FINAL BASIC ASSESSMENT REPORT FOR THE PROPOSED STANDERTON EXTENSION 9 DEVELOPMENT

Two portions of the Remainder of Portion 2 of the Farm Grootverlangen 409 IS

Reference: 1/3/1/16/1 G-47

BOKAMOSO
LANDSCAPE ARCHITECTS & ENVIRONMENTAL CONSULTANTS
P.O. BOX 11375
MAROELANA
0161
TEL: (012) 346 3810
Fax: 086 570 5659
Email:reception@bokamoso.net

January 2017

TABLE OF CONTENTS

List of figures

List of Tables

Appendices

Appendix A: Maps

Appendix B: Specialist Reports

Appendix B1: Geotechnical Investigation

Appendix B2: Floodline Study

Appendix B3: Fauna and Flora Habitat Assessment

Appendix B4: Services Report

Appendix B5: Traffic Impact Assessment Report

Appendix B6: Electrical Report

Appendix B7: Market Study

Appendix B8: Motivating Memorandum

Appendix B9: Letter from Department of Agriculture, Forestry and Fisheries

Appendix B10: SAHRA Comments

Appendix C: Proposed Layout

Appendix D: Environmental Management Programme

Appendix E: Public Participation Information

Appendix F: Company Profile and EAP CV

THE DRAFT BASIC ASSESSMENT REPORT

1. INTRODUCTION AND BACKGROUND

The Lekwa Local Municipality entered into a Deed of Sale with **Sky Village Properties CC** for the alienation of two portions of the Remainder of Portion 2 of the Farm Grootverlangen 409 IS. These portions of land will be referred to in this Basic Assessment Report as the study area and development site. The development site will include two portions of Portion 2 of the Farm Grootverlangen 409 IS measuring ±5.4123ha and ±0.9017ha respectively. These portions will be subdivided from the larger Remaining Extent of Portion 2 of the Farm Grootverlangen 409 IS, which is scattered all over Standerton due to previous subdivisions and township establishment. The combined area of the development site is ±6.314ha. ***Refer to Figure 1 for the conceptual land configuration.***

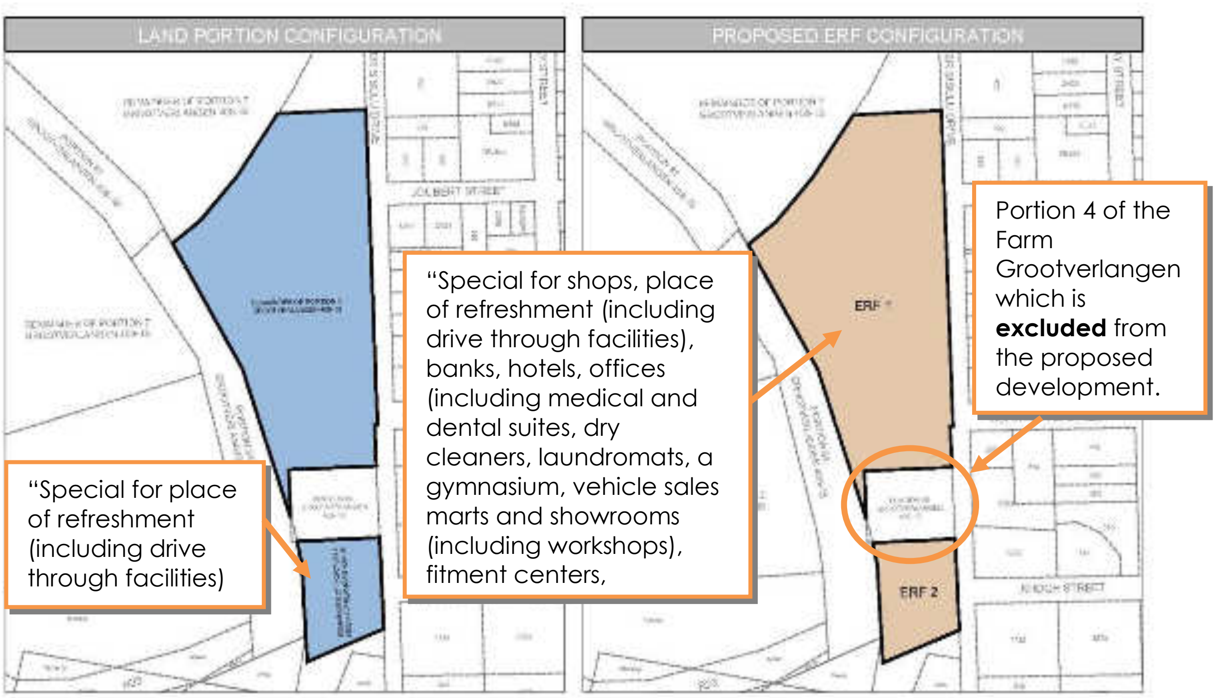


Figure 1: Conceptual Land Configuration

A tributary of Vaal River runs within the proposed study area and mainly traverses Portion 4 of the Farm Grootverlangen which is not included within the proposed development. As indicated in Figure 1, Portion 4 is excluded from the proposed

development. The 1:50 year and 1:100 year flood line does affect the proposed study site on erf 2, however the flood lines do not affect the proposed development footprint. Please refer to Figure 15 for the proposed layout.

Sky Village Properties CC proposed to establish a township consisting of two erven for purposes of developing a Mixed Use Development. This will form the first phase of a large intended Mixed Use Development. The proposed zoning for both erven is places of amusement and wholesale trade. The development will be known as **Standerton Extension 9.**

The study area is located in Standerton west of Walter Sisulu Drive (R546), north of the R23 and east of the Standerton railway line. The study area is within 700m from the Standerton Train Station and within 600m from the Standerton Police Station.

The study area is approximately **6.314ha** in extent and is situated within the municipal area of **Standerton** and within the **Gert Sibande District Municipality, Mpumalanga Province.** ***Refer to Figure 2: Locality Map and Figure 3: Aerial Map of the proposed development.***

The property description of the application site is presented in **Table 1**.

Table 1: Property Description of the application site

Property Description:	Size	Title Deed Number
A Portion of Remainder of Portion 2 of the farm Farm Grootverlangen 409 IS.	5.4123ha	G321/1908
A portion of Remainder of Portion 2 of the farm Farm Grootverlangen 409 IS.	0.9017ha	G321/1908

According to the Standerton Town Planning Scheme, 1995 the study area is zoned as “Agricultural”.

Refer to Appendix A for enlargements of Figures.

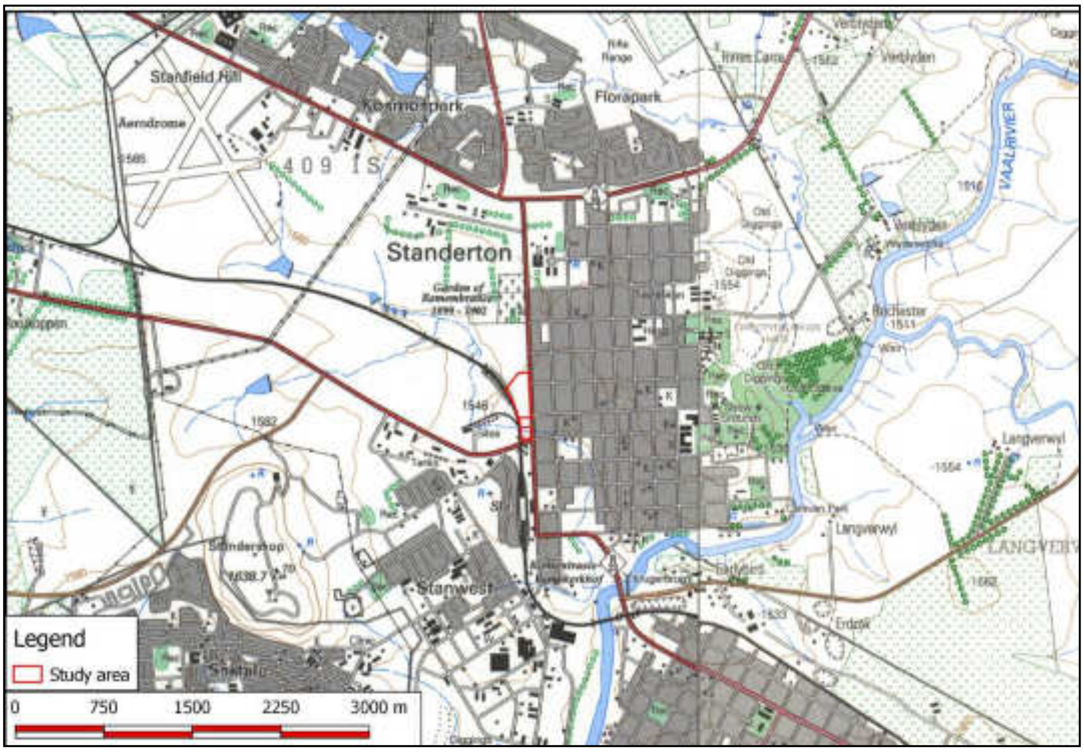


Figure 2: Locality Map

Figure 3: Aerial Map

The study area form part of land situated amidst the urban development area of Standerton. The Central Business District of Standerton lies to the south-east of the subject properties. The study area is bordered by Walter Sisulu Drive to its immediate west and the R23 borders onto the southern-most boundary of the study area. ***Refer to Figure 4 for the picture of these roads.***

Figure 4: View of intersection south of the site

Figure 5: View of the railway line west of the site

The western boundary of the study area follows the alignment of the railway line. ***Refer to Figure 5*** for the picture taken from Walter Sisulu Drive facing north and showing the railway line which forms the western boundary of the site.

Figure 6: View the silos and railway south-west of the site

Refer to Figure 6 for the picture taken from Walter Sisulu Drive, showing the site in a south-western direction with the Silos and the railway to the west of the study area. The Standerton Fire Brigade and the Municipal Licensing Office is situated north of the study area. ***Refer to Figure 7 for the illustration of the proposed site's surroundings.***

Figure 7: Illustration of the proposed site's surroundings.

2. DESCRIPTION OF THE ENVIRONMENT

2.1 Geographic Aspects

2.1.1 Geographical Location

The position of the activity has been indicated below, using the latitude and longitude of the centre point of the site. The projection that is used is the WGS 84 spheroid projection.

Latitude (S):			Longitude (E):		
26 ○	56’	46.84”	29 ○	14’	4.87” E

2.2 Biophysical Aspects

2.2.1 Geology and Soils

(Refer to Appendix B1 for a copy of the Geotechnical Investigation by Soil Kraft CC, 2016)

According to available geological maps the site is located within the Vryheid formation, which forms part of the Ecca group of the Karoo super group. The geology of the Vryheid formation is coarse to medium sandstone, and shale. The soils that occur may be highly variegated, exhibiting patches of rubble and saprolite. There are many surface rocks, and it is expected that these rocks be interspersed within the soils. Towards the lowest point in the landscape, it can be expected to find more vertic soils with swelling and shrinking properties.

<u>The following was concluded from the Geotechnical Investigation:</u>

- **Geology**

  The study area is underlain by dolerite and shale bedrock, with the latter being associated within the Vryheid Formation of the Ecca, Karoo Super group.
- **Soil Profile**

  The profiles on site largely consist of multiple residual dolerite horizons. Limited residual shale and shale bedrock was also encountered, while fill materials occurred on the southern parts of the site.

- **Hydrology**

  Perched water was not encountered on the site, but is expected to occur seasonally and may affect founding depths.
- **Conditions of Excavation**

  A minimum proven depth of excavation by backhoe was established at 1500mm. Conditions of excavation to be moisture-dependent and clayey excavation is anticipated in the majority of the materials encountered if they should be excavated in a moist to wet state. The possible occurrence of seepage water may affect excavation on site. Fill materials are expected to prove unstable in unsupported excavation.
- **Geotechnical Classification**

  The site is divided into three zones, namely ***H3***, ***PFill/H3*** and ***PFill*** Precautionary measures are therefore essential.
- **Material Utilisation**

  None of the in-situ materials are considered suitable for utilisation in the construction of layer works or earth platforms.
- **Soils Corrosively**

  All soil materials tested proved to be non-corrosive on account of soil acidity, but extremely corrosive on account of soil conductivity.
- **Seismicity**

  A 10% probability exists that an earthquake with Peak Ground Acceleration of 0.09g to 0.11g may take place once in 50 years. Tremors in this area are likely to be mining-related rather than naturally occurring.

The following is recommended by the specialist:

It is critical that site drainage and stormwater be planned carefully to ensure efficient drainage. No stormwater or surface runoff should accumulate or pond within 1.5m of the structures. Services and plumbing precautions must be put in place to ensure that underground services are not disrupted by the heaving action of expansive in-situ soils.

The Geotechnical specialist recommended that a groundwater study be undertaken on this site to verify whether seasonal seepage water could occur and adversely affect foundations. If this option is not pursued (i.e. if seepage water cannot be disproved) it is recommended that a conservative approach be adopted and cut-off drains be installed throughout the development.

2.2.2 Climate

The study area lies in a summer rainfall area. The site has a relatively high seasonal rainfall of more than 663mm. When compared with winter, the summers have much more rainfall. The climate here is classified as Cwb by the Köppen-Geiger system. The average annual temperature in Standerton is 15.2 °C.

Implications for the development:

- The climatic character of the region will not have a significant impact on the development potential of the study area;
- Should the construction phase be scheduled for the summer months, frequent rain could cause very wet conditions, which makes construction and environmental rehabilitation works extremely difficult;
- Such wet conditions often cause delays to building projects and the draining of water away from the construction works (in the case of high water tables) into the nearby water bodies, could (if not planned and managed correctly) have an impact on the water quality of these water bodies; and
- If dry and windy conditions occur during the construction phase, dust pollution could become a problem. Recommendations to mitigate dust pollution will be made in the Environmental Management Programme (EMPr) ***(Please refer to Appendix D for the attached EMPr)***.

2.2.3 Topography

The average gradient of the study area is approximately 0.7% from an elevation of approximately 1583 metres above mean sea level on the southern side of Langebaan/Bauman Street (R50) on the north western side of the proposed site to the eastern side of the proposed site at an elevation of approximately 1544 mamsl.

Implications for the development:

Not significant. The current topographical character of the study area will have no detrimental effect on the development potential of the site.

2.2.4 Hydrology

SRK Consulting conducted a 1:50 year and 1:100 year Flood Line Study. ***Refer to Appendix B2 for the Flood Line Study.*** A tributary of Vaal River runs within the proposed study area. A need was therefore identified to carry out a 1:50 year and 1:100 year Flood Line Study for the tributary of Vaal River within the proposed development site to assess any risk of possible flooding on the proposed study area. ***Refer to Figure 8, Hydrology Map and Figure 9, Hydrological Flow.***

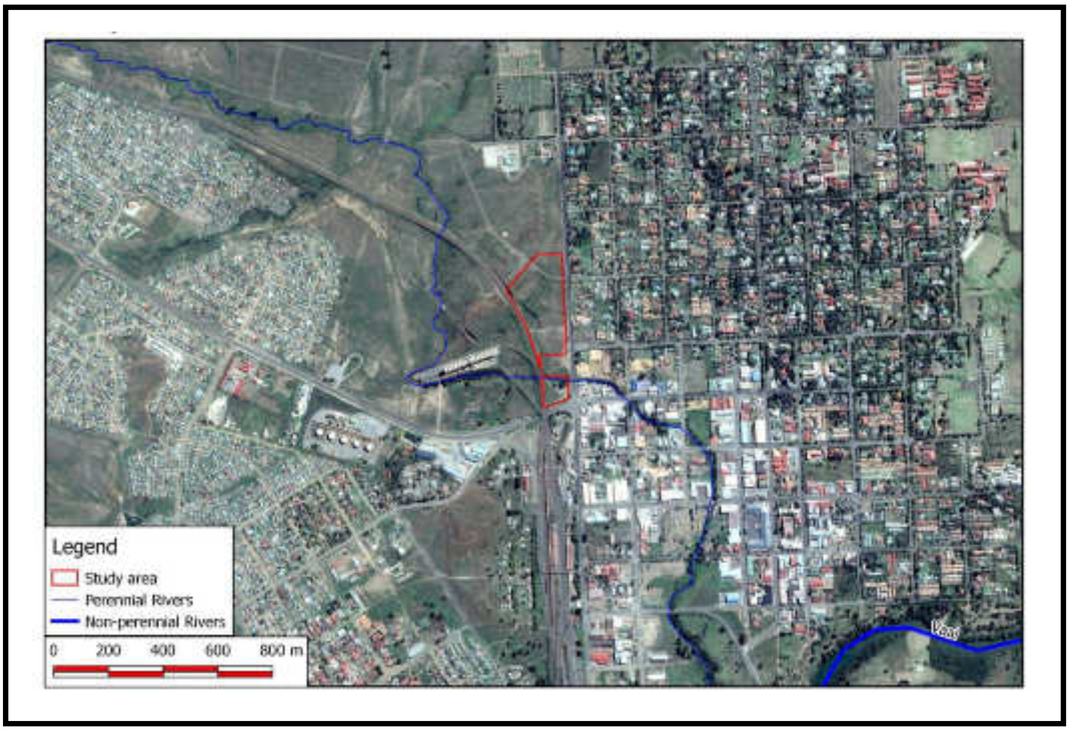


Figure 8: Hydrology Map

There is a rail way line bridge and a road bridge on the western boundary and eastern boundary of the proposed study area respectively**.** According to the specialist the catchment is currently approximately 40% developed consisting mainly of grasslands, trees, roads and residential development. The area of the catchment is approximately 9.1km^2.

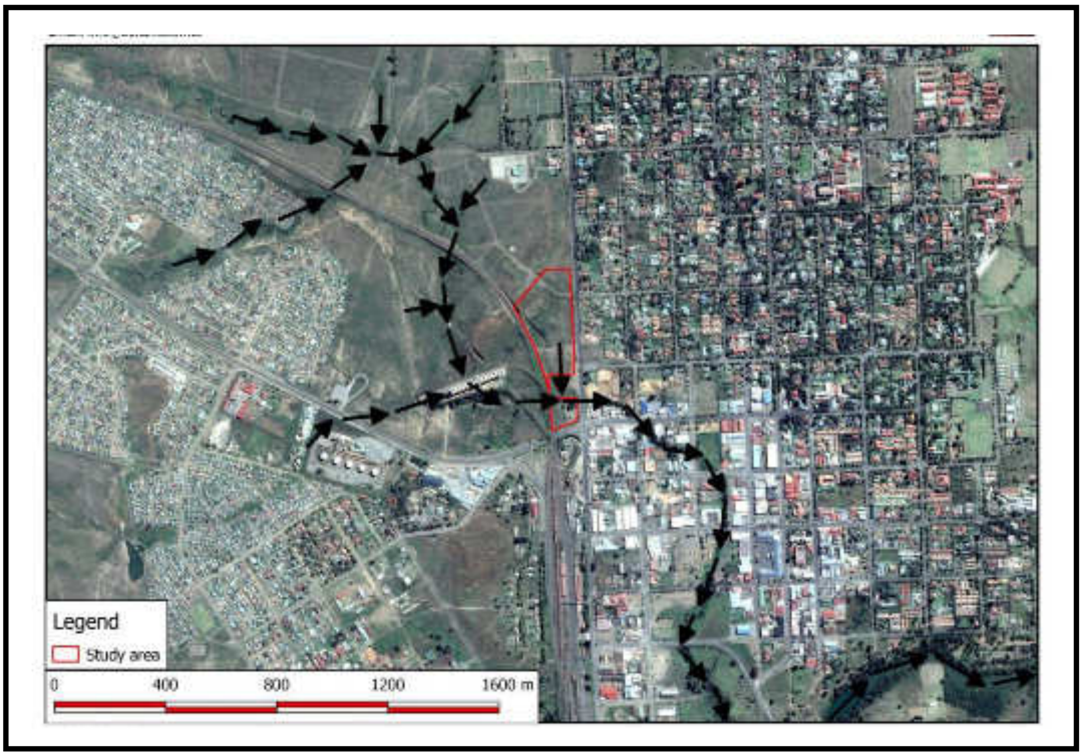


Figure 9: Hydrological Flow

The proposed study area is affected by the 1:50 and 1:100 year flood lines, however the flood lines does not affect the proposed development footprint. Please refer to Figure 15 for the proposed layout. **Also *refer to Figure 10 for the certified Flood lines.***

<u>The following recommendations have been made by the specialist:</u>

- The flood line information to be used to ensure that no new development is situated within the 1:100 year flood line.
- The flood lines be revised should watercourse/control structures be modified in the future.
- If a need to retain the current locations of the affected stands arises, a flood hazard assessment is recommended to further analyze and categorize the risk associated with flooding in the affected areas. Based on this, relevant flood remedial measures to maximize the development potential of the sites and to also avoid possible liability claims against the Town or City Council can then be determined.

- Any specialist studies including the environmental compliance studies that might be needed must be done in consultation with relevant authorities

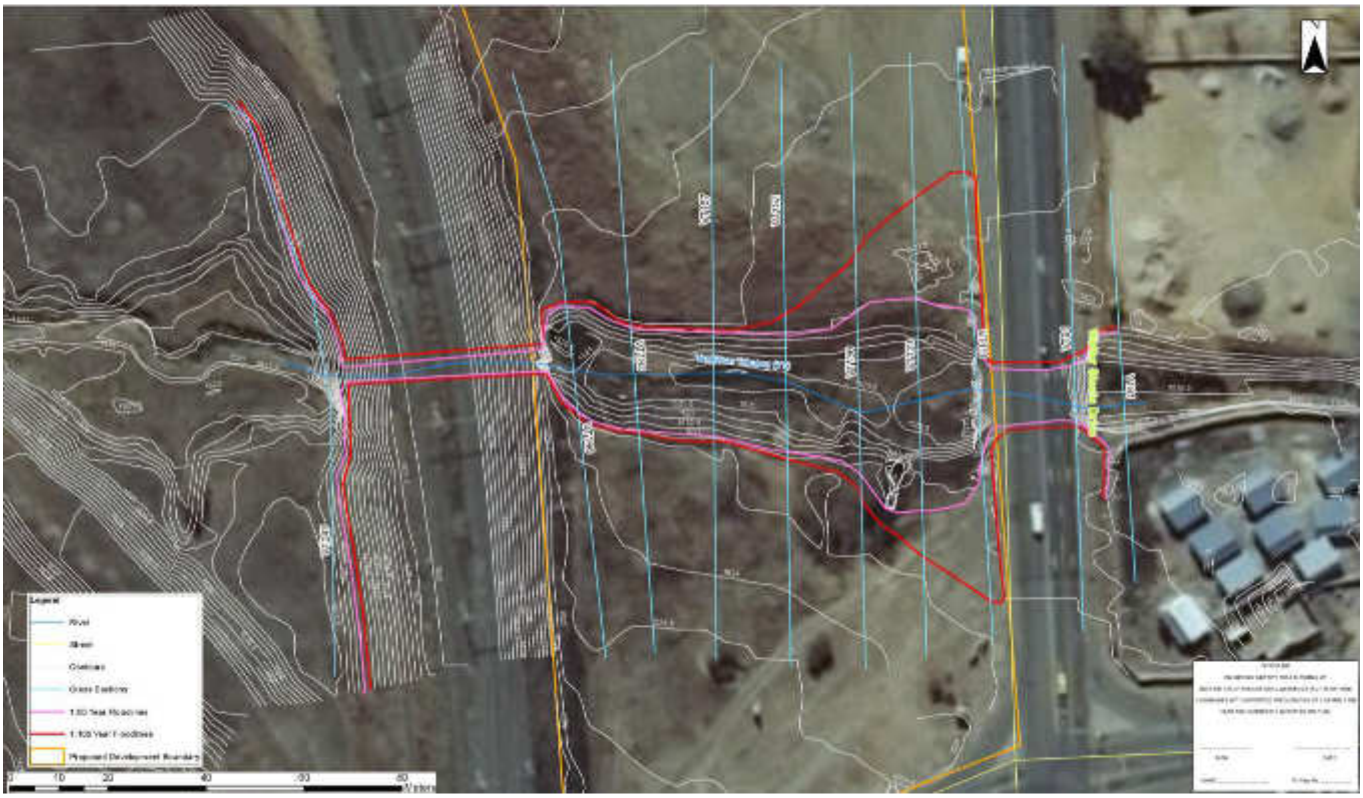


Figure10: Certified Flood lines

2.2.5 Agricultural Potential

(Refer to Figure 11: Agricultural Potential Map)(Appendix A)

According to a GIS desktop study, the application site has a **high** agricultural potential for grains. According to the Standerton Town Planning Scheme, 1995 the subject properties are zoned "Agricultural".

Bokamoso is however of the opinion that due to the current size of the subject property, it will not be possible for the study area to function as a viable economical agricultural unit. Furthermore, the Department of Agriculture, Forestry and Fisheries confirmed that the study area is not subject to the provisions of the Subdivision of Agricultural Land Act, 1970 (Act No. 70 of 1970) as it belongs to the Lekwa Local

Municipality. ***Refer to Appendix B9 for the Letter from the Department of Agriculture, Forestry and Fisheries.***

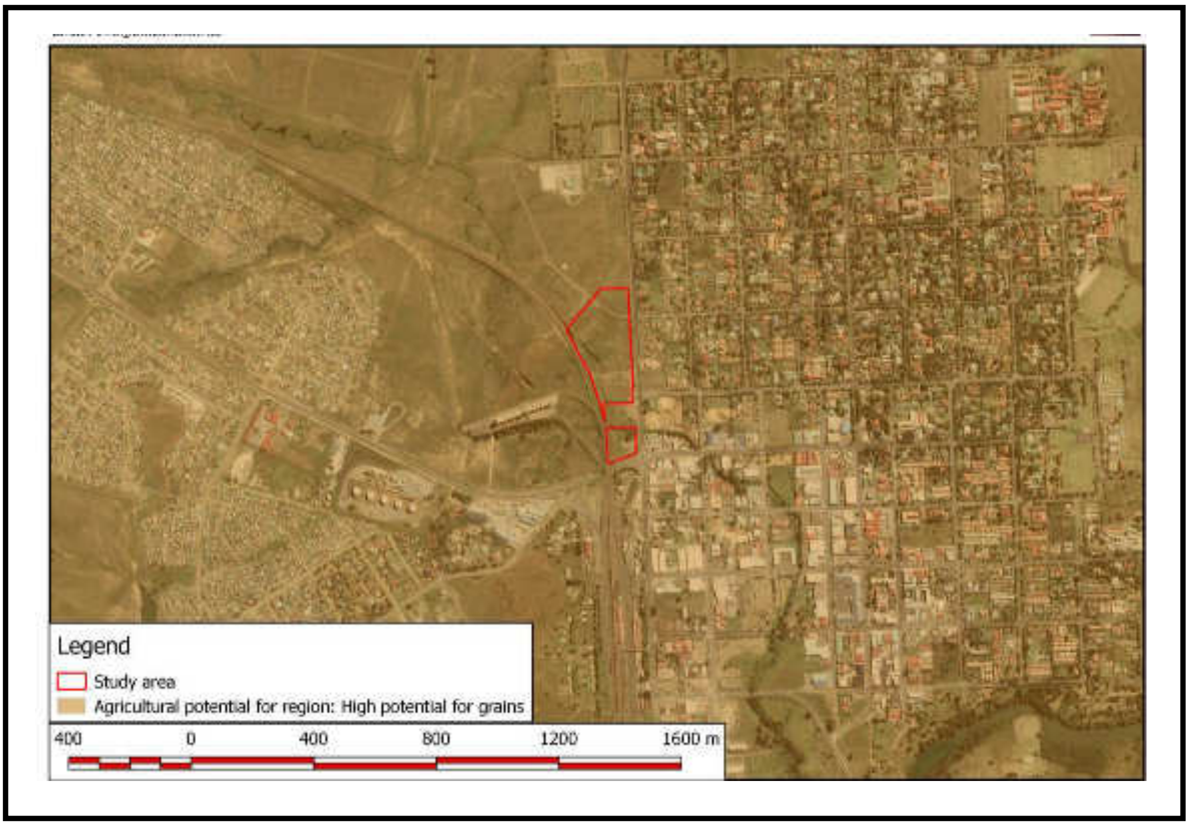


Figure 11: Agricultural Potential

<u>Implications for the development:</u>

- Some agricultural land will be lost.

2.2.6 Flora and Fauna

(Refer to Appendix B3 for the Flora and Fauna Report)

The site is situated in the Soweto Highveld Grassland which is indicated as Vulnerable and forms part of the Mesic Highveld Grassland Group. Faunal species with conservation importance are not expected to occur and/or be resident on the study area as there is unsuitable habitat. ***(Refer to Figure 12).***

The Degraded terrestrial habitat has several alien plant species and rubbish dumping has been observed on the study area.

Figure 12: Vegetation Units

<u>Plants</u>

Due to a recent veld fire and the dry winter conditions it was very difficult for the specialist to record plant species. Based on the site visit, the specialist concluded that the study area is mainly disturbed with several alien plant species. Four species are listed as Category 1b invaders and one Category 2 invader. There may be potential suitable habitats on site for Red Listed Plant Species. Further studies are needed to confirm the presence of Red Listed Species on site prior to any construction activities.

<u>Mammals</u>

Twelve mammal species have been recorded for the QDS 2629CC (MammalMAP, 2016), this is however not representative of the area. **No mammal species** were recorded during the site visit.

Reptiles

Eight reptile species have been recorded for the QDS 2629CC (Reptile MAP, 2016), this is however not representative of the area. **No reptile species** were observed during the site visit.

Amphibians

No amphibian species have been recorded for the QDS 2629CC (FrogMAP, 2016). No amphibian species were observed during the site visit. Common species such as *Xenopus laevis* (Common Platanna), *Amietia angolensis* (Common River Frog), *Cacosternum boettgeri* (Boettger's Caco), *Kassina senegalensis* (Bubbling Kassina), *Amietophrynus gutturalis* (Guttural Toad) and *Amietophrynus rangeri* (Raucous Toad) have been recorded within a 5 km radius from the study area.

It is possible that Threatened species could occur on the ridge which forms part of the study area. Overall, the larger part of the study area is not sensitive with regards to Fauna or Flora Species, as the study area has only sub-optimal habitat. However the recommendations by the specialist below should be followed before clearing and construction activities commence.

The following are included within the Environmental Management Programme (EMPr) and should be included as a condition should the competent authority grant Environmental Authorization:

- Prior to clearing and before construction activities commence, a specialist in the field of botany should scan the study area in the summer months during the flowering season (November-April) for potential Red Listed Plant Species.
- Prior to clearing and before construction activities commence, a specialist in the field of zoology should scan the study area in the summer months (when Fauna species are active) for potential Red Listed Fauna Species.

The following general recommendations and mitigation measures are suggested for the study area:

- An appropriate management authority that must be contractually bound to implement the EMPr and Environmental Authorisation during the constructional and operational phase of the development should be identified and informed of their responsibilities in terms of the EMPr and Environmental Authorisation;

- Induction should be done for all civil contractors and for each building contractor prior to them commencing on site;
- Construction should be restricted to areas deemed to be of low ecological sensitivity;
- A pre- and post-construction alien and invasive control, monitoring and eradication programme must be implemented along with an ongoing programme to ensure persistence of indigenous species. A qualified botanist / ecologist should compile and supervise the implementation of this programme.
- Rehabilitation of natural vegetation should proceed in accordance with a rehabilitation plan compiled by a specialist registered in terms of the Natural Scientific Professions Act (No. 27 of 2003) in the field of Ecological Science.
- Where active rehabilitation or restoration is mandatory, it should make use of indigenous plant species native to the study area. The species selected should strive to represent habitat types typical of the ecological landscape prior to construction. As far as possible, indigenous plants naturally growing within the vicinity of the study area, but would otherwise be destroyed during construction, should be used for re-vegetation / landscaping purposes.
- It is strongly prohibited for Red Listed Species to be relocated, but should be protected in-situ. This means that if any Red Listed Species are recorded at a site, the relevant buffers should be applied and no construction may take place within this area.
- If found on site, the persistence of Red Listed populations should be ensured and the mortality of individuals of all Red and Orange Listed Species should be reduced which should form part of a monitoring programme. A qualified botanist/ecologist should compile and supervise the implementation of this programme;
- The contractor must ensure that no Faunal Species are trapped, killed or in any way disturbed during the constructional phase;

- To ensure minimal disturbance of Faunal Habitat it is recommended that construction should take place during winter, outside the reproductive season of the species present on site;
- Construction, vegetation clearing and top soil clearing should commence from a predetermined location and gradually commence to ensure that Fauna present on the site have enough time to relocate;
- When construction is completed, disturbed areas should be rehabilitated using vegetation cleared prior to construction to ensure that the habitat stays intact and that Faunal Species present on the site before construction took place, return to the area.
- Construction activities at or close to wetlands, drainage lines and water bodies should be limited. A wetland specialist should be consulted with regards to a suitable buffer if deemed necessary;
- Engineering measures are recommended to lower the risk of spillages into any watercourses located in and surrounding the proposed development;
- A plan for the immediate rehabilitation of damage caused to wetlands should be compiled by a specialist registered in accordance with the Natural Scientific Professions Act (No. 27 of 2003) in the field of Ecological Science. This rehabilitation plan should form part of the EMPr and a record book should be maintained on site to monitor and report on the implementation of the plan;
- No vehicles should be allowed to move in or through the watercourse and associated buffer zone. The area should be demarcated prior to construction;
- It is recommended that all concrete and cement works be restricted to areas of low ecological sensitivity and defined on site and clearly demarcated. Cement powder has a high alkalinity pH rating, which can contaminate and affect both soil and water pH dramatically. A shift in the pH can have serious consequences on the functioning of soil, vegetation and fauna;
- The open space system should be managed in accordance with an Ecological Management Plan that complies with the minimum requirements for Ecological Management Plans and forms part of the EMPr;
- The open space system should be fenced off prior to construction commencing (including site clearing and pegging). All construction-related

impacts (including service roads, temporary housing, temporary ablution, disturbance of natural habitat, storing of equipment / building materials / vehicles or any other activity) should be excluded from the open space system;

- Access of vehicles to the open space system should be prevented and access of people should be controlled, both during the construction and operational phases;
- Forage and host plants required by pollinators should also be planted in landscaped areas;
- Where possible, indigenous trees naturally growing on the site should be retained as part of the landscaping. Measures to ensure that these trees survive the physical disturbance from the development should be implemented. A tree surgeon should be consulted in this regard;
- In order to minimize artificially generated surface stormwater runoff, total sealing of paved areas such as parking lots, driveways, pavements and walkways should be avoided. Permeable material should rather be utilized for these purposes.

