Road P79-1 in the west (Diepsloot area) to Road 25 north of Cullinan, a total distance of approximately 80 km. The Basic Planning Report (Preliminary Design) of a 13, 4 kilometre section of Road K54 was completed by VKE Engineers in November 1989 (Report No 1434, Agreement No. 86-53B). The existing preliminary design of the road has been accepted in terms of the Gauteng Infrastructure Act 8/2001.

It is important to note that the K54 has been flagged as an important major sub-regional road for the last two decades. Increasing traffic congestion on Nelmapius Road often brings traffic to a complete standstill and the K54 is considered to be the only provincial alternative to relieve the sub-regional traffic congestion.

Rock Environmental Consulting (Pty) Ltd was appointed by VKE Consulting Engineers in 2000 to compile an Environmental Scoping for the proposed realignment of a five kilometre section of Road K54 in the region south of Irene, Cornwall Hill and Irene Glen. GDACE approved the Rock Environmental Scoping Report that was submitted in November 2000, but stated that additional studies needed to be completed before a Record of Decision could be issued.

It was subsequently decided that a new application would need to be submitted in terms of the newly promulgated Regulations (July 2006) in terms of the National Environmental Management Act, (Act No, 107 of 1998). This application extends over a similar area as that initially described in the Rock application.

3. Project Description

The K54 will be an important link between the south western suburbs of Centurion and the south eastern suburbs in the City of Tshwane. This east-west link forms an

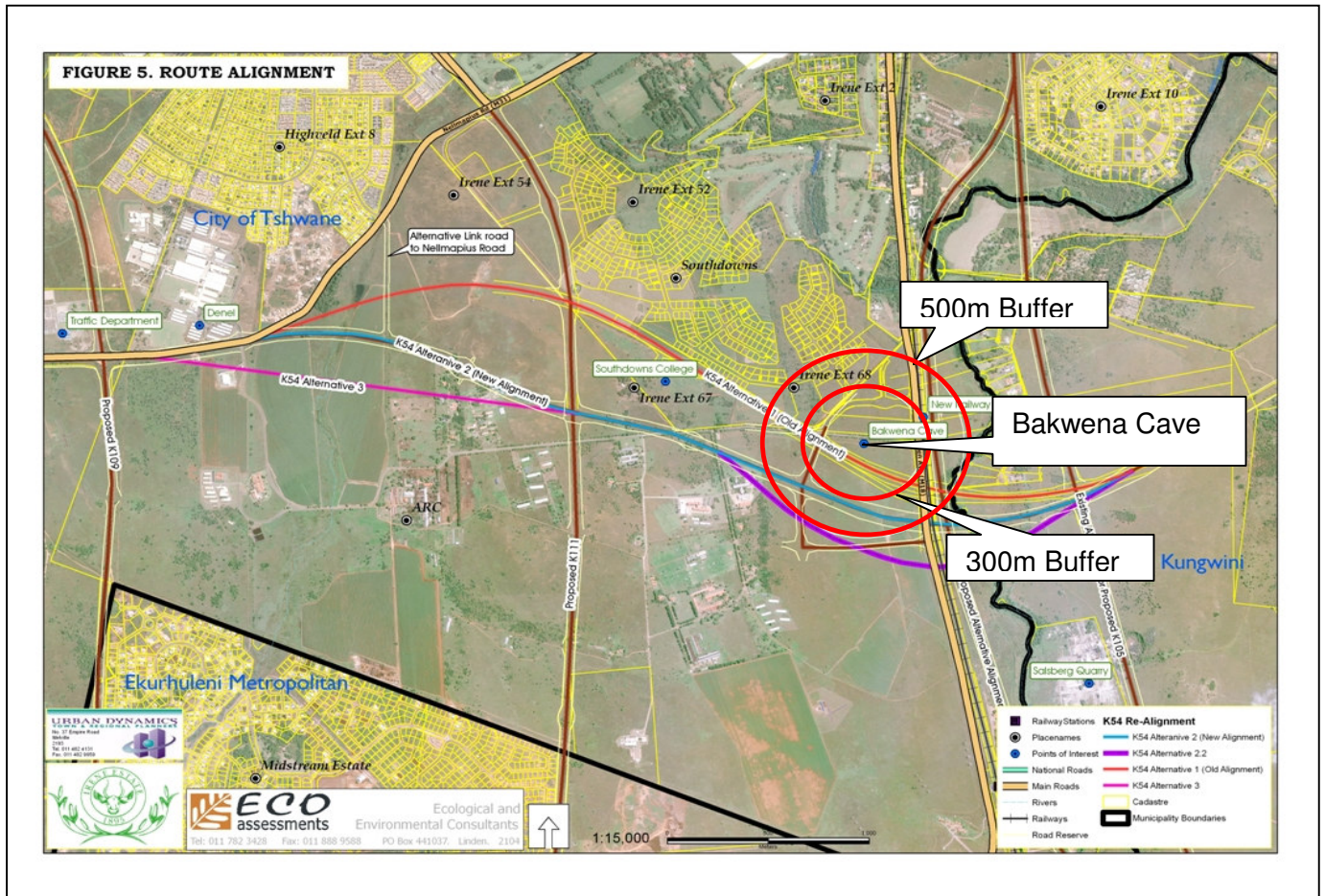
integral part of the secondary PWV-road network system. The K54 is envisaged to form an important link road as well as cater for the new trend of residential, commercial and industrial development that is likely to emerge following the approved development of townships such as Midrand Estates, Southdowns Development, Heritage Hill, Eco Boulevard, etc.

The K54 currently has an alignment that has been gazetted and planned. The approval of the Southdowns Development by the DFA further required that Centurus construct a link road between John Vorster Road and Main Street. The condition was imposed based on public objection in an attempt to harness private investment to enable public road construction of road infrastructure to relieve traffic congestion. The link road is likely to significantly affect a number of biophysical, social and economic environments. Two critical factors have emerged as to why the K54 should be re-aligned from its currently gazetted alignment:

- 3.1 The existing alignment is located less than 50m away from the Bakwena Cave that has been identified by GDACE as sensitive in terms of its ecology. The GDACE has previously indicated that a buffer zone of at least 500m be conserved to protect the cave from development impacts. The Bakwena Cave is located less than 50m away from the envisaged access road that should be constructed to provide access to the Southdowns Development.
- 3.2 The Gauteng Development Tribunal approved two township layouts for the Southdowns development. Subsequent to the approval of the Southdowns Development, it was noted that the planned current alignment of the K54 would sever the Southdowns development's residential component from the proposed private school. In addition it has become apparent that the envisaged school would have to gain access from the K54 (a provincial road) and that the Gauteng Province Department of Public Transport, Roads and Works do not permit access of schools from provincial roads. The construction of the K54 link Road was a development condition as part of the approval by the Tribunal. Such a link road was required to link John Vorster Drive with Main Street. Council and the Tribunal imposed this condition based on public objection in an attempt to harness private investment to enable public road construction.

The realignment of this section of the K54 entails shifting the road south of the currently gazetted alignment. Two alternatives exist that extend -

- From Nellmapius Road, across the ARC land with a 300m buffer south of the Bakwena Cave to link up with the proposed K105 to the east; or
- From Nellmapius Road, across the ARC land with a 500m buffer south of the Bakwena Cave to link up with the proposed K105 to the east.



The proposed design details of the section of the K54 road include:

- An approximate route distance of 4,0 kilometres (between Km18.0 and Km 21.7);
- A road reserve of 48 metres;
- A road comprising of a four lane double carriage way;
- A design speed of 100 kilometres per hour.
- A vertical elevation of $\pm 6\text{m}$ over the Olifantspruit

4. Key Issues

The EIA process for the realignment of the K54 in Irene has highlighted the following key issues –

1. The current alignment of the K54 that has been gazetted and planned as part of the Southdowns Development. The current alignment is considered to be ecologically and environmentally unfavourable as it lies in proximity to the

Bakwena Cave, negatively affects a larger portion of natural grassland and would restrict access to the Southdowns School;

2. The Bakwena Cave, that lies within a 50m distance of the existing alignment, is regarded to be ecologically sensitive. The karst ecologist indicated that the Bakwena Cave is home to a unique invertebrate species while the cave is currently unprotected. This means that people can enter the cave at any time. Such activities will have a significantly negative impact on the bats and subsequently the ecology of the cave. It was recommended that a 500m buffer distance be afforded to the cave;
3. A bat specialist has indicated that the K54 is not likely to significantly affect the bats *per se*. Both a Bat specialist and a Mammal specialist have indicated that the bats do not actually live permanently in the cave but migrate to the cave to roost from Limpopo and other areas. In addition, the bats do not use water from the cave at all. However mitigation measures must be considered to limit the impact of development activities on the bats and the cave. It is the bat specialists view that a buffer of 300m can adequately address these concerns;
4. The Bat specialist has also researched the affects of a provincial road on the bats in the Monument Cave. It was his findings that the bats had not been significantly affected by the road over the last two years and in fact had shown an increase in numbers. This cave is also located within an existing golf course layout that appears not to have significantly affected the bats;
5. Various existing activities are located within proximity to the cave that include the Railway Line, Main Street, Powerline Servitude and the existing sand quarry to the south east of the cave. GDACE has previously indicated that the quarry is likely to have a greater impact on the cave due to its potential impact on ground water, than would surface impacts such as road and rail that affect noise and light pollution levels;
6. No cultural historic resources that could be directly affected by the re-alignments occur in the area;
7. The existing alignment (Alternative 1), as well as alternatives 2 and 3, each bisect sensitive land features in very similar ways. Alternative 1 is however less desirable as it crosses a greater expanse of natural grassland and wetland, than either alternative 2 or 3. Alternative 2 however bisects a rocky outcrop located within the ARC property that is currently fragmented. However, the extent of the natural grassland affected by alternatives 2 and 3 is not significantly different;
8. Neither of the various alternatives directly impact on Red Data faunal or floral species. A wetland ecologist has concluded that the African Bullfrog is not likely to occur, or breed, on site. No Grass Owls were located on site and the area offers marginal habitat for this species. The Stobia's beetle does not occur on the site and habitat for this beetle will not be affected by the road alignments. The butterfly *Metisella meninx* occurs on the site and habitat for this species will be affected by the road. Open space movement corridors are available to ensure that this species is not significantly affected by the road. The same has been proposed for the grass owl.
9. Alternative 3 will impact directly on the ARC Dairy Breeding Building, and this impact will result in a project cost of R18 million. Alternative 2 affects less important buildings where the cost of expropriation will be significantly less.

These costs will have to be born by the Gauteng Department of Public Works, Roads and Transport (Gautrans). Currently, such funds are not likely to be readily available for the purpose of expropriation costs. The No Go option is likely to contribute significant impacts to the social environment, if adopted. This will include excessive traffic congestion, lack of access and associated economic as is currently the case;

10. GDACE in 2006 highlighted that the Bakwena cave was sensitive, that it contained bats that are not Red Data species and that the cave will need to be protected. GDACE classified the caves in Gauteng over the past three years and some 2500 caves were identified and classified according to their sensitivity. The cave received a classification of “high” due to the fact that it supports and accommodates certain species. It was indicated that a 500m zone around the cave be used to buffer the cave from development impacts. GDACE also indicated, that in the event that such a buffer distance was not feasible, then a motivation would be necessary to provide for a win: win solution to the problems and issues of developing in proximity to the cave;
11. An evaluation of options for re-aligning the road indicated that the 500m buffer would result in a direct impact on the ARC Dairy Breeding Building. The 300m buffer however would significantly reduce this relocation cost and subsequently the overall cost & impact of the road.

5. Conclusion

The proposed road alignment alternatives for the K54 have been compared to each other taking ecological, cultural/historical and social aspects into consideration. The preferred alternative has been selected in terms of the significance of the impacts that the alignment and future construction of the road might have on sensitive features in the study area.

An evaluation of the Karst Ecological Report and the Bat Specialist Report indicates conflicting views on the ecological consequences the proposed K54 will have on the bat population and in turn the ecology of the cave. This is not uncommon when ecological issues are debated as the natural sciences are frequently not clear cut. However the socio-economic consequences of using the 500m buffer have been calculated. These amount to a significant need for the road as well as expropriation costs that would total R18 million in the case of alternative 3.

The 300m buffer provides a win: win compromise that mitigates impacts on the cave and the related bat population, as well as reduces the construction costs that will be required to build the road.

In light of the above, it is proposed that the gazetted K54 road be re-aligned with the following requirements –

- i. A 300m NO GO buffer be established around the Bakwena Cave. This area should be kept in its current ecological state and improved with ecological management over time. This area should thus form a bat/cave reserve (similar in concept to the Ruimsig Butterfly Reserve) and no development should be permitted in this area;
- ii. The cave should be rehabilitated utilizing the services of a suitably qualified cave specialist. This rehabilitation should include the removal

- of existing litter, access control into the cave and the ongoing monitoring and reporting of the ecology of the cave;
- iii. Within the 300m and 500m area, limited development that minimizes impacts on the bats and cave should be permitted. This should include the road, along with stringent mitigation measures that include for instance appropriate lighting, drainage, disturbance and noise berms.

In this regard it is proposed that Alternative 2 be selected. The various alternatives have similar impacts along most stretches of the road. However Alternative 2 offers a 300 m NO GO buffer around the sensitive Bakwena Cave, as well as not impacting directly onto the ARC Land and Buildings. An additional 500m buffer for limited land development around the Bakwena Cave is proposed such that impacts on the cave and the associated bats can be mitigated and minimized.

The re-alignment of the K54 away from the current alignment places GDACE in a unique position to establish a conservation reserve around the Bakwena cave. The opportunity for GDACE to create such a reserve as well as move both the existing ARC entrance road as well as the proposed K54 may be lost should the developer be placed in a position that it cannot meet its town planning conditions to construct the proposed link road.

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SECTION ONE - INTRODUCTION AND BACKGROUND INFORMATION

1.1 Introduction

Eco Assessments CC, as independent environmental consultants, was appointed by Centurus (Pty) Ltd to carry out the required Environmental Scoping and Environmental Impact Assessment process for the proposed realignment of the K54 south of Irene in terms of the applicable legislation.

The K54 is to serve as an important link road between the south-eastern and the south-western suburbs of the City of Tshwane and forms an important link in the secondary road network of the PWV system.

The original route determination of the Road K54 has been planned in various stages since 1976, stretching from Road P79-1 in the west (Diepsloot area) to Road 25 north of Cullinan, a total distance of approximately 80 km. The Basic Planning Report (Preliminary Design) of a 13,4 kilometre section of Road K54 was completed by VKE Engineers in November 1989 (Report No 1434, Agreement No. 86-53B). The existing preliminary design of the road has been accepted in terms of the Gauteng Infrastructure Act 8/2001.

Rock Environmental Consulting (Pty) Ltd was appointed by VKE Consulting Engineers in 2000 to conduct Environmental Scoping for the proposed realignment of a five kilometre section of Road K54 in the region south of Irene, Cornwall Hill and Irene Glen. The second realignment started at kilometre 20,5 and rejoined the original K54 alignment east of the substation at approximately kilometre 25,6. The section of the K54 that is addressed in this report extends from kilometre 18,0 to kilometre 21,7 which falls partially into the area for which the previous scoping report was completed.

GDACE approved the scoping report that was submitted in November 2000, but stated that additional studies needed to be completed before a Record of Decision could be issued. The additional information required was:

- The concerned alignment was not assessed against general alignment alternatives of K54, and
- The “No-Go” option of the road was not assessed

It was subsequently decided that a new application would need to be submitted in terms of the National Environmental Management Act (1998) - Section 24(2)(a) and (d) 5 (Government Gazette 28753, April 2006).

The reasons for this decision was based on the following –

- a) The currently approved route alignment of the K54, that was authorised by the Gauteng Development Tribunal, is likely to impact directly on the Bakwena Cave located less than 50m from the proposed road alignment and;
- b) The decision, in terms of the Executive Committee Resolution (26 June 1978) of the Gauteng Province Department of Public Transport, Roads

and Works that private schools are not allowed adjacent to provincial roads.

1.2 Terms of Reference

The terms of reference for the study included compiling an Environmental Impact Assessment Report for the proposed realignment of the road, as required by the National Environment Management Act (NEMA), 1998 (Act No. 107 of 1998). The specific contents of an Environmental Impact Assessment report, according to the NEMA Regulations, must include:

- details of –
 - the EAP who compiled the report; and
 - the expertise of the EAP to carry out an environmental impact assessment;
- a detailed description of the proposed activity
- a description of the activity on which the activity is to be undertaken and the location of the activity on the property, of if it is –
 - a linear activity, a description of the route of the activity; or
 - an ocean-based activity, the coordinates where the activity is to be undertaken
- a description of the environment that may be affected by the activity and the manner in which the physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity;
- details of the public participation process conducted in terms of subregulation (1), including –
 - steps undertaken in accordance with the plan of study
 - a list of persons, organisations and organs of state that were registered and affected parties
 - a summary of comments received from, and a summary of issues raised by registered interested and affected parties, the date of receipt of these comments and the response of the EAP to those comments; and
 - copies of any representations, objections and comments received from registered interested and affected parties
- a description of the need and desirability of the proposed activity and identified potential alternatives to the proposed activity, including advantages and disadvantages that the proposed activity or alternatives may have on the environment and the community that may be affected by the activity;
- an indication of the methodology used in determining the significance of potential environmental impacts;
- a description and comparative assessment of all the alternatives identified during the environmental impact assessment process;
- a summary of the findings and recommendations of any specialist report or report on a specialised process;
- a description of all environmental issues that were identified during the environmental impact assessment process, and assessment of the significance of each issue and an indication of the extent to which the issue could be addressed by the adoption of the mitigation measures;
- an assessment of each identified potentially significant impact, including –
 - cumulative impacts;
 - the nature of the impact;
 - the extent and duration of the impact;
 - the probability of the impact occurring;
 - the degree to which the impact can be reversed;

- the degree to which the impact may cause irreplaceable loss of resources; and
 - the degree to which the impact can be mitigated;
- a description of any assumptions, uncertainties and gaps in knowledge
- an opinion as to whether the activity should or should not be authorised, and if the opinion is that it should be authorised, any condition that should be made in respect of that authorisation;
- an environmental impact statement which contains –
 - a summary of the key findings of the environmental impact assessment; and
 - a comparative assessment of the positive and negative implications of the proposed activity and identified alternatives;
- a draft Environmental Management Plan that complies with regulation 34;
- copies of any specialist reports and reports on specialised processes complying with regulation 33; and
- any specific information that may be required by the competent authority.

The Environmental Scoping and Impact Assessment Process for the proposed development commenced in September 2006. This included the application to the Gauteng Department of Agriculture, Conservation and Environment (GDACE), announcing the project in the public domain in terms of newspaper advertisements, the distribution of Background Information Documents, site notices which were displayed at visible locations in the vicinity of the proposed development site and direct consultation with Interested and Affected Parties (I&AP's). A Public Participation Meeting was held on 23 November 2006 where the detail of the application was presented to Interested and Affected Parties. The Environmental Scoping Report, which provides basic detail of the proposed development and which serves to scope the potential environmental and social impacts of the proposed development, was submitted to registered I&AP's during February 2007 for comment.

The Scoping Report was submitted to GDACE on 03 April 2007 and a letter of response, indicating that the EIA process can be continued in terms of the approved Scoping Report and Plan of Study for EIA, was received on 08 May 2007.

A Public Feedback Meeting was held on 21 June 2007 where the findings of the specialist studies were presented to the attendees and where issues of concern were further discussed and resolved.

This report serves to provide detail of the proposed activity, details and recommendations of the specialist studies which were conducted and to assess the significance of the social and environmental impacts of the proposed development. Potential impacts are measured against the “no-go” alternative or present land-use activities of the development site and feasible measures are proposed to mitigate such impacts.

1.3 Regulatory Requirements

Sections 24 and 24D of the National Environmental Management Act, 1998 (Act No. 107 of 1998) listed the activities in the Schedule that pertain to this development proposal. This came into effect on the date of commencement of the Environmental Impact Regulations, 2006, made under section 24(5) of the Act and published in Government Notice No R.387 of 2006.

The applicable listed activities for the proposed development are:

Government Notice No. R386: Item 1(m) - *Any purpose in the one in ten year flood line of a river or stream, or within 32 meters from the bank of a river or stream where the floodline is unknown, excluding purposes associated existing residential use, but including canals, channels, bridges, dams, and weirs*

Government Notice No. R386: Item 12 - *The transformation or removal of indigenous vegetation of 3 hectares or more or of any size where the transformation or removal would occur within a critically endangered or an endangered ecosystem listed in terms of Section 52 of the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)*

Government Notice no. R387: Item 2 – *Any development activity, including associated structures and infrastructure, where the total area of the developed area is, or is intended to be 20 hectares or more;*

Government Notice No R387: Item 5 – *The route determination of roads and design of associated physical infrastructure, including roads that have not yet been built for which routes have been determined before the publication of this notice and which has not been authorised by a competent authority in terms of the Environmental Impact Assessment regulations, 2006 made under section 24(5) of the Act and published in Government Notice No. 387 of 2006, where:*

- (b) it is a national road as defined in section 40 of the South African National Roads Agency Limited and National Roads Act, 1998 (Act No. 7 of 1998);*
- (c) it is a road administered by a provincial authority;*
- (d) the road reserve is wider than 30 metres; or*
- (e) the road will cater for more than one lane of traffic in both directions.*

Other legislation applicable (but not necessarily facilitated/implemented/managed by Eco Assessments) is:

- A water use licence application would need to be submitted to the Department of Water Affairs and Forestry (DWAF) for the proposed bridge crossing of road K54 over the Olifantspruit (all three proposed alternatives for the realignment will have to cross the Olifantspruit) and for the stream crossing on the ARC property in terms of the National Water Act No. 36 of 1998, Item 21(i) altering the beds, banks, course or characteristics of a watercourse
- The National Heritage Resources Act No. 25 of 1998 - The Irene orphanage and school (1902 – 1907), concentration camps and the Dolomite sinkhole also known as the “Grootboom” or “Bakwena Cave”
- The Resources and Petroleum Resources Development Act, Act No. 28 of 2002 – An application will have to be submitted to the Department of Minerals and Energy (DME) for the utilisation and/or abstraction of materials that is to be used for the construction of the K54 road.
- Department of Environmental Affairs and Tourism Guideline Document on the Integrated Environmental Management Procedure
- Gauteng Transport Infrastructure Act, 2001

- Gauteng Province Department of Agriculture, Conservation & Environment – Red Data Policy Guideline
- Gauteng Province Department of Agriculture, Conservation & Environment – Ridges Policy
- Gauteng Open Space Project
- Gauteng Information Decision Support information including C-Plan
- GDACE Policy in regard with Cave Buffer Conservation

The GDACE has commented on the sensitivity of the Bakwena Cave. This relates to the ecological importance the cave has for red data bat species and other species that inhabit the cave as well as concerns with pollution. The GDACE indicated that a 500m buffer must be conserved around the cave.