<u>Implications for development:</u>

- If the entire area to be developed is cleared at once, smaller birds, mammals and reptiles will not be afforded the chance to weather the disturbance in an undisturbed zone close to their natural territories.
- Noise of construction machinery could have a negative impact on the Fauna Species during the construction phase.
- During the construction and operational phase (if not managed correctly) fauna species could be disturbed, trapped, hunted or killed.
- Loss of habitat can lead to the decrease of fauna numbers and species.
- Loss of natural grassland areas
- Loss of medicinal plant species
- Possible loss of sensitive drainage line and seasonal stream vegetation
- The eradication of weeds and exotic invaders

2.3 Social Aspects

2.3.1 Archaeology

In terms of Section 38 of the National Heritage Resources Act, 1999, SAHRA must be notified of developments on areas that are larger than 5000m². SAHRA has been informed of the proposed development during the notification process, which formed part of the public participation process. We received comments from SAHRA regarding the application stating the following: "*SAHRA Archaeology, Palaeontology and Meteorites (APM) Unit does not require a heritage assessment for the proposed development because the surface topography of the proposed development area has been disturbed by recent activities, the possibility of uncovering any archaeological artefacts is low. Therefore SAHRA grants an exemption to the developer from commissioning further heritage studies.*" ***Refer to Appendix B10 and E for the comments received from SAHRA.***

Due to the current state of the proposed study area it was not deemed necessary to conduct a Heritage Impact Assessment in terms of the requirements as provided for in Section 38 of the National Heritage Resources Act (NHRA) (Act 25 of 1999). No significant cultural and historical features were thus identified on the study area and therefore the anticipated impact on any cultural / heritage resources are regarded as low to neutral.

<u>Implications for development:</u>

- Should any human remains be disturbed, exposed or uncovered during excavations for the proposed project (unlikely), these should immediately be reported to the South African Heritage Resource Agency (SAHRA) and/or museum. Burial remains should not be disturbed or removed until inspected by an archaeologist;
- Site preparation activities must be monitored for the occurrence of any other archaeological material (historic waste disposal sites etc.) and similar hidden/buried chance finds and an archaeologist should be asked to inspect the area when this has reached an advanced stage in order to verify the presence or absence of any such materials;

- The above recommendations must be included in the Environment Management Programme (EMPr) for the proposed project; and
- Should any finds be made or artefacts uncovered during future developments on the study area, an archaeologist and/or the South African Heritage Resources Agency (SAHRA) and / or a museum have to be informed immediately, to conduct an investigation and evaluation of the finds. The developer should note that failing to inform the appropriate person or authority of any such finds, is a legal offence in terms of the National Monuments Act.

2.3.2 Existing and Proposed Zoning and Land Use

Existing and Surrounding Zoning and Land Use:

According to the Standerton Town Planning Scheme, 1995 the subject properties are zoned "Agricultural". Standerton forms part of the larger Lekwa area of jurisdiction which lies on the banks of the Vaal River in Mpumalanga. The area is known for its cattle-, dairy-, maize- and poultry farming. Influential businesses such as Nobel, and Early Bird have established in Standerton in support of the agricultural land uses in the area.

The proposed study area form part of land situated amidst the urban development area of Standerton. The Central Business District of Standerton lies to the south-east of the proposed study area. The land development area is bordered by Walter Sisulu Drive to its immediate west.

The R23 borders onto the southern-most boundary of the land development area and the western boundary follows the alignment of the railway line. ***Refer to Figure 7 for the illustration of the proposed site's surroundings.***

The Standerton Fire Brigade and the Municipal Licensing Office is situated north of the study area. ***Refer to Figure 13, Standerton Fire Brigade and Figure 14, Municipal Licensing Hub.***

Figure 13: Standerton Fire Brigade

Figure 14: Municipal Licensing Hub

<u>Implications for the development:</u>

Not significant. The proposed development is in line with adjacent land uses in the area.

2.3.3 Proposed Land Use

The proposed development will entail a Mixed Use Development of approximately ±6.314ha in extent. ***Refer to Figure 15 and Appendix C for the layout of the proposed development.*** This will form the first phase of a large intended Mixed Use Development. The proposed zoning for both erven is "Special" for shops, place of refreshment (including drive through facilities), banks, hotels, offices (including medical and dental suites, dry cleaners, laundromats, a gymnasium, vehicle sales marts and showrooms (including workshops), fitment centers, places of amusement and wholesale trade. The development will be known as **Standerton Extension 9.**

Figure 15a: Upper level plan

Figure 15b: Lower level plan

Figure 15: Proposed Layout Plan

Implications for the development:

Not significant. The proposed development will be in line with the local authority planning.

2.4 Qualitative Environment

2.4.1 Visual Aspects

The following Visual Impact Assessment Criteria have been used to determine the impact of the proposed development on the state of the environment – the significance is indicated by the respective colour coding for each of the impacts, being high, medium and low:

Table 2: Visual Impact Assessment Criteria

	IMPACT		
CRITERIA	**HIGH**	**MEDIUM**	**LOW**
Visibility	A prominent place with an almost tangible theme or ambience.	**A place with a loosely defined theme or ambience.**	A place having little or no ambience with which it can be associated.
Visual quality	**A very attractive setting with great variation and interest – no clutter.**	A setting with some visual and aesthetic merit.	A setting with no or little aesthetic value.
Compatibility with the surrounding landscape	Cannot accommodate proposed development without the development appearing totally out of place – not compatible with the existing theme.	**Can accommodate the proposed development without it looking completely out of place.**	The surrounding environment will ideally suit or match the proposed development.
Character	The site or surrounding area has a definite character/	**The site or surrounding environment has**	The site or surrounding environment exhibits

	sense of place.	**some character.**	little or no character/ sense of place.
Visual Absorption Capacity	The ability of the landscape not to accept a proposed development because of a uniform texture, flat slope and limited vegetation cover.	**The ability of the landscape to less easily accepts visually a particular type of development because of less diverse landform, vegetation and texture**.	The ability of the landscape to easily accept visually a particular type of development because of its diverse landform, vegetation and texture.
View distance	If uninterrupted view distances to the site are > 5 km.	If uninterrupted view distances to the site are < 5 km but > 1 km.	**If uninterrupted view distances to the site are > 500 m and < 1000 m.**
Critical Views	Views of the site seen by people from sensitive view sheds i.e. farms, nature areas, hiking trails etc.	Some views of the site from sensitive view sheds.	**A limited or partial view of the site from sensitive view sheds.**
Scale	A landscape with horizontal and vertical elements in high contrast to human scale.	**A landscape with some horizontal and vertical elements in some contrast to human scale.**	Where vertical variation is limited and most elements are related to the human & horizontal scale.

- The application site will be visible from the R23 Road and surrounding view sheds predominantly due to the study area's current topographical character. From the visual analysis it is clear that the existing property can be regarded as a place with a loosely defined theme or ambiance but a setting with minimal aesthetic value due to its current land use;

- The proposed development will be highly visible from the surrounding view sheds, the R23 Road and Railway which is ideal for a Mixed Use Development consisting of retail uses; ***see Figure 16***.
- However when driving on the R23 south-west of the study area the proposed development will only be partially visible due to the Railway line. ***Refer to Figure 16.***

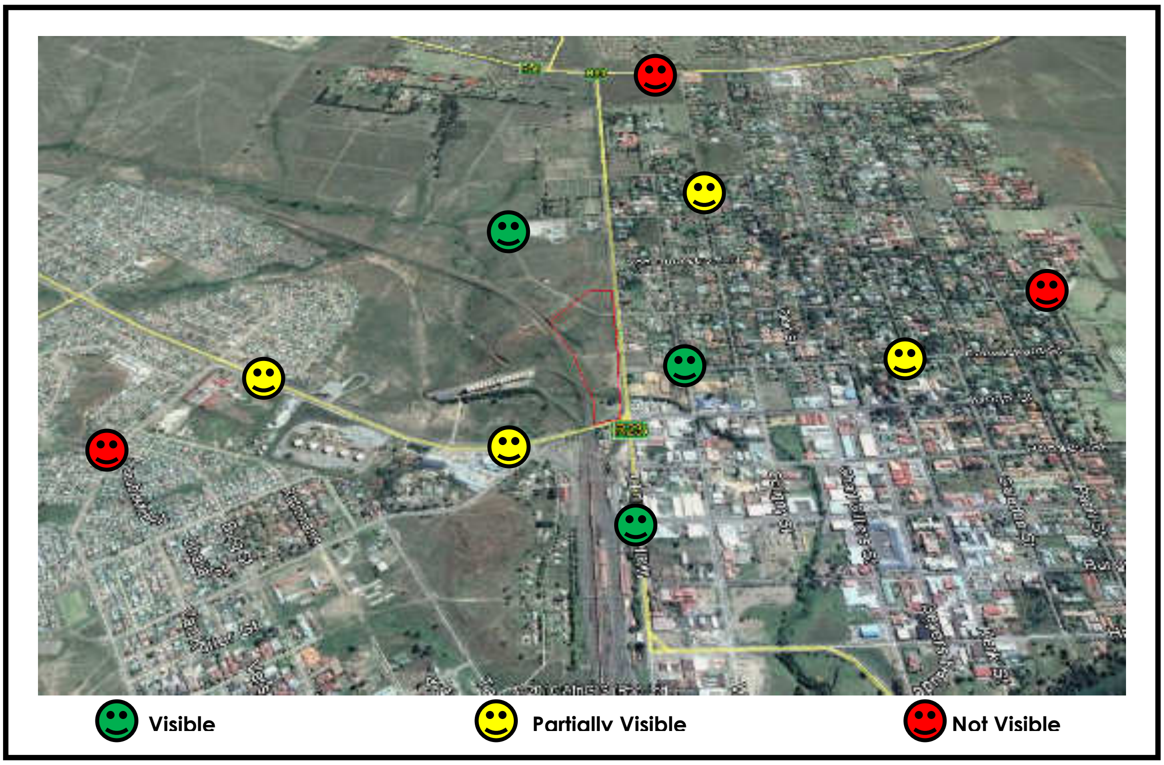


Figure 16: Visibility Map

<u>Implications for development:</u>

- The location of the study area is desirable in terms of accessibility and visibility from Walter Sisulu Drive.
- Due to developments close by (the residential development and railway), it is anticipated that the proposed development will be accommodated from a visual perspective. From the tabulated assessment above it can be concluded that the proposed development will make a significant contribution towards the character and enhanced sense of place of Standerton.

- The following measures are proposed to ensure that the Proposed Mixed Use Development is accommodated by the surrounding view sheds from a visual perspective:
    - The architectural styles, colours, textures and construction materials will determine the visual impact of the proposed development on the surrounding areas;
    - The proposed development will be seen from a distance and therefore the roofs should not reflect the sun or be covered with roofing materials that have bright colours;
    - Bokamoso is of the opinion that it would be possible to mitigate the anticipated visual impact through planning that takes the existing surrounding urban environment and aesthetical features of the site into consideration. The colour scheme for the proposed development must preferably blend in with the mosaic of colours from the surrounding urban environment;
    - Existing trees should be retained as far as possible. The trees will soften the visual impact of the proposed permanent structures and they will bring the scale of the vertical structures in some contrast to human scale;
    - The landscaping to be installed as part of the proposed development must be chosen to assist with the creation and sustaining of a pleasant micro-climate, to act as visual screening and enhancement mechanism, to accentuate important focal points and movement and visual axis and to create a tranquil feeling;
    - Landscaping should be done in concurrence with the building construction in order to create an instant visual enhancement of the development;
    - Trees, shrubs and groundcovers that are prominent to the area and/or indigenous should preferably be used – landscaping that is in line with the natural vegetation of the area will not only help to reduce the visual impact of the development, but it will also create habitats for fauna and flora Species;

- Where legally required, separate signage applications will also have to be submitted to the relevant authorities for approval;
- The lighting for the proposed development as well as all the billboards should be effectively designed so as not to spill unnecessary outward into the oncoming traffic, or into the yards of the neighbouring properties or open spaces;
- The exterior and interior lighting design should be sensitively designed to:
  - Prevent the lighting-up of the evening sky and the skyline;
  - Prevent any unnecessary spillage of lighting into the eyes of oncoming traffic;
  - Prevent the usage of flickering signage and advertising boards, especially where such boards will be visible from busy roads and surrounding residential areas; and
- It is recommended that movement activated lights are installed and that only some of the lights are on during the night in order to save energy. It is also recommended that the use of solar energy for external lighting and signage lighting be investigated.

Sense of Place

The Sense of Place is a subjective feeling a person gets about a place by experiencing the place visually, physically, socially and emotionally. The "Sense of Place" of an area is one of the major contributors to the "Image of an area".

The image of an area consists of two main components, namely **place structure** and **sense of place.** These could be defined as the following:

- Place structure refers to the arrangement of the physical place making elements within a unique structure that can be easily legible and remembered; and

- The Sense of Place is the subjective meaning attached to a certain area by individuals or groups and is linked to its history, culture, activities, ambience and the emotions the place creates.

The study area can be regarded as a place with a loosely defined ambiance but a setting with minimal aesthetic value due to its current land use. The land, being located in close proximity to the CBD and located in the precinct identified for Mixed Use Development has extensive potential for growth in value with the envisaged improvements and refurbishments, which will also lead to increased investment potential. Except for the old structures of the former shooting range, the subject properties are vacant. The structures are not of a permanent nature and will be demolished for purposes of the proposed development.

The railway line to the west, the R23 south and Walter Sisulu Drive to the east, wedges the land portions in and give effect to the peculiar shape of the subject properties.

Noise Pollution

Some noise will be generated during the construction phase and such uneven construction associated noise may become a nuisance to the surrounding land owners, residents and businesses.

Noise generated during the operational phase will mainly be the noise generated by the increased traffic.

Implications for the development:

- It is anticipated that a certain amount of noise will be generated during the construction phase. The contractors should take care, and manage construction works to such an extent to comply with minimum ambient noise levels as defined in local, provincial, and national policies and frameworks. Construction activities must also be restricted to hours as specified in the

National Building Regulations and if specific construction activities require that work continues after hours (i.e. the pouring of concrete slabs which cannot be interrupted), the surrounding residents must be notified of such potential disturbing activities;

- The contractor should notify the local / surrounding land-owners well in advance of any works that will generate noise (i.e. blasting operations);
- Construction site yards, workshops, concrete batching plants, and other noisy fixed facilities should be located well away from noise sensitive areas. All construction vehicles, plant and equipment are to be kept in good repair;
- Blasting operations, if required are to be strictly controlled with regard to the size of explosive charge in order to minimize noise and air blast and timings of explosions. The number of blasts per day should be limited;
- Construction activities are to be contained to reasonable hours during the day. No construction should be allowed on weekends from 14h00 on Saturday afternoons to 06h00 the following Monday morning;
- Working hours during weekdays must be limited from 06h00 until 18h00;
- With regard to unavoidable very noisy construction activities in the vicinity of noise sensitive areas, the contractor should liaise with local residents and be kept informed of the nature and duration of intended activities; and
- As construction workers operate in a very noisy environment, it must be ensured that their working conditions comply with the requirements of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993). Where necessary ear protection gear should be worn.

Air / Dust Pollution

It is not foreseen that the proposed development would contribute significantly in terms of pollution by smoke. It can however be expected that a certain amount of dust will be generated due to earthmoving activities and construction works. One should note that the impact of dust pollution is short term, lasting for the duration of construction only.

Dust suppression techniques such as sprinkling the construction site regularly with water and by putting up dust nets will mitigate this impact to an acceptable level. ***Refer to Appendix D, EMPr.***

<u>Implications for the development:</u>

- If dry and windy conditions occur during the construction phase, dust pollution could become a problem. The regular and effective damping of working areas must therefore be carried out on a continued basis, to enure that the generation of dust due to involved construction works are kept under control.
- Due to the sites location west of the major Walter Sisulu Drive, regular inspections of areas would have to be done to ensure dust control on the site remains effective at all times.

Light Pollution

The Walter Sisulu Drive is located west of the site. Most of the light from the site will be seen from the railway as well as Walter Sisulu Drive. Light from the site might have a small impact on the surroundings as the uses of the surroundings are mainly residential, however these impacts can be mitigated to a level where these are not considered as significant impacts.

<u>Implications for the development:</u>

Street and security lighting must be designed in order not to spread light into the eyes of oncoming traffic on adjacent Walter Sisulu Drive as well as the Railway. Internal streets and security lighting should also be designed not to disturb residents at night. Light beams must face downwards and not higher than a 45 degree angle from the ground. ***Refer to Appendix D, EMPr.***

2.5 Services

EDS Engineers Design Services (Pty) Ltd was appointed to compile a Civil Services Report. ***Refer to Appendix B4 for the Services Report.*** The services report confirmed the flowing for the water demand of the proposed development:

- Daily consumption demand will be 135.3 Kl per day;
- A 63mm connection pipe is required for the domestic water demand for erf 1, and a 32mm for erf 2;
- The expected fire demand for a moderate risk area is 25 l/s; and
- A 140mm connection pipe will be sufficient to supply 30l/s domestic and fire water at 2.5m/s for erf 1, and a110mm water connection pipe to provide 20l/s domestic.

It was concluded from the services report that the proposed development will be able to connect to the existing municipal water sanitation systems. The Lekwa Municipality needs to confirm if the municipal water and sanitation systems can supply the required amount of water required, and receive and treat the additional amount of sewage generated by the development.

Implications for the development:
Significant – We request that the Lekwa Municipality confirms the availability of services to supply the proposed development with these services. Also we request that the Municipality distribute this report to all the sectors within the Municipality in order to provide us with comments.

- **Road Access**

Proposed Site Access
Access will be gain from Schwikard Street and Joubert Street. Access to Erf 2 will be a marginal left in only from Krog Street and a left in and left out access from Walter Sisulu Drive. ***Refer to Appendix B5 for the Traffic Impact Assessment Report.*** Internal parking roads will be provided within the proposed development, and service roads for the loading and offloading of goods as per the Architects layout. There are no

public roads as part of the internal roads layout. ***Refer to Figure 17 for the Access Map.***

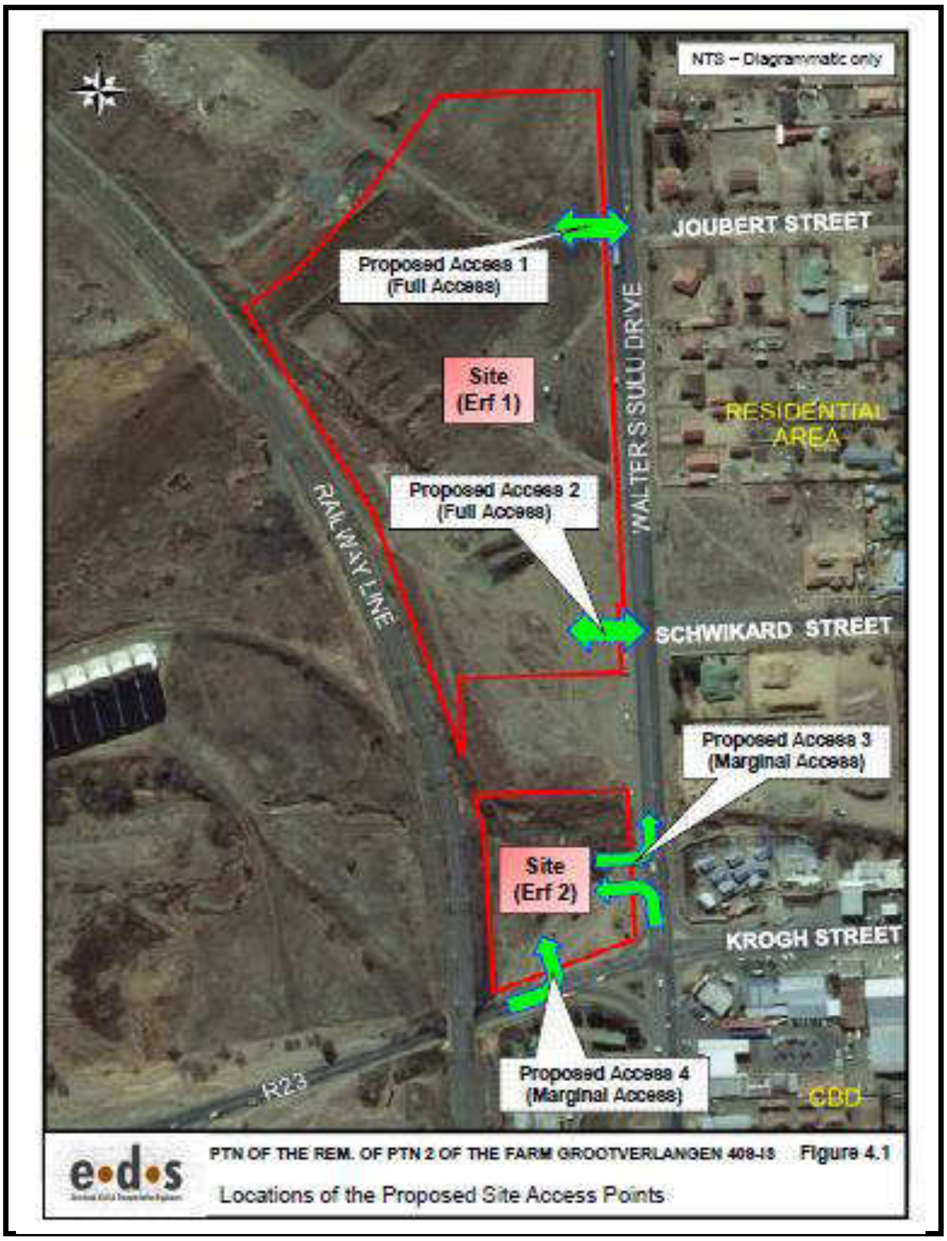


Figure 17: Access Map

- **Storm water**

It is recommended that the proposed development be served by an internal piped storm water system that discharges directly into the existing storm water pipe system that runs in Walter Sisulu Drive.

Implications for the development:

Not Significant as no access upgrades is required for the proposed development.

- **Waste Removal**

The Local Authority will be responsible for the solid waste removal. The waste will be disposed of at a registered landfill site and the landfill site has the capacity to accommodate the additional waste generated by the proposed development.

Implications for the development:

The Local Authority must confirm that they will remove the solid waste and that the existing registered landfill site has the capacity to accommodate the waste to be generated by the development.

- **Electricity**

Plantech Electrical & Mechanical Consulting Engineers was appointed to compile an Electrical Report for the proposed development. ***Refer to Appendix B6 for this report.*** The proposed development will have an expected maximum demand of 2.5MVA. An existing medium voltage network is available to service the new development, but will require the existing 11kV, 33mm2, 3c, Al, PILC cable to be upgraded to an 11 kV, 150mm2, 3c, Cu, PILC cable and will also require the installation of a new Bulk Metering Kiosk at the entrance of the development.

The Lekwa Local Municipality will have to confirm the supply capacity from Eskom, due to the increased demand of the development.

Implications for the development:

The Local Authority must confirm that Eskom has the capacity to supply electricity to the proposed development, due to the increased demand of the development.

3. APPLICABLE LEGISLATION AND GUIDELINES

3.1 Activities applied for in terms of NEMA

It is necessary to apply for Environmental Authorisation in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA).

In December 2014 the Minister of Environmental Affairs passed the Amended Environmental Impact Assessment Regulations[1] (The Regulations) in terms of Chapter 5 of the National Environmental Management Act, 1998[2] (NEMA). The Amended Regulations replaced the 2010 Environmental Impact Assessment (EIA) Regulations, which were also promulgated in terms of the National Environment Management Act, 1998 (Act No. 107 of 1998). The new regulations came into effect on 4 December 2014 and, therefore, all new applications must be made in terms of the New NEMA Regulations and not in terms of the 2010 EIA Regulations. The purpose of this process is to determine the possible negative and positive impacts of the proposed development on the surrounding environment and to provide measures for the mitigation of negative impacts and to enhance positive impacts.

An application for Environmental Authorization for the Proposed Mixed use Development will be submitted to the approving authority, **Mpumalanga Department of Agriculture, Rural Development, Land & Environmental Affairs (MDARDLEA)** thereafter the Department will assign the proposed development with a reference number.

Bokamoso commenced with the Public Participation Process on 27 July 2016 which has been included as part of this report.

Note: The Public Participation Section of this report (Section 4) supplies more detail regarding the entire Public Participation Process that was followed.

[1] Environmental Impact Regulations, 2014
[2] Act No. 107 of 1998

In the environmental application process (to be compiled in terms of NEMA) the applicant is applying for the following listed activities.

Table 3: listed Activities in terms of Notice R983

<table>
<tr><th>Government Notice R983</th><th>Activity Number</th><th>Description</th></tr>
<tr><td>R983,
4 December 2014</td><td>Activity 9</td><td>The development of infrastructure exceeding 1000 metres in length for the bulk transportation of water or storm water-
(i) with an internal diameter of 0,36 metres or more; or
(ii) …-
(a) …; or
(b) ...</td></tr>
<tr><td>R983,
4 December 2014</td><td>Activity 10</td><td>The development and related operation of infrastructure exceeding 1000 metres in length for the bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes
(i) with an internal diameter of 0,36 metres or more; or
(ii) …-
(a) …; or
(b) ...</td></tr>
<tr><td>R983,
4 December 2014</td><td>Activity 11</td><td>The development of facilities or infrastructure for the transmission and distribution of electricity-
(i) outside urban areas or industrial complexes with a capacity of more than 33 but less than 275 kilovolts; or
(ii) inside urban areas or industrial complexes with a capacity of 275 kilovolts or more.</td></tr>
<tr><td>R983,
4 December 2014</td><td>Activity 12</td><td>The development of –
(i) …
(ii) …
(iii) …
(iv) …
(v) …
(vi) Bulk storm water outlet structures exceeding 100 square metres in size;
(vii) …
(viii) …
(ix) …
(x) Buildings exceeding 100 square metres in size;
(xi) …
(xii) Infrastructure or structures with a physical footprint of 100 square</td></tr>
</table>

		metres or more; **(xiii) Infrastructure or structures with a physical footprint of 100 square metres or more;** Where such development occurs – **(a) Within a watercourse;** (b) … **(c) If no development setback exists, within 32 metres of a watercourse, -** Excluding – (aa) … (bb) … (cc) … (dd) … (ee) …	
R983, 4 December 2014	Activity 19	The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from – **(i) A watercourse;** (ii) … (iii) … But excluding where such infilling, depositing, dredging, excavation, removal or moving – **(a) Will occur behind a development setback;** (b) … (c) …	
R983, 4 December 2014	Activity 27	The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, …	
R. 985, 4 December 2014	Activity 4	The development of a road wider than 4 metres with a reserve less than 13,5 metres.	(a) In Mpumalanga: i. In an estuary; ii. Outside urban areas, in: **(aa) A protected area identified in terms of NEMPAA excluding disturbed areas;** (bb) … (cc) … (dd) … **(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;** (ff) … (gg) …

			(hh) …
R. 985, 4 December 2014	Activity 12	The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.	(b) In Mpumalanga: i. … **ii. Within critical biodiversity areas identified in bioregional plans;** iii. … iv. ...
R. 985, 4 December 2014	Activity 14	The development of – (i) Canals exceeding 10 square metres in size; (ii) … (iii) … (iv) … (v) … (vi) Bulk storm water outlet structures exceeding 10 square metres in size; (vii) … (viii) … (ix) … (x) Buildings exceeding 10 square metres in size; (xi) … (xii) Infrastructure or structures with a physical footprint of 10 square metres or more where such development occurs – (a) Within a watercourse; (b) … (c) If no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse; Excluding the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour.	(a) In Mpumalanga– i. In an estuary; ii. Outside urban areas, in; (aa) … (bb) … (cc) … (dd) … (ee) … **(ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;** (gg) … (hh) … (ii) …

3.2 Relevant Legislations and Regulations

3.2.1 International Legislations and Regulations

Relevant International Conventions to which South Africa is a party:

- Convention relative to the preservation of fauna and flora in their natural state, 8 November 1993 (London);
- Convention on Biological Diversity, 1995
  (Provided, and added stimulus for a re-examining and harmonization of its activities relating to biodiversity conservation. This convention also allows for the in-situ and ex-situ propagation of gene material);
- Agenda 21 adopted at the United Nations Conference on Environment and Development (UNCED) in 1992. (An action plan and blueprint for sustainable development.)

3.2.2 National Legislations and Regulations

The Development Facilitation Act, 1995 (Act No. 67 of 1995)

This Act formulates a set of general principles to serve as guidelines for land development *inter alia* revolving around:

- The promotion of integration of the social, economic, institutional and physical aspects of land development;
- The promotion of integrated land development in rural and urban areas in support of each other;
- The promotions of the availability of residential land and employment opportunities in close proximity to or integrated with each other;
- The promotion of a combination of diverse land-uses, with each proposed Land Development Area to be judged on its own merit and no specific use, whether residential, commercial, conservational, etc., to be regarded as less important;
- Discouraging urban sprawl to promote more compact towns/cities;
- Encouraging environmentally sound land development practices; and

- Promoting sustained protection of the environment.

Principles Contained in NEMA and the SPLUMA

Principles of NEMA and the SPLUMA, which give effect to sustainable development, were followed:

- Development must be socially, environmentally and economically sustainable; and
- Promotion, of integrated land development in rural and urban areas in support of each other.

<u>Implications for the development</u>

The proposed development is in line with the principles of NEMA and the SPLUMA and will be economic and environmentally sustainable.

National Environmental Management Act, 1998 (Act No. 107 of 1998) and the Environmental Impact Assessment Regulations

The Environmental Impact Assessment (EIA) process followed is in compliance with the National Environmental Management Act: NEMA, 1998 (Act No. 107) of 1998), as amended and the Environmental Impact Assessment Regulations 2014 (Government Notice No's R982, R983, R984 and R985). The proposed development involves 'listed activities', as defined by the NEMA, 1998. Listed activities are activities, which may potentially have detrimental impacts on the environment and therefore require Environmental Authorisation from the relevant authority, before such activities are implemented.

NEMA provide for co-operative, environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote co-operative governance and procedures for co-ordinating environmental functions exercised by organs of state and to provide for matters connected therewith.

This Act formulates a set of general principles to serve as guidelines for land development and it is desirable that:

- The law develops a framework for integrating good environmental management into all development activities;
- The law should promote certainty with regard to decision-making by organs of state on matters affecting the environment;
- The law should establish principles guiding the exercise of functions affecting the environment;
- The law should ensure that organs of state maintain the principles guiding the exercise of functions affecting the environment;
- The law should establish procedures and institutions to facilitate and promote co-operative government and inter-governmental relations;
- The law should establish procedures and institutions to facilitate and promote Public Participation in environmental governance; and
- The law should be enforced by the State and that the law should facilitate the enforcement of environmental laws by civil society.