The GDACE has previously approved a development and buffer width of 200m from a cave as part of the Monument Park Golf Course. Following a meeting that was held on 24 February 2006 it was acknowledged that the relaxation of the buffer to 300m could be considered. It was also emphasised at the meeting that there are currently activities with a distance of less than 300m from the cave. These include the existing ARC road, Main road and the Railway line. A detailed Karst Ecological Assessment and three surveys on the bats of the Bakwena Cave were conducted and is attached as Appendix C8 and Appendix C9 respectively.

1.4 Qualifications of Environmental Consultant

Mark Custers (Pri. Sci. Nat) of Eco Assessments CC prepared the Scoping and Environmental Impact Assessment Reports for the proposed realignment of the K54 road as well as conducting notification to interested and affected parties. Mark is a registered environmental scientist with over 9 years experience in the field of EIA (please refer to CV in Appendix B).

SECTION TWO – PROJECT AND DEVELOPMENT DETAILS

2.1 Applicant Details

Project Applicant	Centurus (Pty) Ltd
Contact Person	Mr. Trevor Glass
Postal Address	P.O. Box 3, Irene
Postal Code	0062
Telephone	(012) 667 5101
Fax	(012) 667 5105
E-mail	tglass@centurus.co.za

2.2 Need and Desirability of the Re-Alignment of the K54

Two critical factors have emerged as to why the K54 should be re-aligned from its current approved alignment. These are -

- 2.2.1. The Bakwena Cave is located less than 50m away from the envisaged access road that should be constructed to provide access to the Southdowns Development. The GDACE has previously indicated that a buffer zone of at least 500m should be used to protect the cave from development impacts.
- 2.2.2. The Gauteng Development Tribunal approved two township layouts for the Southdowns development -
 - With K54 along its planned current alignment; and
 - With K54 located to the south of the development.

Subsequent to the approval of the Southdowns Development Proposal, it was noted that the planned current alignment of the K54 would sever the Southdown development's residential component from the proposed private school. In addition it has become apparent that the envisaged school would have to gain access from the K54 (a provincial road) and that the Gauteng Province Department of Public Transport, Roads and Works do not permit access to schools adjacent to provincial roads.

Centurus, in terms of their approval and obligations as part of the Development facilitation Act, must construct the relevant link road that would be aligned on the existing ARC entrance Road.

Personal communication with Mr. Klaus Schmid¹ of GPTRW (please refer to Appendix E) concluded that the K54 is part of the strategic road network for Gauteng and as such, is a long route serving regional traffic, as well as local traffic. Regional linkage for the area under consideration could be as far as eastern areas of Tshwane/ western areas of Kungwini to Centurion, and Centurion to Diepsloot and further west. The further development of the Centurion area south of the N1 can however not be supported if any of the planned routes or sections thereof in this area are removed from the network.

K54 links with all planned and existing K routes, including K109, K111, K105 and road P38-1 in the area under consideration, and K101 just west of N1 (Ben

¹ Professional Engineer with the Gauteng Department of Transport, Roads and Works

Schoeman). In addition intersections have been planned at regular intervals along the route for linkage with the local road network to complete an integrated functional transport network for the area.

A letter received from the City of Tshwane Public Works and Infrastructure Development Department (Appendix F) stated the following:

The original route determination of the K54 was planned in various stages since 1976. It stretches from Road P79-1 in the west (Diepsloot area) to road P2-5 north in Mamelodi (and even further northwards) a distance of approximately 80km.

K54 will link the following suburbs in the Tshwane and Kungwini Areas:

- The Reeds
- Rooihuiskraal
- Highveld
- Irene
- Rietvalleirand
- Moreletapark
- Mooikloof
- Silver Lakes
- Mamelodi

The east-west road crossings over the Pretoria-Germiston railway line are limited. Nellmapius Drive is at present the only road crossing under the Pretoria-Germiston railway line.

The capacity problems at the Main Road/Nellmapius Drive intersection will be alleviated by the additional capacity created by the construction of the K54 and Olievenhoutbosch Roads. K54 will be linked to the R21 with south-facing ramps.

2.3 Locality of the proposed activity including description of the study area

The study area for the road section is located south-west of Tshwane and the south-west portion of Kungwini and the greater length of this section of the K54 road falls on Portion 41 of the farm Doornkloof 391 JR (Figure 1). The proposed road is located south of Irene and the greater length of the road will traverse land that is owned by the Agricultural Research Council (ARC). This land is currently used predominantly for the purposes of agricultural research activities and grazing.

The realignment of the section of the K54 road will extend from Nellmapius Road in the west, across land owned by the Agricultural Research Council, across Main Road (P38-1), across a Railway line and the Kaalspruit (Olifantspruit) and intersects with the proposed K105 in the east (Figure 2).

The area of the proposed realignment of the K54 falls in the Planning Zone 1 of the Tshwane Metropolitan Municipality.

2.4 Design Standards and Description of the Route

The proposed design standards of the section of the K54 road entail:

- An approximate route distance of 4,0 kilometres (between Km18.0 and Km 21.7);

- A road reserve of 48 metres;
- A road comprising of a four lane double carriage way;
- A design speed of 100 kilometres per hour.
- A vertical elevation of $\pm 6/7$ m over the Olifantspruit

It is proposed that the section of the K54 road would extend from Nellmapius Drive in Irene, across a large section of the ARC land to intersect with the proposed K105 in the east.

2.5 Surrounding Land Use

The surrounding land use is characterised by residential, recreational, cultural, commercial and business development. The area includes:

- Doringkloof
- Lyttelton Manor
- Rooihuiskraal
- Pierre van Ryneveld
- Irene
- Cornwall Hill
- Centurion City
- Zwartkops and Waterkloof Airforce Bases

The Centurion CBD includes the Centurion Lake with retail, commercial, offices and residential components. Areas around Centurion are experiencing exponential urbanisation as a result of their proximity to the Centurion CBD. Nellmapius Road is located to the north and west of the study site. John Vorster Drive is situated to the north and will extend further to the south. Glen Avenue is located to the east of the study area.

2.6 Future Land Uses

The future land uses were obtained from “Centurion and South Eastern Suburbs of Tshwane, Land Use and Socio-Economic Projections 2000/2001-2020”, prepared by Plan Associates during July 2002.

The 2020 land uses are:

- Residential development south of K54’s existing alignment of less than 20 units per hectare, and
- 1 dwelling unit per hectare to the east of the Olifantspruit

2.7 Existing Infrastructure and Requirements

Infrastructure in the vicinity of the development area, and that could possibly be affected by the proposed development, includes:

- Tshwane’s 132 KV Overhead Power Line
- Tshwane’s Sewer Line
- Telkom Overhead Line
- Rand Water Pipes
- Telkom Cables to the West of P38-1
- Tshwane’s Overhead Power Line

- Service Ducts

2.7.1 Drainage and Storm Water Provision

The developer will provide storm water management infrastructure and the discharge of storm water will take place into the Olifantspruit. The detail design of the storm water management system is not yet available. Storm water is proposed to be disseminated by surface flow and natural seepage into the ground. Where steep slopes exist and where storm water runoff may give rise to erosion, gabions, swales and other energy dissipating structures will be used to minimise the velocity of the runoff water and allow for the gradual seepage of water into the ground and into the Olifantspruit.

A 1:50 year flood discharge of 59 m³/s was calculated at the wetland in the west. The provision of a bridge with a 25m clear span would be adequate to retain the hydrological functions for Alternatives 1 and 2, provided that the full width of the delineated riparian area, plus buffer zone, is spanned on elevated pedestals or wide culverts that do not impede water flow functioning during high water events. The 25m clear span would not be adequate for the original alternative alignment 1. From a wetland point of view this alignment has the highest impact as it crosses a wide wetland area at an oblique angle. The bridge for alternative 1 has to be 34 m long to provide a 25 clear span perpendicular with the wetland.

The unimpeded water flow speed of 1,38 m/s will be reduced to 0,59m/s when the bridge is provided. The lower water flow speed will benefit the wetland. The bridge will create a 60m long backwater with a height of 0,5m.

A 1:50 year flood discharge of 280m³/s was calculated by VNJ Consulting Engineers for the Olifant Spruit at the road crossing. A 60m long bridge will be provided for Alternatives 2 & 3 to accommodate this flood (2 X 15m and 1 X 30 spans).

A 40m, long bridge is proposed for Alternative 1 across the Olifant Spruit. A 40m long bridge is provided where the K54/K105 link in the case of Alternatives 2 & 3 crosses the Olifant Spruit (2 X 10m and 1 X 20m spans). Vela VKE provided for 2 X 900mm pipe culverts at the low point to the east of the K111.

Spigot and socket stormwater pipes with rubber rings have been proposed by VELA VKE in dolomite areas where the fills are low and the culverts shallow. The joint box culverts must be sealed in the high risk dolomite areas.

It is recommended that side and median drains be lined with concrete in all dolomite areas where the risk of sinkhole formation is considered high.

2.7.2 Other Services Provision/Management

Services such as sewage, water supply and solid waste management will be addressed in an Environmental Management Plan for the construction of the K54 Road.

2.8 Traffic Aspects

2.8.1 Introduction

The K54 does not exist and therefore only traffic projections are addressed.

2.8.2 2010 Traffic Projections

Centurus is in terms of the Gauteng Development Tribunal, responsible to construct a section of K54, between K111 (John Vorster Drive) and Road P38-1.

The traffic projections, should the Southdowns development be fully developed, were obtained from "Centurus (Pty) Ltd, Irene Extensions 52, 54 and 68, "Addendum 4 to the Traffic Impact Study, March 2006." The two way morning traffic peak volume is 825 vehicles per hour. The afternoon peak volume is 660 vehicles per hour. A single carriageway road will accommodate the traffic volumes along John Vorster Drive/P38-1.

2.8.3 2020 Traffic Projections

BKS (Pty) Ltd provided the 2020 traffic projections from Tshwane's EMME/2 regional transport model. All the K-roads in the area and Brakfontein Road further south were included in the road network.

The morning peak hour projections are shown in Table 1

Table 1: 2020 Morning Peak Hour Traffic Projections for K54

Section	Two Way Volume (vehicles/hour)
K109 to K111	1260
K111 to Road P38-1	1700
East of Road P38-1	1852

The heavy vehicle percentage during peak hours was assumed to be 3%.

2.8.4 Conclusion

The K54 will have to be a dual carriageway road by 2020 in order to accommodate traffic pressures currently experienced and expected to increase in the future to 2020. The construction of the road is crucial to ensure the commuting of the south-eastern suburbs of Pretoria and the south-western suburbs of Centurion and to relieve current and projected traffic congestion associated with existing and proposed roads in the area. The road will also provide access to existing and proposed roads in the area.

SECTION THREE – DESCRIPTION OF THE PHYSICAL ENVIRONMENT

3.1 Introduction

This section of the report serves to describe the physical environment in which the proposed alignments of the road will fall. A description of the impacts that the road alignments will have on these elements is given in Section Six of this report.

3.2 Geotechnical and Soil Conditions

The general characteristics of the underlying geology have been described in the Basic Planning Report for K54 (1989) as compiled by VKE Engineers. In addition, an overview of geological conditions was prepared by VKE Engineers relevant to this road planning section of K54, as the previous study was done on the “1989” road alignment. The current investigation revealed that the section from km 20,5 to km 23,0 crosses the Monte Christo Formation that is classified as an Unsafe Development Zone because of the risk of sinkhole formation. The report states, however, that the previous alternative alignments for this section of K54 would have had the same problems.

The low lying area (wetland) in the study area, at km 19,2 was mentioned (Rock Environmental Consulting (Pty) Ltd, 2000) as being particularly susceptible to sinkhole formation as the site is underlain by Chert-rich dolomite of the Monte Christo Formation which forms part of the Chuniespoort Group in the Transvaal Sequence. The detailed geotechnical investigation completed for the Southdowns Scoping Report however indicates that kilometre 20 to 21.7 consists of a combination of geology types including dolomite stability zones 2, 3, 4 and 2A. These are interpreted as follows:

Table 2: Zones of Dolomite Stability

Dolomite Stability Zone	Characteristics
1	Potentially reflecting a low to medium risk of sinkhole and doline formation with respect to water ingress (Class 1 to Class 2)
2	Potentially reflecting a medium risk of sinkhole and doline formation with respect to water ingress. During the construction stage exposed areas of shallow dolomite bedrock will be mapped as Zone 2a – (Class 4 with pocket of Class 5)
2a	Largely reflecting a medium to high risk of doline and sink hole formation with respect to water ingress (Class 5)
3	Largely reflecting a medium risk of doline and sinkhole formation with respect to water ingress (Class 4)
4	Largely reflecting a medium to high risk of doline and sink hole formation with respect to water ingress (Class 5 and 7)
5	Largely reflecting a high risk of doline and sinkhole formation with respect to water ingress (Class 7 to Class 8)

It is anticipated that kilometre 18- 20 will have similar characteristics which will have to be addressed by road engineers during the planning and design of the road. A more detailed assessment of the latter section will have to be completed.

The soils of the study area are strongly related to the underlying geology and most of the dolomite is overlain by shallow red-brown gravelly soils. The soils are generally less than 500 mm deep.

Mr. J.A Gouws of Index carried out a study which determined the significance of the impacts that the proposed realignment of the K54 will have on the agricultural potential of land in the area. The land evaluated was a strip of 100 metres off the centre line of the proposed road. The report is attached as Appendix C6.

Presently the land is used for various agricultural activities. Recent aerial photographs indicate rocky areas with patches of arable land in between, the largest portions are at the western side of the ARC research farm. Land on the research farm is used for cattle grazing and for cash crops and fodder for cattle. The remainder of the study area is undisturbed land.

A variety of soil types occurs in the study area, which derived from the weathering of dolomite. Rocky outcrops occur throughout the site but are more pronounced on the ridges.

Table 3: Soil Types of the Study Area

Dominant Soil Forms	Description	Area (hectare)
Hutton Shortlands	The unit consists of weathered dolomite that generally produces red apedal clay loam soil and because of its clay content, is high in plant nutrients. This unit consists of soil that is deeper than 900mm with a clay loam texture (<30% clay). The soil is dark red and free of mottles. Manganese and iron concretions and hard ferricrete may occur in places. It is fairly stable and erosion is not expected under normal vegetation cover. The soil has a few impediments to agricultural development.	8
Hutton Rock	The unit consists of brown topsoil that overlies weathered dolomite. The topsoil consists of variable depth red brown apedal sandy loam soil that is moderately leached. Rock fragments occur throughout the profile. The main impediment is the rock outcrops of dolomite or chert. It is 400 to 1000mm deep with a sandy clay loam texture. The deeper soil has a moderate potential for crop production while the more shallow soils should be retained for grazing pastures.	17.5
Hutton Rock	The unit consists of brown topsoil that overlies weathered dolomite. The topsoil is apedal sandy loam that is moderately leached. Rock fragments occur throughout the profile with abundant surface rock. It is not suitable for cultivation due to the limiting depth and rock outcrops and should be left in its natural state.	59.2
Glenrosa	Consists of an old sports field	3.2
Glenrosa, Mispah, Rock	Rocky outcrops are common. These soils are not suitable for cultivation.	7.2
Wetland	Wetland area, only suitable for grazing	5.2

The only land that could be classified as high potential occurs on the alluvium of the Hennops River. The remainder of the land of the study area is considered to be of low potential. A more detailed survey indicated that the alluvium along the Hennops is high potential but there are loose boulders and rock outcrops that would downgrade them to medium potential for commercial production. High potential soils were also found on the western part of the site. The new alignment, however, cuts across the most northern part that minimises the impact.

3.3 Hydrology (Surface and Groundwater Resources)

3.3.1 Surface Water Hydrology

The study area is situated in the Sesmyl Spruit drainage system, flowing in an east-west direction from regions south of the Rietvlei Dam where it flows into the Jukskei River west of Centurion. The Sesmyl Spruit/Hennopsriver bisects the land of the Irene Country Club before it flows just west of the Dairy Farm. The stream drains towards the Centurion Lake located in the Centurion CBD. The Sesmyspruit/Hennopsriver becomes the Sesmyspruit/Hennopsriver approximately 7.5km west of the Centurion Lake when the Sesmyspruit/Hennopsriver and Rietspruit join together. The Kaal Spruit, also known as the Olifantspruit, is a prominent tributary of the system and originates in the Kaalfontein region south of the study area. These streams are perennial and quick flowing drainage courses.

3.3.2 Groundwater Aquifers

The aquifer prevalent in this area comprises that of the Karst aquifer type (Chuniespoort Group). The Monte Christo Formation contains sediments that are chert rich. This aquifer type is considered to be the most important aquifer type as it has a generally high to very high storage capacity and often high permeable characteristics. Vertical and sub vertical structures in the form of intrusive dykes serve to compartmentalise the aquifer and act as barriers to the movement of ground water. In many instances the ground water level is located within chert and dolomite residuum of the blanketing layer. It is anticipated that any significant lowering of the ground water level will generate ground movement and stability problems.

3.4 Topography and Visual Environment

3.4.1 Topography

The study area surrounding the route generally comprises of a gently undulating landscape. The K54 enters the study area from the west and crosses across a drainage channel before climbing to the highest point that lies on the ARC property. The route then descends down & crosses over the Kaalspruit before exiting the study area approximately 1/4 of the way up the slope.

3.4.2 Aesthetic Value/Quality of the area

A Visual Impact Assessment was conducted by Mr. Graham Young and the report is attached as Appendix C5.

The following summary was abstracted from the Report.

The proposed road cuts through open grassland and agricultural land. Its alignment begins at the M31 and continues eastward over a small grassy ridge until it intersects with the M18 approximately 200m west of the Olifantspruit stream. The road extends

over the Olifantspruit valley and up the opposite slope where it crosses with the proposed K105. The valley is dominated by grassland, with mostly exotic trees clustered in the floodplain and along the spruit.

The area north of Nellmapius Road is dominated by housing and office developments. Immediately south of the intersection the land type changes to agricultural land. Further east, and to the north of the alignment are new residential developments and a school. Salsberg Quarry lays to the south-east of the proposed road alignment, just east of the M18.

Although the proposed alignment are routed through open grassland and “natural” areas, the overall character and sense of place of the adjacent areas north of the alignment is of an urban edge that is moving southwards from Irene.

The scenic beauty of a rolling rural landscape is giving way to a scene that will soon be dominated by urban structures, roads, a railway line and other industrial uses.

The study area is considered to have a *moderate* aesthetic value because it is a common landscape that exhibits some positive character (grassland and river) but which has evidence of alteration/degradation/erosion of features resulting in areas of more mixed character.

It was initially proposed that the K54 will cross over the railway line and proposed K105. Subsequent to discussions with Interested and Affected Parties, it was decided that the vertical alignment of the K54 to go under the railway line and proposed K105. The consequence of this is that where the road crosses the Olifant Spruit, it will do so with 7m high fill embankments as opposed to the initial 15m embankments (Please Refer to Appendix C5a). This will reduce the affect the K54 will have on the visual environment.

3.5 Ambient Noise Levels

JH Consulting conducted a preliminary noise impact assessment with the purpose of determining the impacts of the proposed road alignments of K54 on the noise climate of the area. This was achieved by predicting the noise levels at the sensitive locations from predicted traffic flows on the alternatives routes, and comparing their different impacts. The report is attached as Appendix C4.

3.5.1 Ambient Noise Levels along the Existing Road

There are no existing roads; all the alternatives will be new constructions. However, the alternatives meet the existing road system at the M18 Irene-Clayville road, Glen Avenue, south of the existing ARC entrance, and noise levels were measured here to establish the current noise climate, as this is the noisiest part of the site.

The current noise impact on the area is almost entirely from Nellmapius and Glen Avenues which dominate the noise climate, and the north-south railway line which generally follows the line of Glen Avenue, but is much more infrequent and therefore much less significant noise source. There are no other significant industrial or transportation noise sources in the area.

3.6 Climatic Conditions

The site is located on the edge of the Highveld Climatic Zone that experiences cool to cold winters and warm and wet summers.

3.6.1 Precipitation

Summer precipitation occurs in the form of convectional thundershowers and averages 717mm per year. The majority of rain falls in the summer months of November, December and January. The winter months of July and August usually receive on average less than 9mm of rain.

3.6.2 Temperature

Average daily temperatures range from a maximum of 23.7°C to a minimum of 9.8°C. Summer temperatures reach a maximum of 27.0°C in January. The winter minimum is 2.7°C in June and July.

3.6.3 Extreme Weather

Extreme weather conditions include thundershowers, hail and fog. Snowfall is rare.

3.6.4 Wind Conditions

Wind with moderately high speeds occurs from late winter to early summer.