Integrated Environmental Management

Integrated Environmental Management (IEM) is a philosophy, which prescribes a code of practise for ensuring that environmental considerations are fully integrated into all stages of the development process. This philosophy aims to achieve a desirable balance between conservation and development (Department of Environmental Affairs, 1992). The IEM guidelines intend endearing a pro-active approach to sourcing, collating and presenting information at a level that can be interpreted at all levels.

The Environmental Impact Assessment Regulations (EIA)

The Minister of Environmental Affairs, promulgated and passed in (April 2006) Environmental Impact Assessment Regulations (the new regulations) in terms of Chapter 5 of the National Environmental Management Act, 1998 (Act No. 107 of

1998) (NEMA). When these regulations came into effect on 3 July 2006 they replaced the Environmental Impact Assessment Regulations that were promulgated in terms of the Environmental Conservation Act, 1989 (Act No. 73 of 1989) (ECA) in 1997, and introduced new provisions for EIAs.

The National Environmental Management Amendment Act, 2008 (Act 62 of 2008) (NEMAA), that was promulgated on 9 January 2009 (came into effect on 1 May 2009), made a number of significant amendments to the general provisions applicable to EIA's. On 2 August 2010 the Amended EIA Regulations came into effect and replaced the previous EIA Regulations that were promulgated on 21 April 2006. Subsequent to this, the EIA Regulations were once again amended and the amended EIA Regulations were promulgated on 4 December 2014.

Notices R 982, R 983, R 984 & R 985 of the 2014 Regulations list activities that indicate the application for Environmental Authorization process to be followed. The Activities listed in Notices R. 544 & R 546 (2010 Regulations) and R983 and R985 (2014 Regulations) require that a Basic Assessment process be followed and the activities listed in Notice No. R 545 (2010 Regulations) and R984 (2014 Regulations) requires that the Scoping and EIA process be followed.

Implications for the development:

Significant- The application for the proposed development consists only of activities listed under Notices **No. R983 and R985 ,** therefore a Basic Assessment Report will be submitted to the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (MDARDLEA) for consideration.

The National Water Act, 1998 (Act No. 36 of 1998)

The purpose of this Act is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways that take into account, amongst other factors, the following:

- Meeting the basic human needs of present and future generations;

- Promoting equitable access to water;
- Promoting the efficient, sustainable and beneficial use of water in the public interest;
- Reducing and preventing pollution and degradation of water resources;
- Facilitating social and economic development; and
- Providing for the growing demand for water use.

In terms of Section 21 of the National Water Act, the developer must obtain Water Use Licenses if the following activities are taking place:

a) Taking water from a resource;
b) Storing water;
c) Impeding or diverting the flow of water in a water course;
d) Engaging in a stream flow reduction activity contemplated in Section 36;
e) Engaging in a controlled activity identified as such in Section 37(1) or declared under Section 38(1);
f) Discharging waste or water containing waste into a water resource through a pipeline, canal, sewer, sea outfall or other conduit;
g) Disposing of waste in a manner which may detrimentally impact on a water resource;
h) Disposing in any manner which contains waste from or which has been heated in any industrial or power generation process;
i) Altering the beds, banks, course or disposing of water found underground if it is necessary for the safety of people;
j) Removing, discharging, or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and
k) Using water for recreational purposes.

The National Water Act (Section 144) also requires that (where applicable) the 1:50 and 1:100 year flood line be indicated on all the development drawings that are submitted for approval.

<u>Implications for the development:</u>

Not Significant. The study area is affected by a river however the proposed development footprint is not affected by the 1:50 and 1:100 year flood line.

National Environmental Management: Air Quality Act (Act No. 39 of 2004)

The NEMA: Air Quality Act, 2004 serves to repeal the Atmospheric Pollution Prevention Act, 1965 (Act 45 f 1965). The Air Quality Act regulates air quality in order to protect the environment. It provides reasonable measures for the prevention of pollution and ecological degradation and for securing ecological sustainable development while promoting justification economic and social development.

The purpose of the Act is to set norms and standards that relate to:

- Institutional frameworks, roles and responsibilities;
- Air Quality management planning;
- Air Quality monitoring and information management;
- Air Quality management measures; and
- General Compliance and enforcement.

Amongst other things, it is intended that the setting of norms and standards will achieve the following:

- The protection, restoration and enhancement of air quality in South Africa;
- Increased public participation in the protection of air quality and improved public access to relevant and meaningful information about air quality; and
- The reduction of risks to human health and the prevention of the degradation of air quality.

The Act describes various regulatory tools that should be developed to ensure the implementation and enforcement or air quality management plans. These include:

- Priority Areas, which are air pollution "hot spots";
- Listed activities, which are 'problem' processes that require an Atmospheric Emission License;
- Controlled emitters, which includes the setting of emission standards for 'classes' of emitters, such as motor vehicles, incinerators, etc.;
- Control of noise; and
- Control of odours.

Implications for the development:

Not Significant- It can be expected that a certain amount of dust will be generated, due to earthmoving activities and demolition works. One should note that the impact of dust pollution is short term and lasting for the duration of construction only.

The National Heritage Resources Act, 1999 (Act 25 of 1999) (NHRA)

The NHRA requires Heritage Resources Impact Assessments for various categories of development stipulated in Section 38 of the Act. It also provides for the grading of heritage resources and the implementation of a three-tier level of responsibilities and functions for heritage resources to be undertaken by the State, Provincial Authorities, depending on the grade of the heritage resource. The Act defines cultural significance, archaeological and paleontological sites and materials (section 35), historical sites and structures (section 34), and graves and burial sites (section 36) that fall under its jurisdiction. Archaeological sites and material are generally those resources older than a hundred years, including gravestones and grave dressing. Procedures for managing graves and burial grounds are set out in Section 36 of the NHRA. Graves older than 100 years are legislated as archaeological sites and must be dealt with accordingly.

Section 38 of the NHRA makes provision for application by developers for permits before any heritage resource may be damaged or destroyed.

Implications for the development:

Not Significant- No significant cultural / historical resources / features were identified on the study area and therefore it is subsequently anticipated that the impact on any cultural resources are regarded as low to neutral.

If any remains / cultural resources are exposed or uncovered during the construction phase, it should immediately be reported to the South African Heritage Resources Agency (SAHRA). Burial remains should not be disturbed or removed until inspected by an archaeologist.

The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)

The Act provides for the control over the utilisation of Natural Agricultural resources of South Africa, in order to promote the conservation of soil, water sources and vegetation, as well as combating of weeds and invader plants and for matters connecting therewith.

Implications for the development:

Not Significant- According to a GIS desktop study, the study area has high agricultural potential for grains.

National Environmental Management: Protected Areas Act, 2003 (Act No 57 of 2003)

The purpose of this Act is to provide for the protection, conservation and management of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes, for the management of those areas in accordance to national norms and standards, as well as for the intergovernmental co-operation and public consultation in matters concerning protected areas. Protected areas are to be conserved for their biodiversity and ecological integrity.

Implications for the development:

Not Significant- From the GIS desktop study it is evident that the application site is not located within **any conservancy** or **protected area.**

National Environmental Management: Waste Act, 2008 (Act 59 of 2008)

The Waste Management Act which was finally Gazetted on 10 March 2009, is to give effect to the White Paper on Integrated Pollution and Waste Management and the National Waste Management Strategy (NWMS).

Purpose:

To reform the law regulating waste management in order to protect the health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development to provide for institutional arrangements and planning matters national norms and standards for regulating the management of waste by all spheres of government; to provide for specific waste management measures; to provide for the licensing and control of waste management activities; to provide for the remediation of contaminated land; to provide for the national waste information system; to provide for compliance and enforcement; and to provide for matters connected therewith.

Objectives:

- To ensure sound environmental management of waste;
- To provide for utilization of environmentally-sound methods that maximize the utilization of valuable resources and encourage resource conservation and recovery;
- To reduce risk to human health and prevent the degradation of the environment through usage of mechanisms that promote the following:
  - Pollution prevention and cleaner production;
  - Volume reduction at source;
  - Recycling, recovery and re-use;
- Set guidelines and targets for waste avoidance and volume reduction

through source reduction and waste minimization measures, including composting, recycling, re-use, recovery, green charcoal process, and others, before collection, treatment and disposal in appropriate and environmentally sound waste management facilities in accordance with this act;

- To ensure the proper segregation, collection, transportation, storage, treatment and disposal of waste through the formulation and adoption of the best environmental practice in ecological waste management;
- To promote national research and development programs for improved waste management and resource conservation techniques, more effective institutional arrangement and indigenous and improved methods of cleaner production, waste reduction, re-use, collection, treatment, separation and recovery;
- To encourage greater private sector participation in waste management;
- To encourage co-operation and self-regulation among waste generators through the application of market-based instruments;
- To institutionalize Public Participation in the development and implementation of national, provincial and local integrated, comprehensive, and ecological waste management programs;
- To strengthen the integration of ecological waste management and resource conservation and recovery topics into the academic curricula of formal and non-formal education in order to promote environmental awareness and action among the citizenry; and
- To control the export, import, transit, re-use, recovery, treatment and disposal of waste to ensure that all operations relating to export, import, transit, re-use, recovery, treatment and disposal will be undertaken in an environmentally sound manner.

<u>Implications for the development:</u>

Not significant. The construction and operation of the proposed development are not subjected to any activity as listed in Category A and B of NEM: WA, 2008.

National Spatial Development Perspective, 2006

Principle 5 of the National Spatial Development Perspective deals with the spatial distortion of apartheid and calls for future settlement and economic development opportunities to be channelled into activity corridors and nodes that are adjacent to, or that link the main growth centres. It continues to call for infrastructure investment that should primarily support localities that will become major growth nodes in South Africa and the SADC Region to create regional gateways to the global economy.

Implications for the development:

Significant- The proposed development is ideally situated and will provide economic growth and infrastructure upgrading and therefore complies with Principle 5 of the National Spatial Development Perspective.

3.2.3 Provincial Legislations and Regulations

The Mpumalanga Provincial Growth and Development Strategy (MP GDS), 2004 – 2014

This strategy is the overall strategic framework for the Provincial Government. It is the embodiment of the broad strategic policy goals and objectives of the Province and as a policy framework it sets the tone and pace for growth and development in Mpumalanga, whilst aiming to promote integrated planning.

According to the MP GDS, the growth and development challenges in the Province can be summarized in a few distinct, but interrelated categories, namely:

- Poverty (unemployment and lack of access to opportunities);
- High levels of HIV and AIDS (the Province has one of the highest infection rates in the country with 30%);
- The negative growth rate in the Agricultural and mining sectors;

- Manufacturing of downstream products
- The socio-economic development potential of the province is constrained by insufficient road / rail infrastructure;
- The backlog in the delivery of services, water supply and sanitation, especially in rural areas;
- Lack of appropriate skills which is enhanced by the rural nature of the province;
- Corruption limits the effects of good governance measures and service delivery; and
- Environmental degradation - pressures on environmental resources are not comprehensively monitored.

After consideration of these challenges the Province has identified six priority areas of intervention. These priority areas have been identified primarily based on the social, economic and developmental needs of the Province:

- Economic Development (i.e. investment, job creation, business and tourism development and SMME development);
- Infrastructure Development (i.e. urban / rural infrastructure, housing and land reform);
- Human Resource Development (i.e. adequate education opportunities for all);
- Social Development (i.e. access to full social infrastructure);
- Sustainable Environmental Development (i.e. protection of the environment and sustainable development); and
- Good Governance (i.e. effective and efficient public sector management and service delivery).

<u>Implications for the development:</u>

Significant- The proposed development is in line with the Mpumalanga Provincial Growth and Development Strategy. The land, being located in close proximity to the CBD and located in the precinct identified for mixed use development has extensive potential for growth in value with the envisaged improvements and refurbishments, which will also lead to increased investment potential.

The Mpumalanga Integrated Spatial Framework (MPISF), 2005

The Mpumalanga Integrated Spatial Framework (MPISF), 2005 provides for:

A provincial-wide perspective on social, environmental, economic, transport, settlement and land-use factors, and other development trends and impacts in Mpumalanga and strives to develop a spatial rationale of the scope and location of areas with economic (e.g. tourism, agriculture, petro-chemical) development potential, as well as the areas with the major challenges in terms of addressing poverty, service backlogs, etc. in the Province and for the various district municipal areas.

In harmony with the National Spatial Development Perspective, the MPISF puts forward the following directives:

- There should be development focus on localities with greater economic potential.
- There should be development focus on localities that will facilitate the creation of more sustainable human settlements through the provision of more than just houses and basic infrastructure.
- There should be focus on the development of people through skills development and the creation of social opportunities; thus facilitating choice and ability to move between settlements.
- There should be focus on broadening the range of housing products in appropriate localities to address an extended and diverse need of a range of people, including the elderly, people with disabilities, children headed households, single headed households and migrant families.
- The range of suitable localities within existing settlements for infill development should be broadened, by development of appropriate brown field sites in close proximity to the urban areas.

Implications for the development:

Significant- The proposed development will allow for infill development in an urban area where economic growth will benefit not only the Standerton area, but also the larger area. The proposed development is in compliance with the goals of the policies on Provincial level and serves to contribute and support the principles of the Municipality as set out in the abovementioned policy documents.

The Gert Sibande SDF, 2014

The Gert Sibande SDF identifies Standerton as a first order node. Standerton is centrally located within the LLM and being the main urban settlement it dominates industrial and manufacturing activities within the local municipal area. In terms of business activities, Standerton is regarded as one of the areas that make the largest contribution to private sector services, retail activities, and public services and administration activities. It is also the focus of most of the main roads as well as the railway network, thus reinforcing its importance. The largest contributors to the Standerton economy are agriculture, mining, construction and finance and business services. This highlights the importance of Standerton as urban centre. The framework echoes the principles of the national and provincial strategic policies and calls for protection of environmental sensitive areas, economic growth, job creation, upliftment of communities and improved service delivery, etc.

The SDF lists specific development proposals with regard to Lekwa Local Municipality and identifies Standerton as a first order node. The framework also acknowledges the R38 between Standerton and Bethal as well as the R35 between Morgenzon and Amersfoort as First Order Priority corridors where development should be encouraged. ***Refer to Figure 18, Gert Sibande SDF.***

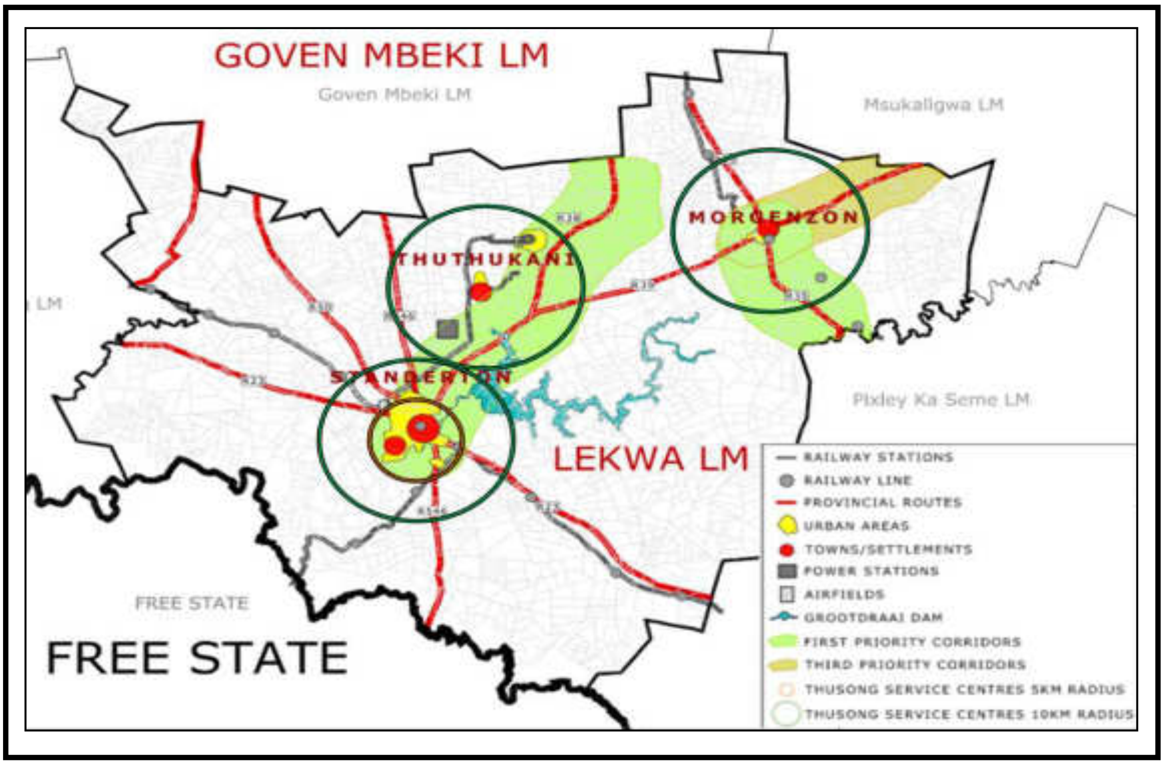


Figure 18: Gert Sibande SDF

The higher order plans provide, amongst others, the following guiding directives in the Gert Sibande SDF for Lekwa Local Municipality:

- Protection and sustainable utilisation of valuable natural resources;
- Improving road and rail infrastructure to stimulate socio-economic development, improve access to comprehensive community facilities and services and facilities and link all settlements;
- Promotion of small and micro-sized rural enterprises;
- The backlog in the delivery of services, water supply and sanitation, especially in rural areas.
- Focusing on localities with greater economic potential.
- Promoting tourism, specifically eco-tourism activities.
- Promoting intensive and extensive commercial farming activities;
- Establishing a functional hierarchy of settlements.
- Facilitating the establishment of business initiatives, rural and agro-industries, co-operatives, cultural initiatives and vibrant local markets; and

- The revitalization of old and creation of new economic, social, and information and communication infrastructure, public amenities and facilities in villages and small rural areas, etc.

Implications for the development:

Significant- The proposed development is in line with the Gert Sibande Spatial Development Framework.

The Gert Sibande District Growth and Development Strategy (GS GDS)

GS GDS aims to guide the development of the District over the next five years, by consolidating and exploiting its natural resources and development opportunities and to assist all role players in helping to grow the District's economy. To this effect and in line with the development priorities of the MP GDS, the District has delineated five district strategic focus areas". These are:

- Tourism Promotion: Traditionally, this sector has not received much attention within the District, yet this sector possesses incredible potential within the District because of the availability of tourist attraction facilities and natural sites e.g. conferencing facilities, casino, resorts, motels and hotels, game farms, wetlands and B&B accommodation;

- Spatial Development Initiatives: The District, in line with the provincial GDS, will explore the economic development nodes identified in order to facilitate the beneficiation and down streaming of products within the mining, agriculture and petrochemical nodes. Focus will be placed on exploring possible partnerships and infrastructure investments needed to act as a catalyst for industrial growth and development.

- Local Economic Development and Growth: The District, in partnership with other spheres of government, will use its resources to:

- Promote and support SMMEs and emerging entrepreneurs;
- Promote and support the sustainability of existing business; and
- Increase local beneficiation and shared economic growth.

- Agriculture, Forestry, Manufacturing and Mining: The District will facilitate and actively promote investment opportunities in downstream opportunities of its raw materials within agriculture, forestry, manufacturing / petrochemicals, and mining sectors.

- Environmental Management: The District boasts one of the country's largest wetlands, and features a unique and sensitive eco-system, responsible for the general well-being of not only the District, but also the economic hub of South Africa, namely Gauteng. Consequently, the District will all support development(s) aimed at meeting the following objectives:

    - Biodiversity;
    - Promotion and protection of indigenous plants and vegetation;
    - Rehabilitation and revival of local streams and rivers;
    - Eco-tourism activities.

The Gert Sibande District Integrated Development Plan, 2009/2010 (GSDM IDP)

The GSDM IDP identifies a number of priority development issues and objectives to address the priority issues in the District. These priority issues include the following:

- To accelerate the provision of, and to ensure that all communities have access to clean water and decent sanitation infrastructure;

- To accelerate the provision of and to ensure that all communities have access to electricity;

- To accelerate the provision of and to ensure that all communities have access to better roads and storm water infrastructure;

- To provide infrastructure that will create an environment that is conducive to economic growth and development;
- To provide infrastructure via using the approach of the Expanded Public Works Program (EPWP), so as to reduce unemployment;
- To accelerate the provision of quality health services that is affordable and accessible to all communities;
- To support the provision of comprehensive community facilities and services (school, clinics, etc.) to all communities where they are needed;
- To ensure that housing developments are located closer to places of work / economic opportunity;
- To provide comprehensive and effective disaster management, fire and emergency services to all communities;
- To ensure comprehensive transport planning in support of economic growth and development;
- To promote tourist attraction areas, and to increase the participation and benefication of the previously marginalised communities; and
- To ensure protection of the environment.

Implications for the development:

Significant- The proposed development is in compliance with the goals of the policies of the Gert Sibande District Municipality and serves to contribute and support the principles of the Municipality as set out in the above-mentioned policy documents.

3.2.4 Local Legislations and Regulations

Lekwa Spatial Development Framework, 2010

The Lekwa SDF acknowledges that the vast portions of Municipal owned land should be put to better use. The SDF encourages the expansion of uses along major routes. The area to the west of Walter Sisulu Drive and North of the R23 is identified as land earmarked for Mixed Use and Infill Development. The SDF also emphasizes the importance of the creation of a functional hierarchy of nodes and identifies the area where Standerton as a first order node. The insert below serves to illustrate the proposals of the SDF.

The proposed development will form the first phase of a larger Mixed Use Development as per the goals of the SDF document. ***Refer to Figure 19, The Lekwa SDF Map.***

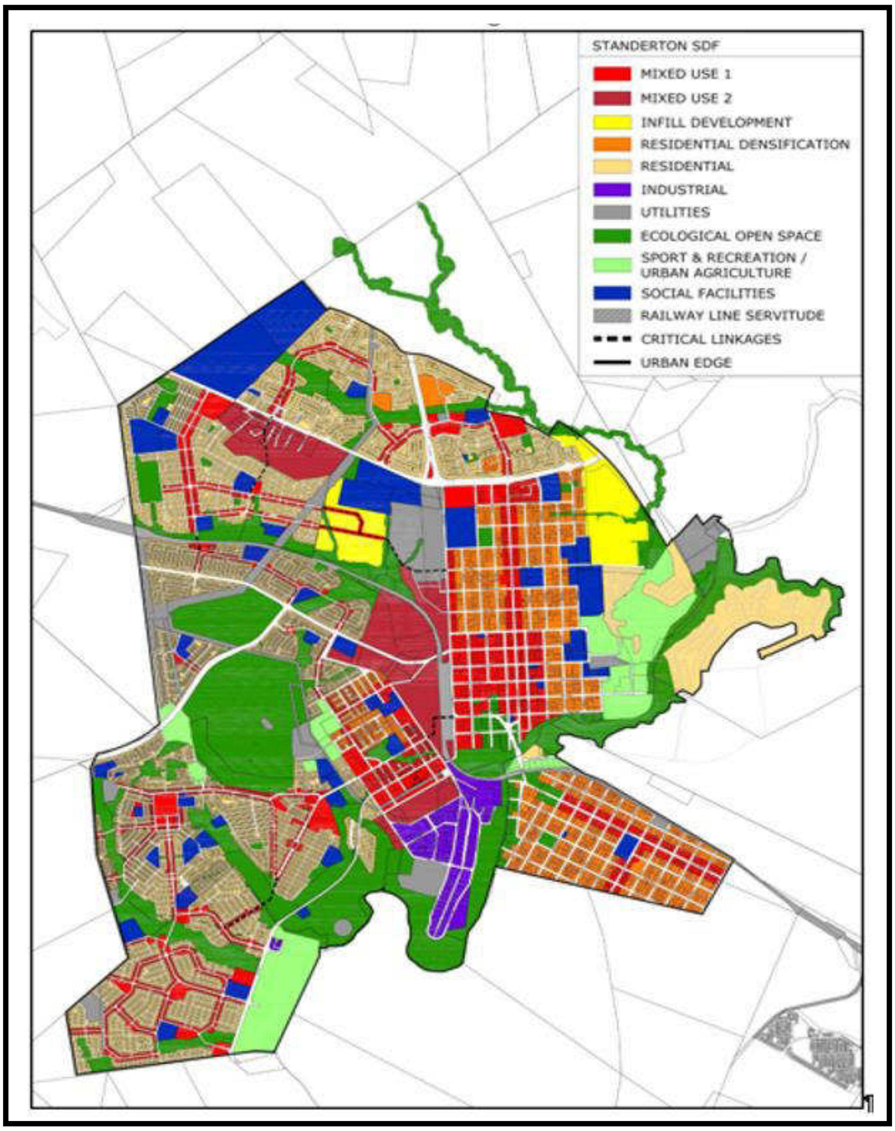


Figure 19: Lekwa SDF.

The Lekwa Integrated Development Plan (IDP) 2016/2017

The Integrated Development Plan, 2016/2017 for Lekwa identifies the challenges confronting the Municipality, which include a declining revenue base and poor management of resources, inefficiencies that limit the manner in which the municipality interface with the communities, aging infrastructure due to truck haulage and deferred maintenance, structural inefficiencies that result in poor service delivery standards, low economic growth and high unemployment rate, vulnerable environmental assets and natural resources.

Objectives were identified in order to optimise development in order to achieve *inter alia* the following priorities:

- o Build a local economy to create more employment, decent work and sustainable livelihoods for the residents of Lekwa;
- o Improve local public engineering services and infrastructure and broaden the community's access to services;
- o Build more united, non - racial, integrated and safer communities.
- o Promote more active community participation in local government.
- o Ensure more effective, accountable and clean local government that works together with national and provincial governments.

At the background of national, provincial and local legislation, policies and frameworks, the IDP echoes the important role of, amongst others:

- o Compact development of our urban areas;
- o Optimal usage of land and infrastructure;
- o Provision of secure housing opportunities, addressing, inter alia, privacy, safety, social facilities and economic opportunities;
- o Viable communities with access to clean and sufficient services,
- o Promotion of densification and integration; and
- o Creation of economic growth and job opportunities, etc.

Effective services provision is catered for in the IDP in the form of allowing for maintenance and management of existing infrastructure, whilst planning for the provision of new engineering services infrastructure. Apart from the money that was paid for the procurement of the land portions that form the subject properties, the bulk services contribution amounts that will be levied for the proposed development will contribute to the funding for the upgrading and maintenance of the services network within the larger Standerton area. The bulk services contribution will contribute to the funding available for upgrading of Lekwa.

Implications for the development:

Significant- The proposed development is in compliance with the goals of the Municipal policies and serves to contribute and support the principles of the Municipality as set out in the abovementioned policy documents.

4. DETAILS OF THE PUBLIC PARTICIPATION PROCESS

(Refer to Appendix E for the Public Participation details)

The principles of the National Environmental Management Act, 1998 (Act No 107 of 1998) and the Environmental Impact Assessment Regulations, December 2014 govern many aspects of Environmental Impact Assessments, including Public Participation. These include provision of sufficient and transparent information on an ongoing basis to stakeholders to allow them to comment and ensuring the participation of previously disadvantaged people, women and youth.

Effective public involvement is an essential component of many decision-making structures, and effective community involvement is the only way in which the power given to communities can be used efficiently. The Public Participation Process is designed to provide sufficient and accessible information to Interested and Affected Parties (I&AP's) in an objective manner to assist them to:

- Raise issues of concern and suggestions for enhanced benefits;
- Verify that their issues have been captured;
- Verify that their issues have been considered by the technical investigations; and

- Comment on the findings of the Basic Assessment Report.

In terms of the Guideline Document for Environmental Impact Assessment (EIA) Regulations promulgated in terms NEMA, stakeholders (I&AP's) were notified of the Environmental Evaluation Process through:

1) A site notice that was erected (at prominent points on and around the study area) on **27 July 2016** ***(Refer to Appendix E (i))****;*
2) Notices regarding the project were **further e-mailed, faxed and sent via registered mail to a list of Interested and Affected Parties and the councillors** in the area that registered for other projects in the area ***(Refer to Appendix E (ii));***
3) An advertisement was placed in the **Local Newspaper on 27 July 2016** ***(Refer to Appendix E (iii))****;*
4) A list of all persons, organisations and organs of state that were registered as Interested and Affected Parties in relation to the application are attached ***(Refer to Appendix E (iv))****; and*
5) No issues were raised by the Interested and Affected Parties and no objections were received. ***Refer to Appendix E (v) for correspondence to and from I & APs.***

5. LONGTERM SUSTAINABLILITY, NEED AND DESIRABILITY

(Please refer to Appendix B7, for the Market Study).

Demacon Market Studies have been appointed to attend to the required market research to assess the economic drivers and trends, trade area based demographic profile, as well as the development and growth potential of the proposed development.

Study Area

The proposed development site is located on a parcel of land in Standerton Town along Walter Sisulu Drive. Because of its location in Standerton Town the development site is surrounded by higher density areas, as oppose to more rural locations. The development site is also just north of the central business district of the town, which is characterised with street front retail and limited parking access.

Walter Sisulu Drive is a regional road which is evidently also one of the primary connector roads in the area. This provides the opportunity to access through fare traffic from surrounding areas. The R23 road, which is situated just south of the proposed development, also functions as a regional road which further compliments the accessibility of the development.

Findings

An estimated 22 668 households and 83 697 people (2016) reside within a ten-minute drive time from the proposed development site. Existing retail supply within the market area include The Junxion Complex (4 995m^2 GLA), Standerton Centre (6 213m^2 GLA), and Monument Shopping Centre (7 722m^2 GLA).

These existing shopping centres can all be classified as convenience-type neighbourhood shopping centres. An initial appraisal of the supply-demand profile of the market area would suggest that a community-type shopping centre (i.e. a centre of up to 22 000m^2 GLA) will be viable.

6. IDENTIFIED ALTERNATIVES

6.1 "No-Go" Alternative

The "No-Go" option entails that the study area remains in its current state. If no development takes place, the existing infrastructure on site will remain neglected and unmaintained which could create a safety and security threat. The site will not be utilised to its fullest potential and it will not contribute to the commercial theme of the area.

Based on the above, the "No-Go" option is not regarded as the preferred alternative for the study area.

6.2 Locality Alternatives

No other properties were investigated for the proposed development seeing that it will not be viable for the applicant to consider other properties as locality alternatives.

6.3 Land-use Alternative

6.3.1 Agricultural

The study area has high agriculture potential for grains. We are however of the opinion that the proposed development site is in the first instance too small to act as a viable and economical agricultural unit. In addition, it is situated in close proximity of the Standerton Township and agricultural activities are not regarded as compatible with township areas.

6.3.2 Residential

A residential development was not regarded as desirable for the study area due to the need for business and retail development of the area.

6.3.3 The Development of a Mixed-Used Development (The Preferred Option)

The Proposed Mixed Use Development as described in this report is regarded as the preferred land-use for the study area and to follow are some of the most important benefits associated with this development:

- There is a need for retail development in the area;
- More rates and taxes payable to the involved local authority;

- Promote the optimisation of existing services;
- Increased jobs;
- Easy access;
- Maximum exposure; and
- Development on already disturbed areas.

6.4 Layout Alternatives

Refer to Figure 15 and Appendix C for the Final layout

Many alternative layouts for the development will be considered during the planning phase of the development before the layout was finalised. The physical constraints of the study area are considered as the main form giving elements for the layout. The final layout will also be tested against an environmental sensitivity map that will be compiled for the study area.

The final layout is a product of a multi-disciplinary workshop (during the planning phase) between the appointed professionals. At the workshops each discipline (including the Environmental Consultant) is afforded the opportunity to share his / her findings with the other members of the project team. The environmental consultants did also present the environmental sensitivity map to the project team during the workshops.

The following disciplines will most probably take part in the workshop:

- The Civil Engineers;
- The Electrical Engineers,
- The Geotechnical Engineers;
- Town and Regional Planners;
- The Architects and Landscape Architects;
- The Environmental Consultants (Bokamoso); and
- The Applicant.

7. DESCRIPTION AND ASSESSMENT OF ENVIRONMENTAL IMPACTS

7.1 Anticipated Environmental Impacts

7.1.1 Environmental Impact Description, Environmental Management & Mitigation measures

The most significant anticipated environmental impacts associated with the development of the proposed application site are discussed in this section with reference to possible mitigation measures that will minimize negative impacts and enhance positive impacts.

7.2 Construction Related Impacts

Beneficial Impacts

7.2.1 Socio-economic

Creation of Job opportunities

The proposed development would create job opportunities during the construction phase. The value that the jobs created by the construction industry should not be underestimated as it benefits a lot of people that have no other work and further transfer skills.

Adverse Impacts

7.2.2 Bio-Physical Environment

Geology and Soils

- Dust pollution;
- Degradation of soils;
- Unstable conditions; and
- Dangerous excavations.

Proposed Mitigation measures-

- Implementation of temporary storm water management measures during construction;
- Appointing of a Geotechnical Engineer to assist with foundation designs and other stability and geotechnical issues;
- Implementation of dust suppression measures during the construction phase; and
- Clear marking of dangerous excavations.

Hydrology

- More exposed areas and increased erosion and siltation and water pollution;
- Construction during the rainy periods.

Proposed Mitigation measures-

- Implementation of temporary storm water management measures during construction; and
- Schedule (where possible) construction associated with earthworks for the dryer winter months.

Climate

- Should the construction phase be scheduled for the summer months, frequent rain could cause very wet conditions, which makes it difficult to build in and rehabilitate disturbed areas on site;
- These wet conditions often cause delays to building projects; and
- The drainage of water away from the construction site into the surrounding open space areas could (if not planned and managed correctly) have an impact on the water quality of these water bodies.

Proposed mitigation measures-

- It is recommended that the construction phase be scheduled for the winter months, especially activities such as the installation of services, foundations, excavations and road construction;

- It is also recommended that precautionary measures be taken in order to prevent the extensive loss of soil during rainstorms. Large exposed areas should be protected against erosion by matting or cladding;
- Measures should be implemented during the rainy season to channel storm water away from open excavations and foundations; and
- Construction workers and construction vehicles and machinery must stay out of the soggy areas during the wet periods. Barrier tape should be used to demarcate the areas that are drenched with water it should only be removed when the appointed Environmental Control Officer (ECO)/ Site Supervisor/ Project Manager /Main Contractor regard the conditions as favorable.

Flora & Fauna

The proposed development could have the following impacts on the biological and ecological environments:

- Change in water quality during construction phase, contaminated storm water;
- Loss of natural grassland areas;
- Loss of medicinal plant species;
- Possible loss of sensitive drainage line and seasonal stream vegetation;
- If the entire area to be developed is cleared at once, smaller birds, mammals and reptiles will not be afforded the chance to weather the disturbance in an undisturbed zone close to their natural territories;
- Noise impact of construction machinery could have a negative impact on the fauna species during this phase;
- During the construction and operational phase (if not managed correctly) fauna species could be disturbed, trapped, hunted or killed; and
- Loss of habitat can lead to the decrease of fauna numbers and species.

Proposed Mitigation measures-

- As much as possible of the medicinal plant species should be removed prior to construction and be transplanted in a suitable area by a vegetation specialist.

- Entrance by vehicles, especially off-road cars and bakkies, off-road bicycles and quad bikes to the areas to be excluded should be prohibited, both during the construction phase and during the lifespan of the project.
- The areas earmarked for exclusion from development must be fenced off during the construction phase to ensure that the developer and his contractors do not damage these areas or do not cover them with soil, builders' rubble or waste.
- As many as possible of the mature indigenous trees that occur on the site should be retained as part of the landscaping. Measures to ensure that these trees survive the physical disturbance of the development should be implemented. A tree surgeon should be consulted.
- The integrity of the small wetland must be regarded inviolate, and its seasonal stability should be enhanced through the use of retention ponds for storm water, and buffer zones of regenerated natural grasslands on either side.
- It is suggested that where work is to be done close to the drainage lines, these areas be fenced off during construction to prevent heavy machines and trucks from trampling the plants, compacting the soil and dumping in the system.
- Category 1 Declared weeds, Category 2 Declared invaders and one Category 3 Declared invader occurred on the study area and must be eradicated prior to construction and throughout the operational phase of the development.

Veld fires may cause damage to infrastructure, vegetation and Fauna-

Construction workers could start uncontrolled fires, which could damage infrastructure on site and the adjacent open space areas.

Proposed mitigation measures-

- One central cooking and fire area should be established on site. This should be located in a fire safe area where vegetation (especially Veld grass) has been removed;
- Cooking fires and smoking should strictly be limited to only this area. No smoking at the construction site should be permitted outside this area; and

- No fires or smoking should be allowed on windy days.

Air Pollution, Localised Vibration and Noise pollution

Nuisance to neighbours in terms of dust generation-

It can be expected that a certain amount of dust will be generated due to earthmoving activities and demolition works. One should take note that the impact of dust pollution is short-term and lasting for the duration of construction only.

Proposed Mitigation measures-

- The application site must be damped on a regular basis with water during dry and windy conditions.

Nuisance to neighbours in terms of noise generation, especially due to demolition works-

A certain amount of noise will be generated during the construction phase which may definitely become a nuisance to the surrounding land owners, residents and businesses.

Proposed Mitigation Measures-

- It is anticipated that a certain amount of noise will be generated during the construction phase. The contractors should take care, and manage construction / demolition works to such an extent to comply to minimum ambient noise levels as defined in local, provincial, and national policies and frameworks;
- The contractor should liaise with local residents on how best to minimise the impact. The local population should be kept informed of the nature and duration of intended activities;
- Construction yards, workshops, concrete batching plants and other noisy fixed facilities should be located well away from noise sensitive areas;
- All construction vehicles, plant and equipment are to be kept in good repair;
- Blasting operations (if required) are to be strictly controlled with regard to the size of explosive charges in order to minimise noise and air blast and timings of explosions;

- Construction activities should remain and take place during reasonable hours during the day and early evening. No construction should be allowed on weekends from 14h00 on Saturday afternoons to 06h00 the following Monday morning; and
- It must be ensured that the working conditions of construction workers comply with the requirements of the Occupational Health and Safety Act, 1993 (Act No 85 of 1993).

Heavy vehicle traffic and noise increase on the local roads-

Construction vehicles will have a negative impact on traffic volumes, road safety and noise levels during the construction period. Heavy construction vehicles will have an added negative impact on traffic flow during the peak hour traffic times.

Proposed mitigation measures-

- The heavy construction vehicles should avoid the local roads during peak traffic times and large deliveries should also be scheduled outside the peak traffic times;
- Signs should be erected in the vicinity of the site and on all major junctions that the construction vehicles will use; and
- The construction vehicles should obey all traffic rules and stay within the speed limits.

Visual Impact & Waste Management

If the site office and camp is not managed according to the EMPr-

The area where the site office, material stockyards, and workshops are to be erected should be located in an already disturbed part of the site.

Absence of proper sanitation facilities and good housekeeping could negatively impact the local community, surface / sub-surface hydrology and soils.

Proposed Mitigation measures-

- Identify a central waste storage area and establish suitable containers and skips for the different waste streams;

- The wind direction and the proximity to neighbouring properties should be taken into account, when a central waste storage area is established;
- Rubble and waste should be removed from the construction site on a weekly basis by a service provider;
- The contractor should communicate with other trades and businesses in the area to establish waste exchange and recycling possibilities;
- Rubble and waste should be removed to registered dumping sites that are acceptable to the Local Authorities; and
- Chemical toilets, one for every ten workers, should be erected close to the area where construction works are taking place.

Dumping of builder's rubble on site-

The dumping of builder's rubble on site may cause visual pollution. Dumping of waste in open space areas adjacent to the site could have a detrimental effect on the Fauna and Flora of the open space areas. Builder's rubble can also pollute the hydrological system and soil of the open space area. It is therefore critical that no builder's rubble be dumped within the open space areas or vacant land within the surrounding area.

Proposed Mitigation measures-

- Identify a specific point for waste and rubble on site;
- The area should be located in an area that is already disturbed and which can be hidden from the surrounding residents to prevent visual pollution;
- All the rubble and waste materials should be transported and disposed at this central waste disposal site that should be established;
- Rubble should be removed from this area on a regular basis as to not cause a negative visual impact;
- Appropriate containers for different waste streams should be provided on site; and
- Barriers and screens should be erected around the waste storage area to mitigate and reduce its visual impact.

Vehicle maintenance on site could cause visual pollution-

Temporary maintenance and refuelling workshops may be required for construction vehicles. Soil and water pollution by oil, lubricants and fuel may occur at these facilities. The volume of lubricants and fuel expected to be on site should only cause localised pollution. However, any pollution of the soil and water is undesirable and should be prevented.

Proposed mitigation measures-

- One area in the site camp should be used for fuel or hazardous materials and lubricant storage;
- This area should be bounded to contain 1.5 times the storage volume of fuel and should have a concrete base;
- A working area should be established at the site camp with a concrete base on which all machinery repairs, vehicle services and such activities should take place; and
- After the construction works are completed this area should be rehabilitated and the soil quality should be restored.

Light Pollution-

Security and temporary lighting on site during the construction phase could have an adverse impact on the surrounding neighbours and driving conditions on the surrounding roads.

Proposed Mitigation measures:

- Security lighting should be directed to the ground;
- Only the needed lighting should be installed;
- Lighting should not shine into the neighbouring properties or onto the surrounding roads and oncoming traffic; and
- The design, placement and arrangement of exterior lighting should take the sensitive night views into consideration.

Construction Works could cause an adverse visual impact to the surrounding land owners / residents-

The infrastructure associated with the construction phase (Site camp and waste storage area) could cause an adverse visual impact.

Proposed mitigation measures-

- Waste and building material stockyards should at all times be cleaned and kept tidy;
- No litter, plastic package or cement bags should at any time be left on site. It is expected that the site be kept neat and tidy at all times. Waste items should be disposed of once a week by a contracted service provider;
- Screens should be erected to hide unsightly waste storage areas or any other temporary infrastructure that may cause an adverse visual impact; and
- Where possible, screens should be erected around the site, to mitigate the adverse visual impact that construction activities have on the surrounding urban environment.

<u>Cultural & Historical</u>

The potential occurrence of cultural and historical assets on site-

Archaeological sites / sites of cultural and historical importance can be disturbed and/or destroyed during construction works, if exposed.

Proposed Mitigation Measures-

- Archaeological sites that are exposed during construction work, should immediately be reported to a museum, preferably one at which an archaeologist are present, so that an investigation and evaluation of the findings can be made;
- It should be noted that in terms of the National Heritage Resources Act, 1999 (Act 25 of 1999), Section 35(4) no person may without a permit issued by the responsible heritage resources authority destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or paleontological site or material; and

- Section 34 (1) also in addition states that no person may alter or demolish any structure or part of a structure, which is older than 60 years without a permit, issued by the relevant provincial heritage resources authority.

Safety and Security

The following safety and security problems can arise during the construction phase-

- Reckless operators of construction vehicles can cause dangerous conditions on the nearby roads as well as on the construction site;
- Deep excavations without warning signs can pose a health and safety risk to the construction personnel on site, as well as the public / surrounding residents / pedestrians; and
- Possible crime initiated due to an influx of people that are associated with construction.

Proposed mitigation measures-

- Although regarded as a normal practice, it is important to erect proper signs indicating the operation of heavy vehicles in the vicinity of dangerous crossings and access roads;
- Dangerous excavations where construction is not actively taking place, should be properly marked and demarcated with orange safety barrier tape;
- Construction must be completed in the shortest possible time. No construction worker or relative may reside on the application site during the construction phase. All construction workers must leave the site at the end of the day's work. A security company must be appointed to secure the site, and to ensure a safe and controlled environment;
- No construction worker, friend or relative may reside on site. Only security personnel may be present on site after construction hours; and
- No construction worker should be allowed to enter any adjacent private property for any reason without written consent.

7.3 Operational Related Impacts

➢ **Beneficial Impacts**

7.3.1 Socio-Economic

Economical and Institutional:

- More rates and taxes payable to the involved Local Authority;
- Promote the optimisation of existing services;
- Increased jobs;
- Maximum exposure; and
- The proposed expansion is in line with the planning frameworks for the area.

Social:

- Increased jobs; and
- Easy access to retail development.

7.3.2 Bio-Physical Environment

Geology and Soils:

- Prevention of any further erosion and siltation.

Hydrology:

- Promotion of surface drainage.

Fauna and Flora:

- Removal of exotic invaders.

➢ **Adverse Impacts**

Roads and Traffic

- The proposed development could have an impact on passing traffic volumes and the interception of traffic could cause minor disruptions.

Proposed mitigation measures:

- Care should be taken pertaining to the placing of signage in the proximity of access points to the proposed development.

7.3.3 Qualitative Environment

Lighting Pollution

- The proposed development could cause a significant level of light pollution due to security and advertisement lighting. These lighting could easily glare into the surrounding environment, especially surrounding residences if not designed appropriately.

Proposed mitigation measures:

- It is recommended that all the lighting on site be designed to point downwards and the lighting system should be designed not to cause glare, dispersal or unnecessary flickering.

Air pollution-

The development will generate additional traffic on the local roads that will contribute to the air pollution levels in the immediate area.

Proposed mitigation measures:

- Air pollution levels will not exceed acceptable levels. No mitigation measures proposed.

Noise pollution-

Some additional noise will be generated during the operational phase of the proposed development due to:

- The interception of traffic on surrounding roads to the development; and
- Activities associated with the operation of the shopping centre (air conditioning, compressors, places of refreshment etc.)

Proposed mitigation measures-

- The design, placement and orientation of extractor fans for the ventilation of the buildings must take the noise impact aspect into consideration. Equipment with the best noise rating should be used. Roof mounted fans may further require attenuators and need to be screened from noise sensitive areas;
- High quality air conditioning equipment should be installed. Equipment with the best noise rating should be used;
- Where required, high quality refrigeration compressors should be installed. Equipment with the best noise rating should be used. Exterior installations should be acoustically encapsulated; and
- All mechanical equipment should be well maintained.

Visual Impact-

The application site will be highly visible from Walter Sisulu Drive and surrounding view sheds predominantly due to the study area's current topographical character.

Proposed mitigation measures-

- The architectural styles, colours and textures and construction materials will determine the visual impact of the proposed development on the surrounding areas.

Hydrology:

- **Storm water Management**

Surface water run-off from the site has the potential to affect the surrounding open-space areas if not well managed.

Proposed mitigation measures

- Adequate storm water management must be incorporated in the design of the proposed development to ensure the effective management of surface water run-off from the site, and to prevent erosion and the associated sedimentation of the surrounding areas;
- The release points of storm water to the surrounding open space areas must be done carefully and the use of energy dissipation structures, reno-mattresses and geo-textiles should be made to prevent erosion down gradient of the discharge points;
- Sheet run-off from paved surfaces and access roads need to be curtailed;
- All areas which have been affected by construction, which are to remain as open space should be rehabilitated upon the completion of the construction phase;
- Discharge of storm water runoff from site should be limited to pre-design development peak flows and volumes;
- Where practical, retention and detention storage systems should be used to manage peak storm water flows within the on-site storm water management system; and
- Uncontaminated storm water run-off from roofs, parking bays and the landscape should not be allowed to mix with process effluent, stored chemicals or storm water runoff from areas susceptible to chemical / petroleum based spills.

- **Surface and groundwater pollution**

Surface and groundwater pollution could occur due to leaking equipment and spillages associated with the proposed development.

Proposed mitigation measures

- Compilation of a storm water management plan that will address storm water management during the construction and operational phases of the project.

- **Economic impact on Standerton area.**

The proposed development will not have a significant impact on economy of the Standerton area.

7.4 Significance Description Methodology

The significance of Environmental Impacts was assessed in accordance with the following method:

Significance is the product of probability and severity. Probability describes the likelihood of the impact actually occurring, and is rated as follows:

- Improbable - Low possibility of impact to occur either, because of design or historic experience.
  Rating = 2
- Probable - Distinct possibility that impact will occur.
  Rating = 3
- Highly probable - Most likely that impact will occur.
  Rating = 4
- Definite - Impact will occur, in the case of adverse impacts regardless of any prevention measures.
  Rating = 5

The severity factor is calculated from the factors given to "intensity" and "duration". Intensity and duration factors are awarded to each impact, as described below.

The Intensity factor is awarded to each impact according to the following method:

Low intensity	-	natural and man-made functions not affected – Factor 1
Medium intensity	-	environment affected but natural and man-made functions and processes continue - Factor 2
High intensity	-	environment affected to the extent that natural or man-made functions are altered to the extent that it will temporarily or permanently cease or become dysfunctional - Factor 4

Duration is assessed and a factor awarded in accordance with the following:

Short term	-	<1 to 5 years - Factor 2
Medium term	-	5 to 15 years - Factor 3
Long term	-	impact will only cease after the operational life of the activity, either because of natural process or by human intervention - Factor 4.
Permanent		mitigation, either by natural process or By human intervention, will not occur in such a way or in such a timespan that the impact can be considered transient - Factor 4.

The severity rating is obtained from calculating a severity factor, and comparing the severity factor to the rating in the table below. For example:

The Severity factor	=	Intensity factor X Duration factor
	=	2 x 3
	=	6

A Severity factor of six (6) equals a Severity Rating of Medium severity (Rating 3) as per table 16 below:

Table 4: Severity Ratings

RATING	FACTOR
Low Severity (Rating 2)	Calculated values 2 to 4
Medium Severity (Rating 3)	Calculated values 5 to 8
High Severity (Rating 4)	Calculated values 9 to 12
Very High severity (Rating 5)	Calculated values 13 to 16
Severity factors below 3 indicate no impact	

A Significance Rating is calculated by multiplying the Severity Rating with the Probability Rating.

The significance rating should influence the development project as described below:

Low significance (calculated Significance Rating 4 to 6)

- Positive impact and negative impacts of low significance should have no influence on the proposed development project.

Medium significance (calculated Significance Rating >6 to 15)

- Positive impact:
  Should weigh towards a decision to continue

- Negative impact:
  Should be mitigated to a level where the impact would be of low significance before project can be approved.

High significance (calculated Significance Rating 16 and more)

- Positive impact:
  Should weigh towards a decision to continue, should be enhanced in final design.

- Negative impact:
  Should weigh towards a decision to terminate proposal, or mitigation should be performed to reduce significance to at least low significance rating.

7.5 Significance Assessment

Refer to **Table 5** for the Calculation and Result of the Significance Assessment of Impacts identified to be associated with the Proposed Development.

Note proposed mitigation measures are supplied in EMPr and in Item 5 above – no mitigation required for beneficial impacts

Table 5: Calculation and Result of the Significance Assessment of Impacts Identified to be Associated with the Proposed Development

Impact	Probability Rating	Severity Rating		Severity Factor	Severity Rating	Significance Rating- prior to mitigation and after mitigation
		Intensity	Duration			
THE CONSTRUCTION PHASE						
BENEFICIAL IMPACTS (Note: Not necessary to mitigate because the impact are positive)						
Socio-Economic						
Creation of Employment opportunities.	4	4	2	8	3	**12 Medium**
Improved site security.	5	2	3	6	3	**15 Medium**
Flora						

The eradication of exotic invades and weeds on the subject property.	5	4	2	8	3	**15 Medium**
ADVERSE IMPACTS						
Geology and Soils						
The site clearance and leveling will cause some additional exposed areas and could trigger some additional erosion and siltation, especially during rainy periods.	4 2	2 2	2 2	4 4	2 2	**8 Medium** **4 Low**
Dust pollution.	4 2	2 2	2 2	4 4	2 2	**8 Medium** **4 Low**
Degradation of soils.	4 2	2 2	2 2	4 4	2 2	**8 Medium** **4 Low**
Unstable conditions.	4 2	2 2	2 2	4 4	2 2	**8 Medium** **4 Low**
Dangerous excavations.	4 2	2 2	2 2	4 4	2 2	**8 Medium** **4 Low**
Surface & Sub-surface Hydrology						
More exposed areas and increased erosion, siltation and water pollution.	3 2	2 2	2 2	4 4	2 2	**6 Medium** **4 Low**
Construction during the rainy periods.	4 2	2 2	2 2	4 4	2 2	**8 Medium** **4 Low**

Excavated materials that are stockpiled in wrong areas can interfere with the natural drainage, cause sedimentation and water pollution.	4 2	2 2	2 2	4 4	2 2	**8 Medium** **4 Low**
Subsoil fuel contamination is a possibility if disused tanks are not removed properly due to possible presence of a perched water table during the wet season. Any surface or subsurface contamination could cause serious damage to the underground water regime.	4 2	2 1	4 2	8 2	3 2	**8 Medium** **4 Low**
Climate						
Should the construction be phased for the summer months, frequent rain could cause very wet conditions, which makes it difficult to build in in and rehabilitate disturbed areas on the site	4 2	2 2	2 2	4 4	2 2	**9 Medium** **4 Low**
The wet conditions often cause delays to building projects. The drainage of water away from the construction site into the surrounding open space areas could (if not planned and managed correctly) have an impact on the water quality of these water bodies.	4 2	2 2	2 2	4 4	2 2	**10 Medium** **4 Low**
Flora and Fauna						
The clearance of the site and the construction of the proposed structures and infrastructure will result in the eradication of the existing vegetation on site.	4 2	2 2	4 4	8 8	2 3	**8 Medium** **6 Medium**

Accidental introduction of exotics and invaders.	2 2	1 1	4 2	4 2	2 2	**4 Low** **4 Low**
Veld fires may cause damage to infrastructure, vegetation and fauna.	2 2	1 1	2 2	2 2	2 2	**4 Low** **4 Low**
Areas where vegetation cleared for construction are not properly rehabilitated.	4 2	2 1	4 2	8 2	3 2	**12 Medium** **4 Low**
Increase in surface drainage to accommodate infrastructure and structures.	4 2	2 1	4 4	8 4	3 2	**12 Medium** **4 Low**
Air pollution, Localized vibration & noise pollution						
Nuisance to neighbours in terms of dust generation.	4 2	2 1	2 2	4 2	2 2	**8 Medium** **4 Low**
Nuisance to neighbours in terms of noise generation during construction.	4 2	2 1	2 2	4 2	2 2	**8 Medium** **4 Low**
Heavy vehicle traffic and noise increase on the local roads.	4 2	2 1	2 2	4 2	2 2	**8 Medium** **4 Low**
Visual Impact & Waste Management						
If the site office and camp, and associated waste are not managed according to the EMPr.	4 2	2 1	2 2	4 2	2 2	**8 Medium** **4 Low**
Builder's rubble is dumped during the construction phase on site, and the surrounding open space areas.	4 2	2 1	2 2	4 2	2 2	**8 Medium** **4 Low**

Vehicle maintenance on site could cause pollution.	2 2	2 1	2 2	4 2	2 2	**4 Low** **4 Low**
Lighting pollution.	3 2	2 1	2 2	4 2	2 2	**6 Low** **4 Low**
Construction works could have an adverse visual impact on the surrounding residents and landowners.	4 2	2 1	2 2	4 2	2 2	**8 Medium** **4 Low**
Cultural & Historical						
The occurrence of cultural and historical assets on the proposed development site.	2 2	2 1	4 2	8 2	3 2	**6 Low** **4 Low**
Safety and Security						
The following safety and security problems are likely to occur during the construction phase: • Reckless operators of construction vehicles can cause dangerous conditions on the subject property and surrounding roads; • If ground works, especially deep excavations are not properly marked or demarcated for safety reasons; and • Possible crime initiated by construction workers / friends / relatives during the construction phase.	3 2	2 1	2 2	4 2	2 2	**6 Low** **4 Low**

OPERATIONAL PHASE						
BENEFICIAL IMPACTS (Note: Not necessary to mitigate because the impacts are positive)						
Socio-Economic						
Economical and Institutional						
More rates and taxes payable to the local authority.	5	4	4	16	5	**25 High**
Promote the optimum utilisation of services.	5	4	4	16	5	**25 High**
Job opportunities in close proximity of residential areas.	5	2	4	8	3	**15 Medium**
The proposed development is in line with the planning frameworks for the area.	5	2	4	8	3	**15 Medium**
Social						
Increased jobs.	4	2	4	8	3	**12 Medium**
Job opportunities in close proximity of residential areas.	4	2	4	8	3	**12 Medium**
It is anticipated that the proposed development will enhance the "Sense of Place" of the study area and the surrounding environment.	4	2	4	8	3	**12 Medium**
Services, Roads and Traffic						
The proposed development will promote the optimum utilisation of services.	4	2	4	8	3	**12 Medium**
Safety & Security						
Increase security in the immediate and surrounding urban environment.	4	2	4	8	3	**12 Medium**
Bio-Physical Environment						

Geology and Soils						
Prevention of any further erosion and siltation.	2	2	4	8	3	**6 Low**
Hydrology						
Promotion of surface drainage.	2	2	4	8	3	**6 Low**
Fauna and Flora						
Implementation of a weed control programme.	2	2	4	8	3	**6 Low**
Replacement of exotic species with indigenous species.	4	2	4	8	3	**12 Medium**
Removal of exotic invaders.	2	2	4	8	3	**6 Low**
Development of the already built up areas.	4	4	4	16	5	**20 High**
ADVERSE IMPACTS						
Roads & Traffic						
The impact if additional vehicular traffic.	4 2	4 2	4 4	16 8	5 3	**8 Medium** **6 Low**
Qualitative Environment, Pollution & Visual Impact						
Light pollution	4 2	4 2	4 4	16 8	5 3	**20 High** **6 Low**
Air Pollution.	2	2	4	8	3	**6 Low**

	2	1	4	4	2	**4 Low**
Visual Impact.	4 2	4 2	4 4	16 8	5 3	**20 High** **6 Low**
Hydrology						
Surface run-off from the site has the potential to affect the surrounding open space areas of not well managed.	4 2	2 1	4 4	8 4	3 2	**12 Medium** **4 Low**
Surface and ground water pollution due to leaking equipment and spillages associated with the proposed development.	4 2	2 1	4 4	8 4	3 2	**12 Medium** **4 Low**
Possible surface water pollution due to unaddressed spillages associated with the proposed development.	4 2	2 1	4 4	8 4	3 2	**12 Medium** **4 Low**

7.6 Discussion of Significance Assessment

The above results can mainly be ascribed to the current developed and transformed state of the study area, and its immediate surrounding environment. In addition to this, no geotechnical condition exists to the extent of not allowing the proposed development to proceed.

It is evident from the results above that 76 % of all the adverse impacts, associated with the development, are of a short term in nature, lasting for construction only and can be successfully mitigated.

It is clear that the socio-economic and institutional environment will benefit significantly from the proposed development.

In light of the above, it can be provisionally concluded that, no "fatal flaw" adverse impacts or impacts that cannot be adequately mitigated, are anticipated to be associated with the proposed development. This is subjected to the condition that all recommended mitigation measures as stipulated in the Environmental Management Programme (EMPr) and as supplied in this report, be adhered to, in order to mitigate the adverse impacts and to achieve the maximum gain from the identified beneficial impacts ***(Please refer to Appendix D for the attached report).***

7.7 INPUTS AND RECOMMENDATIONS BY SPECIALISTS

SAHRA confirmed that no heritage investigations are required for the proposed development because the surface topography of the proposed development area has been disturbed by recent activities; the possibility of uncovering any archaeological artefacts is low.

The study area is not regarded as ecological sensitive. ***Refer to Appendix B3 for the recommendations made by die Fauna and Flora Specialist.***

No watercourses will be affected by the proposed development, thus no aquatic / wetland studies will be required.

8. ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPr)

Containing the aspects contemplated in Regulation 33

Please refer to Appendix D for the attached Environmental Management Programme (EMPr)

9. ASSUMPTIONS, UNCERTAINCIES AND GAPS IN KNOWLEDGE

The following assumptions and gaps in knowledge are implicit in this Basic Assessment Report (BAR)

9.1 Assumptions:

- The primary assumption underpinning this BAR and the individual specialist studies upon which this BAR is based, is that all information received from the applicant, professional consultants, and other stakeholders including registered I & AP's was correct and valid at the time of the study; and
- The significance of impacts was not underestimated. The specialist assessed impacts under the worse-case scenario situation.

10. ENVIRONMENTAL IMPACT STATEMENT

Environmental Impact Statement that summarizes the impacts that the proposed development may have on the environment after the management and mitigation of impacts that have been taken into account

The major impacts that are likely to occur during the construction and operational phases are the following:

10.1 The Physical and Biological Environment:

Construction Phase

- The natural environment will be affected by construction related activities. The study area is in a developed and transformed state with no important or significant faunal or flora Species present; and

- The study area is not affected by any drainage line or sensitive wetland / riparian habitat. It must however be noted that runoff from the proposed development site has the potential to affect the surrounding open space areas if adequate storm water management measures are not implemented.

Operational Phase

- Increased storm water volumes due to an increase in impermeable surfaces; and
- Possible surface and groundwater pollution due to spillages and leaking equipment.

10.2 The Socio-economic Environment

Construction Phase:

- Nuisance to neighbours due to dust pollution that are associated with construction activities;
- Nuisance to neighbours due to noise that is generated by construction activities;
- Nuisance to neighbours due to the undesirable visual impact that is associated with construction activities;
- Damage to local roads by heavy vehicles; and
- Heath, safety and security problems that is likely to occur during construction.

Operational Phase:

- Increased traffic volumes; and

- Possible noise pollution and visual pollution caused by the signage, interior lighting, security lighting, exterior lighting, transformers, air conditioners, places of refreshments etc.

Finding:

None of the adverse impacts that were identified are regarded as impacts that cannot be mitigated to acceptable levels and therefore it is our opinion that there are no "fatal flaws" associated with the proposed development.

11. CONCLUSION AND RECOMMENDATIONS

As mentioned throughout the report, on the study area there is an abandoned shooting range of approx. one hectare, including the old clubhouse building towards the north west of the study area. Approximately 0.4ha of the study area is bare ground, situated north and south of the watercourse.

The significance assessment of the impacts that is associated with the development indicates that almost 76% of the anticipated adverse impacts are of a short term nature lasting for construction only. In addition, it is important that one should take cognizance of the fact that the significance of these impacts is predominantly low to medium, with high mitigation levels.

The significance assessment further indicated that a great number of beneficial impacts are associated with the proposed development. These impacts are generally of a socio-economic nature with medium to high significance ratings.

Opinion and Recommendations by EAP:

It is believed that both beneficial and adverse impacts were thoroughly assessed, and the needs and benefits have been assessed so as to give the proposed development the go-ahead. As a result Bokamoso is of the opinion that the proposed development will have a significant long-term beneficial socio-economic impact on the subject property and its immediate surroundings.

It is therefore recommended by Bokamoso that the proposed development be approved, subjected to the implementation of appropriate mitigation measures as stipulated in this report and the Environmental Management Programme (EMPr), to achieve maximum advantage from the beneficial impacts and the sufficient mitigation of adverse impacts.

It is recommended that, based on the findings of the BAR and supplemental specialist information that:

- Should the proposed development obtain the necessary Environmental Authorisation, an Environmental Management Programme (EMPr) must be implemented for the construction and operational phases of the development. The EMPr, as attached to this document, should be made part of the contractual documents of the contractors;
- The construction of all structures, roads and services must be in accordance with the specifications of the Geotechnical Investigation;
- The implementation of a Groundwater Monitoring Plan;
- The design and implementation of the infrastructure and services are to be done in accordance with engineering specifications so as to comply with the requirements, regulations and standards of the local controlling authority;
- Runoff from the proposed development site has the potential to affect the surrounding open space areas. It is therefore recommended that adequate storm water management be incorporated in the design of the proposed development in order to prevent erosion and the associated sedimentation of the surrounding areas; and
- Signage / advertising board signage should comply with the relevant by-laws, regulations and standards of the Local Authority.