3.7 Ecological Systems (Rivers, Wetlands, Bakwena Cave and Sensitive Areas)

3.7.1 Wetlands, Rivers and Riparian Areas

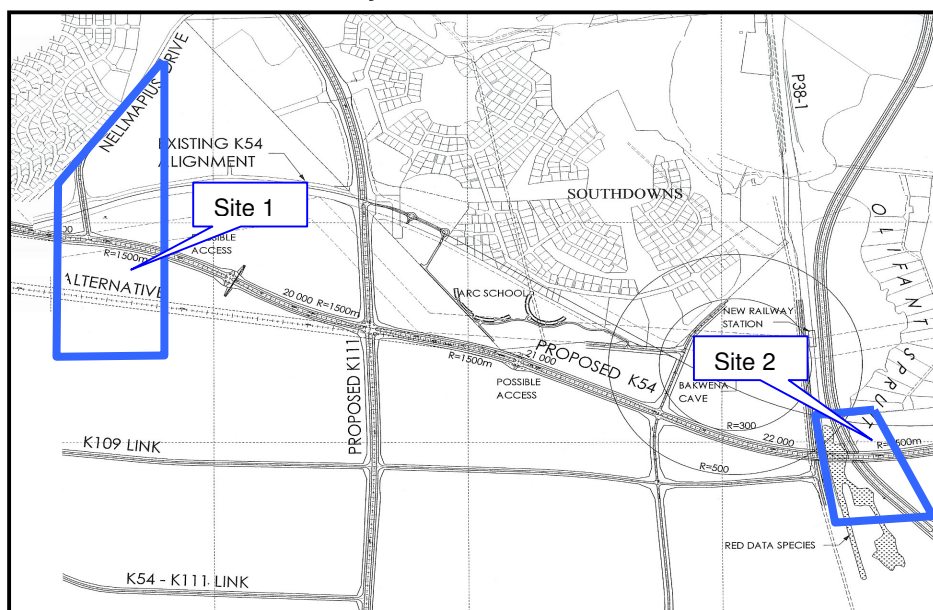
The study area is situated in the Sesmyl Spruit drainage system, flowing in an east-west direction from regions south of the Rietvlei Dam where it flows into the Jukskei River west of Centurion. The Kaal Spruit, also known as the Olifantspruit, is a prominent tributary of the system and originates in the Kaalfontein region south of the study area. These streams are perennial and quick flowing drainage courses.

VC Management Services CC conducted a Wetland Study during January 2007. The report is attached as Appendix C7.

Please note that this study did not include the determination of the 1:50 or 1:100 floodlines.

Two study areas were covered by the survey. Both fall on Portion 41 of the farm Doornkloof 391 JR, which is owned by the ARC. The proposed alignment and alternative alignments of the K54 cross the ARC property from west to east, traversing two separate wetland/riparian areas. Study Area 1 is located to the west of Portion 41 of Doornkloof 391 JR. hereinto referred to as "Doornkloof Vlei".

Figure 3. Wetland Assessment Study Sites



Study Area 1 (Doornkloof Vlei): is a one-kilometre reach of a temporary watercourse through a shallow alluvial valley with considerable emergent vegetation. The hydrophytic nature of the vegetation and the periodic inundation of the area classify it as a wetland in terms of the National Water Act No. 36 of 1998

Co-ordinates of Study Area 1

	Latitude 25° S	Longitude 28° E
North-west corner	53' 25.6"	11' 41.3"
North-east corner	53' 9.6"	11' 55.9"
South-east corner	53' 44.3"	11' 54.5"
South-west corner	53' 45.6"	11' 42.4"

The proposed alternative routes for the K54 road cross this area at right angles to the watercourse. The original proposed alignment and two alternatives together span a watercourse frontage of about 500m. In addition, a proposed access road runs along and through the wetland in a north-south direction. The study area therefore covers a 1 km reach of the watercourse and adjacent wetland areas to include all proposed points of intersection and potential impact.

The wetland area has been fenced by the land owners, ARC, and is bordered by cultivated fields on the east and west and by Nellmapius Drive and townhouse development on the north.

Residential and commercial developments upstream are impacting on the watercourse. In parts of the reach the watercourse has eroded, due to increased storm water runoff, a shallow channel that retains water for most of the wet season.

A wetland delineation was conducted to determine the periphery of the temporary zone of the wetland. This outer edge marks the boundary between the temporary zone and adjacent terrestrial areas. The procedure identifies indicators of prolonged saturation by water: wetland plants and wetland soils. The presence of these distinctive indicators in an area implies that the frequency and duration of saturation is sufficient to classify the area as a wetland. The wetland was identified according to

criteria as defined in a publication by DWAF: *A practical field procedure for identification and delineation of wetlands and riparian areas* (September 2005).

Table 4: Wetland Delineation Peg Co-Ordinates

<i>Western wetland boundary</i>		
Latitude 25° S	Longitude 28° E	Peg number / Comments
53' 13.9"	11' 52.6"	1
53' 15.7"	11' 51.5"	2
53' 19.0"	11' 49.5"	3
53' 21.5"	11' 48.5"	4
53' 26.1"	11' 47.4"	5
53' 31.6"	11' 45.6"	6
53' 39.1"	11' 42.7"	7
53' 43.1"	11' 42.0"	8
<i>Eastern wetland boundary</i>		
Latitude 25° S	Longitude 28° E	
53' 14.5"	11' 55.4"	9
53' 17.3"	11' 53.4"	10
53' 20.8"	11' 52.1"	11
53' 23.8"	11' 51.0"	12
53' 27.5"	11' 49.0"	13
53' 33.0"	11' 47.1"	14
53' 40.0"	11' 44.8"	15
53' 44.0"	11' 44.5"	16
<i>Western buffer boundary</i>		
Latitude 25° S	Longitude 28° E	Peg number / Comments
53' 15.6"	11' 50.5"	17
53' 20.7"	11' 47.0"	18
53' 27.9"	11' 44.7"	19
53' 35.9"	11' 41.6"	Road – no peg
53' 42.0"	11' 41.9"	Road – no peg
<i>Eastern buffer boundary</i>		
Latitude 25° S	Longitude 28° E	
53' 14.5"	11' 55.4"	Road – no peg
53' 18.3"	11' 55.3"	Road – no peg
53' 30.0"	11' 48.5"	Fence – no peg
53' 44.9"	11' 44.9"	Road – no peg

Study Area 2 (Olifantspruit): is the locality of the proposed crossing of the K54 over the Olifantspruit, a perennial river, which forms the eastern boundary of the ARC property. The river is also the boundary of the Gauteng urban edge so the eastern (rural) and western (urban) banks are subject to different regulations.

Co-ordinates of Study Area 2

	Latitude 25° S	Longitude 28° E
North-west corner	53' 57.0"	13' 32.0"
North-east corner	53' 56.6"	13' 41.7"
South-east corner	54' 7.7"	13' 48.0"
South-west corner	54' 13.6"	13' 35.7"

The study area is a 500m reach of a perennial river across the proposed K54 alignment crossing. It rises about 15 km to the south and is fed by dolomitic springs, seepage and numerous small tributaries upstream. Some of the source streams are dammed and some pass through Thembisa Township, but for the most part the Olifantspruit is subject to less excessive storm water runoff and urban pollution than

most Gauteng Rivers. About a kilometre downstream from the site it converges with the Sesmylspruit (or Hennops River).

The river is moderately fast-flowing and has cut a deep central channel through the alluvial substrate to the dolomitic bedrock onto which a mobile sandy silt is deposited. The steeply incised banks at this point are approximately 6m high with flood benches supporting large trees and other riparian vegetation

At the point of intersection of the proposed K54, the river bends sharply to the west through a rocky gully. The scarp rises abruptly above the riverbed on the west to the level of the railway, which is only 75m from the river at this point and about 25m above it. An irrigation furrow has been led across the scarp about 18m above the river at this point.

A Riparian delineation was conducted according to criteria specified in a DWAF publication: A practical field procedure for identification and delineation of wetlands and riparian areas. The site shows distinct riparian structures with a clearly demarcated active channel and flood benches within the macro-channel extending for 10m to 15m on either bank. The riparian area is thus relatively narrow (20m to 30m with a seldom-inundated floodplain on the western bank. The banks of the channel are well wooded with a mix of large trees, dominated by typically riverine species such as *Combretum erythrophyllum* and *Celtis africana*. The woodland is interspersed with thick stands of reeds, grasses and some hydrophytic plants, typically riverine in species composition and growth form. The vegetation indicator is clear and correlates closely with the topography.

Table 5: Riparian Area Delineation Peg Co-Ordinates

<i>Western riparian boundary</i>		
Latitude 25° S	Longitude 28° E	<i>Peg number / Comments</i>
53° 56.9"	13° 33.4"	1
53° 59.7"	13° 34.5"	2
54° 02.4"	13° 36.5"	3
54° 04.9"	13° 39.4"	4
54° 08.3"	13° 42.7"	5
<i>Eastern riparian boundary</i>		
Latitude 25° S	Longitude 28° E	
53° 57.1"	13° 36.0"	6
54° 00.2"	13° 38.1"	7
54° 03.5"	13° 41.4"	8
54° 08.3"	13° 42.7"	9
<i>Western buffer boundary</i>		
Latitude 25° S	Longitude 28° E	<i>Peg number / Comments</i>
53° 57.0"	13° 32.0"	1
54° 02.6"	13° 32.5"	2
54° 07.9"	13° 34.0"	3
54° 13.5"	13° 35.7"	4
<i>Eastern buffer boundary</i>		
Latitude 25° S	Longitude 28° E	
53° 56.8"	13° 38.7"	5
54° 01.2"	13° 41.0"	6
54° 05.1"	13° 45.0"	7

3.7.2 The Karst Ecology of the Bakwena Cave

The GDACE has previously commented on the sensitivity of the Bakwena Cave. This relates both to the archaeological significance of the cave as well as the ecological importance the cave has for bat species, insects and concerns with pollution.

Dr. Francois Durand of the University of Johannesburg conducted a Karst Ecological Assessment that includes information about the ecology of the Bakwena Cave. The report is attached as Appendix C8

The following summary was abstracted from the report.

Caves on the Highveld are dolomitic, situated in the massive calcareous formation generally spoken of as “the dolomite”. The main area occupied or underlain by this system forms a ring around the bushveld basin. The calcium carbonate fraction of the dolomite dissolves relatively easy in water, causing the structure of the dolomite to weaken, with the result that periodic collapses of part of the roof or sides take place, causing caves or cavities, many providing suitable roosting conditions for various bat species

The Bakwena cave has very little to offer aesthetically, but houses several species of animals, including arthropods and bats.

3.7.2.1 Terrestrial Arthropods occurring in the Vadose Zone

The arthropod Orders Opoliones, Pseudoscorpiones and Dipteralsopoda; the Classes Collembola, Chilopoda; and the beetle Family Carabidae were encountered in a survey of the arthropods of the Bakwena Cave.

A very significant finding was the high abundance of the family Teneidae from the order Lepidoptera. The area in which these specimens were connected in Bakwena Cave is relatively close to the entrance, thus the teneids are probably opportunistic cave dwellers.

3.7.2.2 Aquatic Arthropods that occur in the Phreatic Zone

The groundwater is occupied by amphipods, colloquially known as “blind shrimps”. Amphipods are peracarid crustaceans, which are, probably next to the nematodes, the most ubiquitous animals on earth.

Because of the dark environment stygobitic amphipods live in, they have undergone convergent evolution, similar to that of troglobites, and have acquired troglomorphic adaptations including reduced or absence of pigmentation and eyes and the attenuation of appendages, usually antennae or pereopods.

The amphipods that occur in the Bakwena Cave are known as *Sternophysinx robertsi* and *Sternophysinx filaris*.

It has been postulated that troglobites, including amphipods, subsist on inter alia on bat faeces. The bat guano accumulates on the floor, rocks or water under the bat roost. Micro organisms specifically bacteria and fungi decompose the guano. The decomposed guano, and associated fungi and bacteria are ingested by arthropods. Some arthropods may also utilise the guano directly, like the bagworm larva of the Family Tineidae, which is capable of digesting keratin.

- Bats

Many of the caves, sinkholes, abandoned mine tunnels and buildings in the Gauteng area serves as roosting sites for bats, contributing to high biodiversity of the region. After the mammalian predators and cave-dwelling hominids abandoned the caves, bats have become by far the most important active importers of organic matter into caves. Bats are therefore one of the most important links between the photosynthetic process outside the cave and the troglobitic end consumers within the cave. The food web above the water table in caves consists of micro-organisms, fungi, crustaceans and insects that feed on the bat guano and spiders, millipedes and predatory insects that feed on the coprovores in turn. The survival of the bats depends directly on the vegetation types, which support the insects they feed on. The availability of food varies seasonally due to climatological factors such as rainfall. A loss in the habitats bats depend on due to urbanisation would lead to their demise.

3.7.3 Bats of the Bakwena Cave

Prof. van der Merwe of the Mammal Research Institute of the University of Pretoria conducted a specialist survey on the bats of the Bakwena Cave and the report is attached as Appendix C9. A survey was also conducted by Prof van der Merwe of the possible impacts of the Southdowns residential development on the bat species of the Bakwena Cave. This report is attached as Appendix C9.

The following summary was abstracted from the reports. References made to research/reports that were conducted by Prof van der Merwe that was included in the Karst Ecological Assessment by Dr. Durand is also summarised below:

Three bat species are known to occur in the Bakwena Cave. *Miniopterus schreibersii natalensis* (Schreiber's long-fingered bat), *Rhinolophus clivosus* (Geoffroy's horseshoe bat) and *Myotis tricolor* (Temminck's hairy bat) that are found regularly or occasionally in the Bakwena cave are all classified as LC (lower risk or least concern) of mammal species. *Miniopterus schreibersii* has very particular humidity and temperature needs and would therefore be found mostly in caves where these requirements are met LC (least concern): A taxon is least concern if it has been evaluated not to qualify for critically endangered, endangered, vulnerable or near threatened. Widespread and abundant taxa are included in this category.

Bakwena Cave currently contains a big colony of *Miniopterus schreibersii natalensis*, numbering between one to two thousand individuals. *Miniopterus schreibersii* is very sensitive to humidity and temperature, due to its small body size, which is the reason why they congregate in colonies numbering in the thousands of individuals. *Miniopterus schreibersii natalensis* undertakes annual migrations between the Gauteng Highveld and the Limpopo bushveld. These annual movements do not only involve long distance seasonal migrations of over 150km to and from the Gauteng Highveld, but also local inter-cavern movements between the various Highveld caves.

Rhinolophus clivosus is a common resident in caves and abandoned mines in Gauteng. Its preferred habitat is savannah-bushveld, but it also occurs in open grassland and the Drakensberg Mountains and even in deserts. *Rhinolophus clivosus* has a feeding range of up to 10km from its roost. It feeds mainly under the tree canopy and according to the insect remains in the roosts; it seems as if they mainly feed on moths and small beetles. This species is migratory only to a limited extent, and all known migrations are local.

In a meeting that was held with GDACE on the 24th of February 2006 (Appendix D) 2006, the present parties noted the following:

GDACE:

- The Bakwena Cave is classified as an “A” type cave and therefore a 500m buffer around it was initiated to protect the cave
- The cave is sensitive to pollution and the 500m buffer will protect the cave against groundwater pollution
- The Department is aware that the bats occurring in the cave do not have a high IUCN conservation status
- A relaxation of part of the buffer area may be considered (a relaxation to 350m was mentioned).
- Concerned about the disturbance of the bats and their abandonment of the cave and how this will affect the invertebrate populations that rely on the guano of the bats for survival.

Bat and Mammal Specialists (Prof Mac van der Merwe and Prof John Skinner):

- All the bats making use of the cave have a conservation status of Least Concern
- The relaxation of the buffer from 500m to 250m will not affect the bats making use of the cave
- The cave does not need a large buffer as they fly out and up into the sky. A buffer of 50m will suffice as they fly up in a perpendicular trajectory, then outwards.
- The bats are not disturbed by urban related activities
- A development application in Monument Park Tshwane was approved within a 200m buffer of a cave.

Centurus and Eco Assessments:

- Best practice processes were followed with the Southdowns development. 100ha were included within the boundaries of the development for open space conservation
- The present alignment of the K54 will have a direct impact on the cave
- The buffer policy was not put to public or affected land owners for comment

In a meeting that was held with GDACE on the 30 March 2006 (Appendix D) 2006, the present parties noted the following:

Centurus:

- A precedent of a 200m buffer around a cave which accommodates the same bat species as the Bakwena cave (Appendix C9) had been set by the GDACE in the approval of Monument Park Golf Course development.
- Current activities within a 300m buffer of the Bakwena Cave includes Main Road and the Railway line
- A larger buffer zone would directly impact on the ARC
- The GDT approved an alternative layout that included the provision of a road that would lie less than 100m from the cave. As part of this approval, Centurus would be liable for the construction of the road and the provision of appropriate access to the Southdowns Development.

GDACE:

- It is GDACE's policy to support a 500m buffer but should not be seen to be “anti-development”.
- A proper motivation has to be provided that the GDACE could evaluate should the applicant wish to reduce to buffer distance.

- Appropriate consultation with relevant role-players be undertaken by the applicant so as to support a motivation for an appropriate buffer
- A suitable range of alternatives, including the 300m, 350m and 500m distances have to be further investigated.

3.8 Terrestrial Ecology

Eco Assessments CC was appointed by Centurus to complete an Ecological Assessment and Red Data Scan of the proposed K 54 road alignments. The report is attached as Appendix C1. Please refer to Plate 1 and 2 for Photographs of sensitive areas that have been identified during the Ecological Scan in February 2007.

3.8.1 Vegetation

The study site falls within the area designated as the Rocky Highveld Grassland vegetation type. This is referred to as Bankenveld by Acocks (1988). The updated vegetation map of South Africa refers to this vegetation unit as Carletonville Dolomite grassland (Mucinda, Rutherford and Powrie 2005). Andesite Mountain bushveld occurs to the east of the site beginning in the vicinity of Rietvlei Dam. This vegetation type is situated in the Grassland Biome (Rutherford & Westfall 1994) but towards the edge and therefore in a transition zone between grassland and savanna.

3.8.2 Floral Assessment

Nine vegetation units were observed where the three road alignments are proposed, namely (Figure 4): -

- Asparagus/Acacia woodland;
- Drainage channel and associated wet vegetation;
- Disturbed grassland;
- *Tristachya rehmannii* – *Cymbopogon excavatus* Rocky grassland;
- Open *Acacia karroo* woodland;
- *Eragrostis chloromelas* – *Trachypogon spicatus* grassland;
- Agricultural fields;
- *Themeda triandra* grassland; and
- Riparian vegetation.

3.8.3 Red Data Floral Assessment

Eleven Red/Orange listed plant species have been recorded from the quarter degree grid that the study site is situated on (GDACE). Two of these species have been recorded as occurring on or in the near vicinity of the site (GDACE). A further Vulnerable species has been recorded within 5km of the site (GDACE). Of the eleven species recorded in the quarter degree five species are considered to have a high probability of occurring on the site. Four of these species were flowering during the initial site visits of which one species, *Hypoxis hemerocallidea* (Gifbol) was observed. This species is an orange listed species and is described as declining. The three species flowering during the site visit were not observed during the site visit and are therefore considered unlikely to occur on the site.

Red data information was highlighted on a map in the section between Main road and the Olifantspruit. GDACE indicated that this was not from their data. This area

was searched during March for the two species recorded as occurring on or in the near vicinity of the site but neither was observed.

During the site visit *Eucomis autumnalis* subsp. *clavata* (Pineapple flower) was observed. This species was not in the GDACE list for the quarter degree grid provided by GDACE but is an Orange listed species for Gauteng and is recorded as being declining.

3.8.4 Faunal Assessment

3.8.4.1 Mammals

Evidence was found along the alignment of the presence of various rodents, including: Common Mole Rat (*Cryptomys hottentotus*) and Vlei rat (*Otomys irroratus*). Signs were also present of mongoose (unidentified), Scrub hare (*Lepus saxatilis*) and Common Duiker (*Sylvicapra grimmia*).

Twelve Red Data mammal species were considered to have a high likelihood of occurring on the study site. Seven of these species are bat species. Two of these bat species have been recorded on the same quarter degree historically (GDACE), namely: Welwitsch's hairy bat (*Myotis welwitschii*) and Geoffroy's horseshoe bat (*Rhinolophus clivosus*).

The other threatened mammal species likely to occur on the site include: South African hedgehogs (*Atelerix frontalis*), Water rat (*Dasymys incomtus*), White-tailed rats (*Mystromys albicaudatus*), Honey badgers (*Mellivora capensis*) and Forest shrews (*Myosorex varius*). Hedgehogs are known to make use of areas with high levels of disturbance and are therefore still likely to make use of the site, despite the pedestrian activity on the site. Water rats require wet habitats and could potentially occur along the stream or river. White-tailed rats require sandy soils with good cover, resulting in them being likely to occur in the natural grassland areas. Honey badgers are generalist predators that are more likely to make occasional use of the site for foraging purposes. Forest shrews are known to occur in dense grass along the banks of streams, and may be present in the drainage channel areas of the study site.

Please refer to section 3.7.3 for bat species that occur in the area.

3.8.4.2 Avifauna

The habitat is considered to be suitable for several bird species. This would particularly include many grassland species. Birds observed during the site survey are listed in Table 6 below:

Table 6: List of Birds Observed On Site

Common name	Scientific name
Helmeted Guinea fowl	<i>Numida meleagris</i>
Common Fiscal	<i>Lanius collaris</i>
Diderick Cuckoo	<i>Chrysococcyx caprius</i>
Crowned Lapwing	<i>Vanellus coronatus</i>
Hadedda Ibis	<i>Bostrychia hagedash</i>
Dark-capped Bulbul	<i>Pycnonotus barbatus</i>
Southern Masked-weaver	<i>Ploceus velatus</i>
Greater Striped Swallow	<i>Hirundo cucullata</i>
Unidentified Cisticola	<i>Cisticola</i> sp.

Rufousnaped Lark	<i>Mirafr africana</i>
Mousebird	Probably <i>Colius striatus</i>
Whitewinged Korhaan	<i>Eupodotis afraoides</i>
Cattle Egret	<i>Bubulcus ibis</i>
Cape Turtle Dove	<i>Streptopelia capicola</i>
Blacksmith Lapwing	<i>Vanellus armatus</i>
Southern Red Bishop	<i>Euplectes orix</i>
Olive Thrush	<i>Turdus olivaceus</i>
Pied crow	<i>Corvus albus</i>
Yellowbilled duck	<i>Anas undulat</i>
White fronted Bee-eater	<i>Merops bullockoides</i>

Six of the listed Red Data species are considered likely to occur on the site. These are the Whitebellied Korhaan (*Eupodotes senegalensis*), Grass Owl (*Tyto capensis*), Melodious Lark (*Mirafr cheniana*), Stanley's Bustard (*Neotis denhami*), Secretarybird (*Sagittarius serpentarius*) and Lesser Kestrel (*Falco naumanni*). None of these birds were observed during the site visit.

Adequate habitat exists for African Grass Owls, particularly with the availability of both natural grassland and wetland just east of Nellmapius Road within the ARC property. This species has been recorded in Midrand Estates just south of the proposed route and is highly likely to occur along the stream in the eastern section.

3.8.4.3 Reptiles

The site offers suitable habitat for a number of common reptile species. The only species that were observed on site were: Striped skinks (*Trachylepis striata*). It is likely that many more reptile species could exist on site, including brown house snakes (*Lamprophis fuliginosus*), Herald snakes (*Crotaphopeltis hotamboeia*), Rinkhals (*Hemachatus haemachatus*) and Transvaal thick-toed geckos (*Pachydactylus affinis*).

The striped harlequin snake (*Homoroselaps dorsalis*) and the Southern African python (*Python natalensis*) are the only Red Data listed reptiles with recorded distribution ranges that include the study site. Available habitat is not considered optimal for pythons to make permanent use of. This is mainly due to a general lack of suitable refuges for these large snakes. Striped harlequin snakes may occur on the site, where they may occur in association with the present termite mounds (Harlequin snakes being known to only prey on thread snakes, which in turn rely on termites as a food source). The reporting rate for this species has been very low in the province.

3.8.4.4 Amphibians

Suitable habitat is present for a number of common amphibian species, particularly along the stream on the western section and the river on the eastern section. Common Cacos (*Cacosternum boettgeri*) and Red toads (*Schismaderma carens*) were observed here. Other common species expected to make use of the area included Guttural toads (*Amietophrynus gutturalis*), Common river frogs (*Amieta angolensis*) and Bubbling Kassinas (*Kassina senegalensis*).

The Giant Bullfrog (*Pyxicephalus adspersus*) is the only threatened amphibian species listed for the area. This species makes use of temporary pans formed during summer months for breeding. A wetland assessment conducted by V. Carruthers (Appendix C7) noted the following:

- Giant Bullfrogs are known to breed about 8km south and closer breeding colonies unknown to the writer, may be closer.
- The small dam and the standing pools in the watercourse were considered suitable for this species;
- No evidence of breeding Bullfrogs (eggs, tadpoles, juveniles or attendant adults) was observed;
- The possibility of individuals visiting the site from an unknown breeding colony nearby is remote;
- In conclusion, the occurrence of Giant Bullfrogs on the site is possible but highly improbable.

3.8.4.5 Invertebrates

Some common invertebrates were found during the ecological assessment. An in-depth invertebrate assessment was completed by P. Roos & G. Henning CC. The report is attached as Appendix C2.

The invertebrate report recorded the following general invertebrate species:

- 19 Lepidoptera (Butterflies) species. There are more than 70 butterfly species recorded from the quadrant and surrounding area;
- An unidentified Tiger Beetle (*Cicindelidae*);
- Ground beetles (*Atractanotis* sp.);
- Small green Dung Beetle (*Gymnopleurus humanus*);
- Grooved Dung Beetle (*Heteronitis catelnaui*);
- Miniature Dung Chafer (*Aphodius species*);
- Striped Toktokkie (*Psammodes striatus*); and
- Spindle Toktokkie (*Psammodes bertoloni*).

A number of other common insects were recorded including: cockroaches, spiders, solifugues, beetles, weevils and flies.

The Key findings of this report were:

- Suitable habitat and the host plant of *Metisella menix* (Marsh Sylph butterfly) was found on the banks and along the tributary of the Sesmylspruit but the butterfly was not observed;
- It was assumed that the altitude is too low for this species and that there is no migration corridor to existing colonies;
- No indications of trapdoor or baboon spiders;
- Suitable habitat was found on the site for Corklid trapdoor spiders (*Stasimopus robertsi*), Shield bum trapdoor spiders (*Galeosoma* sp.) and Wafer lid trapdoor spider (*Ancylotrypa rufescens*); and
- Stobias fruit Chafer (*Ichnesstoma stobbiai*) has a core population at Smuts Koppie to the north-east of the study site. The only area along the re-alignment that may be suitable for this species is within the Southdowns college area, north of the ARC concrete palisade walling.

3.9 Social, Recreational and Economic Features

The area mainly consists of urban characteristics with –

- Irene
- Centurion
- The approved Southdowns Residential Estate
- Highveld

- Centurion Country Club
- Irene Country Club
- Agricultural Research Council
- Southdown Shopping Centre

Schools within a four-kilometre radius include:

- Allenby Campus;
- Montessori Primary;
- Irene Primary
- The approved Southdowns school;
- Laerskool Doringkloof;
- Cornwall Hill College

Shopping facilities in a four-kilometre radius include:

- Southdown Shopping Mall;
- Higveld Centre; and
- Irene Centre.

Recreation facilities within a four-kilometre radius include:

- Supersport Park;
- Sarel Baard Park;
- Centurion Country Club;
- Irene Country Club;
- The Oval Park; and
- Smuts House.

No medical facilities exist within a four-kilometre radius of the site. It is a possibility that small medical facilities exist within shopping centres that have been listed above.

The Danie Joubert Freeway (N1) provides the main access to the eastern suburbs of the Tshwane Metropolitan Municipality. John Vorster Drive, Main Road, Glen Avenue and Nellmapius Road are the roads that are important for economic activities in the following areas within a four-kilometre radius of the site for the proposed realignment of the K54:

- Highveld Techno Park (Industrial);
- Denel Offices;
- Southdowns Shopping Centre (Regional Shopping Centre);
- Irene Country Lodge,
- Businesses situated along John Vorster Drive, Main Road, Glen Avenue and Nellmapius; and
- Residential and Business uses in Highveld, Irene, Cornwall Hill, and Southdowns.

The proposed K54 Road will be an important link between the south-east suburb of Tshwane Metropolitan Municipality and Kungwini Local Municipality.

3.10 Cultural and Historic Features

Mr. J. van Schalkwyk of the National Cultural History Museum conducted an archaeological study to locate, identify, evaluate and document sites, objects and structures of cultural importance found within the boundaries of the area in which it is proposed to develop the K54 road. Information was also sourced from

Archaeological studies that were conducted by the Archaeology Contracts Unit of the UNISA for the proposed establishment of the Southdowns Residential area during March 2006. These reports are attached as Appendix C3.

Although Irene and its surroundings are rich in culture historical elements of regional and national importance (e.g. The Smuts House), the proposed alignment and the four-kilometre section under investigation does not affect any of these elements or structures directly. The site assessment did not reveal any gravesites within the boundaries of the future road reserve or adjacent thereto.

Sites of importance in the vicinity of the proposed realignment have already been incorporated in the planning of the road. These sites are:

3.10.1 The Bakwena or Grootboom Cave

According to popular belief, this is a cave (dolomite sinkhole) where some Kwenaspeaking people hid from Mzilikazi's soldiers through his sojourn in 1826. They were eventually 'smoked out' and killed. A plaque commemorating this event was erected here some years ago by the Pretoria City Council as part of their tourism drive.

3.10.2 Cornwall Hill

The Battle of Cornwall Hill took place in this area on 4 June 1900. The British forces, under command of Lord Roberts, were marching north, in the vicinity of Irene Station, with the aim to occupy Pretoria. The Boer forces, under Gen. Botha and Gen. Smuts, were harassing them in order to prevent this. Although this was not a cardinal battle in the Anglo Boer War, it signalled the end of the Pretoria based ZAR government and the start of the guerrilla warfare. Shortly afterwards the well-known blockhouse was built by the Duke of Cornwall's Light Infantry on the hill that came to be known as Cornwall Hill. A smaller support blockhouse, consisting of at least two circular structures, was built just over 1km to the northwest. These structures fall outside the study area. A fort was built on the highest hill in the area by the Duke of Cornwall to safeguard the railway station from post-war raids. The suburb of Irene was proclaimed on 21 September 1902.

3.10.3 Irene Orphanage

An orphanage was constructed in October 1902 after the war for children who were orphaned by the war. By November the orphanage accommodated 50 girls and 21 boys. After the amalgamation of the Pietersburg (Polokwane), Potchefstroom and Irene orphanages with Potchefstroom as the new head office, the Irene orphanage closed on 20 September 1907. Only remains of the building were found.

The site is older than 100 years and therefore protected by the National Heritage Resources Act (Act 25 of 1999) as a historical and archaeological feature.

The site is located at co-ordinates 25°53'38,3" S ; 28°12'37,3" E.

3.10.4 Concentration Camps

Development in Irene was interrupted by the South African War which commenced on 11 October 1899. Of importance is the location of the concentration camps and related activity areas which resulted from the war. The construction of the well known Irene Camp (Camp 1) was initiated on 9 December 1900. It was initially situated north of the Hennops River and west of the railway line but later moved further north

and west of the railway station. With the transfer of people from the Nylstroom (Modimolle) Camp in March 1902 to Irene, a new camp (Camp 2) was laid out. It was situated approximately 1,5 kilometres south of Camp 1 and approximately 800 metres west of the Hennops River (*Sesmylspruit*). It was apparently situated on a slope which provided protection against the cold south-easterly wind. It would appear that Camp 2 was probably situated near the south-western boundary of the newly acquired so-called, Irene Estate. The transfer from the Nylstroom Camp, which necessitated Camp 2, introduced 2000 new inhabitants to the area. A small hospital was erected to attend the sick and a school was opened which operated until December 1902. Apart from a few glass and porcelain fragments, no distinguishing structures, features or even surface deposits mark the location of Camp 2. Only historical documents and oral history make mention of the existence and location of the camp. The site of Camp 2 is located at co-ordinates 25°53'12,0"S ; 28°12'55,1"E. The camp was occupied in March 1902 and only for a few months.

3.10.5 Conclusion

No sites were identified in the direct study area, but a number of sites of significance are known to occur in the region. However, none of these are threatened by the proposed re-alignment

SECTION FOUR – ALTERNATIVES ASSESSMENT

4.1 Introduction

The EIA Regulations in terms of the National Environmental Management Act (Act No. 107 of 1998) requires that alternatives for the project be evaluated. An alternative is defined to include a possible course of action, in place of another, that would meet the same purpose and need as the proposal. Alternatives can refer to any of the following, but are not limited thereto:

- Alternative location for the proposed activity
- Alternative type of activity for the particular site
- Alternative layouts or designs for the proposed activity
- Alternative operational aspects for the activity
- Alternative processes and materials

The option not to act is often used as a base case against which to measure the relative performance of other alternatives. The option not to act might also be taken forward in its own right for evaluation against the other alternatives.

Since the application is considered in terms of the proposed alignment for the K54 Road, only layout alternatives and the “no-go” alternatives will be considered for the purpose of this study. An alternative location for the K54 will not be considered as this road is proposed to relieve congestion on the Nellmapius drive and the K54 is to serve as an important link between the south-eastern and the south-western suburbs of the City of Tshwane. This link road forms an important link in the secondary road network of the PWV system. Alternatives for the detail design of the road and bridge crossings will be considered during the detail design for the construction phase of the road.

4.2 Proposed Alternative Alignments for the K54 Road

4.2.1 *Alternative Alignment 1 (Gazetted Alignment)*

This alternative represents the northern most alternative of the three alternatives and comprises the currently gazetted alignment for the K54. The alignment would begin at the Denel Building entrance and gradually curve northwards where it bends away and is taken across Road P38-1 and the Pretoria-Germiston railway lines where it intersects with the preliminary alignment of the proposed K105.

A quarter link is provided between Road P38-1 and K54 in the north-western quadrant of the crossing of the two roads.

This alternative extends along the existing ARC entrance road that lies less than 50m from the Bakwena Cave.

The alignment crosses a small drainage line that is bordered by seasonally wet grassland in the west, cultivated land and the Olifant Spruit to the east.

The intersections with K54 are:

- K109
- Nellmapius Drive

- K111
- K54/Road P38-1 quarter link, and.
- K105

The accesses provided are:

- To Denel (km 18,584), and
- A farm access (km 21,000)

The spacing between the intersections and accesses are shown in Table 7

Table 7: Intersection Spacing of K54's Alternative 1 Alignment

SECTION	SPACING (m)
K109 to the Denel access	690
Denel access to Nellmapius Drive	549
Nellmapius Drive to K111	1131
K111 to the farm access	739
Farm access to P38-1/K54 link	669
P38-1/K54 link to K105	1361

The intersection spacing along K111, between K54 and Karee Street is 506m.

This Alternative will not affect ARC's houses, but will sever Southdowns College and the Southdowns Township.

The costs of developing Alternative 1 would be:

Roadworks: R 122,951,850.00

Expropriation Cost: R 12,600,000.00

4.2.2 Alternative Alignment 2

Alternative alignment 2 deviates from K54's existing alignment at a 3000m radius curve to the east of K109. It turns right with a 1500m radius, crosses over a wetland and under a 132 KV overhead power line.

The alignment then turns left with a 1500m radius, intersects with K111 and turns right with a 1500m radius curve. It then turns left with a 1500m radius curve and crosses under Road P38-1, the Pretoria-Germiston railway lines and the K105. The alignment then crosses over the Olifant Spruit and joins with Alternative alignment 1.

This road extends from the existing ARC entrance and crosses across the ARC land with a slight southward curve $\pm 300\text{m}$ from the Bakwena Cave.

The roads included in the Tshwane's Roads Masterplan are used for the quarter link between K54 and Road P38-1. The quarter link consists of sections of the K109/M18 link and the K54/Johannesburg link.

K105 is aligned along the Pretoria-Germiston railway lines. A quarter link is provided between K54 and K105 in the north-eastern quadrant of the grade separated crossing of the two roads.

The intersections with K54, according to Tshwane's Road Masterplan are:

- K109
- K54/K111 link
- Nellmapius Drive
- K111
- K54/Johannesburg link, and
- K54/K105

There is a possible access on K54 to the west of K111. The Agricultural Research Council (ARC's) future access will be located to the east of K111.

The spacing between the intersections and accesses are shown in Table 8.

Table 8: Intersection spacing of K54 Alternative 2 Alignment

SECTION	SPACING(m)
K109 to K54/K111 link	691
K54/K111 link to Nellmapius Drive	625
Nellmapius Drive to possible access	552
Possible access to K111	553
K111 to ARC's future access	604
ARC's future access to K54/Johannesburg link	607
K54/Johannesburg link to K105/K54 link	1012

The existing alignment of K54 will become a street in a 20m wide road reserve when K54's southern alignment is accepted.

This alternative will affect ARC's most northern house. (km 19,65). It will also affect the cattle and sheep facilities to the east of the houses (approximately km 19,925).

The cost of developing Alternative 2 would be:

Roadworks: R 173,764,800

Expropriation Cost: R 15,400,000 which includes the demolishment and relocation of a house on ARC land and the ARC's Cattle and Sheep Facilities.

4.2.3 Alternative Alignment 3

K54's alternative 3 alignment is straight between the K109 and K111 intersections. It then coincides with alternative 2, before deviating along the 500m buffer around the Bakwena Cave.

This alignment will also cross under Road P38-1, the Pretoria-Germiston railway lines and the K105. It then crosses over the Olifant Spruit and joins with existing alignment.

The K54/P38-1 link will consist of sections of the K109/M18 and the K54/Johannesburg link. The K54/K105 link will be provided in the north eastern quadrant of these grade-separated roads.

The spacing between the intersections and accesses are shown in the Table 9.

Table 9: Intersection spacing of K54's Alternative 3 Alignment

SECTION	SPACING(m)
K109 to K54/K111 link	712
K54/K111 link to Nellmapius Drive	600
Nellmapius Drive to K111	1032
K111 to ARC's future access	642
ARC's future access to K54/P38-1 link	640
K54/Johannesburg link K105/K54 link	1026

The spacing along K111 between the access to Southdowns College and K54's Alternative 3 is 599m.

Alternative 3 will affect Tshwane's substation and the guard house and security gate at the access road opposite to the Denel (this guard house will be decommissioned when the future access to the east of K111 is implemented). ARC's houses (km 19,6 to 19,65) and the cattle and sheep facilities (km 19,9) will also be affected.

The cost to develop Alternative 3 would be:

Road Works: R 176,358,000

Expropriation Cost: R 32,450,000 which includes the demolition and relocation of:

- 2 houses on ARC land
- ARC's Cattle and Sheep Facilities
- ARC Dairy Science Building
 - Double Storey
 - Single Storey

4.3 Other Alternatives

4.3.1 Alternative Alignment of the K54 link road with Nellmapius Drive

Mr. V Carruthers of VC Management Services recommended that the link road from Nellmapius Drive with the K54 must be re-aligned to minimise impacts on the western wetland (See Appendix C7). The link road was subsequently realigned to the east and away from the delineated wetland riparian area and buffer. (Refer to Figure 5 for Initial Alignment and to Figure 2 for the new alignment).

4.3.2 Alternative Alignments of the K105

The preliminary design of the K105 was done by Liebenberg and Jenkins Consulting Engineers in 1998/1999 from Olifantsfontein in the south to a point approximately 1km south of the N1-21 in the north.

A further report was prepared to clearly motivate to GDACE the need of the proposed road and identify and consider alternative alignments, including the no-go option. GDACE recorded opposition to the road, based on various environmental concerns including the presence of various Red Data fauna and flora species. The alternative alignments flowed from further environmental investigations, which were carried out during the first three months of 2006. The alignments are motivated by the need to avoid or minimise the impact on two sensitive floral areas identified during these investigations. The southern area, which impacts on the alignment of the K105 in the vicinity of the K54 crossing, is situated between the railway lines and the Olifant Spruit, south-west of the southern boundary of Twin River Estate.

This area comprised of pristine natural grassland with a high species diversity. A

total of 101 plant species was recorded here. The area consisted of gentle grassy slopes and a few rocky ledges, which formed the ideal habitat for Red Data orchid, *Holothrix randii*. None of these species were found, because they did not flower during the time of the survey.

Where the K105 avoided the southern environmental sensitive area, it affected Portion 15 of the farm Doornkloof 391-JR, which belongs to Ostiprop 1168 (Pty) Ltd.

Dr. Herman Joubert, acting on behalf of Ostiprop 1168 (Pty) Ltd, requested that K105 be aligned along the railway line to provide improved accessibility to Pinedine Station further south. The re-alignment has been proposed (Please refer to Figure 5 for initial alignment and Figure 2 for new alignment). An ecological assessment that was conducted by Eco Assessments did not find any Red Data orchids during the flowering season. The K105's alignment will therefore be further investigated during the preliminary design.

4.3.3 Alternative Alignments of the K54 subsequent to Public Participation

4.3.3.1 Ostiprop 1168 (Pty) Ltd –Owner of Portion 15 of the farm Doornkloof 391 JR

Dr. Herman Joubert of Tech IQ Consulting Engineers acted as representative of the land owners.

He emphasised in a letter to Civil Concepts Consulting Engineers that the construction of a road over the railway line would have a high environmental (visual and noise) impact on the proposed township, which is envisaged on this property. He requested that the feasibility of an alignment of K54 below the railway line against the background of the dolomite geological conditions be further investigated.

He also emphasised that Tshwane's IDP referred to a new SARSS railway station halfway between the Irene Station and Pinedine Station.

BKS (Pty) Ltd provided the proposed alignment of the K105 adjacent to the railway line. An at-grade intersection between the K54 and K105 was considered, but abandoned due to insufficient westward shoulder distance along the K54, through the bridge structure under the railway line and Road P38-1.

In IQ Consulting Engineer's view, the principles of Integrated Environmental Management dictate that all transportation needs should be addressed in an integrated process and not a piecemeal basis. This includes the alignment of the K54, the alignment of the K105, planning of future commuter stations, access to the public transport infrastructure, as well as links between major roads, intersections of minor roads and access to all properties.

BKS (Pty) Ltd explained that their brief was to align K105 to avoid the potential environmental sensitive areas. Should this alignment be acceptable to GDACE, then DARBA Design Services will then complete their preliminary design appointment. They would address the accessibility to the new station. Tech IQ Consulting Engineers requested that K105 be aligned along the railway line to provide improved accessibility to Pinedine Station. It was pointed out that the potential environmental sensitive area would be affected and that access roads from the properties to the east of the Olifant Spruit have to cross the spruit with bridges.

It was decided that K54 be taken under the railway line.

4.4 The “No-Go” Alternative

This alternative defines the situation which would result should the proposed realignment and subsequent construction of the K54 road not proceed.

Currently the issue of traffic congestion and lack of access along Nellmapius Road preclude that the No Go option be pursued.

Nellmapius Road is currently the only east – west link between Centurion’s south western suburbs and Tshwane’s south eastern suburbs. The Nellmapius Drive / Main Road (Road P38-1) intersection is operating at capacity and there is little available space for the upgrading of this intersection. The Irene residents oppose the installation of traffic signals at this intersection. This is because it may result in the increase in the speeds of heavy vehicles driving along Main Road when the traffic light is green.

The “No-Go” alternative is socially less acceptable as the development of the K54 is crucial in terms of the planning for the area.

The capacity problems at the Road P38-1 / Nellmapius Drive can then only be deviated by the additional east west capacity to be created by construction of the K54. The K54 is an important link in the PWV road network.

SECTION FIVE – PUBLIC PARTICIPATION PROCESS

5.1 Introduction

The EIA Regulations in terms of Chapter 5 of the National Environmental Management Act (Act No. 107 of 1998) defines the public participation process as “*a process in which potential Interested and Affected Parties are given and opportunity to comment on or to raise issues of concern*” in regard with the proposed project. Interested and Affected Parties includes “*any person, group of persons or organisation interested in or affected by the proposed activity or any organ of state that may have jurisdiction over any aspect of the proposed activity*”.