Appendix A
Enlargements of Figures

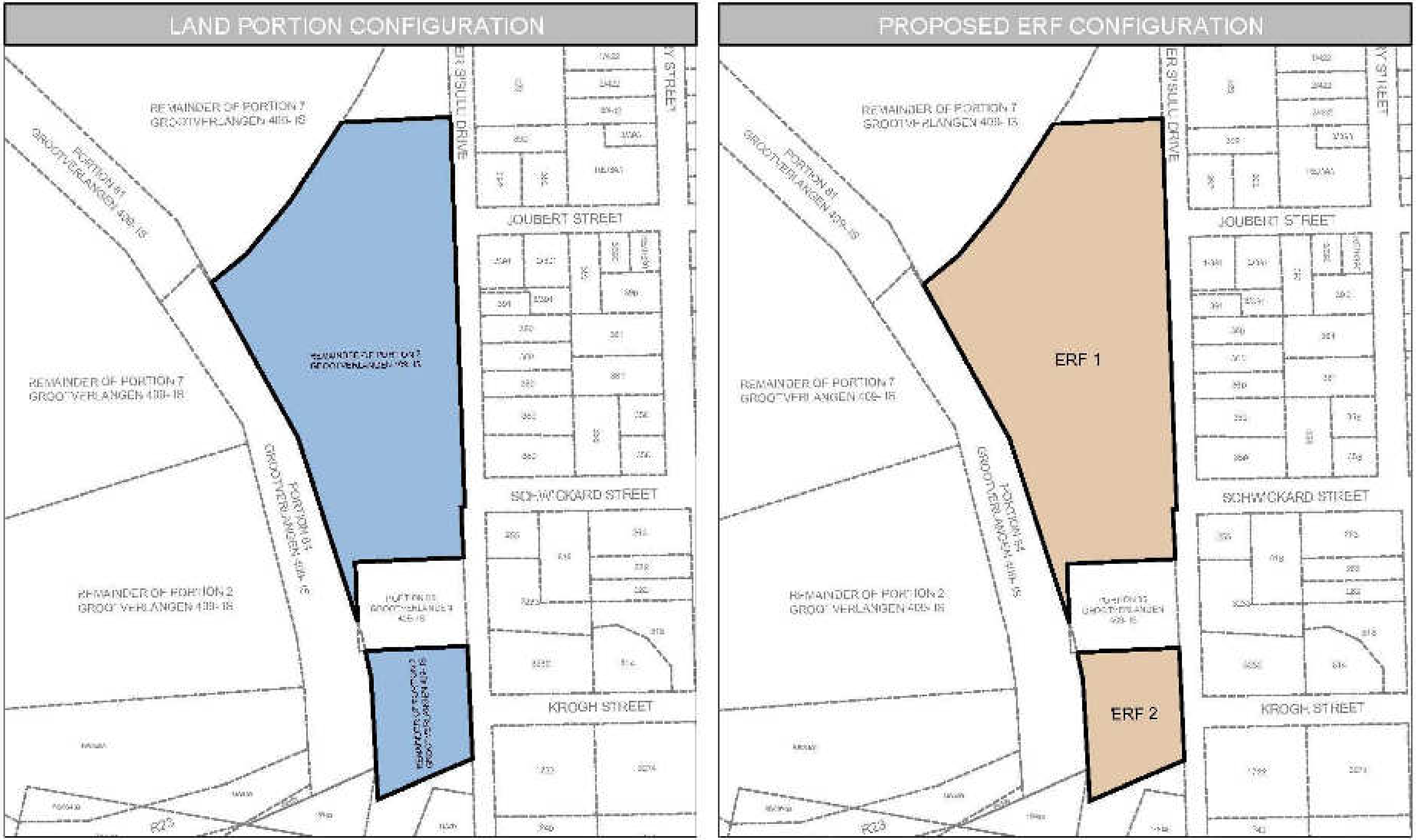
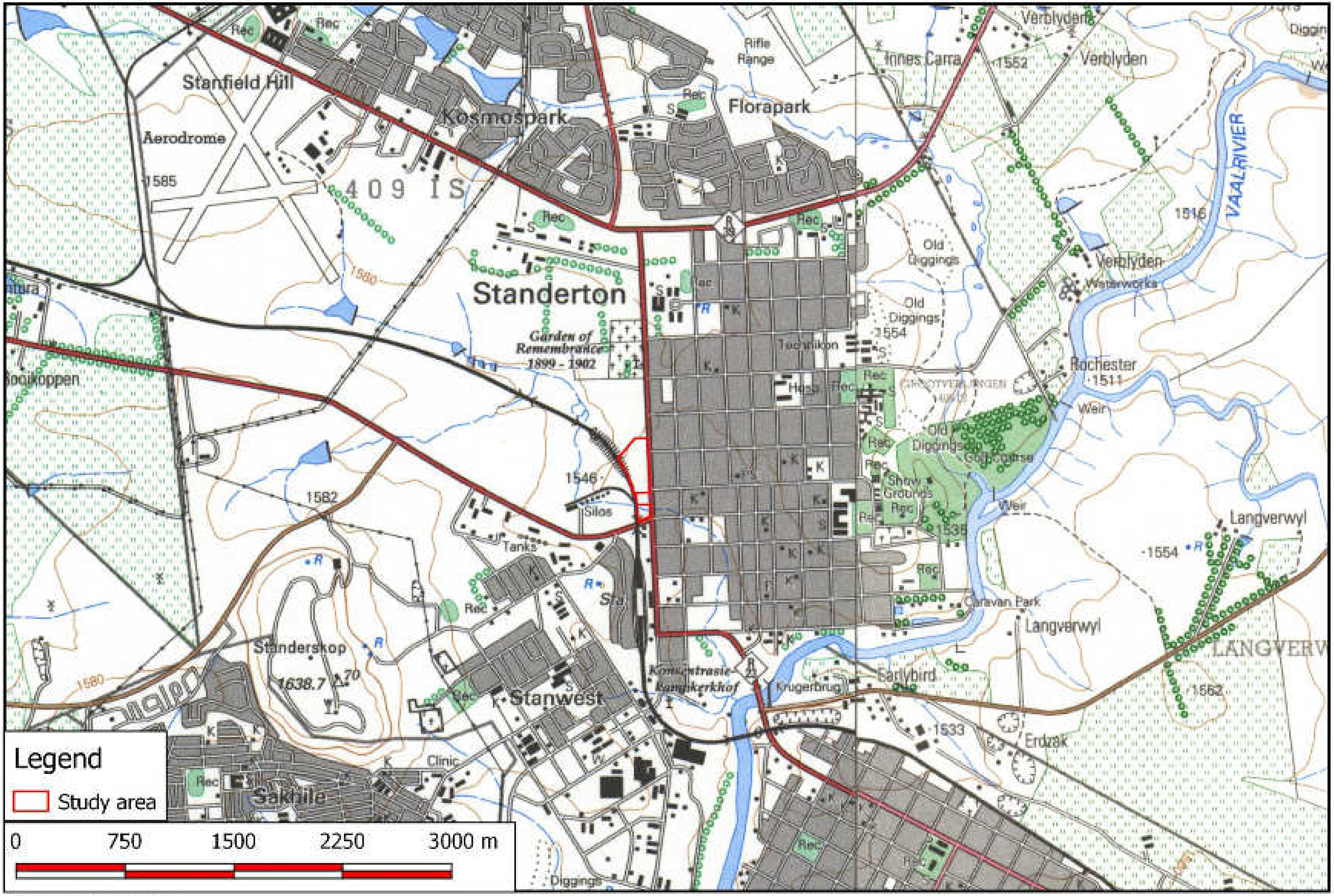


Figure 1: Conceptual Land Configuration

Bokamoso Environmental Consultants
Website: www.bokamoso.net
Email: info@bokamoso.net

Locality



Projection: Transverse Mercator
Datum: Hartebeeshoek 1994
Reference eillipsoid: WGS 1984
Central meridian: -29

Bokamoso Environmental Consultants
Website: www.bokamoso.net
Email: info@bokamoso.net

Aerial

Projection: Transverse Mercator
Datum: Hartebeeshoek 1994
Reference eillipsoid: WGS 1984
Central meridian: -29

Figure 4: View of intersection south of the site

Figure 5: View of the railway line west of the site

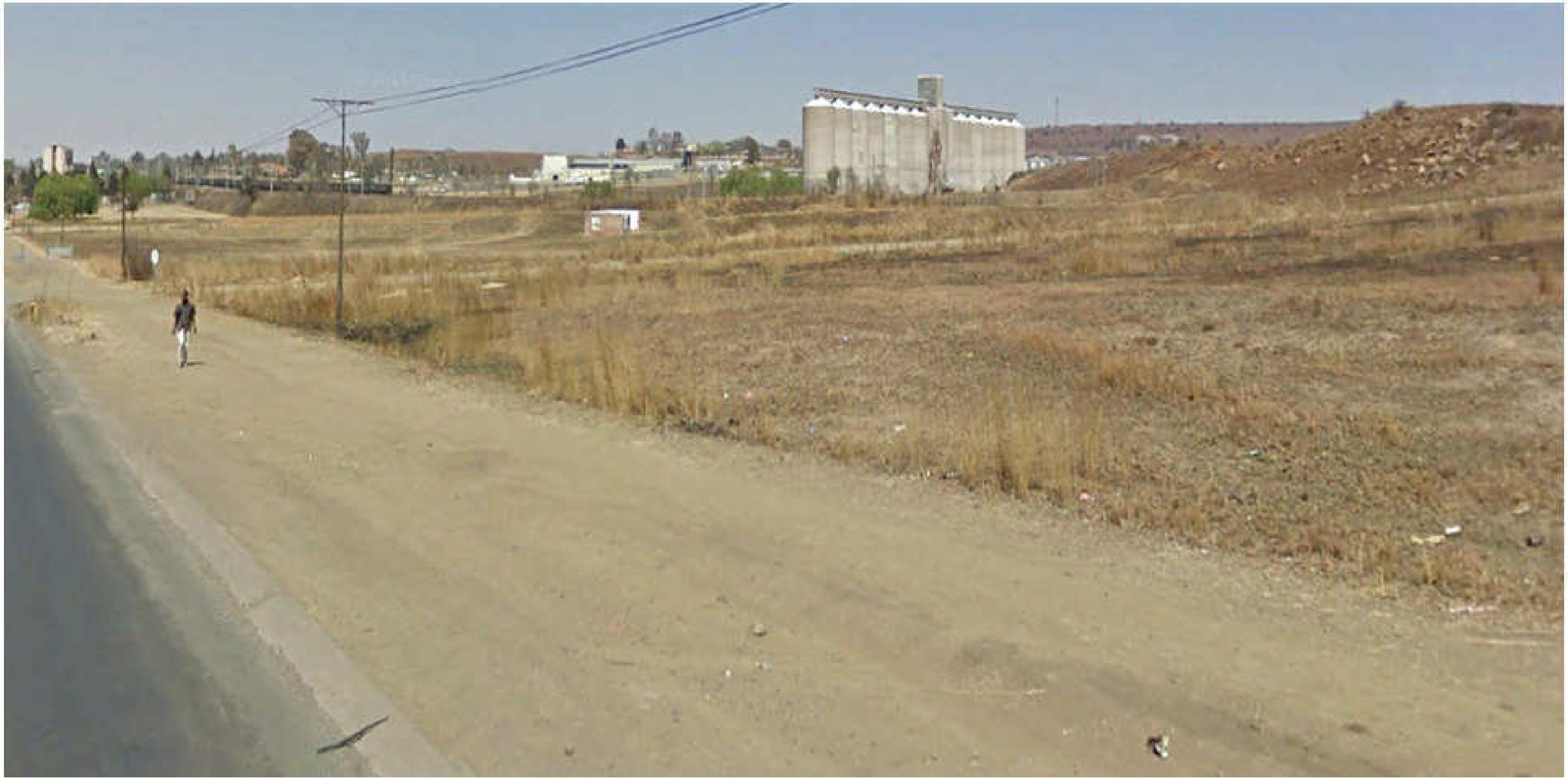


Figure 6: View the silos and railway south-west of the site

Figure 7: Illustration of the proposed site's surroundings.

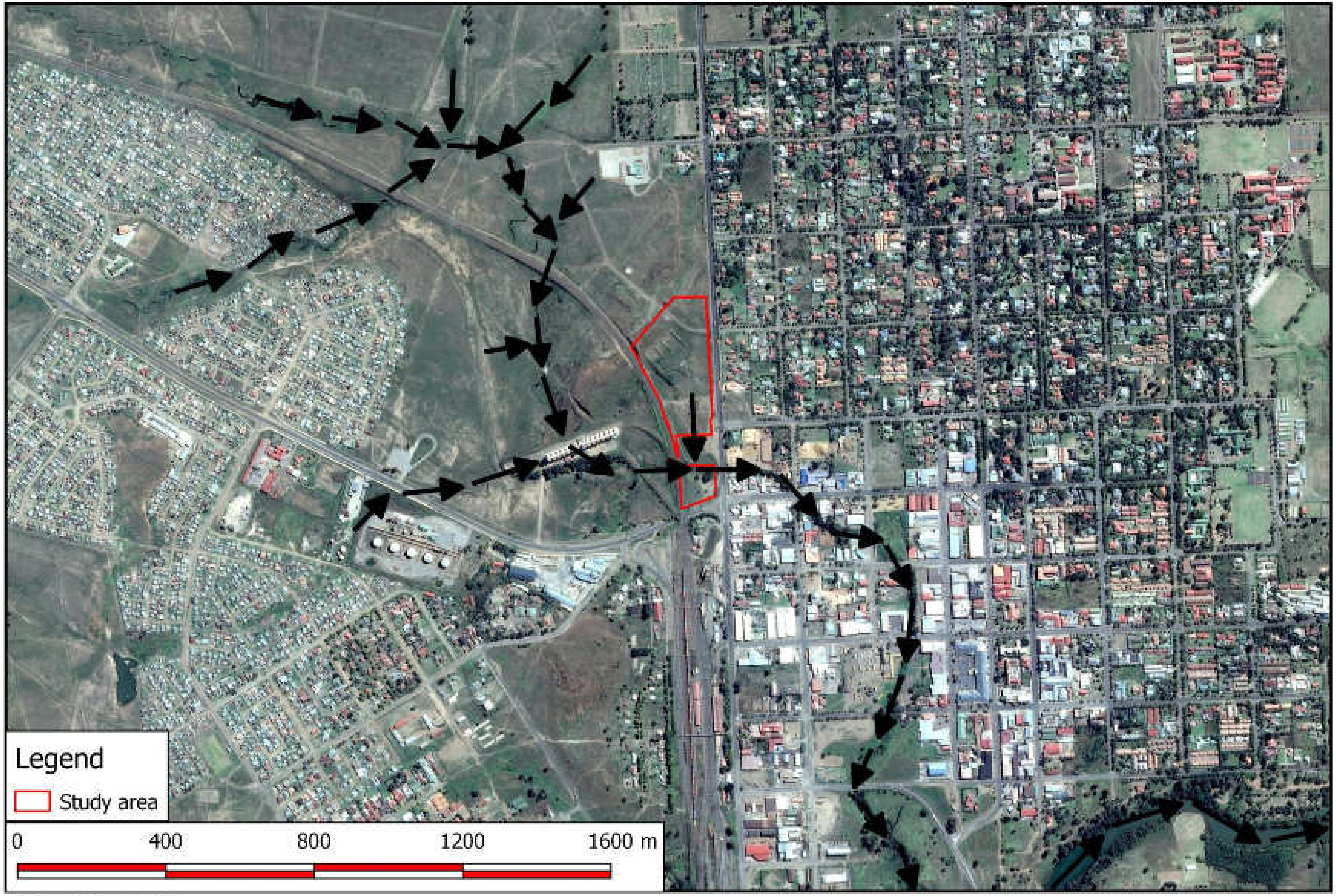
Bokamoso Environmental Consultants
Website: www.bokamoso.net
Email: info@bokamoso.net

Rivers and Wetlands

Projection: Transverse Mercator
Datum: Hartebeeshoek 1994
Reference eillipsoid: WGS 1984
Central meridian: -29

Bokamoso Environmental Consultants
Website: www.bokamoso.net
Email: info@bokamoso.net

Hydrology



Projection: Transverse Mercator
Datum: Hartebeeshoek 1994
Reference eillipsoid: WGS 1984
Central meridian: -29