5.2 Process of Engagement

5.2.1 Notification and Public Liaison

The following process has been used to inform interested and/or affected parties of the proposed development:

- The project was registered with the Gauteng Department of Agriculture, Conservation and Environment on 11th October 2006;
- A notice advertising the proposed development appeared in The Pretoria News and The Centurion Record on the 2 November 2006 (Appendix G2);
- Four site notice boards were placed at visible locations on the site and in the surrounding area on the 2 November 2006 (Appendix G1);
- Letters notifying the surrounding land owners with background information of the proposed development and public meeting, were sent to surrounding land owners and potential I&AP's by 8th November 2006 (Appendix G3);
- Parties were requested to return the registration form (as provided with the notice letter) to Eco Assessments before 4 December 2006 (Appendix G4);
- A Public Meeting was held on the 23rd November 2006 in which I&AP's were provided with additional information and detail of the proposed project (Appendix G6). Parties signed an attendance register (Appendix G7); and
- Notes of the meeting (Appendix G8) were distributed and interested and affected parties were asked to provide comment, where relevant by 7 December 2006.
- The Draft Environmental Scoping Report was submitted for public review during February 2007. The commenting period ceased on 23 March 2007. (Comments are included in Appendix G13)

5.2.2 Particulars of Public Participation Process that was conducted during the EIA Process in terms of the Plan of Study for the EIA

- A Public Feedback Meeting (Appendix G11) was held on 21 June 2007 with Interested and Affected Parties (Please refer to Appendix G10 for the Attendance Register). The purpose of the meeting was to provide feedback on comments/issues that were raised, details of the various Specialist Studies that were conducted, and the way forward in terms of the Environmental Impact Assessment Process. All Interested and Affected parties that registered during and subsequent to the Scoping phase of the project was invited to attend the meeting. The notes of the meeting (Appendix G12) was distributed to I &AP's on 06 July 2007.

- An EIA Report is made available to I&AP's for comment prior to the submission of the report to the relevant authority. The report will be available through the Eco Assessments webpage and hard copies will be placed at the municipal library and local councillors' offices. I&AP's are requested to provide comments no later than 14 September 2007. Comments received will be incorporated into the Final EIA before submission to the GDACE.

5.2.3 Interested and Affected Parties contacted

Table 10: List of Interested and Affected Parties Contacted and Notified of the Proposed Realignment of the K54 Road (Scoping Phase)

Organisation	Name	Fax.	Tel.
National Department of Agriculture	S. Rathebe	011 3551000	011 3551917
ARC Irene	C. Oosthuizen	012 6651605	0868367264
Agricultural Research Council	C. Zwiendelaar	012 665 1563	012 672 9130
Bokamoso Environmental Consultants	L. Gregory	012 4607079	012 3481914
BKS	C. Pretorius	012 4213737	012 4213736
CTMM City Planning & Env.	M. Wheeler	012 358 8934	012 358 8920
CTMM Engineering	Mr. Potus	012 3587999	012 3587741
CTMM Power	J. Snyman	012 3584272	012 3584251
CTMM Roads	F. Lombaard	012 3583862	012 3583739/3351
Councillor – Ward 64	C. McDonald	012 6616575	0825634570
Councillor – Ward 65	Mrs. Spoelstra	012 6673095	0828805300
Denel	E. Rambotha	012 6751555	012 6711555
Doornkloof Owners Association	D. Larsen	0866895220	011 3161393
DWAF	P. Ngulwana	012 3921438	012 3921415
Eskom Land & Rights+ Distribution	E.C. Lennox	011 800 3917	
Execucrete Readymix	F. Kruijer	011 3161489	011 3161486
Gauteng Conservancy Association	B. Dehning	086 5107814	0826511501
Gauteng Department Transport, Public Roads and Works	D. Visser	011 3557099	0823731152
Gauteng Department of Housing	M. Mnyani	011 3554541	0113554020
GDACE	M. Dzvihani	011 355 1000	
Irene Vigilance Society	F. Taljaard	0865023702	0827399491
Kungwini Municipal Manager	J.S. Gomba	0139323752	0139326200
Kungwini Planning	C. Matjila	0139351311	0139326387
Midrand Estate	J. Zederberg	012 6611139	012 6611177
National Association of Conservancies of SA	B. Dehning	086 5107814	0826511501
National Department of Minerals & Energy	L. Ndimade	011 3391927	0824466035
Nellmapius Drive Resident Committee	A. van Blottnitz	012 6674119	012 674120

Ostiprop Developments	H. Joubert	012 346 2509	012 346 5336
SAHRA	T. Kgomonnu	011 4032609	011 4030683
Salberg Concrete Products	P. Pretorius; D. Salburg; N. Preston; T. Dutton.	011 3163402	011 3163410
Smuts Farm Conservancy		012 4202552	
SARCC	H. Emeran	011 8042961	
Twin Rivers	P. van Rensburg		0832301076
UNISA	O. Lombaard	012 4293260	0124293220
Ward committee (65) & Irene land owners director	M. Knoetze	012 6641916	012 6672632
Wetland Specialist	P. Van Eeden	0119725298	0833794419
WESSA	M. Mengell	012 6672183	0834551736
	T. Muller		0823385455

5.2.4 Raised issues and concerns

Table 8 lists I&AP's that registered issues on the comment sheets.

All registered Interested and Affected Parties were invited to the Public Meeting held on the 23rd November 2006 that was held at the Irene Country Lodge at 18:00. Table 8 lists the issues that were raised during the public meeting.

Table 11: Summary of Issues that were received before the Public Meeting of 23 November 2006

Date	Interested and Affected Party	Raised Issues
3 Nov 06	Dr. H. Joubert	<ul style="list-style-type: none"> Impact of a 15m high fill across the Olifantspruit; Noise pollution; Visual aspect; Impact on the flood line of the spruit; Impact on township development; Impact on public transport; Impact on the character of the area; and Impact on the value of property in the area.
13 Nov 06	Mrs. F. Taljaard (Irene Vigilance Association)	<ul style="list-style-type: none"> Construction of the road must take place in an environmentally friendly manner
21 Nov 06	Councillor J.C. Spoelstra	<ul style="list-style-type: none"> Impact of the traffic congestion in the area. The only solution is that the K54 must be built.

Table 12: Summary of issues raised during the public meeting

Interested and Affected Party	Raised Issues	Response
Mr. A. von Blottnitz	<ul style="list-style-type: none"> The proposed K54 will not cater for traffic movement from east of Irene to Rooihuiskraal. Will the crossing over the railway line be fill and how high it will be 	<ul style="list-style-type: none"> The K54 is envisaged to cater for east west traffic travelling to and from Kungwini. It will eventually in future cross the R21 and link with Silverlakes. The K111 will then link with the K54 and K220 to provide additional east west routes.

		<ul style="list-style-type: none"> ○ The fill will be 15m high from the railway line.
P. Pretorius	<ul style="list-style-type: none"> ○ Is an intersection planned at the St. Georges Hotel in order to join the highway to Kempton Park to Pretoria. ○ The proposed K105 will cross their factory and how will the K54 interact with the K105; ○ He wants to know whether a new railway station is planned 	<ul style="list-style-type: none"> ○ Access will be provided to the Highway. The intersection is not relevant to the K54 application. ○ Engineers will address issues and specific steps must be followed to resolve the influence of the alignment of the K105 on the K54 and vice versa; ○ There is a possibility of a new railway station. It will form part of the integrated planning for the area.
J. Joubert	<ul style="list-style-type: none"> ○ A solution must be provided for the K54 together with the K105 and the commuter station; ○ There will be a problem with the K54 crossing the rail line; ○ The K105 must accommodate legal roads; ○ The 200m servitude must be reduced with the new proclaimed design. Access must be provided to new developments in the planning phase of the road alignment. 	
M. Knoetze	<ul style="list-style-type: none"> ○ Concern about the end points of the K54. An end point for the proposed alignment will be the starting point for the future alignments. 	<ul style="list-style-type: none"> ○ Plans for the rest of the alignment are available at the Gauteng Department of Transport, Public Roads and Works and via D Garner. The proclaimed status is in the government gazette. The existing status will remain until re-proclamation.

5.2.5 List of Critical Issues

The following key issues have been identified based on the responses received during the scoping phase as indicated in Table 10.

Table 13: Key Issues that been identified based on the responses received during the Scoping Phase

Issue	Nature of Issue
<ul style="list-style-type: none"> ○ Noise pollution 	<ul style="list-style-type: none"> ○ Traffic along the K54 is likely to give rise to noise impacts. This noise impact was likely to impact on the Twin Rivers

	development area.
o Visual Impact	o The proposed fill to obtain a height of 15m from the railway line to the Olifantspruit is likely to give rise to a visual impact. This impact was likely to impact on the Twin Rivers development area.
o Integrated Planning needed	o Integrated planning must be adopted for the K54 realignment, K105 and the commuter station. This must include liaison with relevant participating bodies such that a proactive and logical development plan can emerge to guide development in the short, medium and long term.
o Access	o Access must be provided to the respective proposed developments from the K54. This must be planned during the planning phase of the proposed road.
o Environmental sensitivities	o Environmental sensitivities must be protected. This includes the Bakwena Cave, Red Data plant and fauna habitats, sensitive areas avoided by the K105 and the flood line of the Olifantspruit.
o Sensitive vegetation east of Railway line	o Vegetation east of the railway line and on the Smuts Koppie are sensitive. The K54 should not affect these areas that are potential habitat for Red Data plant species

Table 14: List of Interested and Affected Parties Contacted and Notified of the Public Feedback Meeting of the K54 Road (EIA Phase)

Organisation	Name	Fax.	Tel.
National Department of Agriculture	S. Rathebe	011 3551000	011 3551917
ARC Irene	C. Oosthuizen	012 6651605	0868367264
Agricultural Research Council	C. Zwiendelaar	012 665 1563	012 672 9130
Bokamoso Environmental Consultants	L. Gregory	012 4607079	012 3481914
BKS	C. Pretorius	012 4213737	012 4213736
CTMM City Planning & Env.	M. Wheeler	012 358 8934	012 358 8920
CTMM Engineering	Mr. Potus	012 3587999	012 3587741
CTMM Power	J. Snyman	012 3584272	012 3584251
CTMM Roads	F. Lombaard	012 3583862	012 3583739/3351
Councillor – Ward 64	C. McDonald	012 6616575	0825634570
Councillor – Ward 65	Mrs. Spoelstra	012 6673095	0828805300
Denel	E. Rambotha	012 6751555	012 6711555
Doornkloof Owners Association	D. Larsen	0866895220	011 3161393
DWAF	P. Nguluana	012 3921438	012 3921415
Eskom Land & Rights+ Distribution	E.C. Lennox	011 800 3917	
Execucrete Readymix	F. Kruijer	011 3161489	011 3161486
Gauteng Conservancy Association	B. Dehning	086 5107814	0826511501
Gauteng Department Transport, Public Roads and Works	D. Visser	011 3557099	0823731152
Gauteng Department of Housing	M. Mnyani	011 3554541	0113554020

GDACE	M. Dzvihani	011 355 1000	
Irene Vigilance Society	F. Taljaard	0865023702	0827399491
Kungwini Municipal Manager	J.S. Gomba	0139323752	0139326200
Kungwini Planning	C. Matjila	0139351311	0139326387
Midrand Estates	J. Zederberg	012 6611139	012 6611177
National Association of Conservancies of SA	B. Dehning	086 510 7814	0826511501
National Department of Minerals & Energy	L. Ndimade	011 3391927	0824466035
Nellmapius Drive Resident Committee	A. van Blottnitz	012 6674119	012 674120
Ostiprop Developments	H. Joubert	012 346 2509	012 346 5336
SAHRA	T. Kgomonnu	011 4032609	011 4030683
Salberg Concrete Products	P. Pretorius; D. Salburg; N. Preston; T. Dutton.	011 3163402	011 3163410
Smuts Farm Conservancy		012 4202552	
SARCC	H. Emeran	011 8042961	
Twin Rivers	P. van Rensburg	086 671 7227	0832301076
UNISA	O. Lombaard	012 4293260	0124293220
Ward committee (65) & Irene land owners director	M. Knoetze	012 6641916	012 6672632
Wetland Specialist	P. Van Eeden	011 972 5298	0833794419
Wildlife and Environment Society of S.A (WESSA)	M. Mengell	012 6672183	0834551736
	T. Muller		0823385455
M&T Developments	Francois van Rensburg	(012) 991 3034	(012) 991 9700

5.2.6 List of Issues/Comments received During EIA Process

Table 15: List of Issues/Comments received During EIA Process

Interested and Affected Party	Issue/Comment
Mr. Francois van Rensburg – M&T Development	With reference to land surveyor information that was provided by Mr. Herman Joubert and Mr. Eras Venter, it does not seem that their property is directly affected by the changes to the K54. He stated that they could however be indirectly affected. (refer to Appendix G13 for email). The impacts of the vertical alignment of the road must be considered.
Mr. D. Larsen – Doornkloof Owners Association.	Concerned with noise impacts related to the K54 on Residential Areas. Noise attenuation barriers, close to the road, comprising earth berms and/or concrete walls, and road surface options must merit careful consideration. Please refer to Appendix G13 for comments received from Mr. Larsen)

Please refer to Appendix G12 for the Notes of the Public feedback Meeting.

5.3 Way Forward

The commenting period (30 Day) for the Environmental Impact Assessment Report ceases on **01 October 2007**. The Final Report will subsequently be submitted to the GDACE for their consideration. The Record of Decision (RoD) for the proposed realignment will then be issued by the GDACE which will be made available to the I&AP's.

SECTION SIX – ASSESSMENT OF IMPACTS OF THE ALTERNATIVE ROAD ALIGNMENTS FOR THE K54

6.1 Introduction

The Regulations in terms of Chapter 5 of the National Environmental Management Act, Act No. 107 of 1998 requires that a description must be given of the potential impacts the proposed development will have on the environment.

6.2 Methodology Adapted in Assessing the Impacts

The identified impacts are based on information that has been received and reviewed from specialist studies and the public participation process. Some of the information has been collected during site visits and field surveys. These impacts may be subject to re-evaluation should an alternative be authorised for the realignment of the road and the subsequent studies for the proposed construction of the road.

As a means of determining the significance of the various impacts that can or may be associated with the proposed development, a series of assessment criteria were used for each impact. These criteria include an examination of the nature, extent, duration, intensity and probability of the impact occurring, and assessing whether the impact will be positive or negative for the natural as well as the biophysical environments at, and surrounding, the site.

The potential impacts related to the three alternatives realignments of, and not the construction of, the K54 is provided. The impacts of the three alignments on identified features of ecological, social and cultural/historical significance are compared. The evaluation of impacts for the construction of the K54 will be done according to a series of assessment criteria. This will be undertaken by considering the effects that may result should the impact occur.

DEFINITION OF TERMS USED TO ASSESS IMPACTS:

Extent:

This indicates the special area that may be affected by the impact and further describes the possibility that adjoining areas may be impacted upon. This includes four classes that are listed as follows:

- Local – Extending only as far as the site
- Limited – Limited to the site and it's immediate surrounds
- Regional – Extending beyond the immediate surrounds to affect a larger area
- National or International

Duration:

This refers to the period of the time that the impact may be operative for (i.e. the lifetime of the impact). This includes the following four classes that are listed as follows:

- Short – 0 - 5 years
- Medium – 5 -15 years

- Long – > 15 years and/or where natural processes will return following the cessation of the activity or following human intervention
- Permanent – Where mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient

Intensity:

This indicates whether the impact is likely to be destructive or have a lesser effect. Three such classes of intensity are defined and these are listed as:

- Low – Where natural, cultural and social functions and processes are not affected by the development
- Medium – Where natural, cultural and/or social functions and processes are affected by the development but can continue in a modified way
- High – Where natural, cultural and /or social functions and processes are altered to the extent that it will temporarily or permanently cease

Probability:

This refers to the likelihood of the impact actually occurring. The following four classes are used to describe the probability of the impact:

- None – The impact will not have an influence on the decision and requires no mitigation
- Medium – The impact is likely to have an influence on the decision and requires mitigation
- High – Mitigation is required and this may not be sufficient to ensure that the environment is not detrimentally affected by the proposed development

Significance:

The significance of the impact (i.e. whether it will lead to a marked change in the environment or not) is determined through a synthesis of the aspects produced in terms of their nature, intensity, extent and probability. Four classes of significance exist:

- None – The impact will not have an influence on the decision and requires no mitigation
- Low – Where it is likely to have an influence on the decision and requires mitigation
- Medium – Where it should have an influence on the decision unless it is mitigated
- High – Where it would influence the decision regardless of any possible mitigation

6.3 Identified Impacts

6.3.1 Impacts on Agricultural Value of the Land

Alternatives 1, 2 & 3 would result in the direct loss of approximately 2,1 hectares of high potential agricultural land. The inaccessibility of land north of the proposed road could lead to the loss of approximately 7,5 hectares of cultivated land, and would lead to a decline in the amount of maize cultivated which is harvested for animal feed, and thus lead to a shortage of animal feed. It would then be necessary to import sufficient animal feed, which would raise the running costs of the ARC Irene. An implement culvert will be provided to allow for continued cultivation of the 7,5ha of land to the north.

According to the Draft Status Quo Report generated for the N1/R21 Quadrant, the area to be affected by the K54 will fall into land which has a General Agricultural Potential for Irrigated Crops (Tomato, Cabbage and Spinach) of Low to None, a General Agricultural Potential for Maize of Low to None, and a Moderate to High Grazing Potential. However, due to problems such as theft and slaughtering of livestock, the profitability of cattle farming is declining, and thus the use of the land for grazing may become redundant over time.

The agricultural study that was conducted by Index in November 2006 concluded the following –

- Approximately 8 hectares will be impacted on but only 2,1 hectares directly affected land will be lost of the production of crops.
- The realignment of the road will influence approximately 2,1 hectares of land suitable for horticulture.
- The land under discussion has a high potential for poultry production, but due to the size of the farm, can be placed elsewhere which will then not detrimentally influence the potential.
- The site has a high potential for pig farming. Pigs can be produced on the land on condition that it does not impose a health hazard to residential areas.
- The building of the road will take approximately 25 hectares out of production (calculated at the road and the reserve of 48 metres)

The size of the farm will allow that facilities affected by the road can be placed elsewhere.

In a meeting with Carl Zwiegelaar of the ARC and Index on 26 January 2006, ARC in essence agreed with the report. He however indicated the following:

- There is a borehole located near to where the road will cross that they want to use as standby source for irrigation. This pump in some way needs protection
- They accept that the road will fragment the farm and will make management more difficult.
- Theft once access is improved is a concern. It will be desirable to erect a security fence along the road.

In summary, the impact of the realignment on the Agricultural Potential of the land is likely to be of Local extent, Permanent duration, Low intensity and Highly probable. The significance of the impact is considered to be Low.

Significance of the Impact				
Alternative	None	Low	Medium	High
Alternative 1		√		
Alternative 2		√		
Alternative 3		√		
"No-Go"	√			

6.3.2 Impacts on Terrestrial Ecology

6.3.2.1 Loss of habitat and potential habitat and eco systems

The K54 could potentially have a negative impact on the ecology along the new route. This will include the loss and alteration of the habitat of common faunal and floral species that are found in natural grassland and primary rocky outcrop areas.

The construction of a K54 route road will require a 200m road reserve but the disturbance and removal of vegetation will be limited to a 50m wide strip

Alternatives 1 and 2 affect similar habitat types along their routes. Alternative 1 is the only route to affect the rocky grassland in the north-western corner which is considered sensitive due to a good species composition and faunal habitat. Both these alignments cross the tributary of the Sesmylspruit and the Olifantspruit which will impact on the functioning of these eco-systems if not properly mitigated. This alternative however runs along the Southdowns development for a section which reduces the quality of habitat due to edge effects. The loss of habitat/eco-systems for these alternatives is considered to be similar.

Alternative 3 affects the least number of habitat types. This alignment affects agricultural fields, disturbed grassland and infrastructure associated with the ARC land.

This alternative will impact on the tributary of the Sesmylspruit and the Olifantspruit which will affect the functioning of these eco-systems. Due to the amount of disturbed areas to be affected by this alternative its impacts on loss of habitat/eco-systems is considered to be less than alternatives 1 and 2.

Mitigation measures can include:

- Specific management plans must be implemented where the road crosses sensitive areas like the wetlands (stream and river) and natural grassland areas;
- The area to be disturbed in the road servitude should be demarcated to allow for the conservation of land not to be affected (give the large servitude – 200m);
- Duration of construction in the wetlands must be minimised as far as possible and all construction activities must be done in as shortest time possible;
- Access routes for construction vehicles must be planned before construction begins and kept within the road reserve. This is to prevent several tracks forming over the grassland;
- The construction camps location should be determined in association with the ECO;
- According to the wetland study both the stream and river must be fully spanned (i.e. a bridge). The footprint of supports or other structures in the buffer area (indicated in the wetland report) must be kept to a minimum;
- Runoff from the road surface must be prevented from entering the wetland

directly. Flow energy must be dissipated in attenuation dams or other means and dispersed gradually into the adjacent substrate. The storm water management system must be approved by DWAF and the ECO;

- No vehicular access must be allowed into the wetland except a single, temporary crossing which must be fully rehabilitated after construction;
- Construction that may impact on the wetland should be conducted in the dry season;
- Strict regulation – with penalties – against dumping of rubble, water runoff, pollution or contamination of the wetland, including accidental contamination must be enforced;

In summary, the impact of these alignments on the land will be of Local extent, Permanent duration, Medium intensity and High probability. The significance of the loss of habitat will be High for Alternative 1, Medium for Alternative 2 and Low for Alternative 3.

Significance of the Impact				
Alternative	None	Low	Medium	High
Alternative 1				√
Alternative 2			√	
Alternative 3		√		
"No-Go"	√			

6.3.2.2 Loss of sensitive species

Five Red/Orange data floral species were considered to have a high probability of occurring on the site based on availability of suitable habitat and GDACE data. One of these species was observed on the site and another not included on the GDACE list for the quarter degree grid. Both these species are orange listed and considered to be declining. All three alternatives will impact on individuals of this species which must be mitigated.

A number of red data bird and mammal species can potentially occur on the site and will make use of the large consolidated sections of grassland as well as along the stream and river. These habitats will be impacted on by all the alternatives fragmenting the grasslands and affecting the wetland systems. Most of these species are able to move away from the disturbances and the wetlands will only be impacted on at one point. The smaller rodents will potentially be killed by construction vehicles or predators when displaced.

No invertebrates of concern were observed during the assessment. An area by the Southdowns College was considered to be suitable habitat for the Red Data Stobias fruit Chafer and will be impacted on by Alternative 1 which will result in the loss of habitat for this species. This species has however not been confirmed to occur on the site by the invertebrate specialist.

P. Roos & G. Henning CC has indicated in their specialist report that it is not expected that the realignment of the road will adversely affect the colony of *Ichneustoma stobbiai* at Smuts Koppie to the extent of it being in danger of extinction. The greatest detrimental effect would probably be that the colony might become more isolated than it is at the moment. It has been established that it already is a small satellite colony with no gene flow to other colonies. It is known that bat species feed on Invertebrate species in the area. It is not envisaged that the realignment of the road will disturb and cause the possible abandonment of the bats in the Bakwena

Cave and will therefore not influence the invertebrate populations of the area.

It must be made apparent that the proposed change of land use will permanently and irreparably change the present landscape and result in displacement of existing land users and activities including invertebrates and other living organisms.

In their opinion there are no specific invertebrate habitats within the survey area worthy of any special conservation considerations other than the small dam or wetland and the patch of woodland between the dam and Nellmapius Road.

The specialist report that was conducted by VC Management Services has indicated that the surveyed riparian and wetland areas on the development property does not offer suitable or aestivating sites for Giant Bullfrogs. The small dam on site may provide suitable breeding conditions but the frogs does not breed in moving water and water flow and fluctuation may be excessive after heavy rains. The realignment of the road is therefore not likely to have an affect on Giant Bullfrog populations that could possibly occur in the area.

Mitigation measures include:

- The two (2) orange listed species that are under direct threat from construction activities must be transplanted to suitable areas on the site;
- Any protected or medicinal flora to be removed by construction must either be protected in the road reserve or re-located to other suitable areas
- Some of the large *Eucalyptus* trees must be retained as they provide roosting places for bat species;

In summary, the impact of the realignment on the general sensitive species will be of Local extent, Permanent duration, Medium intensity and Medium probability. The significance of the loss of these species will be High for Alternative 1 and Medium for Alternatives 2 and 3.

Significance of the Impact				
Alternative	None	Low	Medium	High
Alternative 1				√
Alternative 2			√	
Alternative 3			√	
"No-Go"	√			

6.3.2.3 Impacts on habitat/rural connectivity and open space

The impact on connectivity is likely to be the most negative impact associated with construction of the K 54 road due to its linear nature.

Connectivity on the ARC land is generally considered to be good. Large patches of grassland are still present and the land is still linked to some undeveloped land to the east. The land is however not pristine or unaffected in totality as existing infrastructure, tarred roads, agricultural fields and buildings are present on sections of the property.

On a more regional perspective, urban development has occurred to the south (Midrand Estates), north (Southdowns Estate) and west (Brakfontein) of the study area which has affected connectivity to a certain extent. In both the Southdowns and Midrand Estates developments, attention was however given to the development of connected open spaces. The K54 would run through the northern extremities of the habitat for the African Grass Owl which consists of disturbed and cultivated grass

land portions in Irene. A migration corridor is currently being conserved for the Grass Owls in the southern more sensitive habitat which extends through to Midrand Estates.

Elements of these connected open spaces include grassland habitats, streams, rivers and servitudes. Wetlands are important corridors especially in built up areas and connect open spaces separated by developments.

Should the K54 be constructed without acknowledging existing open spaces and allowing for the linking of already created open spaces in the landscape, it will potentially impact more negatively on connectivity on a regional level.

The K54 should therefore allow for specific design features that will allow for connectivity at critical points (See Figure 6) In addition construction activities should be implemented to limit impacts on surrounding natural land.

- Connectivity must be maintained along the stream and river by constructing a bridge type crossing rather than a culvert;
- Where the road cuts through large sections of grasslands, design measures must be taken to allow movement of species across the road. Pipes, culverts, bridges or other structures large enough for small to medium sized mammals to pass through must be placed under the road to allow species to safely cross the road. A specialist in this regard should be consulted timeously;
- The open spaces of the proposed developments (on sections of ARC land) must be marked and measures, such as the pipes mentioned above, must be implemented to allow for connectivity between these open spaces specifically in these areas;
- Boundary walls/fences must primarily be palisade-type fencing which will ensure that smaller faunal species are able to move freely between areas;

In summary, the impact of the realignment on connectivity is likely to be of Limited extent, Permanent duration, Moderate intensity and Highly probable. The significance of the loss in connectivity is considered to be Medium.

Significance of the Impact				
Alternative	None	Low	Medium	High
Alternative 1			√	
Alternative 2			√	
Alternative 3			√	
"No-Go"	√			

6.3.3 Impacts on Topography and Hydrology of the Site

VC Management Services CC has identified several impacts associated with the realignment of the road on the wetland and riparian areas of the study site.

6.3.3.1 Impacts on Doornkloof Vlei

The three alternatives alignments of the K54 all have the potential to impact negatively on the wetland area particularly during the construction phase. The link road from Nellmapius Drive will have the most serious impacts at its present alignment (Alternative 1) cuts diagonally across the most sensitive parts of the site. VC Management Services CC recommended that the Alternative 2 or 3 be realigned by about 300m to the south to avoid permanent damage to the functioning of the

wetland. This recommendation however would have serious socio-economic and engineering repercussions.

The impacts that have been identified are related to stream flow regulation, storm water and flood attenuation, sediment arrest, phosphate, nitrate and toxicant reduction, Carbon storage and erosion control, maintenance of biodiversity and recreation -

- The structural footprint of the road in the wetland could disturb stream flow with consequences on the natural management of floods, contamination and erosion.
- Construction activity, including vehicle movement in the wetland, waste disposal and other disturbances could cause temporary or permanent damage to hydrological functions.
- The consequences of damage to these particular functions will become more serious as the wetland has to absorb greater runoff from neighbouring developments.
- Disturbance during construction and traffic use thereafter will reduce faunal diversity, at least temporarily, at the site.
- Recreational use is currently very little. However, with growing urban development the demand for open space and wetland will increase. Any such future use may be reduced by the presence of a main road.

Measures can be implemented to ensure the functionality and protection of the wetland system.

In summary, the impact of development on the Doornkloof Vlei is likely to be of Regional extent, Permanent duration, Moderate intensity and Highly probable. The significance of the impacts on the wetland system is considered to be High for Alternative 1 and Medium for Alternatives 2 and 3.

Significance of the Impacts				
Alternative	None	Low	Medium	High
Alternative 1				√
Alternative 2			√	
Alternative 3			√	
"No-Go"	√			

6.3.3.2 Impacts on Olifantspruit

All three proposed road alignments will cross the Olifantspruit.

The site of the intersection (or overpass) of the K54 and K105 will cause considerable disturbance to the riparian ecology. The superstructure and earthworks necessary to accommodate the sharp fall in ground level from the railway to the river will severely damage the ridge and riverbank.

The impacts that have been identified are related to stream flow reduction, storm water and flood attenuation, bank stabilisation and floral habits, faunal habits, aesthetics and recreation –

- The structural footprint of the two major roads will impact on flood terraces and possibly the central channel unless carefully engineered to avoid this.
- The natural stabilisation of the bank and the riparian woodland will be disturbed, particularly by the K105 alignment

- Construction of the roads and particularly the intersection/overpass will have major impact on the habitat for Red Data species on the west bank and the connectivity corridor for the other species.
- The aesthetic appearance of this relatively unspoilt river will be irreparably damaged. Recreational use is currently nil or very low.

VC Management Services concluded that “the cumulative impact of the K105 and K54 in this sensitive riparian area is, we suggest, sufficient to merit investigation of an alternative alignment for both roads. Two kilometres south of the site the access road to the cement works passes under the railway. This may offer a suitable alternative alignment for the K54. An alternative to the K105 may be possible to the east of the site”.

If a realignment of the roads cannot be accommodated, we recommend that the planning of the footprint structures associated with the road should be conducted in close collaboration with scientists from all of the disciplines concerned with the site. Because of the complexity of the topography and the magnitude of the intersection / overpass, preliminary guidelines for an EMP or engineering specifications cannot be attempted at this stage without the resolution of further details.

In summary, the impact of development on the Olifant Spruit is likely to be of Regional extent, Permanent duration, Moderate intensity and Highly probable. The significance of the impacts on the wetland system is considered to be High.

Significance of the Impacts				
Alternative	None	Low	Medium	High
Alternative 1				√
Alternative 2				√
Alternative 3				√
“No-Go”	√			

The storm water management system for the K54 would have to be designed in such a way that the impact of storm water discharge into the drainage lines is minimal. This can be achieved by equipping the system with energy dissipaters, gabions, etc. These issues will be further addressed in the Environmental Management Plan for the construction and operation of the K54.

6.3.4 Impacts related to the Socio-Economic Factors

The approval of the existing alignment of the road (Alternative 1) would mean that the proposed layout of the Southdowns Development would need to be amended and that the school site would not be feasible. This is likely to have a large social impact on the Southdowns Development and general area.

Consequently it is suggested that the K54 be realigned so as to limit the impact on the Bakwena Cave as well as facilitate the development of the school as part of the Southdowns Development (i.e. win-win scenario)

Alternative 1 does not affect any ARC infrastructure. Alternative 2 would affect a residential dwelling and the ARC's Cattle and Sheep Facilities. Alternative 3 would directly affect a number of residential dwellings, ARC's Cattle and Sheep Facilities and the ARC's Dairy Science Buildings. The Expropriation costs associated with the demolishing and relocation of these facilities is significant. For example, in the case

of relocating the ARC Dairy Sciences Building that would be affected by alternative 3, a cost of R18 million has been calculated.

VC Management Services CC recommended that the road be realigned by about 300m to the south to avoid permanent damage to the functioning of the Doornkloof Vlei. This recommendation would have serious socio-economic and engineering repercussions.

To the north west of the site, a firm (Denel) has established their operational facilities. The realignment of the proposed K54 Route will not affect their operation any more or less than the existing proposed alignment, since the route deviates little from the original alignment to the south of the establishment.

The development of the K54 road would provide means of commuting between the south-western suburbs of Centurion and the south-eastern suburbs in Pretoria.

A number of job opportunities will be created during the construction and operational phases of the development.

In summary, the impact of development on the socio-economics is likely to be of Regional extent, Short, Moderate intensity and Highly probable. The significance of the impacts on the socio-economics is considered to be High for Alternatives 1, Medium for Alternative 2, High for Alternative 3 and High should the "No-Go" Alternative be pursued.

Significance of the Impacts				
Alternative	None	Low	Medium	High
Alternative 1				√
Alternative 2			√	
Alternative 3				√
"No-Go"				√

6.3.5 Impacts on Infrastructure and Services in the area

The following services will be affected by the realignment of the K54 Road.

- Tshwane's 132 KV Overhead Powerline

The vertical clearance of this power line where it crosses alternative 1 has to be 7,5m. Its has to be raised if the clearance is insufficient.

A pylon will be affected by Alternatives 2 and 3 and has to be relocated outside the proposed road reserve.

- Tshwane's Sewer Line

An existing 200mm diameter sewer line will cross under K54 at km 21.06. This sewer line has to be encased in concrete.

- Tshwane's Substation

It was learnt that this substation would be decommissioned in the medium term.

- Telkom Overhead Line

The Telkom overhead line along the ARC's access road off Road P38-1 has to be replaced with a cable under K54 at approximately km 20.8

- Rand Water Pipes to the west of Road P38-1

A 3,8m x 2m box culvert has to be constructed in the case of Alternative 1 to protect the existing 710mm diameter steel pipe.

This pipe has to be deviated and constructed below the cutting level of alternatives 2 and 3.

- Tshwane's Overhead Powerline

Tshwane's overhead powerline to the east of the Olifant Spruit has to be raised (if required) to provide a vertical clearance of at least 6.1m above K54's final road level.

- Telkom cable ducts to the west of Road P38-1

The cable ducts and manholes have to be deviated and/or lowered under alternative 1's access road A, K54 and the K54/Road P38-1 link.

The cable ducts and manholes have to be constructed below the cutting level of Alternatives 2 and 3.

In summary, the impact of re-alignment on the services infrastructure is likely to be of Regional extent, Short duration, Moderate intensity and Highly probable. The significance of the impacts on the services is considered to be Medium

Significance of the Impacts				
Alternative	None	Low	Medium	High
Alternative 1			√	
Alternative 2			√	
Alternative 3			√	
"No-Go"	√			

6.3.6 Impacts on Cultural and Historical Features

Although Irene and its surroundings are rich in culture historical elements of regional and national importance (e.g. The Smuts House), the proposed alignment and the four-kilometre section under investigation does not affect any of these elements or structures directly. The site assessment did not reveal any gravesites within the boundaries of the future road reserve or adjacent thereto.

Heritage sites are fixed features in the environment, occurring within specific spatial confines. Any impact upon them is permanent and non-reversible.

Sites of importance in the vicinity of the proposed realignment have already been incorporated in the planning of the road. A suitable buffer zone will be implemented around the Bakwena Cave on recommendations that have been made by the consultants and specialists. The sites that have been identified should be avoided as far as possible and clearly demarcated during the construction period of the future development of the road.

It must also be noted that archaeological material, by its very nature, occurs below ground. The developer should therefore keep in mind that archaeological sites might

be exposed during excavation activities during the construction period. Measures will be recommended in the Environmental Management Plan for construction for the protection and management of cultural features in the area.

In summary, the impact of the re-alignment on the cultural/historic features is likely to be of Local extent, Permanent duration, Low intensity and Highly probable. The significance of the impacts on the cultural/historic features is considered to be Low.

Significance of the Impact				
Alternative	None	Low	Medium	High
Alternative 1		√		
Alternative 2		√		
Alternative 3		√		
"No-Go"	√			

6.3.7 Cumulative Impacts of the future construction of the K54

The construction of the K54 will create an important east-west link between the south-west suburbs of Centurion and the south-east suburbs in the City of Tshwane. The road also proposes to relieve current and projected traffic congestion in the area. The road will also create access to existing and proposed roads for the area. The cumulative impacts are considered to be positive.

In summary, the cumulative impact of the re-alignment is likely to be of Regional extent, Permanent duration, High intensity and Highly probable. The significance of the cumulative impact is considered to be Low for Alternative 1, High for Alternatives 2 and 3 and High should the No-Go Alternative be pursued.

Significance of the Impact				
Alternative	None	Low	Medium	High
Alternative 1		√		
Alternative 2			√	
Alternative 3			√	
"No-Go"				√ (negative)

6.3.8 Foreseen Impacts Associated with the Construction and Operational Phases of the K54.

This assessment was conducted to determine the impacts of the proposed re-alignment of the K54 Road and not for the construction of the road. Should an alternative alignment for the road be approved, issues related to the construction and operation of the road would be addressed in more detail in the Scoping and EIA and associated Environmental Management Plan for the Application.

6.3.8.1 Impacts on the Karst Ecology of the Bakwena Cave

Dr Durand identified the following impacts that could possibly occur on the karst ecology of the Bakwena Cave:

- Abstraction of Water

The groundwater of the cave serves as habitat for the identified species of amphipods in the cave. The evidence in Bakwena Cave shows that the water table has dropped by at least 5m over the past decade. Two boreholes were sunk right

through the main chamber to access ground water in a compartment below the main chamber.

Mitigation can include the piping of stormwater into the drainage channels as opposed to natural seepage that could impact on the groundwater and dolomitic structure of the cave.

- **Habitat Loss**

Loss of foraging habitat threatens the survival of bat populations. Research has shown that fragmentation and degrading of habitats are major threats to bat populations that accompany urbanisation due to the removal of indigenous species. Urban areas show a notable reduction in number and diversity of insects that can be utilised by bats.

- **Alien Species**

Habitat degradation is amplified by the introduction of alien species into urban areas that not only displaces indigenous fauna and flora but also may become invasive. Several alien species occur along the riparian zone of the river that runs through Irene with the resulting habitat degradation.

- **Drainage**

The drainage pattern in built-up areas is dramatically altered, necessitating the installation of elaborate drainage systems. The effect this will have on the underlying karst system is profound. It has been observed in Gauteng that a leaking drain or even the rainwater concentrated on a spot by means of a gutter, will chemically erode the surrounding dolomite. Due to its high solubility, even rainwater with a pH of 6.8 may have an adverse effect on limestone and dolomite. Due to the fractured nature of the area in which Irene Cave is situated, this is an aspect that has to be carefully considered when planning development near the cave. It must also be kept in mind that Irene Cave is actually a sink hole.

Mitigation can include the piping of stormwater directly into the drainage channels as opposed to natural seepage that could impact on the groundwater and dolomitic structure of the cave.

- **Pollution and Waste Management**

Due to the solubility of dolomite, pollution can influence cave ecology in several ways. Since many cave habitats are dependent on water, the pollution of water entering the karst system and recharging the natural cave reservoirs could have a devastating and long-term effect on cave ecosystems. Structural damage to the karst and pollution of the groundwater pose a serious threat to karst ecosystems.

Mitigation can include the piping of stormwater directly into the drainage channels as opposed to natural seepage that could impact on the groundwater and dolomitic structure of the cave.

Many factors can contribute simultaneously to the degradation of the karst system. Studies have shown that urbanisation contributes to the degradation of groundwater as well as cave environments. French drains, as in the case of sewage works, lead to the eutrophication of water due to the high concentrations of sulphate, phosphate,

nitrite/nitrate and ammonia in addition to metals. It has been shown that a plume of pollutants emanates from landfills as the pollutants leach into the groundwater.

- Caving

Caves are used today as tourist attractions, for caving, education and for research. Caving activities occur in many of the hundreds of caves in Gauteng, Northwest and Limpopo Provinces whereas tourism is limited to only a few caves. Unfortunately visitors to caves wittingly or unwittingly disturb the organisms that dwell within. There are signs that Irene Cave is used by people for recreation and even to squat occasionally, judging by bedding, plastic bags, bottles and a metal ladder permanently fixed in the shaft. Whereas the amphipods seem to be impervious to short-term human interference, bats can be much more susceptible to human interference. The development of a fenced bat reserve around the cave would prevent unauthorised access to the cave.

- Use of Caves as Dumping Sites

It is a disturbing fact that caves have been used for decades as dumping sites. As in the case of old disused mine shafts, carcasses of cattle that died of diseases such as Anthrax were dumped in caves in the previous century. Many cavers and researchers are witnesses of this practice. In the case of inert materials it is unsightly and an environmental nuisance, but it can become a serious environmental problem in the case where toxic waste and carcasses are dumped in a cave. Dumping is one of the major concerns at Irene Cave. Over time people have dumped motor car parts, decaying metal containers and carcasses of animals in the cave. The development of a fenced bat reserve around the cave would prevent unauthorised access to the cave.

In summary, the impact of development on the cave is likely to be of Local extent, Permanent duration, Moderate intensity and Highly probable. The significance of the impacts on the cave is considered to be of High for Alternative 1, Medium for Alternative 2 and Low for Alternative 3.

Significance of the Impacts				
Alternative	None	Low	Medium	High
Alternative 1				√
Alternative 2			√	
Alternative 3		√		
"No-Go"	√			

6.3.8.2 Impacts on the Bats of the Bakwena Cave

Prof van der Merwe identified the following impacts on the bats of the Bakwena Cave:

A main road running 300 m from the cave should have a minimum effect on the bat populations of the cave. A similar bat survey was conducted at the Monument Park golf course where the residential development, Sterrewag Ext. 2 was proposed. Because this development was near a very sensitive cave it was again stipulated by the GDACE that the nearest developments must not be closer than 500 m from the cave. This cave is situated against a relatively steep sloping rocky face facing the very busy dual carriage way (the R21) about 80 m away. The only barrier between the opening of the cave and the road is a palisade fence. The noise of the vehicles

chasing past at high speeds is tremendous and can be heard for more than 500 m away. There is no buffer zone between this road and the cave opening 80 m away. The survey was conducted during October 2004, and subsequently took post graduate students on annual visits to the cave to monitor the bats, and to give the students training in how to catch bats (mist nets or harp traps), handle them and identify them. They were then immediately released. A significant change in the bat numbers could not be found. On my advice the developers had sealed off the opening of the cave with a steel grid. The nearest putting green to the cave is less than 30 m from the cave entrance. These greens, as well as the other lawns of the golf course are treated with various insecticides during the year. The nearest house to the cave opening is approximately 290 m away.

- The effects of lights and human activity on bats

Bats are adaptable and are not easily disturbed by development. The big problem is people entering the caves, especially maternity caves where they enter the breeding chambers. Some species actually benefit from human constructions. Free-tailed bats can even become a nuisance where they occupy the ceilings of buildings in large numbers. On the Groenkloof campus in Pretoria some of the buildings are occupied by hundreds of free-tailed bats, which are not at all affected by the proximity of other buildings, lights of these buildings or street lights in and around the campus, or human activities. People also attract bats successfully to their homes by erecting bat houses. Bats occupy vertical mine ducts as well as horizontal mine tunnels in close proximity to residential areas and roads. Some of these tunnels are also part of active mines, e.g. the Rooiberg mines before they were finally closed. The roof space of many houses in Pretoria are occupied by *Scotophilus dinganii* (African yellow bats) and *Neoromicia capensis* (Cape serotine bats), although not in large numbers.

A problem arises when people who want to get rid of bats make use of drastic measures such as poison without seeking professional advice. The biggest problem is unauthorized people entering old mines and caves and thereby disturbing the bats, sometimes deliberately.