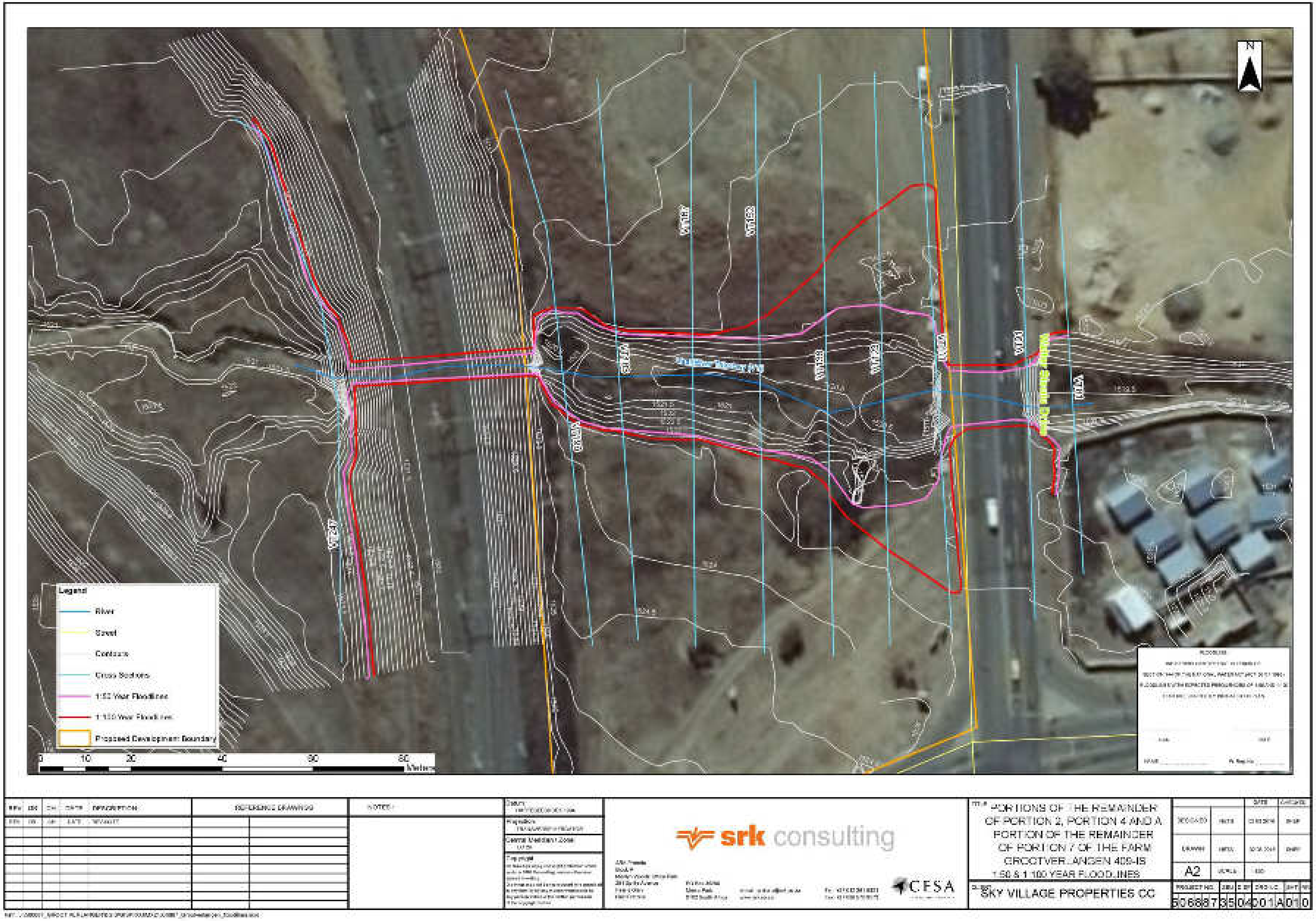


Figure10: Certified Flood lines

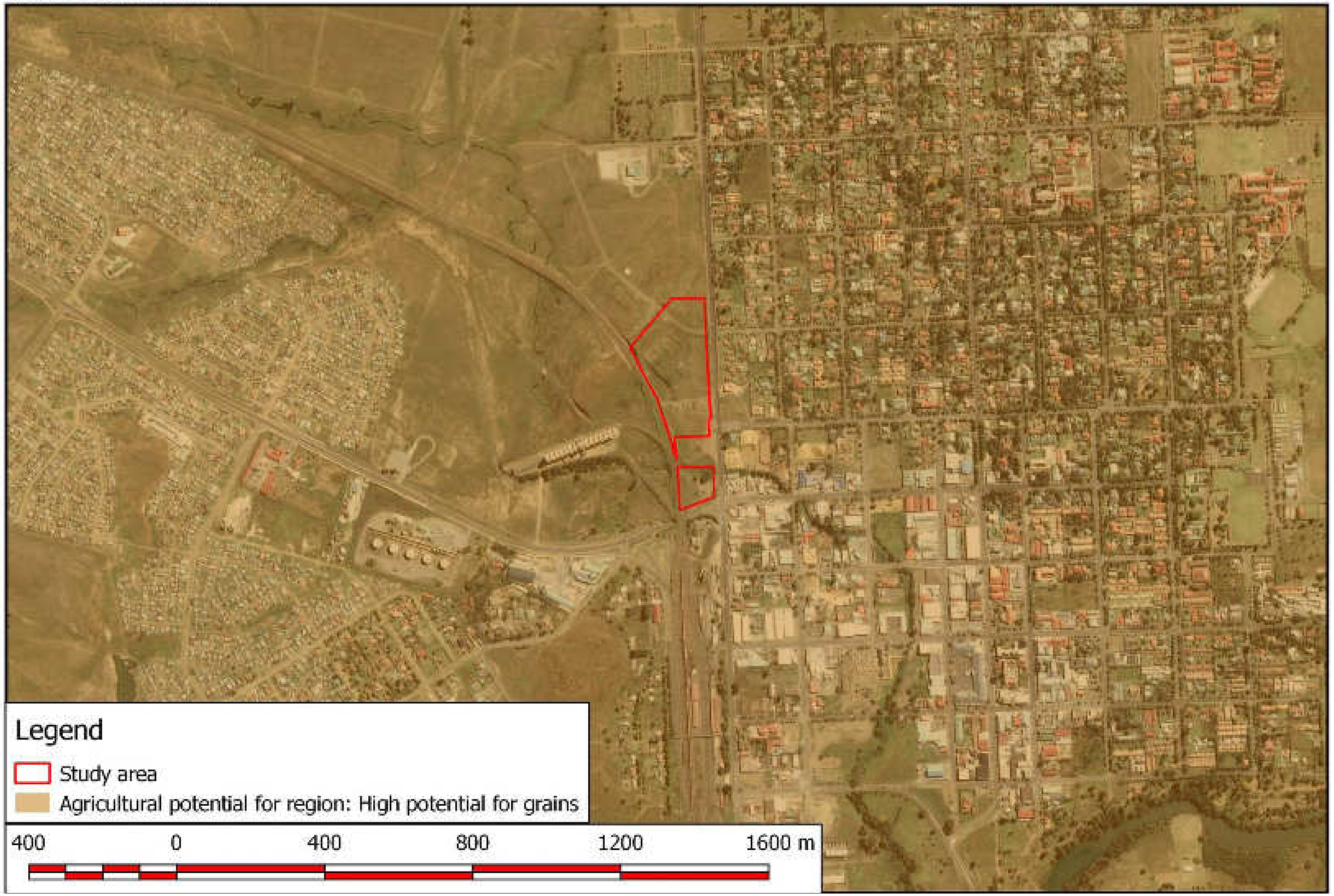


Figure 11: Agricultural Potential Map

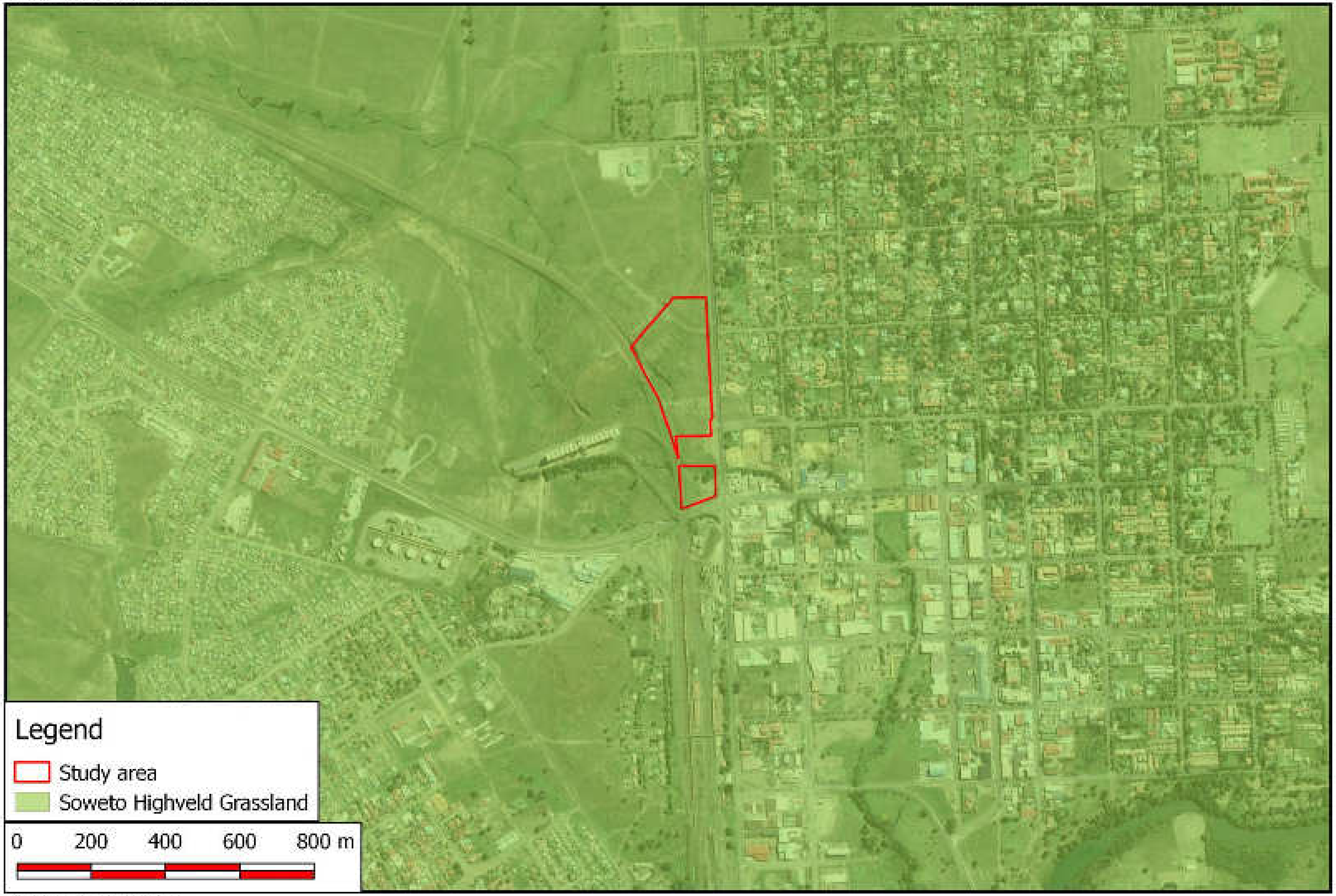


Figure 12: Vegetation Units

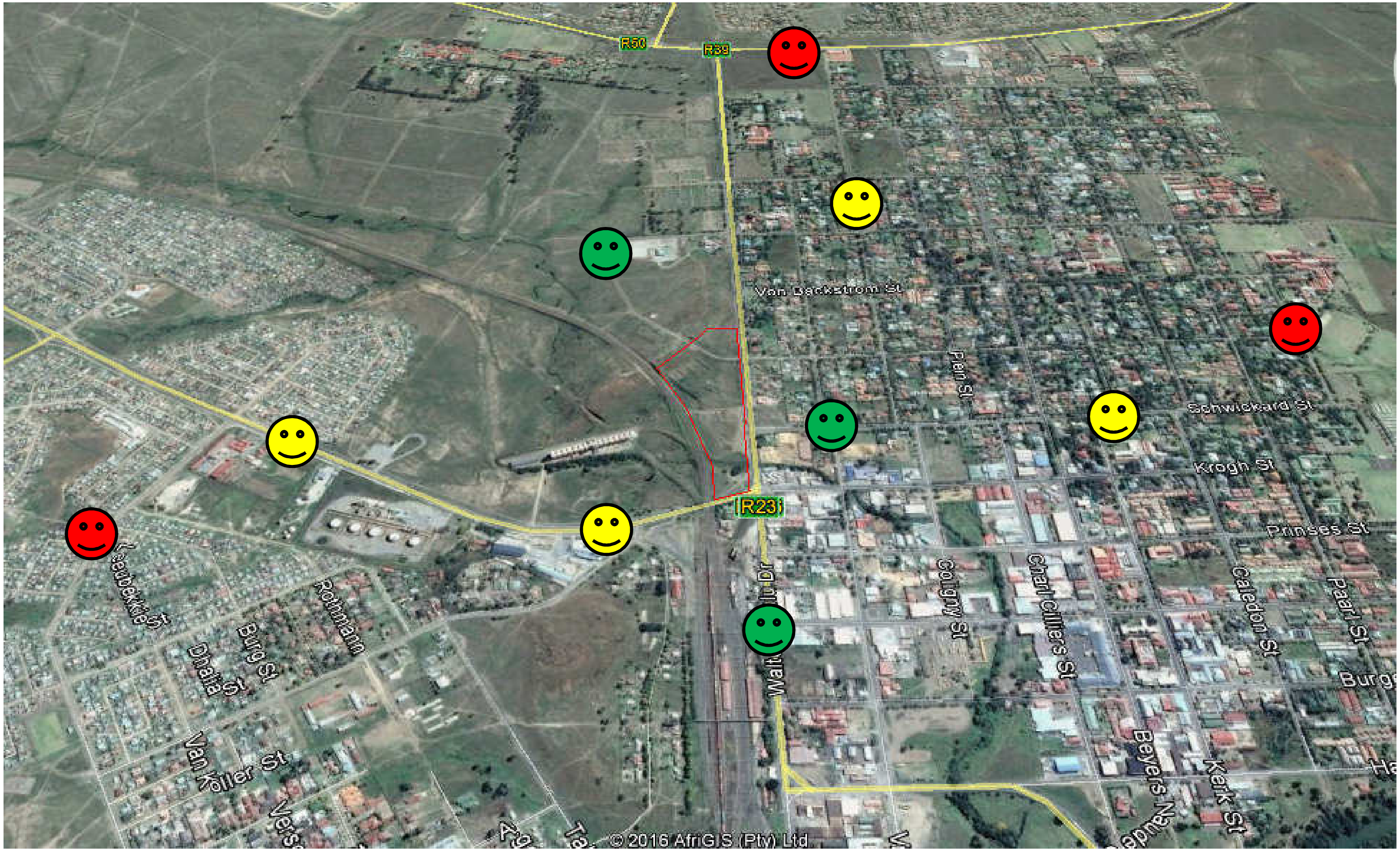
Figure 13: Standerton Fire Brigade

Figure 14: Municipal Licensing Hub

Figure 16a: Upper level plan

Figure 16b: Lower level plan

Figure 15: Proposed Layout Plan



Visible Partially Visible Not Visible

Figure 16: Visibility Map

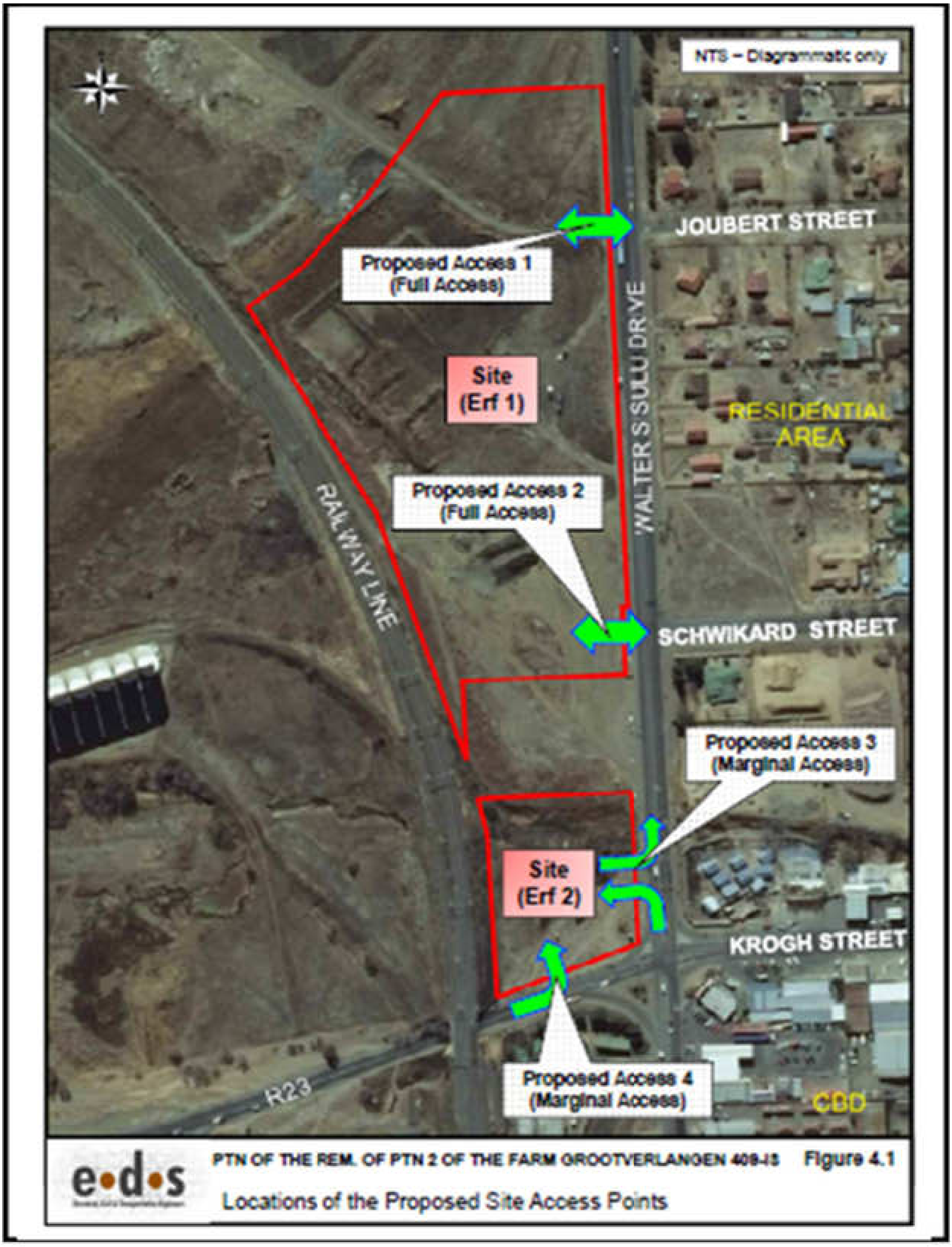


Figure 17: Access Map

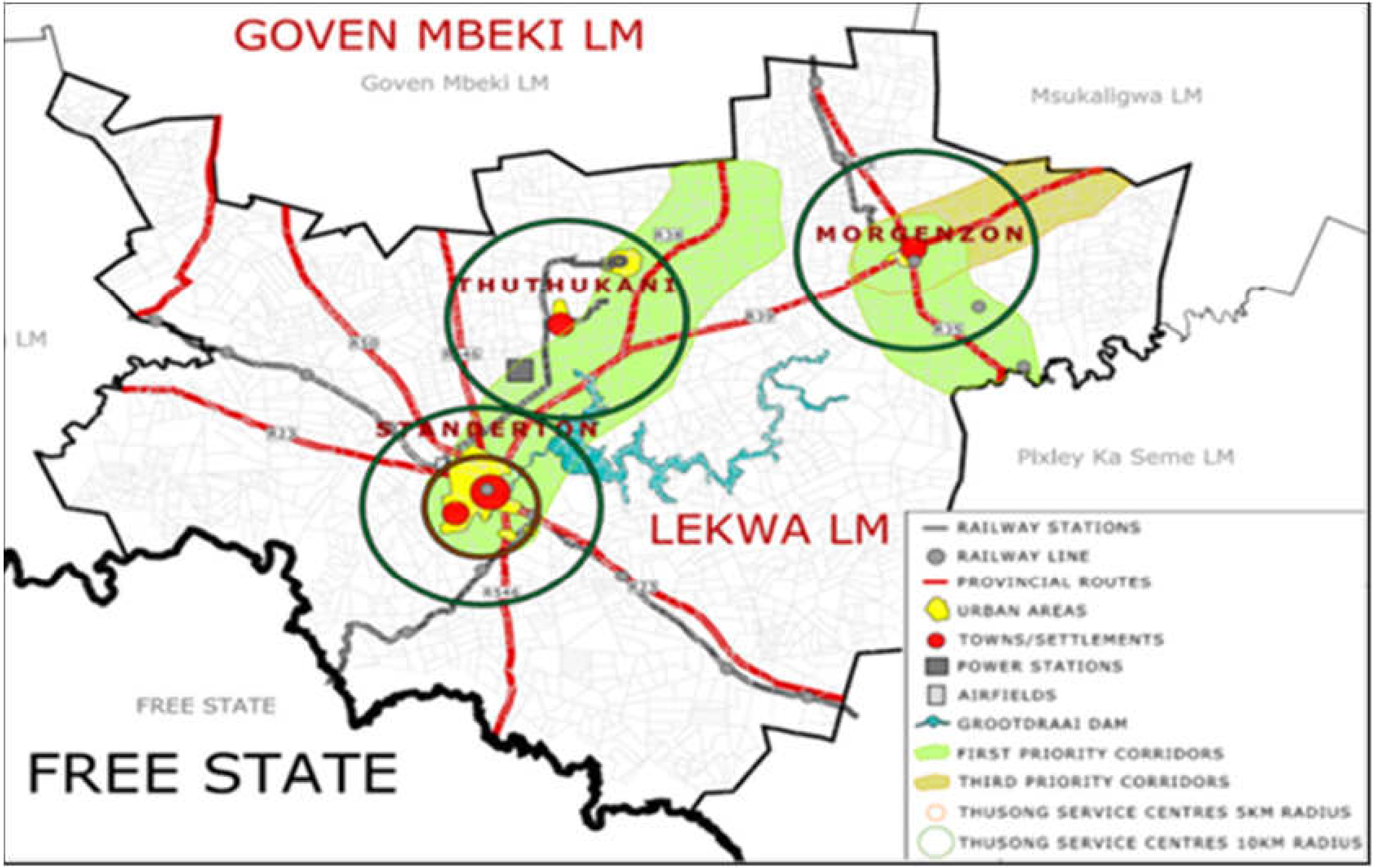


Figure 18: Gert Sibande SDF

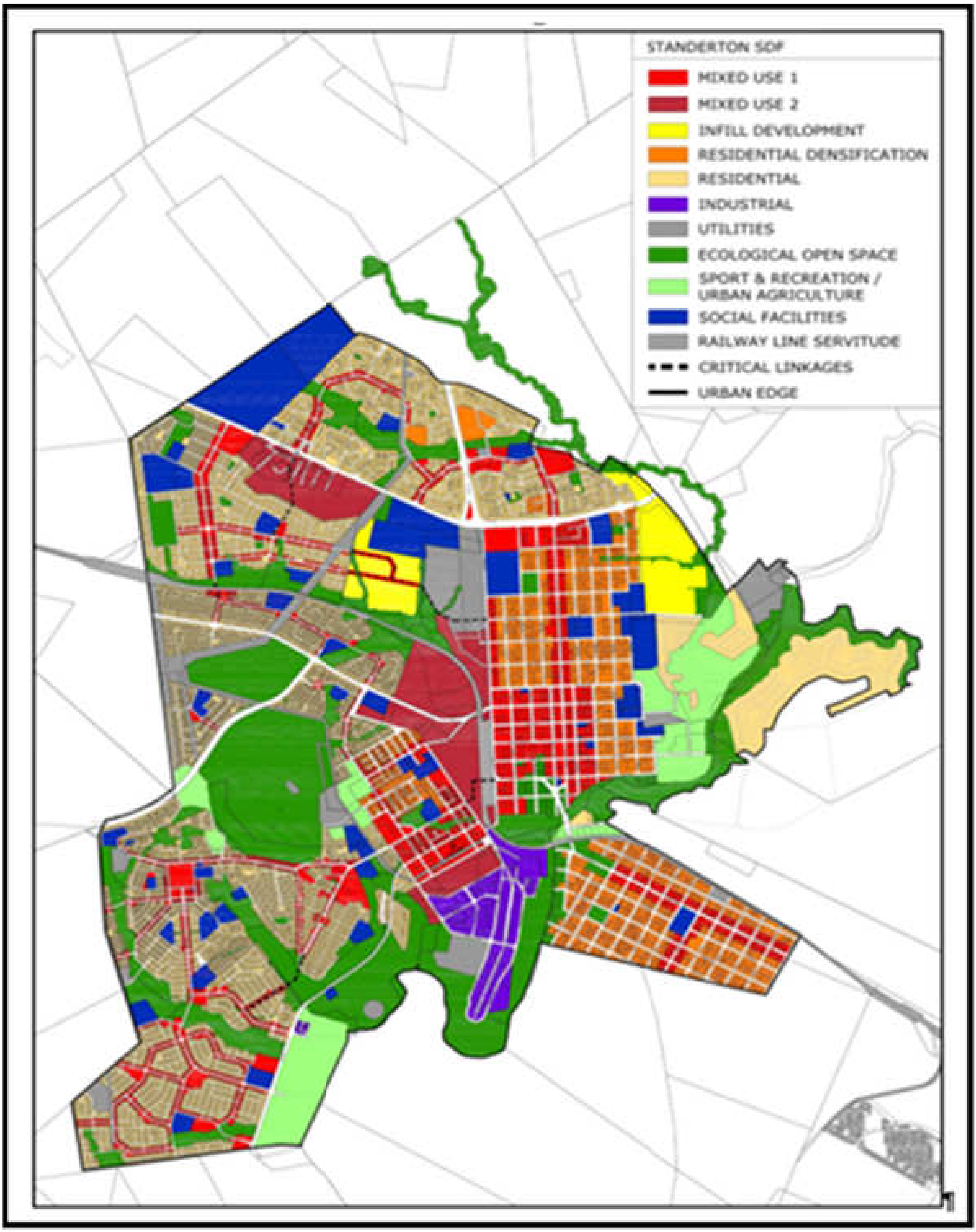


Figure 19: Lekwa SDF.

Appendix B

Specialist Report(s)

Appendix B1

Geotechnical Investigation

A GEOTECHNICAL REPORT ON MULTIPLE PORTIONS OF THE FARM GROOTVERLANGEN 409 IS, STANDERTON, FOR THE PROPOSED REZONING AND ESTABLISHMENT OF STANDERTON EXTENSION 9

Report Number: 2016/J022/CTL

Prepared by:	Soilkraft cc	**On Behalf of**:	Sky Village Properties CC
	PO Box 73478		PO Box 211
	Lynnwood Ridge		Secunda
	0040		2302
	(012) 991 0426		(017) 634 2056

Table of Contents

Reg no CK 96/08031/23

PO Box 73478
Lynnwood Ridge
0040
Tel: 012-9910426
Fax: 012-9912555
Email: izak@soilkraft.co.za

A GEOTECHNICAL REPORT ON MULTIPLE PORTIONS OF THE FARM GROOTVERLANGEN 409 IS, STANDERTON, FOR THE PROPOSED REZONING AND ESTABLISHMENT OF STANDERTON EXTENSION 9

1 INTRODUCTION

1.1 Appointment

Soilkraft cc was appointed by Sky Village Properties cc to undertake a geotechnical investigation multiple portions of the farm Grootverlangen 409 IS in Standerton as part of the proposed subdivision of the property and township establishment of Standerton Extension 9.

2 AVAILABLE INFORMATION

The following sources of information were consulted:

- 1 : 250 000 scale geological map: 2628 East Rand, published in 1986.
- 1 : 50 000 scale topographical map: 2629CC Standerton, published in 1997.
- Existing geotechnical investigations conducted in the Standerton area.

3 SITE DESCRIPTION

3.1 Site Location

The area investigated spans two pieces of land namely:

- Portion A: A portion of the remainder of portion 2 of the farm Grootverlangen 409 IS measuring 5.4123ha in size.
- Portion B: A portion of the remainder of portion 2 of the farm Grootverlangen 409 IS measuring 0.9017ha in size.

The two portions of land are located between the railway line and Walter Sisulu Drive in Standerton, north west of the intersection between Walter Sisulu Drive and Road R23 (Krogh Street). The site was easily accessible from Walter Sisulu Drive by vehicle or on foot.

Figure 1 : Locality Plan shows the position of the site.

3.2 Land Utilisation

At the time of the investigation the study area was largely vacant. Earth embankments and remnants of a small building were found at the location of the defunct shooting range. No other infrastructure was noted on the surface, but some underground utilities were noted in the immediate vicinity.

Site conditions are illustrated in Photo 1.

3.3 Climate

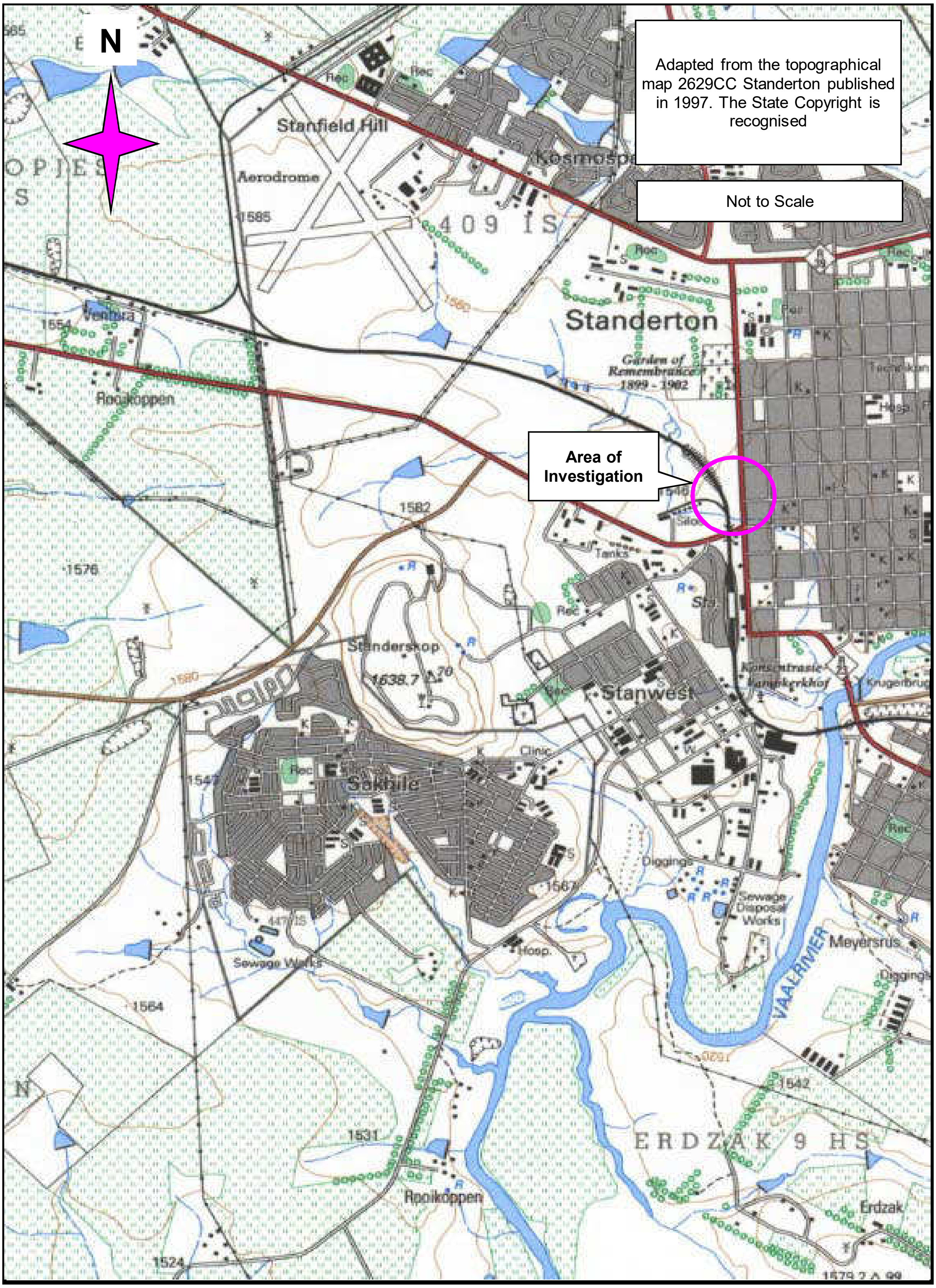
The site is located in an area with an approximate Weinert N-value of 2.6 and a Thornthwaite Moisture Index between -20 and 0. Climatically the area may thus be described sub-humid. This signifies that chemical weathering of rock material will take place, rather than mechanical breakdown thereof, resulting in the formation of active clays if suitable parent material is available. Minerals such as amphiboles, pyroxenes and olivine are particularly susceptible to such weathering. That being stated, the effects of mechanical weathering cannot be disregarded, particularly where brittle materials – such as shale or sandstone – are involved.

4 METHOD OF INVESTIGATION

4.1 Trial Holes

For the purposes of the investigation a total of nine trial holes were excavated on 27 June 2016. The trial holes were excavated with the aid of a Cat428F backhoe, supplied by Sahara Sand in Standerton. The machine was found to be in an excellent condition.

Trial holes were excavated, inspected, sampled and profiled by a professional engineering geologist according to the standard profiling parameters of SAICE[Reference 8.1]. These parameters are summarised



SOIL KRAFT	LOCALITY PLAN	FIGURE 1

SOIL KRAFT

SITE CONDITIONS

PHOTO 1

in the attached Table 1.

The trial hole soil profiles are included in Appendix A of this report and the exact coordinates for each trial hole are included on respective log sheets (provided in WGS84 format).

Figure 2 shows the placement of trial holes across the site.

4.2 Soil Tests

Samples of the in situ soil materials were retrieved for material test analyses. Material samples were delivered to Specialised Testing Laboratory (STL) in Pretoria for analyses. The following tests were performed:

- Foundation indicator tests were done to determine the general geotechnical properties of materials. This test includes a grading (and hydrometer) analysis and the determination of Atterberg Limits. The grading (i.e. hydrometer) results and Atterberg Limits are used to derive the materials' potential to heave.
- Soil chemistry tests included soil paste pH and conductivity determinations. The tests were done to determine the corrossivity of in situ materials towards buried steel objects (e.g. utilities).

No undisturbed soil samples were collected for consolidation or collapse potential tests, as materials were not conducive to this. Also, California Bearing Ratio (CBR) tests were not collected as in situ materials were considered to be of unsuitably poor quality.

The results of the soil tests can be found in Appendix B, but for easy reference are summarised in the attached Table 2 : Summary of Soil Tests.

5 DISCUSSION

5.1 Geology

The geology in the immediate vicinity consists of the Vryheid Formation. This Formation belongs to the Ecca Group, Karoo Supergroup and largely contains bedrock materials such as shale, sandstone and deposits of coal. The Volksrust Formation also occurs in the area, to the west and south west of the study area. In addition, dolerite intrusions of a Jurassic age are present in the vicinity and have intruded into the sedimentary materials.

At least one dolerite intrusion is indicated along the northern periphery of the site and was confirmed in outcrop. At the same time, shale bedrock was identified in trial hole three; however, site observations suggest that the geology is more complex than depicted in the regional geological map.

TABLE 1: SOIL PROFILING PARAMETERS

CONSISTENCY : GRANULAR SOILS

CONSISTENCY : COHESIVE SOILS

SPT N	GRAVELS & SANDS Generally free draining soils		DRY DENSITY (kg/m^3)	SPT N	SILTS & CLAYS and combinations with SANDS. Generally slow draining soils		UCS (kPa)
<4	Very loose	Crumbles very easily when scraped with geological pick.	<1450	<2	Very soft	Pick point easily pushed in 100mm. Easily moulded by fingers.	<50
4-10	Loose	Small resistance to penetration by sharp pick point.	1450-1600	2-4	Soft	Pick point easily pushed in 30mm to 40mm. Moulded by fingers with some pressure.	50-125
10-30	Medium dense	Considerable resistance to penetration by sharp pick point.	1600-1750	4-8	Firm	Pick point penetrates to 10mm. Very difficult to mould with fingers.	125-250
30-50	Dense	Very high resistance to penetration by sharp pick point. Requires many blows by pick point for excavation.	1750-1925	8-15	Stiff	Slight indentation by pick point. Cannot be moulded by fingers. Penetrated by thumb nail.	250-500
>50	Very dense	High resistance to repeated blows of geological pick. Requires power tools for excavation.	>1925	15-30	Very stiff	Slight indentation by blow of pick point. Requires power tools for excavation.	500-1000

SOIL TYPE

SOIL TYPE	PARTICLE SIZE (mm)
Clay	<0.002
Silt	0.002-0.06
Sand	0.06-2.0
Gravel	2.0-60.0
Cobbles	60.0-200.0
Boulders	>200.0

MOISTURE CONDITION

Dry	No water detectable
Slightly moist	Water just discernible
Moist	Water easily discernible
Very moist	Water can be squeezed out
Wet	Generally below water table

SOIL STRUCTURE

Intact	No structure present.
Fissured	Presence of discontinuities, possibly cemented.
Slickensided	Very smooth, glossy, often striated discontinuity planes.
Shattered	Presence of open fissures. Soil break into gravel size blocks.
Micro shattered	Small scale shattering, very closely spaced open fissures. Soil breaks into sand size crumbs.
Residual structures	Residual bedding, laminations, foliations etc.

COLOUR

Speckled	Very small patches of colour <2mm
Mottled	Irregular patches of colour 2-6mm
Blotched	Large irregular patches 6-20mm
Banded	Approximately parallel bands of varying colours
Streaked	Randomly orientated streaks of colour
Stained	Local colour variations : Associated with discontinuity surfaces

ORIGIN

Transported	Alluvium, hill wash, talus etc.
Residual	Weathered from parent rock e.g. residual granite
Pedocretes	Ferricrete, silcrete, calcrete etc.

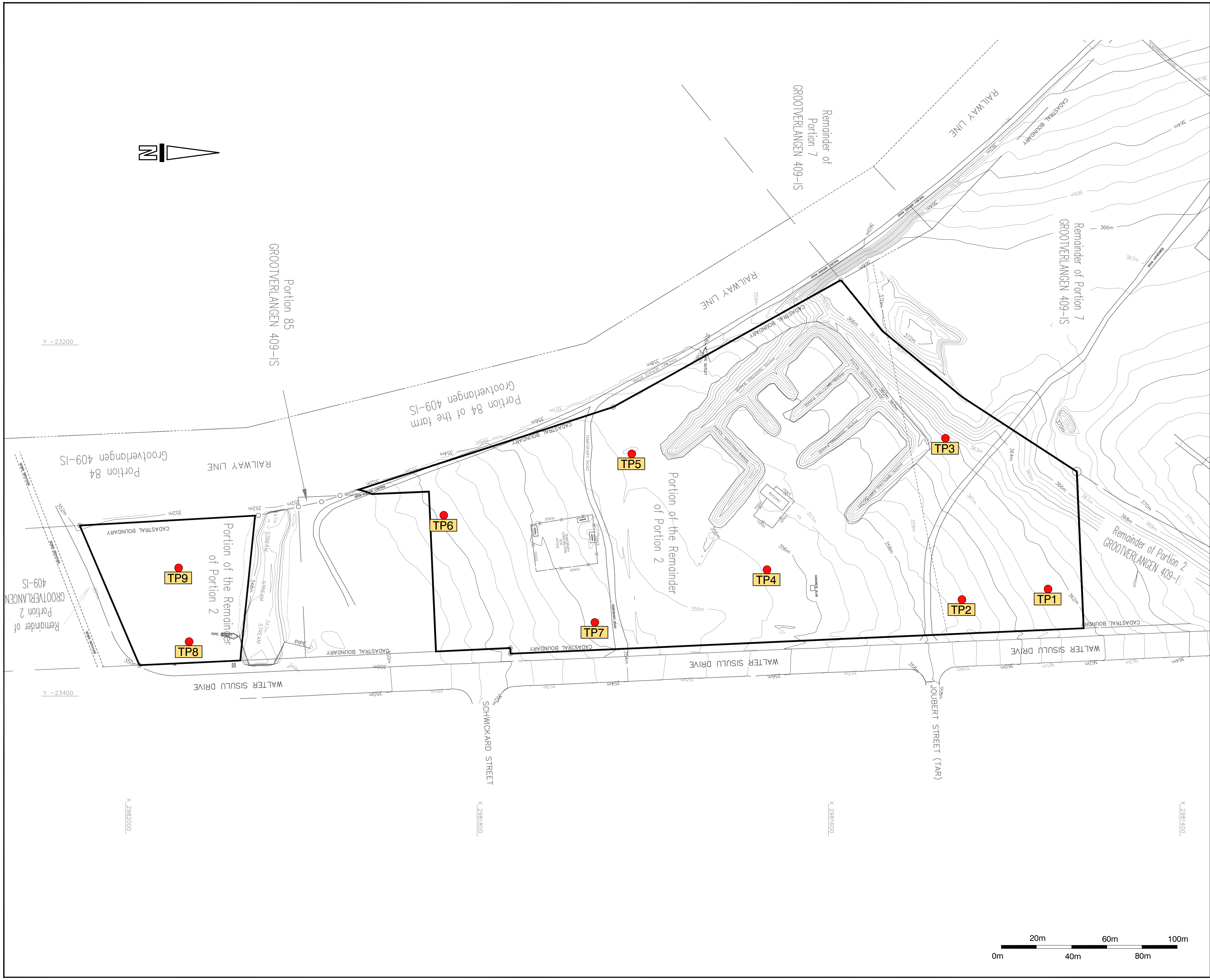
DEGREE OF CEMENTATION OF PEDOCRETES

TERM	DESCRIPTION	UCS (MPa)
Very weakly cemented	Some material can be crumbled between finger and thumb. Disintegrates under knife blade to a friable state.	0.1-0.5
Weakly cemented	Cannot be crumbled between strong fingers. Some material can be crumbled by strong pressure between thumb and hard surface. Under light hammer blows disintegrate to a friable state.	0.5-2.0
Cemented	Material crumbles under firm blows of sharp pick point. Grains can be dislodged with some difficulty by a knife blade.	2.0-5.0
Strongly cemented	Firm blows of sharp pick point on hand-held specimen show 1-3mm indentations. Grains cannot be dislodged by knife blade.	5.0-10.0
Very strongly cemented	Hand-held specimen can be broken by single firm blow of hammer head. Similar appearance to concrete.	10.0-25.0

FIGURE 2

LEGEND

TP1 TRIAL HOLE



FOR ILLUSTRATIVE PURPOSES ONLY

SOIL KRAFT
Tel: 012 991 0426
Fax: 012 991 2555
Cell: 082 577 6215
E-Mail: izak@soilkraft.co.za
Website: www.soilkraft.co.za
P.O. Box 73478, Lynnwood Ridge, 0040

TAAK: JOB NAME:	Grootverlangen 409-IS Standerton
KLIëNT: CLIENT:	Sky Village Properties cc
TEKENING NO: DRAWING NO:	Site Layout Plan
DATUM: DATE:	18 July 2016

TABLE 2 : SUMMARY OF SOIL TESTS

TRIAL HOLE NO	SAMPLE NO	DEPTH (mm)	SOIL ORIGIN	SOIL TYPE	GM	PI	LL	ACTIVITY CLASS	ACTIVE CLAY (%)	pH	CONDUC-TIVITY (S/m)	SOIL CLASS	
												PRA	UNIFIED
1	SKT-08-83	0 - 900	Residual dolerite 1	Silty clay	0.23	27	47	High	38	7.50	0.0565	A-7-6	CL
2	SKT-08-84	500 - 2500	Residual dolerite 2	Silty clay	0.23	28	58	High	44			A-7-6	CH
3	SKT-08-85	1000 - 1500	Shale	Silty gravel	1.27	20	39	Medium	14			A-6	CL
4	SKT-08-86	700 - 2800	Residual dolerite 3	Silty clay	0.28	37	74	Very high	53	8.70	0.1030	A-7-5	MH
5	SKT-08-87	200 - 2900	Residual dolerite 3	Silty clay	0.31	23	62	Medium to high	45			A-7-5	MH
7	SKT-08-88	600 - 2500	Residual dolerite 4	Silty clay	0.13	23	54	Medium to high	43	8.40	0.0973	A-7-5	MH

The attached Figure 3 : Regional Geology Map allows an overview of the geology of the area.

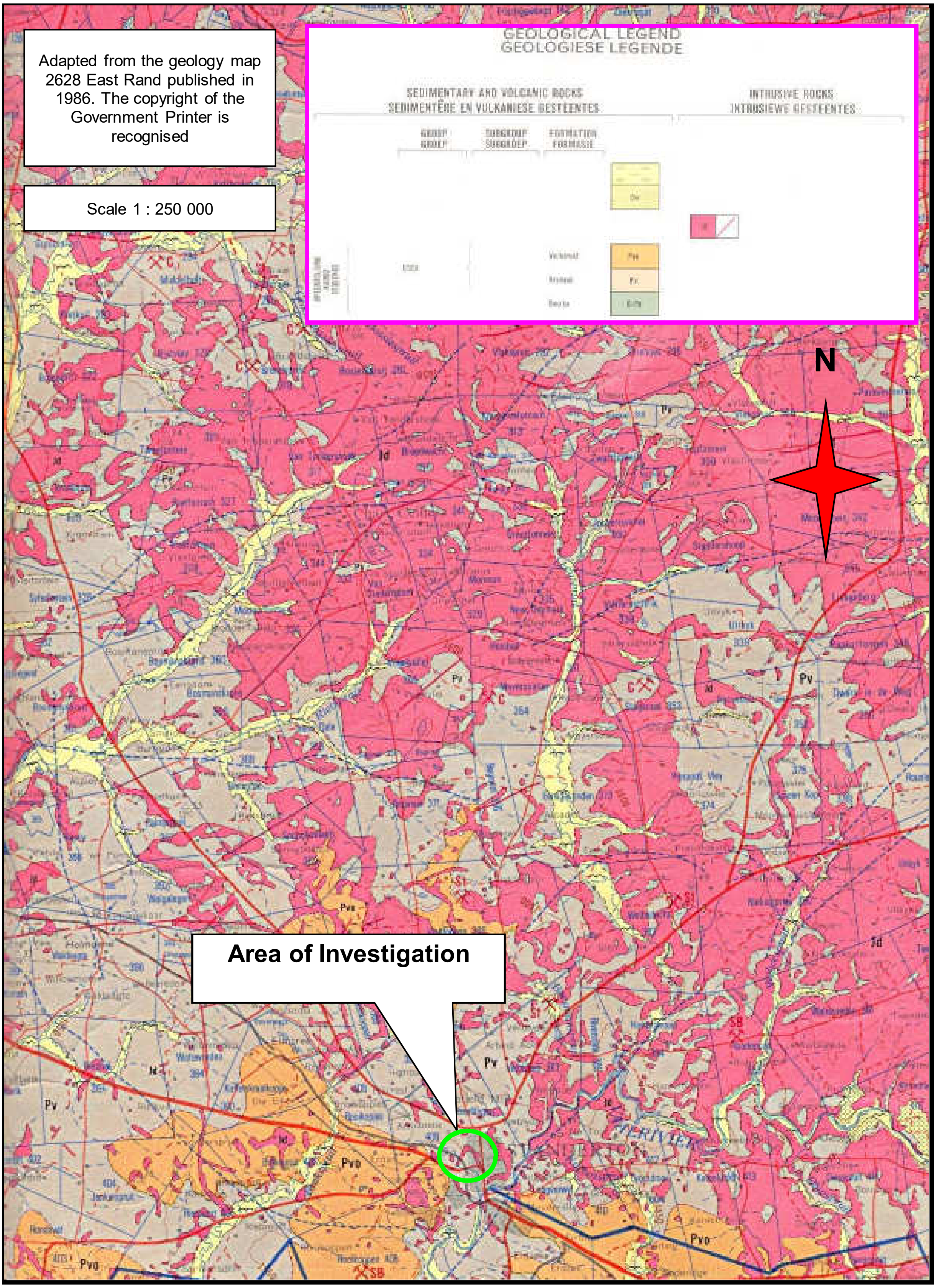
5.2 Groundwater

- *Perched Water*: No perched water or seepage was encountered in any of the trial holes. It should be considered, though, that the investigation was conducted during a period of drought and during the dry season, when seepage or perched water is expected to be absent. Ferruginisation in the profile suggests that seepage water may indeed occur on a seasonal basis and that such water levels may be within conventional founding depths. It must be emphasised that the presence of perched water is a seasonal phenomenon and the extent thereof depends on precipitation, time of the year, etc.
- *Permanent Groundwater*: Vegter[Reference 8.2] indicates the probability of drilling successfully for water in the area to be less than 40%. In addition, should water be encountered, the chances are between 20% and 30% that the yield of such a borehole will exceed 2l/s. Groundwater in the area is usually encountered at depths of between ten metres and twenty metres, occurring in pores and fractures restricted to a zone directly below groundwater level.

5.3 Soil Profiles

Prior to making any recommendations, it is important to distinguish between different materials encountered in the study area. The profiles encountered during the investigation revealed the following materials:

- *Fill / Made Ground:* Fill materials were encountered in trial holes six through nine. In trial holes six and seven, the fill horizons were between 600mm and 900mm in vertical thickness, but in trial holes eight and nine, the bottom of the fill materials were not encountered to depths of 2700mm and 3000mm, respectively. The fill consisted of mixed materials including soil, ash, rubble, construction rubble and other general waste materials (e.g. plastic). Due to its variable composition and unfavourable nature (for construction), the fill was not sampled and it constitutes uncontrolled fill.
- *Residual Dolerite 1:* The first discernible residual dolerite material was encountered in trial holes one through five as a surface horizon with vertical thickness between 200mm and 900mm. The horizon was easily discernible by its distinctive black brown colour. The material consisted of silty clay with a stiff consistency (in a dry state) and a slickensided structure. The latter is generally an indicator of expansive soils, an observation that was confirmed by material test results which indicate that the material is indeed highly expansive. Test results showed active clay content of 38% with an associated plasticity index of 27%. The material had a grading modulus of 0.23 and was awarded a PRA classification of A-7-6.
- *Residual Dolerite 2:* The second residual dolerite horizon was found in trial holes one to three and varied in thickness from 400mm to 1300mm, though in trial hole two, the base of the horizon was



REGIONAL GEOLOGY

FIGURE 3

not found before the machine achieved maximum reach. The material was described as light grey brown mottled white and speckled black, or brown grey mottled white speckled black silty clay with a stiff consistency and slickensided structure. This material, too, was proven to be highly expansive with active clay content and a plasticity index of 44% and 28%, respectively. The material also had a grading modulus of 0.23 and was also awarded a PRA classification of A-7-6, suggesting similar properties to the residual dolerite 1 horizon.