The karst assessment expresses concern that roof-dwelling bats pose an ecological threat to cave-dwelling bats. Bats occurring in vast numbers, such as *Miniopterus schreibersii natalensis* (Schreiber's long-fingered bat) would more likely pose an ecological threat to roof-dwelling bats due to the vast numbers in which they are found. There is no scientific proof that the apparent increase in numbers and expansion of roof-dwelling bats are causing a threat to cavern-dwelling bats.

In summary, the impact of development on the bats of the Bakwena Cave is likely to be of Local extent, Permanent duration, Moderate intensity and Highly probable. The significance of the impacts on the bats is considered to be Medium for Alternative 1 and Low for Alternatives 2 and 3.

Significance of the Impacts				
Alternative	None	Low	Medium	High
Alternative 1			√	
Alternative 2		√		
Alternative 3		√		
"No-Go"	√			

6.3.8.3 Impacts associated with construction activities on Ecology

Construction activities are expected to have a variety of impacts on the fauna and flora of the area. Direct impacts include the removal of vegetation and the destruction of smaller animals unable to escape the construction area. Furthermore, faunal species making use of the site are likely to be disturbed by the increase of human activity associated with construction. Secondary impacts include the generation of noise and dust, which may displace faunal species. The construction activities will also impact on the stream and river potentially affecting their eco-system functioning. Construction activities and the vibration associated with the operation of the road could also pose a risk on the underlying geology of the site and cause further collapse of the Bakwena Cave. A buffer area with a radius of 300m should be demarcated during construction activities to prevent impacts on the cave and bats.

In summary, impacts associated with construction activities are likely to be of Local extent, Short duration, Moderate intensity and Highly probable. The significance of the impacts associated with construction activities is likely to be Medium without mitigation and Low with mitigation.

Mitigation Measures include:

- Siltation must be carefully and specifically managed especially when construction is in close proximity to the wetlands;
- Topsoil must be protected and stored separately for later use during rehabilitation;
- Rehabilitation should be done continuously but specifically making use of the growing season;
- Rehabilitation on steep slopes and in close proximity to streams should be highlighted early on in the design phase and measure be implemented timeously to prevent erosion and siltation of grassland and stream ecosystems;
- A stormwater system should be designed taking into account the sensitivity of open space connector areas such as wetlands;
- Before construction starts, construction workers should be educated with regards to littering, ad hoc veld fires and dumping;
- A sufficient number of chemical toilets must be situated in appropriate places to prevent pollution of the study site;
- The ignition of fires should be avoided unless in specified places for cooking purposes and no solid waste material should be burnt on the site;
- The capture or hunting of any fauna on the site is not permitted as it is unlawful;
- All waste materials should be removed from the site once construction has been completed and disposed of appropriately at a landfill facility;
- The substrate should be protected during construction to avoid soil erosion.

Significance of the Impact				
Alternative	None	Low	Medium	High
Alternative 1		√		
Alternative 2		√		
Alternative 3		√		
"No-Go"	√			

6.3.8.4 Impacts related to Noise

Dr. D Visser conducted a study of noise impacts on the breeding of pigs in 2001/2. The findings of the study indicated that a distance of between 750 meters and 1,5

kilometres must be kept between any noise generating structures, such as roads, and the facilities where pig breeding is in progress. The required distance varies according to many variables such as traffic load, decibels generated, etc. as well which stage of the breeding programme the pigs are at. The requirement of the ARC Irene is that the road be at least 750 meters from the pig, chicken and cattle breeding stations. The sale of the products of the cattle breeding programme at the ARC accounts for a large portion of the income of the research facility, and the negative impact of the noise generated by traffic on the road either during construction or during operation will therefore result in a substantial loss of income. Consequently the further the road from the ARC facilities, the lesser the impact on their operations. Proposed traffic movement along the K54 will result in an increase in the ambient noise levels in the area and is likely to impact on business, residential and social amenities in the area.

The predicted noise levels from the proposed alternatives on identified sensitive sites are:

Table 16: Predicted Noise Levels from the Proposed Road Alternative Alignments on Identified Sensitive Sites.

	Bakwena Cave	ARC School	ARC Complex
Alternative 1	66.6	70.6	61.1
Alternative 2	61.6	65.8	68.2
Alternative 3	As Alternative 2	As Alternative 2	As Alternative 2

For the Bakwena Cave and ARC School sites the noise levels of Alternatives 2 and 3 are approximately 5dB lower than Alternative 1. The comparative noise impact is low to moderate in favour of Alternatives 2 and 3. For the ARC Complex closest to the roads, the noise levels of Alternatives 2 and 3 are approximately 7dB higher than Alternative 1. The comparative noise impact is moderate to high in favour of Alternative 1.

Mr. D. Larsen made the following comments in regard with noise of the proposed road.

Adverse health effects of noise: Sources with low-frequency components. Disturbances may occur even though the sound pressure level during exposure is below 30 dBA. The evidence on low-frequency noise is sufficiently strong to warrant immediate concern. Various industrial sources emit continuous low-frequency noise (compressors, pumps, diesel engines, fans, public works); and large aircraft, heavy-duty vehicles and railway traffic produce intermittent low-frequency noise. Low-frequency noise may also produce vibrations and rattles as secondary effects. Health effects due to low-frequency components in noise are estimated to be more severe than for community noises in general. Since A-weighting underestimates the sound pressure level of noise with low-frequency components, a better assessment of health effects would be to use C-weighting. In residential populations heavy noise pollution could be associated with a combination of health effects.

Electrophysiological and behavioral methods have demonstrated that both continuous and intermittent noise indoors lead to sleep disturbance. The more intense the background noise, the more disturbing is its effect on sleep. Measurable effects on sleep start at background noise levels of about 30 dB. Physiological affects include changes in the pattern of sleep stages, especially a reduction in the proportion of REM sleep. Subjective effects have also been identified, such as difficulty in falling asleep, perceived sleep quality, and adverse after-effects such as headache and tiredness. Sensitive groups mainly include elderly persons, shift

workers and persons with physical or mental disorders. Where noise is continuous, the equivalent sound pressure level should not exceed 30 dBA indoors, if negative effects on sleep are to be avoided. When the noise is composed of a large proportion of low frequency sounds a still lower guideline value is recommended, because low-frequency noise can disturb rest and sleep even at low sound pressure levels. It should be noted that the adverse effect of noise partly depends on the nature of the source.

In dwellings, the critical effects of noise are on sleep, annoyance and speech interference. To avoid sleep disturbance, indoor guideline values for bedrooms are 30 dB LAeq for continuous noise and 45 dB LMax for single sound events. Lower levels may be annoying, depending on the nature of the noise source. The maximum sound pressure level should be measured with the instrument set at "Fast". To protect the majority of people from being seriously annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55 dB LAeq for a steady, continuous noise. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB LAeq. These values are based on annoyance studies, but most countries in Europe have adopted 40 dB LAeq as the maximum allowable level for new developments. Indeed, the lower value should be considered the maximum allowable sound pressure level for all new developments whenever feasible. At night, sound pressure levels at the outside facades of the living spaces should not exceed 45 dB LAeq and 60 dB LMax, so that people may sleep with bedroom windows open. These values have been obtained by assuming that the noise reduction from outside to inside with the window partly open is 15 dB.

Mr. John Hassall recommended that:

In all cases, the use of earth berms at the appropriate positions to partially or completely screen the sensitive sites should be considered if the vertical alignment is suitable and the material available. Depending on the local ground contours and precise alignment of the road, which define the height which an earth berm must extend in order to provide line of sight screening of the road noise sources from the position of a receiver, earth berms can provide a noise reduction of up to 12 dB, which is sufficient to reduce the worst case noise exposure at the nearest facades to approximately 55 dB.

For greatest possible effectiveness, a berm should provide at least complete visual screening of the noise source, usually taken to be 0.5m above the carriageway, be placed as close to the carriageway as possible, and extend for a sufficient distance that the direct noise from this position is the same as that from the screened noise at the nearest position which the road approaches the receiver.

It must also be remembered that a berm must be significantly higher to protect upper floor facades, especially where these are close to the carriageway, than for a ground floor façade.

An increase in noise levels will be experienced during the construction period associated with earth-moving and blasting activities.

In summary, the impact of the re-alignment on the ambient noise levels is likely to be of Regional extent, Permanent duration, Moderate intensity and Highly probable. The significance of the impacts on the traffic is considered to be High without mitigation and Medium with mitigation.

Significance of the Impact				
Alternative	None	Low	Medium	High
Alternative 1			√	
Alternative 2			√	
Alternative 3			√	
"No-Go"	√			

6.3.8.5 Impacts on Groundwater Resources

The realignment of the K54 will not have any detrimental impacts on the groundwater resources of the area. It is not foreseen that groundwater will be abstracted during the operational or construction periods of the proposed development. Measures will have to be implemented however during these periods to prevent groundwater contamination. Stormwater can be piped from the road to be directly discharged into the Olifant Spruit in stead of the proposal of storm water to be disseminated by surface flow and allowed to naturally seep into ground. This will prevent/limit stormwater discharge from the road to enter the groundwater and cause groundwater contamination. This will also limit impacts of the underlying dolomitic nature of the geology of the area. These issues will be further addressed in detail in the application and relevant Environmental Management Plan for the construction of the K54 Road. The groundwater is at risk of contamination of other agricultural and commercial activities in the area.

In summary, the impact of development on the groundwater is likely to be of Regional extent, Permanent duration, Moderate intensity and Medium probability. The significance of the impacts on the groundwater is considered to be Medium without mitigation and Low with mitigation.

Significance of the Impacts				
Alternative	None	Low	Medium	High
Alternative 1		√		
Alternative 2		√		
Alternative 3		√		
"No-Go"	√			

6.3.8.6 Impacts on Air Quality

The realignment of the K54 will not have any detrimental impacts on the air quality in the area. The air quality in the area is/has and will be affected by urban development in the area. An increase in dust levels and vehicle exhaust fumes will be experienced during the construction and operation periods. Mitigation measures for reducing impacts on air quality during the construction and operational period of the K54 will be addressed accordingly in the Environmental Management Plan for Construction and Operation of the K54.

In summary, the impact of development on the air quality is likely to be of Regional extent, Permanent duration, Moderate intensity and Medium probability. The significance of the impacts on the groundwater is considered to be Medium during construction and Medium during the operational phase.

Significance of the Impacts				
Alternative	None	Low	Medium	High
Alternative 1			√	
Alternative 2			√	
Alternative 3			√	
"No-Go"	√			

6.3.8.7 Impacts on Health, Safety and Security

Accessibility to the site will be increased and therefore incidents of stock theft, as well as theft of maize crops, are likely to increase. Increased accessibility to the site will also have a negative effect on any natural grassland or rocky outcrop habitat remaining on the site due to harvesting of medicinal plant material for traditional medicine and trampling. These factors would most likely encourage farmers, in particular the ARC, to increase the security of the property. Mitigation measures will have to be implemented as part of the EMP.

The structural integrity of the buildings existing near the proposed K54 route could potentially be impacted upon by blasting activities during the construction period of the road.

In summary, the impact of development on the air quality is likely to be of Regional extent, Permanent duration, Moderate intensity and Medium probability. The significance of the impacts on the groundwater is considered to be Medium during construction and Medium during the operational phase.

Significance of the Impact				
Alternative	None	Low	Medium	High
Alternative 1			√	
Alternative 2			√	
Alternative 3			√	
"No-Go"	√			

6.3.8.8 Impacts Associated with Traffic

Traffic volumes along the K54 are likely to increase with increased development in the area once construction of the road has been completed.

The approval of an alignment and the future construction of the K54 Road will provide access to and from Nellmapius road and consequently relieve traffic congestion that is currently experienced along this road. The development of the K54 Road will have a positive impact in terms of traffic flow and convenience to the broader community. The impacts on traffic in the area are considered to be positive. The construction of the K54 is crucial to ensure the commuting of areas east and west of the proposed road.

In summary, the impact of the re-alignment on the traffic is likely to be of Regional extent, Permanent duration, Moderate intensity and Highly probable. The significance of the impacts on the traffic is considered to be High (positive).

Significance of the Impacts				
Alternative	None	Low	Medium	High
Alternative 1				√
Alternative 2				√
Alternative 3				√
"No-Go"				√ (negative)

6.3.8.9 Impact on visual characteristics and aesthetic quality of the area

The characteristics of the study area are changing rapidly from rural to urban. This change necessitates the development of infrastructural development such as roads, which would not be considered "foreign" or out of place in this situation. The development of the road would for the most part, be compatible with the patterns and elements that currently define the urban nature of the landscape and would therefore not impact dramatically on the sense of place of the study area. However, where the road crosses the Olifantspruit valley, it does so with 6/7m high fill embankments. This could impact negatively on the quality and sense of place of the valley's landscape.

Potentially sensitive viewing areas are considered to be views from residential properties and public rights of way. Most middle-distant and close-up views to the proposed K54 would be experienced by people travelling along the M18 (Glen Avenue). Middle-distant views of the proposed K54 would also be experienced from the ARC complex and residents of Southdowns and Irene Ext 68 areas immediately north of the proposed alignment. From these areas only sections of the road would be visible at any given location because the houses in the township would block open (panoramic) views of the proposed road.

Close-up views of the road where it crosses the Olifantspruit valley in fill, would be experienced by people living immediately north of the proposed K54 alignment as well as by people travelling along the M18 (Glen Avenue) towards Irene. However, the trees in the valley would block or at least partially screen many of the views to the road.

Subsequent to meetings held with the Owner of Portion 15 of the Farm Doornkloof 391 JR, it was decided that the K54 be taken under the railway line and the K105. This will necessitate an elevation of \pm 6/7m over the Olifant Spruit in stead of the initial proposal of 15m.

This will reduce the affect the K54 will have on the visual environment. Visual intrusion originally rated as High for residents immediately north of the road in the Olifant Spruit Valley and for users of the M18 rating is predicted to reduce to Moderate in the operation phase, if the mitigating measures as proposed in the original Visual Impact Assessment are effectively applied. The primary reason for this is that the road will no longer break the horizon line for most views and it will be easier to screen the embankments with vegetation. However, the K54 will still have a High impact on the sense of place of the study area.

The vertical clearance and the design of the road crossing will be further investigated and alternatives considered during the detail design of the road when an alternative alignment has been chosen.

In summary, the impact of the re-alignment on the visual character is likely to be of Local extent, Permanent duration, Low intensity and Highly probable. The significance of the impacts on the visual character is considered to be Medium.

Significance of the Impact				
Alternative	None	Low	Medium	High
Alternative 1			√	
Alternative 2			√	
Alternative 3			√	
"No-Go"	√			

Please refer to Figure 7 for a General Sensitivity Map

CONCLUSIONS AND RECOMMENDATIONS

The proposed road alignment alternatives for the K54 have been compared to each other taking ecological, cultural/historical and social aspects into consideration. The preferred alternative has been selected in terms of the significance of the impacts that the alignment and future construction of the road might have on sensitive features in the study area.

The EIA process for the realignment of the K54 in Irene has highlighted the following key issues –

1. The current alignment of the K54 that has been gazetted and planned as part of the Southdowns Development. The current alignment is considered to be ecologically and environmentally unfavourable as it lies in proximity to the Bakwena Cave, negatively affects a larger portion of natural grassland and would restrict access to the Southdowns School;
2. The Bakwena Cave, that lies within a 50m distance of the existing alignment, is regarded to be ecologically sensitive. The karst ecologist indicated that the Bakwena Cave is home to a unique invertebrate species while the cave is currently unprotected. This means that people can enter the cave at any time. Such activities will have a significantly negative impact on the bats and subsequently the ecology of the cave;
3. A bat specialist has indicated that the K54 is not likely to significantly affect the bats *per se*. However mitigation measures must be considered to limit the impact of development activities on the bats and the cave. It is the bat specialists view that a buffer of 300m can adequately address these concerns;
4. No cultural historic resources that could be directly affected by the re-alignments occur in the area;
5. The existing alignment (Alternative 1), as well as alternatives 2 and 3, each bisect sensitive land features in very similar ways. Alternative 1 is however less desirable as it crosses a greater expanse of natural grassland and wetland, than either alternative 2 or 3. Alternative 2 however bisects a rocky outcrop located within the ARC property that is currently fragmented. However, the extent of the natural grassland affected by alternatives 2 and 3 is not significantly different;
6. Neither of the various alternatives directly impact on Red Data faunal or floral species. A wetland ecologist has concluded that the African Bullfrog is not likely to occur, or breed, on site. No Grass Owls were located on site and the area offers marginal habitat for this species. The Stobia's beetle does not occur on the site and habitat for this beetle will not be affected by the road alignments. The butterfly *Metisella meninx* occurs on the site and habitat for this species will be affected by the road. Open space movement corridors are available to ensure that this species is not significantly affected by the road. The same has been proposed for the grass owl;
7. Alternative 3 will impact directly on the ARC Dairy Breeding Building, and this impact will result in a project cost of R18 million. Alternative 2 affects less important buildings where the cost of expropriation will be significantly less. These costs will have to be born by the Gauteng Department of Public Works,

Roads and Transport (Gautrans). Currently, such funds are not likely to be readily available for the purpose of expropriation costs. The No Go option is likely to contribute significant impacts to the social environment, if adopted. This will include excessive traffic congestion, lack of access and associated economic as is currently the case;

8. GDACE in 2006 highlighted that the Bakwena cave was sensitive, that it contained bats that are not Red Data species and that the cave will need to be protected. It was indicated that a 500m zone around the cave be used to buffer the cave from development impacts. GDACE also indicated, that in the event that such a buffer distance was not feasible, then a motivation would be necessary to provide for a win:win solution to the problems and issues of developing in proximity to the cave;
9. An evaluation of options for re-aligning the road indicated that the 500m buffer would result in a direct impact on the ARC Dairy Breeding Building. The 300m buffer however would significantly reduce this relocation cost and subsequently the overall cost for the road;
10. In light of the above, it is proposed that the gazetted K54 road be re-aligned with the following requirements –
 - i. A 300m NO GO buffer be established around the Bakwena Cave. This area should be kept in its current ecological state and improved with ecological management over time. This area should thus form a bat/cave reserve (similar in concept to the Ruimsig Butterfly Reserve) and no development should be permitted in this area;
 - ii. The cave should be rehabilitated utilizing the services of a suitably qualified cave specialist. This rehabilitation should include the removal of existing litter, access control into the cave and the ongoing monitoring and reporting of the ecology of the cave;
 - iii. Within the 300m and 500m area, limited development that minimizes impacts on the bats and cave should be permitted. This should include the road, along with stringent mitigation measures that include for instance appropriate lighting, drainage, disturbance and noise berms.

In this regard it is proposed that Alternative 2 be selected. The various alternatives have similar impacts along most stretches of the road. However Alternative 2 offers a 300 m NO GO buffer around the sensitive Bakwena Cave, as well as not impacting directly onto the ARC Land and Buildings. An additional 500m buffer for limited land development around the Bakwena Cave is proposed such that impacts on the cave and the associated bats can be mitigated and minimized.

The re-alignment of the K54 away from the current alignment places GDACE in a unique position to establish a conservation reserve around the Bakwena cave. The opportunity for GDACE to create such a reserve as well as move both the existing ARC entrance road as well as the proposed K54 may be lost should the developer be placed in a position that it cannot meet its town planning conditions to construct the proposed link road.

The significance of the impacts, prior to mitigation, of the proposed road alternatives are -

Table 17: Summary of the significance of the Impacts of the Proposed Road Alternatives (L-Low; M - Medium; H - High)

Impact	Environmental Significance		
	Alternative 1 (Existing Alignment)	Alternative 2 (300m buffer)	Alternative 3 (500m buffer)
Agricultural Value of the Land	L	L	L
Loss of Habitat and Potential Habitat and Eco Systems	H	M	L
Loss of Sensitive Species	H	M	M
Habitat/Rural Connectivity	M	M	M
Doornkloof Vlei	H	M	M
Olifant Spruit	H	H	H
Socio-Economics	H	M	H
Existing Infrastructure and Services	M	M	M
Cultural Historic Features	L	L	L
Cumulative	H	M	H
Foreseen Impacts Associated with Construction and Operation of the K54			
Noise	M	M	M
Groundwater Resources	L	L	L
Ecology	L	L	L
Karst Ecology of the Bakwena Cave	H	M	L
Bats of the Bakwena Cave	M	L	L
Air Quality	M	M	M
Health, Safety and Security	M	M	M
Traffic	H	H	H
Visual Characteristics and Aesthetic Quality	M	M	M
Low	4	5	7
Medium	7	11	9
High	7	2	3

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SECTION SEVEN – PRELIMINARY/GENERIC ENVIRONMENTAL MANAGEMENT PLAN FOR THE CONSTRUCTION AND OF THE K54 PREFERRED ALTERNATIVE (ALTERNATIVE 2)

7.1 Introduction

The purpose and intent of an environmental management plan (EMP) is that it provides guidelines, processes and procedures that can ensure that the environment is not detrimentally affected by the proposed development. This includes strategies for monitoring the impacts on the site.

7.2 Planning and Design

7.2.1 Contractor Requirements

The Contractor must be made aware of the issues and impacts surrounding the proposed development site. The Contractor must also be provided with a copy of the EMP and the EMP must form part of any tender documents.

7.2.2 Waste Management

During the construction phase the Contractor must make provision for the appropriate removal of waste from the site to a permitted waste disposal facility. The accumulation of construction must be avoided as far as possible.

Provision must be made for a refuse storage area for temporary storage of refuse for the proposed development.

Provision needs to be made for the temporary storage of hazardous materials such as fuels, oils and paints. These could be stored in a ventilated, bunded area that can contain 110% of the volume of the largest container. Access to this storage area should be prohibited.

7.2.3 Storm Water Management

A Professional Engineer must draft a storm water management plan before the construction of the road commences. This should include consideration of the following:

- Methods to control storm water run-off during the construction phase so that significant silt does not enter the storm water management system
- Stringent measures must be implemented to prevent stormwater from seeping into groundwater and prevent possible groundwater contamination.
- Implementation of measures to dissipate the energy of the storm water before it is released into the drainage areas (Olifantspruit and Doornkloof Vlei)
- The distribution of storm water runoff as evenly as possible from the road
- Use of gabions, riffle beds and swales to reduce the velocity of water runoff

7.2.4 Sensitive Areas

All Identified sensitive landscapes and features must be included in the planning, management, use and rehabilitation of the site.

7.2.5 Appointment of an Environmental Control Officer (ECO)

An independent ECO should be appointed to oversee all environmental aspects relating to the development. The ECO should be ideally be appointed during the planning phase and his/her responsibilities will include:

- Auditing of compliance with the EMP (the frequency of audits will be determined during the planning phase)
- Writing of auditing reports and submitting it to relevant parties
- Liaison with relevant authorities
- Liaison with contractors regarding environmental management
- Reviewing of the complaints register that is to be kept on site during the construction phase
- Liaison with interested and affected parties when complaints need to be addressed
- Limiting construction activities to the construction areas;
- Waste management;
- Legal compliance with all relevant environmental legislation;
- Compliance with the conditions of the Record of Decision

The ECO shall have the right to investigate the site at any time during the project phases and unexpected visits will be allowed. The ECO shall provide a pre-construction, mid-construction and post-construction feedback report to GDACE. Weekly/Monthly auditing reports shall also be made available to all the relevant parties.

7.3 Site Establishment

7.3.1 Contractor's Camp

The construction camp must preferably be located away from the surrounding residential areas to minimise visual and noise impacts)

All movable materials and associated accessories must be stored overnight in the camp. The camp needs to be fenced with a lockable with access control for security purposes. If staff is to be accommodated on site, then adequate facilities (e.g. chemical toilets, cooking facilities, potable water etc.) must be provided.

7.3.2 Complaints Register

A complaints register must be kept on site in the main construction camp office. All complaints, issues and concerns shall be incorporated in feedback reports to GDACE. Where a complaint requires corrective action, this must be communicated to the relevant parties to ensure that the complainant is satisfied. Interested and Affected Parties must be notified when construction activities are to commence.

7.3.3 Stripping of Topsoil

Topsoil that is removed for the construction of the road must be stockpiled in a designated area. This area must be located upslope and away from any storm water channels, gullies or drains. The stockpile should be planted with grass to prevent erosion and wash-away of topsoil)

The soil that is to be covered by permanent structures must be stripped to a depth of 0.15m and stockpiled to a maximum height of 2.0m. No vehicles shall be permitted to drive onto the stockpiles and the stockpile must not be contaminated with any pollutants, including litter. The topsoil must be used for any rehabilitation after the construction period. The removal of herbaceous material from the stockpile must be prohibited.

7.3.4 Provision of Services

Chemical toilets must be provided for construction workers prior to the commencement of any construction activities. These must be regularly maintained and emptied as and when required. These toilets must be located within walking distance of the work staff and an average of 1 toilet per 5 workers must be provided.

7.3.5 Staff Awareness

Staff must be made aware of their responsibilities to ensure that impacts such as fire, safety and pollution are taken care of. This must include an induction program. The movement of construction workers must be controlled and access to adjacent properties must be prohibited.

7.3.6 Involvement of the ECO

The ECO should be involved in any decisions that are taken on site. This should include the approval of the layout plan and activities that are to be undertaken during the construction phase.

7.4 Construction

7.4.1 General Conditions

The contractor and sub-contractors that are appointed to undertake the works need to comply with the requirement of this EMP as well as any conditions laid down by GDACE.

No fires may be ignited outside the confines of the construction camp unless with just cause and reason. There should be no unnecessary disturbance of areas where construction works are not taking place and the ECO need to approve areas for stockpiling and storage prior to their use.

7.4.2 Storage of Equipment

All materials that can be moved (e.g. wheelbarrows, picks, axes etc.) and all vehicles that remain overnight on the site must be stored in the contractor's camp. This area must be fenced during the construction phase.

7.4.3 Vehicle Movement/Repairs

The movement of heavy vehicles to and from the site must occur of peak traffic hours (after 8h30 and before 16h30 during the week). No heavy vehicles may be permitted to move on site on weekends.

Roads in the direct vicinity of the site will be subject to continual use by construction vehicles, particularly heavy vehicles, carrying building materials, waste, etc. Special care should be taken to prevent spillages on the roads. Vehicles should be equipped with drip trays to prevent oil and fuel spillages. In the event of spillages, it should be reported immediately and cleaned as soon as possible.

Notices should be placed on visible locations in the vicinity of the construction site to warn public of construction activities and indicating that heavy vehicles may be using the road.

7.4.4 Storage of Fuel, Cement, Dangerous and Toxic Materials

All fuels that are stored on site shall be banded to 110% of the capacity of the bulk fuel storage container. This must be protected from damage by vehicles. The fuel storage area must not be located near (i.e. less than 100m) any water resource, including a spring, river, stream or surface water body.

Hazardous materials such as oils and paints should also be stored in specifically designed storage facilities.

Minor vehicle repairs must only take place within the confines of the contractor's camp. An appropriate work surface (i.e. banded concrete floor) must be provided that can collect oils, fuels and the like and these must be collected into an appropriate bin.

Where there have been oil/fuel leakages, contaminated soil must be removed and disposed of at an appropriately permitted site.

Cleaning of cement mixing and handling equipment should be done using proper cleaning trays and all empty cement containers should be removed from the site for appropriate disposal at a licensed commercial facility.

7.4.5 Control of Noise

Construction activities can cause environmental noise pollution. A disturbing noise is one that exceeds the zone sound level or the ambient sound level by 7 dB or more. A noise nuisance is defined as meaning "any sound that disturbs or impairs or may disturb or impair the convenience or peace of persons". This includes the use of power tools, movement of vehicles, etc. The following specific measures must therefore be adhered to:

- Limit construction times to the following hours:
- 06:00 to 18:00 during the week (Monday to Friday);
- 07:00 to 17:00 on Saturdays, and
- No noisy activities on a Sunday.
- Should blasting be required during the construction phase, the necessary permits must be obtained from the local authority and any other relevant authority. The contractor must comply with all applicable occupational health

- and safety requirements during blasting.
- Blasting times must be limited to the hours from 08:00 to 17:00 during weekdays only.
- Screen construction activities from residential, social and business entities with soil berms to limit noise

7.4.6 Safety and Security

The contractor's personnel must be adequately trained and informed in the tasks that they are expected to perform. This is required for their own safety as well as the safety of colleagues and other interested and/or affected parties. The contractor must ensure that his equipment is protected. Solid and construction waste should not accumulate on site as this could attract rodents and also poses a safety hazard. All excavated areas and/or holes should be clearly demarcated.

The movement of construction workers through the residential areas and ARC should be restricted wherever possible.

Adequate fencing needs to be provided around the site. This needs to be checked and maintained during the construction phase.

7.4.7 Waste Management

All domestic waste generated by the contractor's activities at the contractor's camp must be stored in either refuse bins (i.e. steel or plastic 210L drums) or in a waste skip. If weather conditions are windy, nets should cover these bins or skips. The Contractor must ensure that these containers are emptied on a weekly basis, or as and when required. All litter shall immediately be deposited into refuse bins or the waste skip. No litter must be left in the work areas or contractor's camp.

Construction waste must be stockpiled in the contractor's camp and the Contractor must dispose of this waste at a registered waste disposal site.

Contaminated construction waste must be dealt with separately. Soils that have been contaminated by diesel, petrol, oil or any other substance that may inhibit the growth of plants must be removed to a registered waste disposal site for hazardous waste. Only appropriate fill shall be used to replace the lost material.

The burning of waste on site shall be prohibited.

7.4.8 Air Quality

Dust generated by construction and earth moving activities and vehicle movement on temporary access roads must be mitigated by using appropriate dust suppression methods such as wetting these areas. Vehicle movement must be restricted to a speed of 30 km/hour

Stockpiles need to be covered in windy conditions and topsoil wetted down if required.

7.4.9 Surface Water

- DWAF must be consulted where Borrow Pits are excavated within 100m of rivers
- The ponding of water must be allowed to drain without giving rise to erosion or

- flooding
- Borrow Pits may not be used to establish a dam without prior consultation with DWAF
- The National water Act (1998) must be complied with at all times.
- Precautionary measures must at all times be taken to prevent the pollution or contamination of the soil and aquifer by grease, oil, fuels, solvents, chemicals, etc.
- Visual inspections must be undertaken on a regular basis. These must ensure the stability of water control structures, erosion and siltation impacts, clarity of water canalised to rivers by storm water control measures
- The DWAF must be notified in the event of any concern surrounding water quality or pollution.

7.4.10 Groundwater

The abstraction of groundwater, for any purpose during the construction phase, is not necessary and shall be prohibited.

The disturbance of groundwater resources such as fountains or springs must not be affected by the excavation or utilisation of borrow pits.

7.4.11 Sites of Cultural/Historical Significance

All sites that have been identified need to be clearly demarcated and unauthorised and uncontrolled access to these sites shall be prohibited.

Should any archaeological artefacts or resources be exposed during excavation, work on the area where these resources are found should cease immediately and the environmental control officer notified in this regard. The environmental control officer then needs to call on the services of an archaeologist so that the findings can be examined. No resources should be removed or interfered with prior to authorisation from the South African Heritage Resources Agency.

7.4.12 Terrestrial Ecology

- The harming, maiming, hunting or poaching of wildlife in any form or manner shall be prohibited;
- Contain fires ignited on site;
- Prevent the harvesting, removal or destruction of indigenous plant species not associated with construction activities;
- Remove all exotic plant species from site
- The burning of plants shall be prohibited

7.5 Post Construction

7.5.1 Ripping of Compacted Soil

All areas where soil has been compacted due to construction activities must be ripped in two perpendicular directions to a depth of 0.15m.

7.5.2 Site Rehabilitation

The site must be cleared of all construction equipment, waste and associated materials by the end of the construction phase of the project.

The sidewalks must be cleaned of all waste and associated materials by the end of the construction phase. Disturbed sidewalks must be rehabilitated.

Areas that were cleared for construction purposes such as the contractor's camp should be restored to its original condition.

Stockpiled topsoil and indigenous vegetation should be used for all rehabilitation purposes.

All burrow pits that were utilised for the abstraction of building materials should be rehabilitated to the minimum requirements of the Department of Minerals and Energy.

The rehabilitation plan must ensure that erosion by run off water does not occur.

7.6 Mitigation Measures and Proposed Management Programme

Issue	Objective	Mitigation Measure	Responsibility	Compliance (Y/N)
PLANNING & DESIGN				
Contractor Requirements	Ensure that the Contractor is aware of his/her responsibility	Provide the contractor with the EMP and Geotechnical Report	Client	
Environmental Control Officer	Ensure that activities on site are compliant with the requirements of the EMP and GDACE	Appoint an independent Environmental Control Officer to oversee environmental aspects of the development	Client	
Geology & Soils	Ensure surface stability	Decide upon foundation types for the structures from those suggested in the geotechnical report/Engineering Reports	Professional Engineer	
Geology and Soils	Ensure that damp does not rise from underneath structures	Include the necessary precautionary measures in design	Professional Engineer	
Geology and Soils	Ensure road stability and availability of suitable materials for road development	Roads should be designed with consideration given to the nature of the upper site soils.	Professional Engineer	
Storm Water Management Plan	Ensure that adequate provision is made for storm water run-off	Draw up a Storm Water Management plan for the site taking into consideration the gradient and road alignments	Professional Engineer	
Visuals & Aesthetics	Ensure that the visual aspects of construction are taken into consideration to lessen impacts on residential, business and social amenities in the area.	Screen construction areas with shade cloth or other suitable material from adjacent properties.	Contractor	

Issue	Objective	Mitigation Measure	Responsibility	Compliance (Y/N)
Waste Management	Ensure the effective and efficient separation, storage and removal of waste from the site	Develop a Waste Management Plan for the construction phase which will detail: <ul style="list-style-type: none"> - Schedules for collection - Responsible parties for collection - Details regarding waste separation (hazardous vs. general) - Provision of facilities for the separation and storage of waste - Details regarding the disposal of the waste (hazardous and general) - Assigns responsibilities for these activities 	Project Engineer	
SITE ESTABLISHMENT				
Construction activities	Ensure that there is no unnecessary disturbance to areas on the site and that construction activities take environmental considerations into account	A layout plan for construction activities needs to be developed and approved by the Environmental Control Officer	Project Engineer Contractor Environmental Control Officer	
Contractor's Camp	Ensure that the contractor's camp does not pollute the environment and is not located on a sensitive site	Staff facilities, ablutions, chemical toilets, potable water must be provided for the staff	Contractor	
Contractor's Camp	Ensure that camp does not infringe on adjacent property owners	Locate the camp away from immediately adjacent property owners	Contractor	

Issue	Objective	Mitigation Measure	Responsibility	Compliance (Y/N)
Soil	Ensure preservation of the top soil	Top soil stockpiles must be established in disturbed zones	Contractor	
Soil	Ensure that erosion impacts and siltation is kept under control	Areas scheduled for construction should be cleared only 1 week prior to construction	Contractor	
Training	Improve the awareness of all construction personnel with regard to environmental matters	Develop and implement a training programme to address environmental issues and responsibilities	Environmental Control Officer Contractor	
CONSTRUCTION				
Archaeological Evidence	Ensure the protection of archaeological sites	Construction must be stopped and a professional archaeologist consulted should any archaeological remains be uncovered	Contractor Environmental Control Officer Archaeologist	
Borrow Pits	Ensure that the soil resources are not over exploited	No borrow pit may be excavated from any sensitive or open space areas	Contractor & Environmental Officer	
Blasting	Ensure blasting does not pose a danger to workers or staff	Authorisation to undertake blasting activities must be obtained from the relevant authority	Contractor	
Blasting	Ensure blasting does not pose a danger to workers or staff	All conditions relating to blasting and the Occupational Health & Safety Act must be complied to	Contractor	
Cleaning of equipment	Ensure that spillages are minimised and that where these occur, that they are appropriately managed	Proper cleaning trays should be used for the cleaning of cement mixing and handling equipment	Contractor	
Communication	Ensure that interested and affected parties are provided with a medium through which to lay complaints with regard to activities on site	A complaints register should be kept in the site office. GDACEL needs to be informed of all complaints and corrective action must be taken where required.	Contractor	

Issue	Objective	Mitigation Measure	Responsibility	Compliance (Y/N)
Contaminated Soil	Ensure that soils that are contaminated do not pollute the environment	All soils that have been contaminated by fuel spills, paints spills, etc. must be appropriately removed from the site, which must then be rehabilitated.	Contractor	
Contractor's camp	Ensure that the contractor's camp is secure	All materials and equipment that can be moved must be stored overnight in the contractor's camp	Contractor	
Disturbed Ground Conditions	Ensure that disturbed ground conditions are identified	Accurately locate the presence of disturbed ground conditions during installation of underground services and construction	Contractor	
Disturbed Ground Conditions	Ensure the stability of the disturbed ground conditions	Prior to the construction of housing units, stabilise the disturbed ground conditions	Contractor	
Dust	Ensure dust does not significantly pollute neighbouring properties	Wet all exposed sand areas such as roadways, stockpiles and working areas that give rise to dust. This must ensure adequate dust suppression.	Contractor	
Environmental Control Officer	Ensure that there is compliance with the EMP on site	An Environmental Control Officer may inspect the site at any time during the construction phase	Environmental Control Officer	
Environmental Control Officer	Ensure that there is compliance with the EMP on site	A mid-construction and post-construction report should be forwarded to GDACEL for their information	Environmental Control Officer	
Effect of the EMP	Ensure that the EMP is enforced on all contractors	Each contractor and subcontractor must be notified on the content of this EMP.	Project Manager	

Issue	Objective	Mitigation Measure	Responsibility	Compliance (Y/N)
Effect of the EMP	Ensure that the EMP is enforced on all contractors	All contractors and subcontractors must be bound by the content and requirements in this EMP	Project Manager	
Fill Materials	Ensure the stability of fill materials	Fill materials must be compacted to the relevant densities	Professional Engineer	
Ground Water	Prevent the contamination of groundwater resources	Vehicles must be equipped with drip trays to prevent spillages of oils and fuels. Site specific hydrogeology studies should be conducted should any excavation take place	Contractor	
Installation of Services	Ensure that all points for water provision are regularly inspected for erosion impacts	Implement adequate mitigating measures to curtail any erosion impacts	Contractor	
Installation of Services	Ensure that water used to wash machinery and any other "grey" water does not pollute the site	Provide a wash bay with a gravel floor to contain such water	Contractor	
Litter	Ensure that the site remains clean and clear of litter	All litter must be collected into rubbish bins located on the site. These bins must be regularly (i.e. weekly) collected and transported to a registered waste disposal facility	Contractor	
Noise	Ensure that nuisance noise from construction activities does not disrupt the surrounding landowners	Limit construction time to the following hours: 06:00 to 18:00 during week; 07:00 to 15:00 on Saturdays, and no noisy activities on Sundays	Contractor	
Noise	Ensure that nuisance noise does not disrupt the surrounding land owners	Jack hammering and blasting, if required, must take place between the hours of 08:00 and	Contractor	

Issue	Objective	Mitigation Measure	Responsibility	Compliance (Y/N)
		17:00 during the week only		
Noise	Ensure that nuisance noise from construction vehicles does not disrupt the surrounding landowners	No heavy vehicles may be permitted to move on site on the weekend	Contractor	
Road Works and Traffic	Ensure that soil does not erode from culverts or similar structures	All culverts or similar structures must be stabilised with gabions and indigenous grasses or trees	Professional Engineer	
Road Works and Traffic	Ensure that local residents are not inconvenienced by the movement of construction vehicles off-site	The movement of heavy vehicles from the site must occur outside of peak traffic hours (after 08h30 and before 16h30)	Contractor	
Road Works and Traffic	Ensure that local residents are not inconvenienced by the movement of construction vehicles off-site	Spillages on the roads should be avoided. When these occur, they should be cleaned immediately	Contractor	
Road Works and Traffic	Ensure that local residents are not inconvenienced by the movement of construction vehicles off-site	Notices should be placed on Brakfontein Road during the construction period indicating that heavy vehicles are using the road	Contractor	
Safety & Security	Ensure the safety and security of staff and the public	All local authority by-laws must be adhered to	Contractor	
Safety & Security	Ensure the safety and security of staff and the public	All contractors must take cognisance of and abide by the Occupational Health and Safety Act (1993)	Contractor	
Safety & Security	Ensure the safety and security of staff and the public	Trenches to a depth greater than 1.5 m must be supported or appropriate warning must be provided	Contractor	
Safety & Security	Ensure the safety and security of staff and the public	Provided fencing needs to be checked and maintained	Contractor	

Issue	Objective	Mitigation Measure	Responsibility	Compliance (Y/N)
Safety & Security	Ensure the safety and security of staff and the public	The movement of construction workers through the residential area should be restricted wherever possible	Contractor	
Sense of Place	Ensure that the township integrates with the surrounding ecology	Boulders excavated on site must be used in the landscape plan for the township	Client/Contractor	
Soil	Ensure that storm water can not erode the top soil stockpile	Construct and maintain a berm around top soil stockpiles	Contractor	
Storage Facilities	Ensure that hazardous materials are stored according to legislative requirements	Specifically designed storage facilities need to be provided and used for hazardous materials.	Contractor	
Storage Facilities	Ensure that fuel stored on site does not pose a pollution and fire hazard	Fuels stored on site shall be banded to 150% of the capacity of the largest container.	Contractor	
Storage Facilities	Ensure that fuel stored on site does not pose a pollution hazard	The fuel storage area must not be located less than 100m from any water resource	Contractor	
Storm Water Run-off	Ensure that run-off does not contribute to erosion & siltation	Construct and maintain berms on the site to contain storm water run-off or establish riffle beds or retention ponds, as appropriate	Contractor	
Vehicle repairs	Ensure that spillages are minimised and that where these occur, that they are appropriately managed	Minor vehicle repairs on an appropriate work surface may take place in the contractors camp	Contractor	
Waste	Ensure the adequate removal of solid waste	All wastes (hazardous or general) must be collected and disposed of at an appropriate registered facility.	Contractor	

Issue	Objective	Mitigation Measure	Responsibility	Compliance (Y/N)
Waste	Ensure the adequate management of waste	Nets need to be provided over bins and skips should windy conditions prevail	Contractor	
Waste	Ensure the adequate management of waste	No waste should be burnt on site	Contractor	
Wet Wastes	Ensure that no wet waste is disposed of down drains, sewers, etc.	No wet wastes or solvents shall be permitted to be disposed of down sewers, drains or storm water drains	Contractor	
Wet Services	Ensure the integrity of the wet service infrastructure	Non-ferrous metal pipes or plastic pipes must be used for the wet services	Contractor	
POST CONSTRUCTION				
Site Rehabilitation	Ensure the site is left clean, orderly and free of rubble after construction activities	Remove all rubble, rubbish, litter, unused building equipment, contaminated soils or any other relevant articles from the site following the end of the construction phase	Contractor	
Soil	Promote the rehabilitation of the site back to its original condition as far as possible	Soil that has been compacted during construction activities must be ripped in two perpendicular directions	Contractor	
Soil	Ensure the re-use of top soil for rehabilitation	Top soil that is stockpiled on site must be used to rehabilitate the disturbed areas	Contractor	
Sidewalk Rehabilitation	Ensure that the sidewalks are left clean, orderly and free of rubble after construction activities	Rehabilitate disturbed sidewalks; remove all rubble, rubbish, litter or any other relevant articles from the sidewalks	Contractor	
MONITORING				
Audit Reports	Ensure adequate reporting of progress	Regular reports, mid and end	Environmental	

Issue	Objective	Mitigation Measure	Responsibility	Compliance (Y/N)
	with the development	construction are currently proposed, and should be forwarded to GDACEL	Control Officer	
Monitoring	Ensure compliance with the requirements of the EMP and GDACEL	Undertake monitoring activities on a fortnightly basis.	Environmental Control Officer	