- *Residual Dolerite 3:* This horizon was identified in trial holes four and five. The horizon was described as light grey mottled white, silty clay with a stiff to firm consistency and slickensided structure. In trial hole five, the material was slightly ferruginised. Test results suggest that the material varies somewhat in physical properties. Analyses revealed that the horizon is moderately to very highly expansive, with active clay contents between 45% and 53%. The material's plasticity indices ranged from 23% to 37%, while grading moduli were between 0.28 and 0.31. Both samples tested were awarded a PRA classification of A-7-5.
- *Residual Dolerite 4:* The fourth and final residual dolerite horizon was found in trial holes six and seven. In both cases the base of the horizon was not reached before the machine achieved maximum extension and consequently, the final thickness of the horizon is not known. Based on trial hole data, though, the horizon is at least 1900mm thick. Laboratory tests indicate that this material, too, is expansive and that a moderate to high expansiveness is expected. The material had active clay content of 43% and a plasticity index of 23%. A PRA class of A-7-5 was awarded and the grading modulus was calculated to be 0.13.
- *Residual Shale and Shale:* Trial holes one contained residual shale which showed the tendency to grade into shale bedrock, while trial hole three contained shale bedrock which resembled silty gravel in places. While the latter is not a soil material, it was sampled as weathered shale bedrock often also exhibits an expansive nature and is expected to be similar to the residual shale material. The residual shale was described as light grey dense to very dense, intact silty gravel while bedrock was described as grey brown, fine to very fine grained, slightly to moderately weathered, closely jointed, soft rock. A single material test confirmed a moderate expansiveness due to 14% active clay content and a plasticity index of 20%. A grading modulus of 1.27 was calculated and a PRA classification of A-6 was awarded.

5.4 General Soil Movements

Considering the discussion above, the following foundation conditions are expected on this site:

- *Conditions of Heave:* Test results revealed that the all soil materials tested from this site are expansive to some degree. Expansiveness ranges from medium to very high. The method proposed by van der Merwe[Reference 8.3] was applied using RAFT software – developed by the CSIR – and unrestrained heave was calculated. Maximum unrestrained heave of 139mm was calculated for trial hole five, while a minimum unrestrained heave of 41mm was calculated for trial hole three.

- *Conditions of Settlement:* Conditions of settlement are expected to be dominated by conditions of unrestrained heave.
- *Fill / Made Ground:* The fill materials encountered on site appears to have been emplaced strategically, though in an uncontrolled fashion. Considering its placement, it is possible that an attempt was made to elevate ground level in order to reclaim some land from the flood line associated with tributary which crosses the site. This can, however, not be substantiated. While fill materials in trial holes six and seven are largely surficial and can be addressed with limited effort, the fill materials encountered in trial holes eight and nine are of such thickness, that it is considered problematic to development and would necessitate further investigation if development is to continue.
- *Perched Water:* Perched water is expected to occur periodically possibly within conventional founding depths.
- *Areas of Steep Slopes and Bedrock Outcrop:* The northern most peripheral area of the site was characterised by dolerite outcrop and a notably steep slope associated with it.

Considering the above, the study area can be divided into geotechnical zones, as depicted in Figure 4. The zones are summarised as follows:

- *Geotechnical Zone 1:* ***H3***: This zone includes trial holes one through five and is associated with expansive soil profiles. The amount of heave generally varies depending on the expansiveness of residual materials as well as the distribution/occurrence of shale bedrock. Nevertheless, unrestrained soil heave in this zone far exceeds 30mm. Localised areas of dolerite outcrop and notably steep slopes are indicated on Figure 4 and are not included as a separate geotechnical zone.
- *Geotechnical Zone 2*: P_{Fill}/***H3***: The second zone includes trial holes six and seven. Soil movement and residual material properties in this zone are similar to that of Zone 1; however, this zone also sees fill materials in the upper 1000mm of the soil profile which may affect founding.
- *Geotechnical Zone 3*: P_{Fill}: The final zone includes the southernmost part of the study area (i.e. portion B), which contains trial holes eight and nine. Excavated profiles in this zone consisted entirely of fill materials and as such, the zone is considered problematic and (unless modified or rehabilitated) unsuitable for development.

5.5 Conditions of Excavation

The conditions of excavation encountered during the investigation can be summarised as follows:

- *Fill:* The fill materials proved machine excavatible appeared to have consolidated with time and under vehicular traffic. As a result, significant effort was required to excavate the fill materials using a backhoe. The materials are likely to be susceptible to instability in unsupported excavations.

FIGURE 4

LEGEND

TP1 TRIAL HOLE

AREAS OF DOLERITE OUTCROP AND STEEP SLOPES

INFERRED MATERIAL BOUNDARY

FOR ILLUSTRATIVE PURPOSES ONLY

FOUNDATION DESIGN, BUILDING PROCEDURES AND PRECAUTIONARY MEASURES

AREA	GEOTECHNICAL CLASS	% OF TOTAL AREA	ESTIMATED SOIL MOVEMENT	SOIL PROFILE	DEVELOPMENT POTENTIAL	CONSTRUCTION TYPE	FOUNDATION DESIGN	ASSOCIATED PROBLEMS
I	H3	66,1	Soil heave exceeding 30mm	Multiple horizons of residual dolerite Residual shale and shale bedrock in places	Intermediate	Modified	Reinforced concrete raft or Soil replacement raft	Corrosive soils Seepage water Peripheral areas of dolerite outcrop Peripheral areas with steep slopes
II	P_{FILL}/H3	23,3	Soil heave exceeding 30mm	Problematic fill overlying expansive residual dolerite	Intermediate	Modified	Reinforced concrete rafts or Soil replacement raft	Corrosive soils Problematic fill Seepage water
III	P_{FILL}	10,6	N/A	Thick problematic fill materials	Not suitable	N/A	N/A	Problematic fill

SOIL KRAFT
Tel: 012 991 0426
Fax: 012 991 2555
Cell: 082 577 6215
E-Mail: izak@soilkraft.co.za
Website: www.soilkraft.co.za
P.O. Box 73478, Lynnwood Ridge, 0040

TAAK: / JOB NAME: Grootverlangen 409-IS Standerton

KLIëNT: / CLIENT: Sky Village Properties cc

TEKENING NO: / DRAWING NO: Geotechnical Zoning

DATUM: / DATE: 19 July 2016

- *Residual Dolerite:* All residual dolerite horizons were machine excavatible and no refusal of excavation was encountered in any of the trial holes in these residual horizons. The excavatibility of the residual dolerite is highly moisture dependent. In a dry state, the material requires much persistence to cut into and excavate, while when in a moist to wet state, the same materials make for cohesive, clayey excavation.
- *Residual Shale:* Residual shale materials proved at least partially excavatible by backhoe and in trial hole one did not induce refusal of excavation. A dense to very dense consistency means that significant effort is required to penetrate the material.
- *Shale Bedrock:* Though only encountered once, the shale bedrock induced gradual refusal of excavation (i.e. trial hole three) and the shale bedrock was described as soft rock material.
- *Dolerite Bedrock:* No dolerite bedrock was encountered in any of the trial holes; however, considering the state in which dolerite bedrock was observed on the ridge adjacent to the site, it is expected that dolerite would constitute very hard rock material.
- *Depth of Excavation*: Excavatible depths by backhoe varied between 1500mm and 3000mm, with the majority of trial holes exceeding 2500mm without encountering refusal of excavation.
- *Corestones*: No corestones were encountered in trial holes, but the possibility of corestones occurring in the residual dolerite profile cannot be discounted.
- *Sidewall Stabilities*: Excavations proved stable during the survey (not considering the fill materials); however excavations in active clay materials are notorious for being unstable. The removal of overburden and lateral soil support results in soil disequilibrium. The heave movement of the clay then often serves as a triggering mechanism for excavation failure. One sure sign of instability is the bulging of sidewalls.
- *Seepage*: While no seepage was encountered during the investigation, it is expected that it may occur during years of normal rainfall at depths which may affect foundations.

5.6 Material Utilisation

It was initially planned to collect material samples to assess in situ materials' potential to be used in the construction of layer works. Provision was made to collect and test CBR samples. However, during the site investigation it became apparent that none of the materials encountered are of a good quality and as a result, CBR sampling was abandoned. The observations were ultimately confirmed and reflected in the foundation indicator test results, which proved that all materials had elevated plasticity indices and (moderate to very high) potential to heave.

With the above in mind, none of the in situ materials tested from the soil profile is considered suitable for use in the construction of layer works or earth platforms.

5.7 Soil Corrossivity

When discussing soil corrossivity, it is applicable to consider the guidelines as proposed by Evans[Reference 8.4]. The corrossivity of a soil towards buried, exposed, metallic surfaces is dependent on the following properties of the soil:

- Electrical conductivity
- Chemical properties of the soil
- Ability of the soil to support sulphate reducing bacteria
- Heterogeneity of the soil

The pH of a soil gives an indication of potential acid related problems. If the soil pH is less than 6.0, corrosion may take place and if the pH should be less than 4.50, the problem of corrosion may be serious. If the conductivity of the soil is less than 0.001S/m, corrossivity is generally not a problem. However, the corrosion potential of the soil increases with an increase in conductivity. Should the conductivity of the soil exceed 0.005S/m, the soil can be regarded as very corrosive. Should exposed metal pipes pass from argillaceous soils to arenaceous soils or vice versa, electrochemical cells are set up due to the different rates of oxygen diffusion of the soils. Sulphate reducing bacteria is usually present under anaerobic conditions, that is, typically saturated or waterlogged clays.

Three samples were collected from in situ material horizons. The results of soil chemistry tests revealed the following:

- *Soil Acidity*: The materials tested had soil pH levels between 7.50 and 8.70, indicating near-neutral to slightly alkaline materials. As far as acidity goes then, the materials are not considered to be corrosive.
- *Soil Conductivity*: In contrast to the soil acidity, all samples proved to be extremely corrosive on account of high soil paste conductivity. Conductivity measurements revealed values between 0.0565S/m and 0.1030S/m.
- *Waterlogged Conditions*: Waterlogged conditions were not encountered during the investigation, but evidence of perched water levels suggest that such conditions could occur on a seasonal basis. If this is the case, enhanced oxidation is expected to exacerbate conditions of corrossivity.

All things considered, conditions of extremely corrosive soil must be anticipated on this site.

5.8 Seismicity

Kijko[Reference 8.5] indicates the annual probability for an earthquake with intensity of 4.7 on the Modified Mercalli Scale to occur in the area to be less than 10^0 and with an intensity of 7.3 to occur the probability is 10^{-4}. A 10% probability exists that an earthquake with Peak Ground Acceleration of

0.09g to 0.11g may take place once in 50 years. Tremors in this area are likely to be mining-related rather than naturally occurring.

To put the above information into perspective, Table 3 : Earthquake and Magnitude and Intensity, is attached to this report.

6 CONCLUSIONS

The following are the main conclusions that can be made from the discussion above:

- *Geology*: The study area is underlain by dolerite and shale bedrock, with the latter being associated with the Vryheid Formation of the Ecca Group, Karoo Supergroup.
- *Soil Profile*: The profiles on site largely consist of multiple residual dolerite horizons. Limited residual shale and shale bedrock was also encountered, while fill materials occurred on the southern parts of the site.
- *Hydrology*: Perched water was not encountered on the site, but is expected to occur seasonally and may affect founding depths.
- *Conditions of Excavation*: A minimum proven depth of excavation by backhoe was established at 1500mm. Conditions of excavation are expected to be moisture-dependent and clayey excavation is anticipated in the majority of the materials encountered, if they should be excavated in a moist to wet state. The possible occurrence of seepage water may affect excavation on site. Fill materials are expected to prove unstable in unsupported excavations.
- *Geotechnical Classification*: The site is divided into three zones, namely ***H3***, $\boldsymbol{P_{Fill}/H3}$ and $\boldsymbol{P_{Fill}}$. Precautionary measures are therefore essential.
- *Material Utilisation*: None of the in situ materials are considered suitable for utilisation in the construction of layer works or earth platforms.
- *Soil Corrossivity*: All soil materials tested proved to be non-corrosive on account of soil acidity, but extremely corrosive on account of soil conductivity.
- *Seismicity*: A 10% probability exists that an earthquake with Peak Ground Acceleration of 0.09g to 0.11g may take place once in 50 years. Tremors in this area are likely to be mining-related rather than naturally occurring.

7 RECOMMENDATIONS

7.1 Proposals for Founding and Construction

Recommendations below are given as general guidelines to single storey structures of masonry design, in accordance with guidelines proposed by the NHBRC.

TABLE 3 : EARTHQUAKE MAGNITUDE AND INTENSITY

MODIFIED MERCALLI INTENSITY SCALE	INTENSITY	DESCRIPTION	RICHTER SCALE MAGNITUDE	RADIUS OF PERCEPTIBILITY (km)
I	Instrumental	Detected only by seismography		
II	Feeble	Noted only by sensitive people	3.5 to 4.2	3 to 24
III	Slight	Like the vibrations due to a passing lorry. Felt by people at rest, especially on upper floors		
IV	Moderate	Felt by people while walking. Rocking of loose objects, including vehicles	4.3 to 4.8	24 to 48
V	Rather strong	Felt generally ; most sleepers are awakened and bells ring		
VI	Strong	Trees sway and suspended objects swing ; damage by overturning and flling of loose objects	4.9 to 5.4	48 to 112
VII	Very strong	General public alarm ; walls crack ; plaster falls	5.5 to 6.1	110 to 200
VIII	Destructive	Car drivers seriously disturbed; masonry fissured ; buildings damaged	6.2 to 6.9	200 to 400
IX	Ruinous	Houses collapse ; pipes break		
X	Disasterous	Ground cracks badly ; buildings destroyed ; railway lines bent ; landslides on steep slopes	7.0 to 7.3	400 to 700
XI	Very disasterous	Few buildings remain standing; bridges destroyed ; all services out of action ; great landslides and floods	7.4 to 8.1	400 to 700
XII	Catastrophic	Total destruction ; objects thrown into the air; ground rises and falls in waves	>8.1	400 to 700

7.1.1 Geotechnical Zone 1: **H3**

Construction in this zone may be done by means of a reinforced raft or soil replacement raft. The exact amount of heave to be accommodated must be determined during the phase two geotechnical investigation, but a general guideline is that up to 140mm of heave should be accommodated. The superstructure should also have reinforced masonry and articulation joints, as per the engineering design.

7.1.2 Geotechnical Zone 2: **P_{Fill}/H3**

This zone should be rendered suitable for construction by removing all fill materials currently present on surface. The fill materials are not suitable for founding or construction. Once fill materials have been removed entirely, construction in this zone may be done by means of a reinforced raft or soil replacement raft, as described for zone 1 above.

7.1.3 Geotechnical Zone 3: **P_{Fill}**

This zone, in its current state, is not considered suitable for development or construction unless further investigation is undertaken to establish the extent of the fill materials and propose suitable founding methods.

7.1.4 Seepage Water

It is recommended that a geohydrological investigation be undertaken to determine whether the seasonal groundwater fluctuations could reach – and adversely affect – founding conditions. If this is the case, it is recommended that provision be made to address conditions of shallow seepage water. The use of sub-surface drains installed along the proposed internal road reserves may be considered; however alternative engineered proposals may also be implemented.

7.1.5 General Measures

It is critical that site drainage and storm water be planned carefully to ensure efficient drainage. No storm water or surface runoff should accumulate or pond within 1.5m of the structures. Services and plumbing precautions must be put in place to ensure that underground services are not disrupted by the heaving action of expansive in situ soils.

7.2 Conditions of Excavation

As far as conditions of excavation are concerned, the following is recommended:

- *Fill:* The fill materials can be considered machine excavatible, though some effort may be required where materials are compacted or have a clayey nature.
- *Residual Dolerite:* It is recommended that machine excavation be used for excavating residual dolerite materials. Provision should be made for clayey excavation if the materials are excavated in a moist to wet state (i.e. during the rainy season or where ground moisture conditions dictate).
- *Residual Shale:* Residual shale materials should be excavated by machine. While hand excavation will be possible, it is not recommended.
- *Shale Bedrock:* Shale bedrock constitutes soft rock material and was proven to be partially excavatible by backhoe. It is therefore recommended that provision be made for excavation using an excavator and rock bucket. The use of pneumatic equipment may also be required.
- *Dolerite Bedrock:* While no dolerite bedrock was encountered, it is likely that blasting or chemical blasting will be required to remove dolerite bedrock from the profile (if encountered).
- *Depth of Excavation*: Excavatible depths by backhoe varied between 1500mm and 3000mm. The majority of trial holes exceeded a depth of 2500mm without encountering refusal of excavation.
- *Corestones*: No corestones were encountered in trial holes, but the possibility of corestones occurring in the residual dolerite profile cannot be discounted.
- *Sidewall Stabilities*: It is recommended that safety measures be put in place to support open excavations. The use of shoring or bracing may be considered. Alternatively excavated faces can be battered to a slope of 1 (V) : 1.5 (H). Fill material must be treated with caution in open excavations.
- *Seepage*: Despite the absence of seepage water during the investigation, it is recommended that provision be made to pump dry excavations, if required.

7.3 Material Utilisation

It is recommended that all materials required for the construction of layer works be imported from commercial or other sources.

7.4 Soil Corrossivity

Considering the extremely corrosive nature of prevailing soil materials, it is recommended that precautionary measures be taken to protect steel objects buried and exposed to soil materials (e.g. steel piping, joints, etc.). The use of protectively coated steel piping or cathodic protection may be considered.

7.5 Groundwater

It is recommended that a groundwater study be undertaken on this site to verify whether seasonal seepage water could occur and adversely affect foundations. If this option is not pursued (i.e. if seepage water cannot be disproved) it is recommended that a conservative approach be adopted and cut-off drains be installed throughout the development.

8 SOURCES OF REFERENCE

8.1 SAICE: South African Institution of Civil Engineers, Geotechnical Division (1990): *Geoterminology Workshop – Guidelines for Soil and Rock* Logging, published jointly by Association of Engineering Geologists (South Africa Section), South African Institution of Civil Engineers (Geotechnical Division) and South African Institute of Engineering Geologists, Rivonia

8.2 Vegter, J.R. (1995): *An Explanation of a Set of National Ground Water Maps*, published by the Water Research Commission, Pretoria

8.3 Van der Merwe, D (1964).: *The Prediction of Heave from the Plasticity Index and Percentage Clay Fraction of Soils*, published in the Civil Engineer in South Africa, pages 103 to 107.

8.4 Evans, U.R. (1971): *The Corrosion and Oxidation of Metals*, published by Edward Arnold in 1971.

8.5 Kijko A., Graham, G., Bejaichund, D.L., Roblin, D.L. and Brandt, M.B.C. (2003): *Probabilistic Peak Ground Acceleration and Spectral Seismic Hazard Maps for South Africa*, Report 2003-0053, Council for Geoscience.

IJ Breytenbach (Pr. Sci. Nat.)
19 July 2016
For Soilkraft cc

APPENDIX A: SOIL PROFILE LOG SHEETS

Sky Village Properties cc
Proposed Standerton Extension 9

HOLE No: 1
Sheet 1 of 1

JOB NUMBER: 2016/J022/CTL

Scale 1:15

SKT-08-84:

0.00 – 0.90	Dry, black brown, stiff, slickensided, silty clay. Residual dolerite.
0.90 – 2.20	Slightly moist, light grey brown mottled white speckled black, stiff, slickensided, silty clay. Residual dolerite.
2.20 – 2.70	Dry, light grey, dense to very dense, intact, silty gravel. Residual shale grading into bedrock.

NOTES
1) No refusal of excavation.

2) No seepage.

3) Disturbed Sample SKT-08-84: 0.45m.

CONTRACTOR : Sahara Sand
MACHINE : CAT428F
DRILLED BY : Sizwe
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 500mm
DATE :
DATE : 27/06/2016

DATE : 18/07/2016 18:12
TEXT : ..ertonMall\TPProfiles.txt

ELEVATION :
X-COORD : 26° 56 39.3S
Y-COORD : 29° 14 06.1E

HOLE No: 1
Township Establishment

Sky Village Properties cc
Proposed Standerton Extension 9

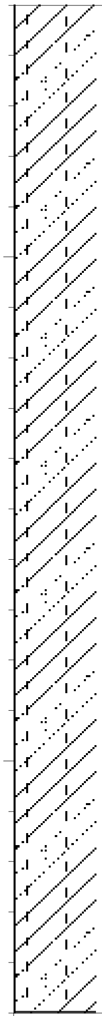
HOLE No: 2
Sheet 1 of 1

JOB NUMBER: 2016/J022/CTL

Scale
1:15

0.00 Dry, black brown, stiff, slickensided, silty clay. Residual dolerite.

0.50 Slightly moist, brown grey mottled white and speckled black, stiff, slickensided, silty clay. Residual dolerite.



SKT-08-85:

2.50

NOTES

1) No refusal of excavation.

2) No seepage.

3) Disturbed Sample SKT-08-85: 1.50m.

CONTRACTOR : Sahara Sand
MACHINE : CAT428F
DRILLED BY : Sizwe
PROFILED BY : Izak Breytenbach
TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 500mm
DATE :
DATE : 27/06/2016
DATE : 18/07/2016 18:12
TEXT : ..ertonMall\TPProfiles.txt

ELEVATION :
X-COORD : 26° 56 40.9S
Y-COORD : 29° 14 06.3E

HOLE No: 2
Township Establishment

Sky Village Properties cc
Proposed Standerton Extension 9

HOLE No: 3
Sheet 1 of 1

JOB NUMBER: 2016/J022/CTL

Scale
1:10

0.00 Dry, black brown, stiff, slickensided, silty clay. Residual dolerite.

0.60 Slightly moist, light grey brown mottled white speckled black, stiff, slickensided, silty clay containing scattered gravel. Residual dolerite.

1.00 Grey brown, fine to very fine grained, slightly to moderately weathered, closely jointed, soft rock: **SHALE**. Material resembles gravel in places.

SKT-08-86:

1.50

NOTES

1) Gradual refusal of excavation.

2) No seepage.

3) Disturbed Sample SKT-08-86: 1.25m.

CONTRACTOR : Sahara Sand
MACHINE : CAT428F
DRILLED BY : Sizwe
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 500mm
DATE :
DATE : 27/06/2016

DATE : 18/07/2016 18:12
TEXT : ..ertonMall\TPProfiles.txt

ELEVATION :
X-COORD : 26° 56 41.2S
Y-COORD : 29° 14 03.0E

HOLE No: 3
Township Establishment

Sky Village Properties cc
Proposed Standerton Extension 9

HOLE No: 4
Sheet 1 of 1

JOB NUMBER: 2016/J022/CTL

Scale 1:15

0.00 – 0.70	Dry, black brown, stiff, slickensided, silty clay. Residual dolerite.
0.70 – 2.80	Slightly moist, light grey mottled white, stiff to firm, slickensided, silty clay. Residual dolerite.

SKT-08-87:

NOTES

1) No refusal of excavation.

2) No seepage.

3) Disturbed Sample SKT-08-87: 1.75m.

CONTRACTOR : Sahara Sand
MACHINE : CAT428F
DRILLED BY : Sizwe
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 500mm
DATE :
DATE : 27/06/2016

ELEVATION :
X-COORD : 26° 56 44.5S
Y-COORD : 29° 14 05.7E

HOLE No: 4
Township Establishment

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 18/07/2016 18:12
TEXT : ..ertonMall\TPProfiles.txt

Sky Village Properties cc
Proposed Standerton Extension 9

HOLE No: 5
Sheet 1 of 1

JOB NUMBER: 2016/J022/CTL

Scale 1:15

0.00 – 0.20	Dry, black brown, stiff, slickensided, silty clay. Residual dolerite.
0.20 – 2.90	Slightly moist, light grey mottled white, stiff to firm, slickensided, silty clay. Residual dolerite.

SKT-08-88:

NOTES
1) No refusal of excavation.
2) No seepage, but seasonal seepage expected.
3) Disturbed Sample SKT-08-88: 1.55m.

CONTRACTOR : Sahara Sand
MACHINE : CAT428F
DRILLED BY : Sizwe
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 500mm
DATE :
DATE : 27/06/2016

DATE : 18/07/2016 18:12
TEXT : ..ertonMall\TPProfiles.txt

ELEVATION :
X-COORD : 26° 56 47.0S
Y-COORD : 29° 14 03.3E

HOLE No: 5
Township Establishment

Sky Village Properties cc
Proposed Standerton Extension 9

HOLE No: 6
Sheet 1 of 1

JOB NUMBER: 2016/J022/CTL

Scale
1:15

0.00	Moist, dark grey brown, firm, sandy clay containing plastic and fragments of broken brick. Fill.
0.90	Moist, light grey brown, firm to soft, slickensided, silty clay. Slightly ferruginised residual dolerite.
2.80	

NOTES
1) No refusal of excavation.

2) No seepage, but seasonal seepage expected.

CONTRACTOR : Sahara Sand
MACHINE : CAT428F
DRILLED BY : Sizwe
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 500mm
DATE :
DATE : 27/06/2016

DATE : 18/07/2016 18:12
TEXT : ..ertonMall\TPProfiles.txt

ELEVATION :
X-COORD : 26° 56 50.5S
Y-COORD : 29° 14 04.6E

HOLE No: 6
Township Establishment

Sky Village Properties cc
Proposed Standerton Extension 9

HOLE No: 7
Sheet 1 of 1

JOB NUMBER: 2016/J022/CTL

Scale
1:15

0.00	Slightly moist, dark brown, stiff, sandy clay . Fill.
0.60	Moist, light grey brown, firm to soft, slickensided, silty clay. Slightly ferruginised residual dolerite.
2.50	

SKT-08-89:

NOTES

1) No refusal of excavation.

2) No seepage, but seasonal seepage expected.

3) Disturbed Sample SKT-08-89: 1.50m.

CONTRACTOR : Sahara Sand
MACHINE : CAT428F
DRILLED BY : Sizwe
PROFILED BY : Izak Breytenbach

INCLINATION :
DIAM : 500mm
DATE :
DATE : 27/06/2016

ELEVATION :
X-COORD : 26° 56 47.7S
Y-COORD : 29° 14 06.8E

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 18/07/2016 18:12
TEXT : ..ertonMall\TPProfiles.txt

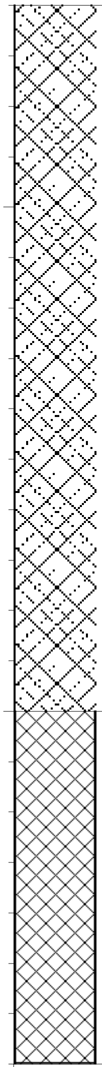
HOLE No: 7
Township Establishment

Sky Village Properties cc
Proposed Standerton Extension 9

HOLE No: 8
Sheet 1 of 1

JOB NUMBER: 2016/J022/CTL

Scale
1:15



0.00 Dry, grey brown, dense, gravelly sand with pieces of wire. Fill.

0.60 Dry, light grey brown, medium dense, gravelly sand containing bricks and rubble. Fill.

2.00 Dry, grey brown, dense, gravelly sand with pieces of wire. Fill.

2.70

NOTES

1) No refusal of excavation.

2) No seepage.

CONTRACTOR : Sahara Sand
MACHINE : CAT428F
DRILLED BY : Sizwe
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 500mm
DATE :
DATE : 27/06/2016

DATE : 18/07/2016 18:12
TEXT : ..ertonMall\TPProfiles.txt

ELEVATION :
X-COORD : 26° 56 55.2S
Y-COORD : 29° 14 07.2E

HOLE No: 8
Township Establishment

Sky Village Properties cc
Proposed Standerton Extension 9

HOLE No: 9
Sheet 1 of 1

JOB NUMBER: 2016/J022/CTL

Scale
1:15

0.00	Dry, grey brown, dense, gravelly sand with pieces of wire. Fill.
0.20	Dry, light grey brown, medium dense, gravelly sand containing layers of ash and pieces of broken brick. Fill.
3.00	

NOTES

1) No refusal of excavation.

2) No seepage.

CONTRACTOR : Sahara Sand
MACHINE : CAT428F
DRILLED BY : Sizwe
PROFILED BY : Izak Breytenbach

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM : 500mm
DATE :
DATE : 27/06/2016

DATE : 18/07/2016 18:12
TEXT : ..ertonMall\TPProfiles.txt

ELEVATION :
X-COORD : 26° 56 55.4S
Y-COORD : 29° 14 05.7E

HOLE No: 9
Township Establishment

Sky Village Properties cc
Proposed Standerton Extension 9

LEGEND
Sheet 1 of 1

JOB NUMBER: 2016/J022/CTL

	GRAVEL	{SA02}
	SILTY	{SA07}
	CLAY	{SA08}
	SHALE	{SA12}
	FILL	{SA32}
Name	DISTURBED SAMPLE	{SA38}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :

INCLINATION :
DIAM :
DATE :
DATE :

ELEVATION :
X-COORD :
Y-COORD :

TYPE SET BY : Izak Breytenbach
SETUP FILE : STANDARD.SET

DATE : 18/07/2016 18:12
TEXT : ..ertonMall\TPProfiles.txt

LEGEND
SUMMARY OF SYMBOLS

APPENDIX B: MATERIAL TEST RESULTS

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Quality | Excellence | On Time

Client Name: Soilkraft
Project Name: Standerton
Job Number: SKT-08
Date: 14-Jul-16
Method: SANS 3001 GR1, GR10, GR20, GR30, GR31, GR40, GR50, GR53, GR54 & ASTM D422 (where applicable)

SUMMARY OF TEST DATA

Grading & Hydrometer Analysis (% Passing)

Sample	TH 1	TH 2	TH 3	TH 4	TH 5	TH 7		
Depth (m)	0 - 900	500 - 2500	1000 - 1500	700 - 2800	200 - 2900	600 - 2500		
Lab No	SKT-08-83	SKT-08-84	SKT-08-85	SKT-08-86	SKT-08-87	SKT-08-88		
53.0	**100**	**100**	**96**	**100**	**100**	**100**		
37.5	**100**	**100**	**89**	**100**	**100**	**100**		
26.5	**100**	**100**	**81**	**100**	**100**	**100**		
19.0	**100**	**100**	**71**	**100**	**100**	**100**		
13.2	**100**	**100**	**70**	**100**	**100**	**100**		
9.5	**100**	**100**	**70**	**99**	**100**	**100**		
6.7	**100**	**99**	**68**	**98**	**94**	**100**		
4.75	**100**	**99**	**64**	**97**	**94**	**100**		
2.00	**100**	**97**	**61**	**95**	**93**	**100**		
1.00	**99**	**97**	**60**	**94**	**93**	**99**		
0.425	**97**	**96**	**59**	**93**	**92**	**98**		
0.250	**92**	**92**	**58**	**91**	**91**	**96**		
0.150	**86**	**89**	**56**	**88**	**89**	**94**		
0.075	**80**	**84**	**53**	**84**	**84**	**89**		
0.050	**70**	**74**	**42**	**76**	**67**	**63**		
0.020	**58**	**65**	**33**	**70**	**59**	**59**		
0.006	**44**	**51**	**21**	**61**	**52**	**51**		
0.002	**38**	**44**	**14**	**53**	**45**	**43**		
GM	**0.23**	**0.23**	**1.27**	**0.28**	**0.31**	**0.13**		

Atterberg Limits

LL (%)	**47**	**58**	**39**	**74**	**62**	**54**		
PI (%)	**27**	**28**	**20**	**37**	**23**	**23**		
LS (%)	**10.7**	**13.5**	**10.0**	**17.7**	**10.6**	**9.5**		

pH & Conductivity

pH	**7.5**			**8.7**		**8.4**		
EC (S/m)	**0.0565**			**0.103**		**0.0973**		

MDD / OMC

MDD (kg/m³)								
OMC (%)								

CBR

100%								
98%								
97%								
95%								
93%								
90%								
Swell (%)								

UCS (MPa)

100%								
97%								
90%								

COLTO Classification

Remarks:

Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical

Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Quality | Excellence | On Time

Client Name: Soilkraft
Project Name: Standerton
Job Number: SKT-08
Date: 2016-07-14
Method: SANS 3001 GR1, GR10 & ASTM D422

FOUNDATION INDICATOR

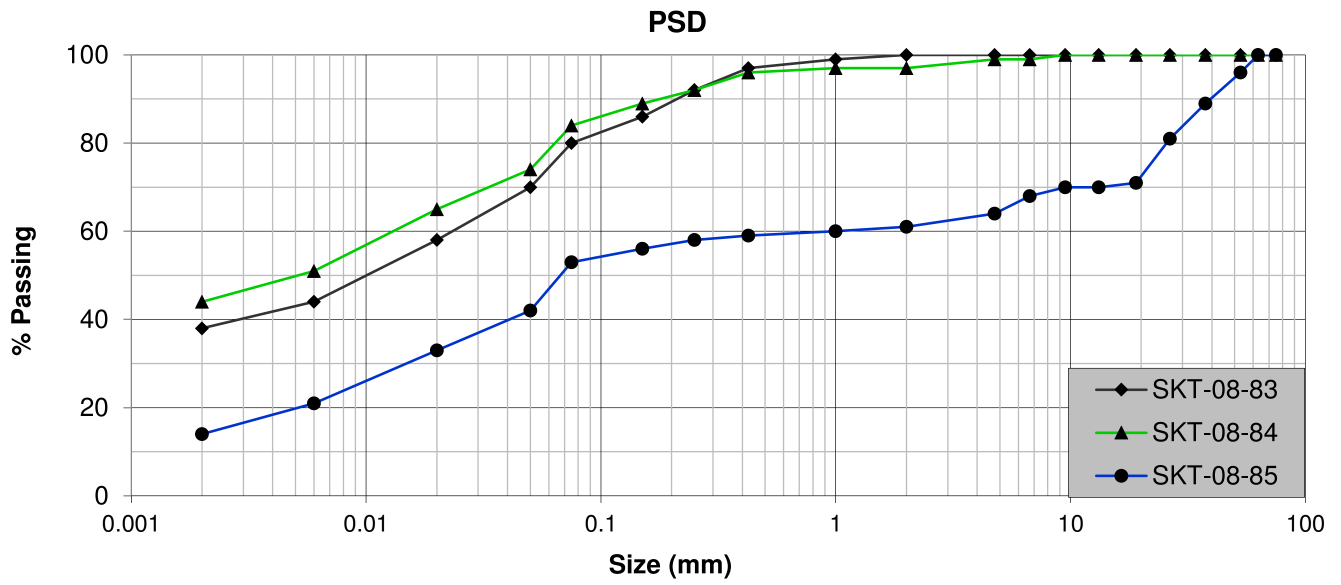
Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				Atterberg Limits & Classification			
Sample	TH 1	TH 2	TH 3	Sample	TH 1	TH 2	TH 3
Depth (m)	0 - 900	500 - 2500	1000 - 1500	Depth (m)	0 - 900	500 - 2500	1000 - 1500
Lab No	SKT-08-83	SKT-08-84	SKT-08-85	Lab No	SKT-08-83	SKT-08-84	SKT-08-85
75.0	**100**	**100**	**100**	Liquid Limit (%)	**47**	**58**	**39**
63.0	**100**	**100**	**100**	Plastic Limit (%)	**20**	**30**	**19**
53.0	**100**	**100**	**96**	Plasticity Index (%)	**27**	**28**	**20**
37.5	**100**	**100**	**89**	Linear Shrinkage (%)	**10.7**	**13.5**	**10.0**
26.5	**100**	**100**	**81**	PI of whole sample	**26**	**27**	**12**
19.0	**100**	**100**	**71**				
13.2	**100**	**100**	**70**	% Gravel	**0**	**3**	**39**
9.5	**100**	**100**	**70**	% Sand	**26**	**19**	**15**
6.7	**100**	**99**	**68**	% Silt	**36**	**34**	**32**
4.75	**100**	**99**	**64**	% Clay	**38**	**44**	**14**
2.00	**100**	**97**	**61**	Activity	**0.7**	**0.6**	**1.4**
1.00	**99**	**97**	**60**				
0.425	**97**	**96**	**59**	% Soil Mortar	**100**	**97**	**61**
0.250	**92**	**92**	**58**				
0.150	**86**	**89**	**56**	Grading Modulus	**0.23**	**0.23**	**1.27**
0.075	**80**	**84**	**53**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.050	**70**	**74**	**42**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**58**	**65**	**33**				
0.006	**44**	**51**	**21**	Unified (ASTM D2487)	**CL**	**CH**	**CL**
0.002	**38**	**44**	**14**	AASHTO (M145-91)	**A - 7 - 6**	**A - 7 - 6**	**A - 6**

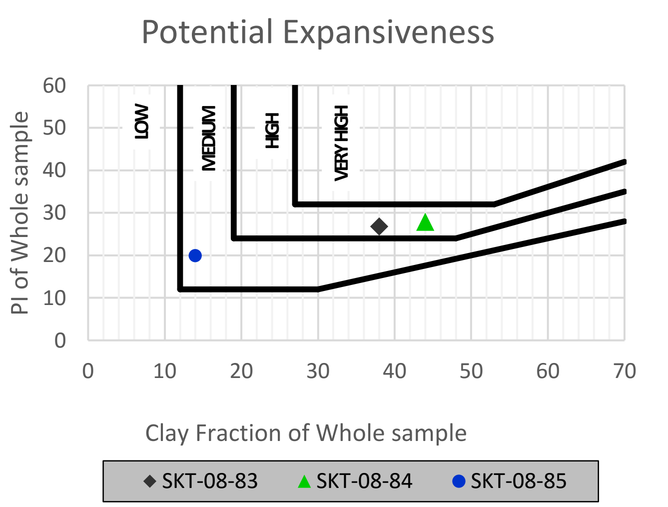
Remarks: *: Assumed
N / T: Not Tested

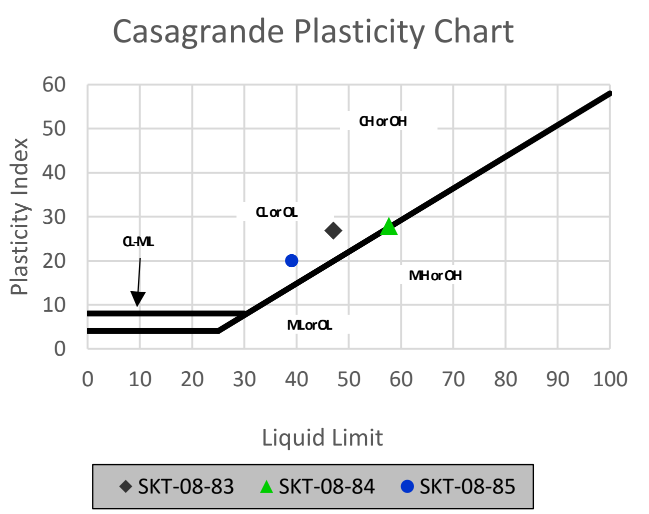
Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Quality | Excellence | On Time
Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Client Name:	Soilkraft
Project Name:	Standerton
Job Number:	SKT-08
Date:	2016-07-14
Method:	SANS 3001 GR1, GR10 & ASTM D422

FOUNDATION INDICATOR







Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical
Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

Quality | Excellence | On Time

Client Name: Soilkraft
Project Name: Standerton
Job Number: SKT-08
Date: 2016-07-14
Method: SANS 3001 GR1, GR10 & ASTM D422

FOUNDATION INDICATOR

Grading & Hydrometer Analysis (Particle Size (mm) & % Passing)				**Atterberg Limits & Classification**			
Sample	TH 4	TH 5	TH 7	Sample	TH 4	TH 5	TH 7
Depth (m)	700 - 2800	200 - 2900	600 - 2500	Depth (m)	700 - 2800	200 - 2900	600 - 2500
Lab No	SKT-08-86	SKT-08-87	SKT-08-88	Lab No	SKT-08-86	SKT-08-87	SKT-08-88
75.0	**100**	**100**	**100**	Liquid Limit (%)	**74**	**62**	**54**
63.0	**100**	**100**	**100**	Plastic Limit (%)	**37**	**40**	**30**
53.0	**100**	**100**	**100**	Plasticity Index (%)	**37**	**23**	**23**
37.5	**100**	**100**	**100**	Linear Shrinkage (%)	**17.7**	**10.6**	**9.5**
26.5	**100**	**100**	**100**	PI of whole sample	**34**	**21**	**23**
19.0	**100**	**100**	**100**				
13.2	**100**	**100**	**100**	% Gravel	**5**	**7**	**0**
9.5	**99**	**100**	**100**	% Sand	**16**	**19**	**27**
6.7	**98**	**94**	**100**	% Silt	**26**	**29**	**30**
4.75	**97**	**94**	**100**	% Clay	**53**	**45**	**43**
2.00	**95**	**93**	**100**	Activity	**0.7**	**0.5**	**0.5**
1.00	**94**	**93**	**99**				
0.425	**93**	**92**	**98**	% Soil Mortar	**95**	**93**	**100**
0.250	**91**	**91**	**96**				
0.150	**88**	**89**	**94**	Grading Modulus	**0.28**	**0.31**	**0.13**
0.075	**84**	**84**	**89**	Moisture Content (%)	**N / T**	**N / T**	**N / T**
0.050	**76**	**67**	**63**	Relative Density (SG)*	**2.65**	**2.65**	**2.65**
0.020	**70**	**59**	**59**				
0.006	**61**	**52**	**51**	Unified (ASTM D2487)	**MH**	**MH**	**MH**
0.002	**53**	**45**	**43**	AASHTO (M145-91)	**A - 7 - 5**	**A - 7 - 5**	**A - 7 - 5**

Remarks: *: Assumed
N / T: Not Tested

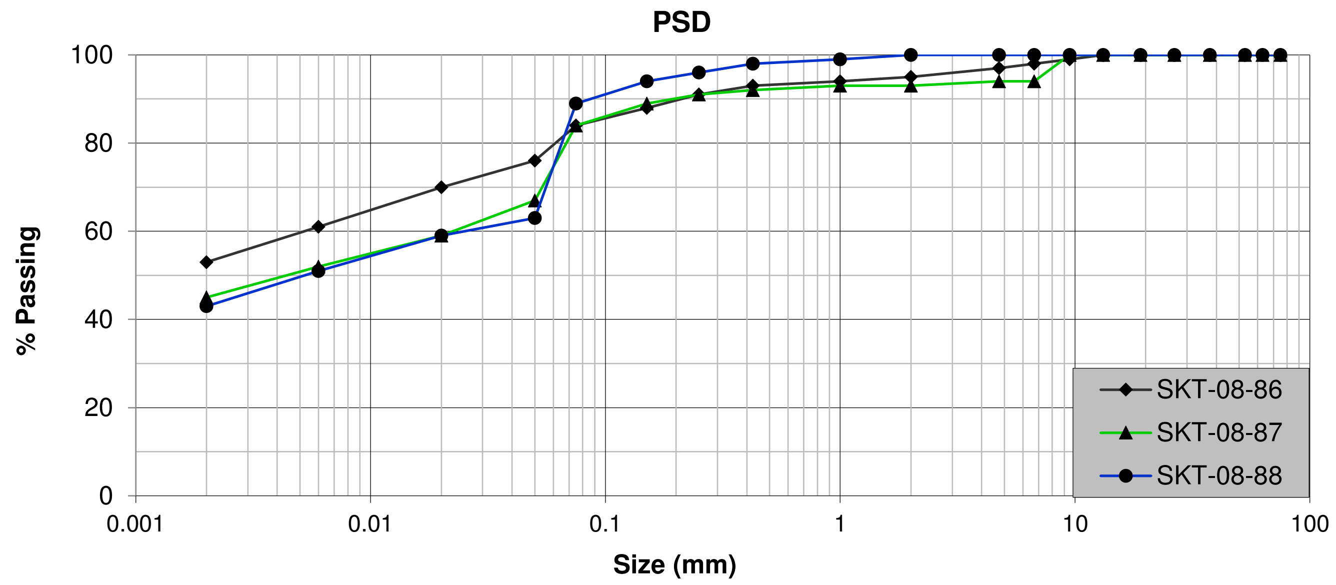
Specialised Testing Laboratory (Pty) Ltd
Asphalt | Aggregate | Bitumen | Geotechnical

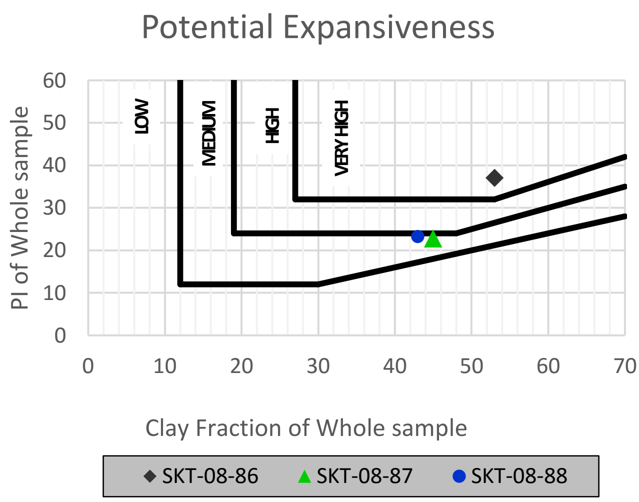
Unit 1, 13 Bloubokkie Street, Koedoespoort 0186
Roelof | 072 674 6343 | roelof@stlab.co.za
Gerrie | 082 309 4448 | gerrie@stlab.co.za
www.stlab.co.za

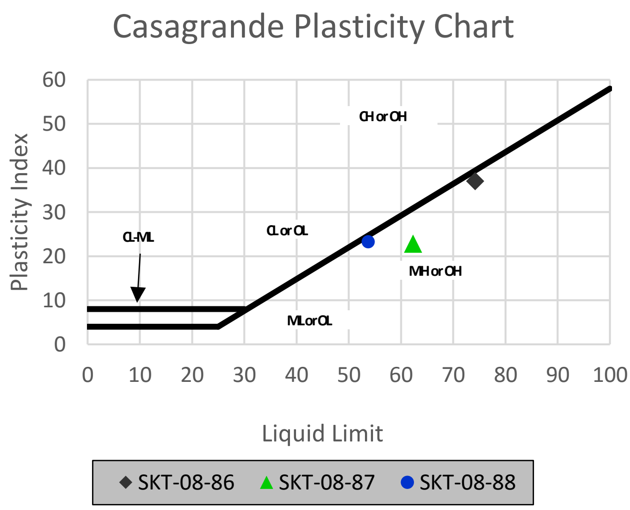
Quality | Excellence | On Time

Client Name:	Soilkraft	
Project Name:	Standerton	
Job Number:	SKT-08	
Date:	2016-07-14	
Method:	SANS 3001 GR1, GR10 & ASTM D422	

FOUNDATION INDICATOR







Appendix B2

Floodline Study

Portions of the Remainder of Portion 2, Portion 4 and a Portion of the Remainder of Portion 7 of the Farm Grootverlangen 409-IS, 1:50 & 1:100 Year Floodlines

Report Prepared for

Sky Village Properties CC

Report Number 506887/1

Report Prepared by

srk consulting

July 2016

Portions of the Remainder of Portion 2, Portion 4 and a Portion of the Remainder of Portion 7 of the Farm Grootverlangen 409-IS, 1:50 & 1:100 Year Floodlines

Sky Village Properties CC
P O Box 211
Secunda
2302

SRK Consulting (South Africa) (Pty) Ltd.
Block A, Menlyn Woods,
291 Sprite Avenue
Faerie Glen
0081 Pretoria
South Africa
E-mail: pretoria@srk.co.za
website: www.srk.co.za

Tel: +27 (0) 12 361 9821
Fax:+27 (0) 12 361 9912

SRK Project Number 506887

July 2016

Compiled by:

Tshilidzi Netshitangani

Peer Reviewed by:

Dingaan Mahlangu ,Partner

Email: tnetshitangani@srk.co.za

Authors:

Tshilidzi Netshitangani

Executive Summary

A new development is planned to be constructed in Portions of the Remainder of Portion 2, Portion 4 and a Portion of the Remainder of Portion 7 of the Farm Grootverlangen 409-IS within Lekwa Local Municipality in Mpumalanga Province. The proposed development site is bounded by the Railway line, Water Sisulu Drive (R546) and Krogh Street (R23). A tributary of Vaal River runs within the proposed development site. A need was therefore identified to carry out a 1:50 year and 1:100 year floodline study for the tributary of Vaal River within the proposed development site to assess any risk of possible flooding on the proposed developments. SRK Consulting was therefore appointed by Sky Village Properties CC to undertake 1:50 year and 1:100 year floodlines for Portions of the Remainder of Portion 2, Portion 4 and a Portion of the Remainder of Portion 7 of the Farm Grootverlangen 409-IS.

The study will include the following:

- Identification and delineation of watercourse that runs in the vicinity of the proposed development site;
- Delineation of catchment that drain into the proposed development site;
- Hydrology of the site to indicate the peak flows emanating from the start of the catchments until when it reaches the proposed development site;
- Determination of the detailed 1:50 and 1:100 year floodlines along the tributary of Vaal River in the vicinity of the proposed development site; and
- Compile a report and associated floodline drawings showing the extent of flooding along the Vaal River tributary.

Results of a floodline study for proposed watercourse conditions are covered in this report.

Summary of principal objectives

The principal objective of this project is to carry out a 1:50 year and 1:100 year floodline study to assess any risk of possible flooding on the proposed developments.

Outline of work programme

The floodlines were determined based on the existing watercourse condition, and survey information supplied by Reed Geomatics INC. Professional Land Surveyors. The catchment hydrology was determined by characterising the hydrological and hydraulic parameters of the catchment within which the future developments may take place. The catchment parameters and the rainfall data obtained from Goedgevonden (0441270_W) rainfall station were used to generate the peak flows using the Rational and SCS methods. The peak flow data and other relevant site information were entered into the backwater model HECRAS to produce the results on the flooding extent along the river banks in the vicinity of the proposed development site.

Conclusions

The following is concluded:

- The proposed development site is affected by the 1:50 and 1:100 year floodlines.

Recommendations

The following is recommended:

- The floodline information to be used to ensure that no new development is situated within the 1:100 year floodline.
- The floodlines be revised should watercourse/control structures be modified in the future.
- If a need to retain the current locations of the affected stands arises, a flood hazard assessment is recommended to further analyse and categorise the risk associated with flooding in the affected areas. Based on this, relevant flood remedial measures to maximise the development potential of the sites and to also avoid possible liability claims against the Town or City Council can then be determined.
- Any specialist studies including the environmental compliance studies that might be needed must be done in consultation with relevant authorities

Table of Contents

List of Tables

List of Figures

Disclaimer

The opinions expressed in this Report have been based on the information supplied to SRK Consulting (South Africa) (Pty) Ltd (SRK) by Reed Geomatics INC. SRK has exercised all due care in reviewing the supplied information. Whilst SRK has compared key supplied data with expected values, the accuracy of the results and conclusions from the review are entirely reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

1 Introduction and Scope of Report

A new development is planned to be constructed in Portions of the Remainder of Portion 2, Portion 4 and a Portion of the Remainder of Portion 7 of the Farm Grootverlangen 409-IS within Lekwa Local Municipality in Mpumalanga Province. The proposed development site is bounded by the Railway line, Water Sisulu Drive (R546) and Krogh Street (R23). A tributary of Vaal River runs within the proposed development site. A need was therefore identified to carry out a 1:50 year and 1:100 year floodline study for the tributary of Vaal River within the proposed development site to assess any risk of possible flooding on the proposed developments. SRK Consulting was therefore appointed by Sky Village Properties CC to undertake 1:50 year and 1:100 year floodlines for Portions of the Remainder of Portion 2, Portion 4 and a Portion of the Remainder of Portion 7 of the Farm Grootverlangen 409-IS.

2 Background and Brief

2.1 Background of the project

Sky Village Properties CC appointed SRK to undertake a 1:50 year and 1:100 year floodline study for the Vaal River tributary that runs within the proposed development site in Portions of the Remainder of Portion 2, Portion 4 and a Portion of the Remainder of Portion 7 of the Farm Grootverlangen 409-IS within Lekwa Local Municipality in Mpumalanga Province. In terms of the National Water Act, Act 36 of 1998, the 1:100 year floodlines must be indicated on the layout plans of the developments for information purposes.

2.2 Program objectives

The project objectives are as follows:

- Identification and delineation of watercourse that runs in the vicinity of the proposed development site;
- Delineation of catchment that drain into the proposed development site;
- Hydrology of the site to indicate the peak flows emanating from the start of the catchments until when it reaches the proposed development site;
- Determination of the detailed 1:50 and 1:100 year floodlines along the tributary of Vaal River in the vicinity of the proposed development site; and
- Compile a report and associated floodline drawings showing the extent of flooding along the Vaal River tributary.

2.3 Purpose of the Report

This report provides the findings of the study and gives necessary information and recommendations on the flood prone areas due to a 1:50 and 1:100 year flood events.

2.4 Available Information

The following information sources were consulted as part of this task:

- Topographical information in the form of maps, aerial photographs;
- Contour survey as supplied by Reed Geomatics INC. Professional Land Surveyors;
- Satellite photos available on Google Earth.

3 Legal and Council Requirements

The **1:100-year** floodline is required in terms of the National Water Act, Act 36 of 1998, Chapter 14 Part 3 as given below.

***144**. For the purposes of ensuring that all persons who might be affected have access to information regarding potential flood hazards, no person may establish a township unless the layout plan shows, in a form acceptable to the local authority concerned, lines indicating the maximum level likely to be reached by flood waters on average once in every 100 years.*

4 Description of Study Area

The proposed development site is bounded by the Railway line, Water Sisulu Drive (R546) and Krogh Street (R23). There are existing residential developments to the east of the proposed developments site. The study area is shown in Figure 4.1 below**.**

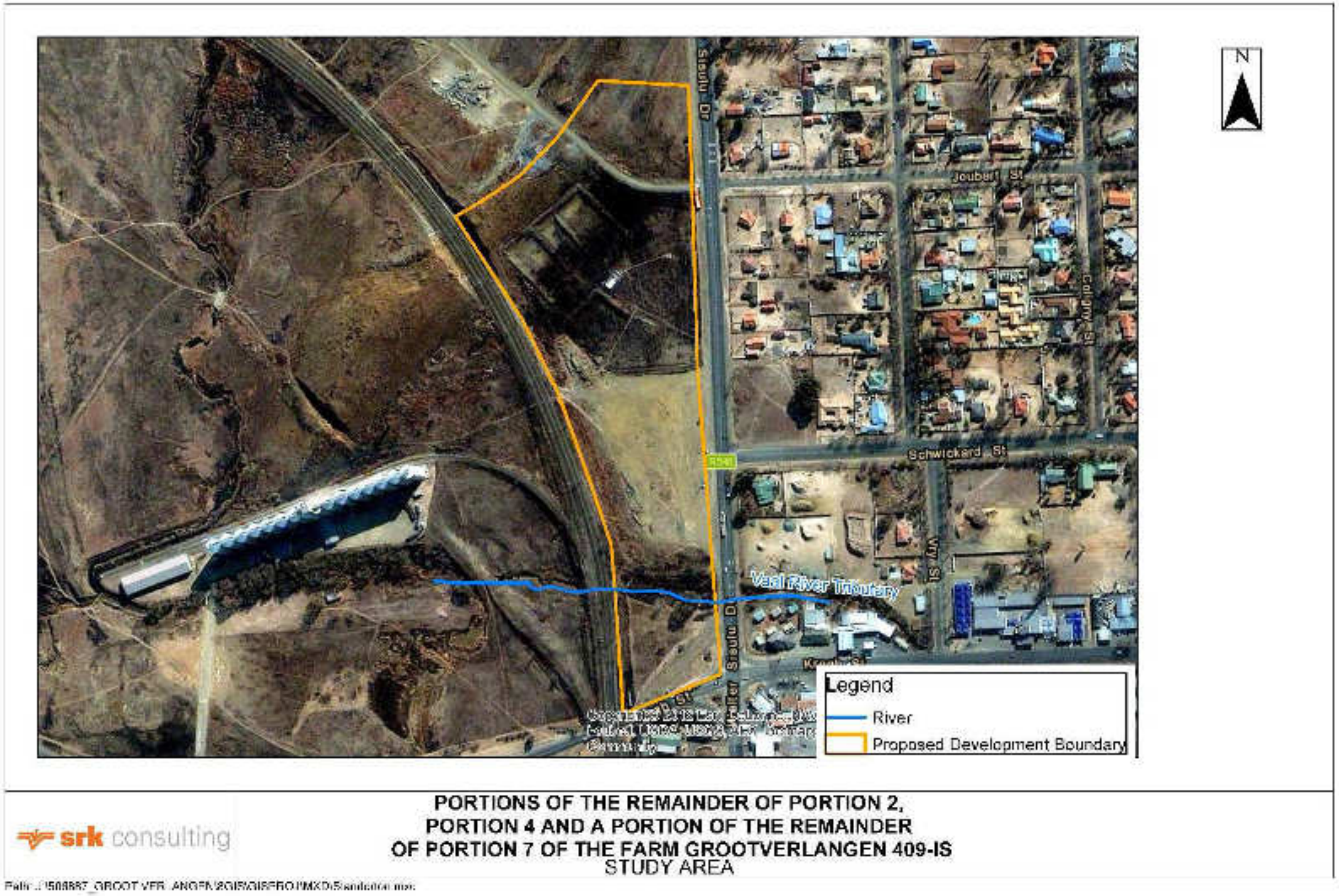


Figure 4-1: Portions of the Remainder of Portion 2, Portion 4 and a Portion of the Remainder of Portion 7 of the Farm Grootverlangen 409-IS (Study Area)

The floodplains along tributary of Vaal River in the vicinity of the proposed development site consist mainly of commercial developments, residential area, tarred roads, grass and trees. The tributary of Vaal River in the vicinity of the proposed study is well defined. There is a rail way line bridge and a road bridge on the western boundary and eastern boundary of the proposed development site respectively. The total catchment that drains towards the proposed development site starts on the southern side of Langebaan/Bauman Street (R50) which is situated on the north western side of the proposed development site. The catchment is currently approximately 40% developed, consisting mainly of grasslands, trees, roads and residential development. The area of the catchment is approximately 9.1km^2.The catchment that drains into the study area is shown in Figure 4.2 below.

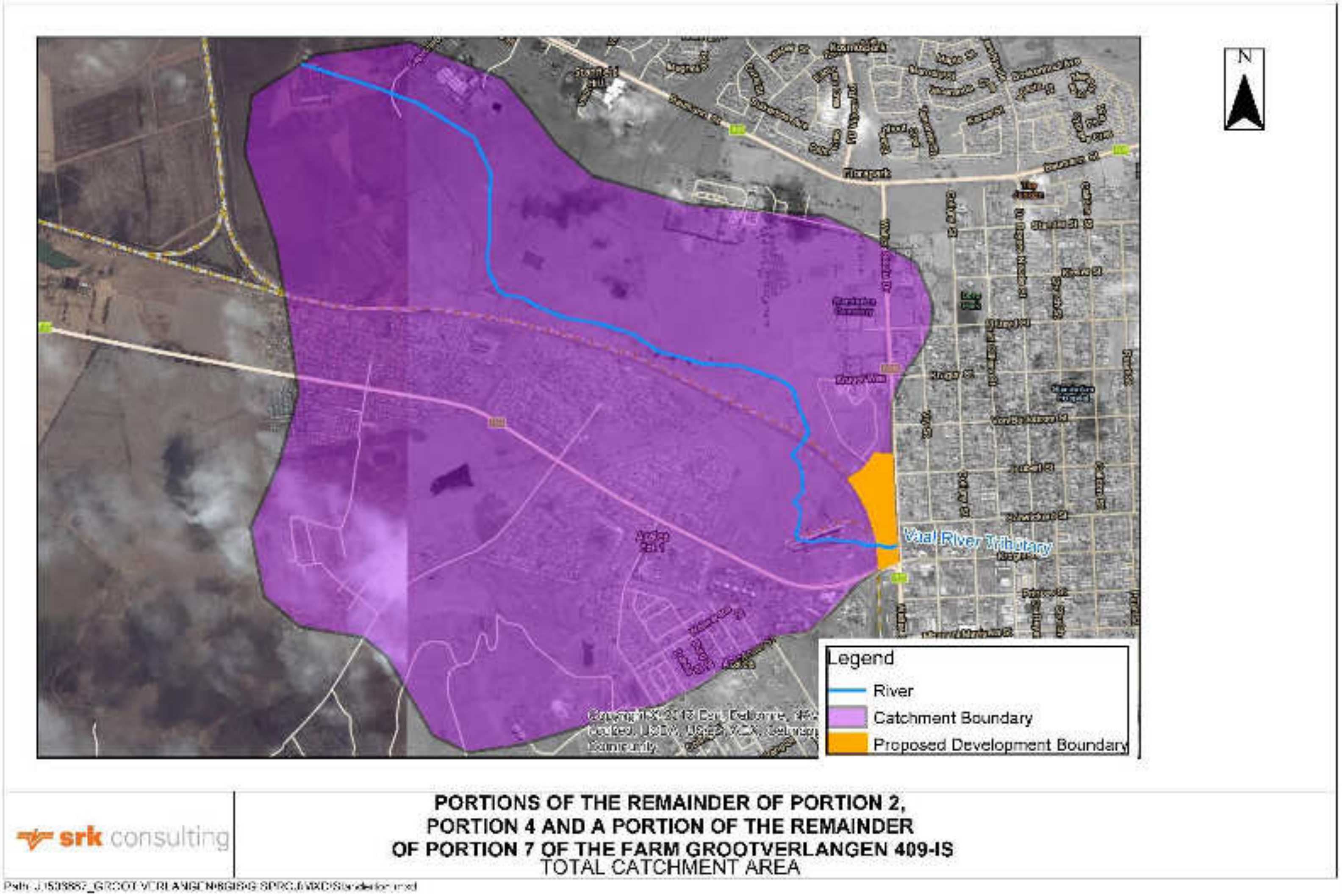


Figure 4-2: Portions of the Remainder of Portion 2, Portion 4 and a Portion of the Remainder of Portion 7 of the Farm Grootverlangen 409-IS

5 Topographical Details

The general topography was determined using 1:50 000 topographical map. In order to improve the accuracy of the aerial survey an additional survey was received from Reed Geomatics INC. Professional Land Surveyors.

The average gradient of the catchment is approximately 0.7% from an elevation of approximately 1583 metres above mean sea level (mamsl) on the southern side of Langebaan/Bauman Street (R50) on the north western side of the proposed development site to the eastern side of the proposed development at an elevation of approximately 1544 mamsl. The 5m contours from surveyor general and the survey from Reed Geomatics INC. Professional Land Surveyors was used to delineate the catchment and it gave the topographical data the watercourse and the floodplains within the proposed development site.

5.1 Site Visit

A site visit of the study area was conducted to determine the catchment characteristics from the on-site observations and to obtain details of the typical land cover. From the observations made during the site visit as well as using the available topographical information and the satellite images on Google Earth, the catchment was divided into sub catchments based on the existing and proposed land use.

5.2 River Vegetation and Manning's n-value

Manning's n-value is a coefficient which is a measure of the roughness of the river. This roughness is determined by the irregularity of the stream, presence of boulders, density and type of vegetation, degree of erosion of the river banks, etc. This section includes a selection of photographs illustrating the condition of the river beds and flood plains. Mannings "n" values within the watercourse and along the floodplains are shown as roughness in pictures in Figure 5.1 below.

	
Existing Railway Bridge	Vegetated Watercourse on the eastern side of Railway Bridge

Vegetated floodplain (northern side of the watercourse)

Clear flood plain(southern side of the watercourse)

Walter Sisulu Drive Culvert with Silt

Watler Sisulu Drive Culverts with vegetated watercourse

Watercourse with vegetation on the east of Walter Sisulu Drive

Channel on the southern side of the watercourse

Figure 5-1: Photos taken during site visit showing the existing conditions of river and floodplains.

6 Rainfall Data

6.1 Storm Rainfall depths

The rainfall analysis was based on the “Design Rainfall Estimation in South Africa” (DRE) program developed by JC Smithers and RE Schulze. The program implemented procedures from the Water Research Commission (WRC) project entitled “Rainfall Statistics for Design Flood Estimation in South Africa” (WRC Project K5/1060. The hydrological simulations were run on rainfall data obtained from Goedgevonden (0441270_W) rainfall station using the Design Rainfall extractor (Smithers and Schulze, 2002). The rainfall station was selected based on criteria such as altitude relative to the area of interest, the record history of the weather station and proximity to the study area.

Goedgevonden rainfall station is situated approximately 10km from the proposed development site. This station was therefore selected as the representative rainfall data set for the site.

The 1 day to 7 day design rainfall depth for the area for various return periods are given in Table 6.1 below.

Table 6-1: Adopted storm rainfall depths (mm)

Duration		Return Period Rainfall (mm)					
	1:2 Year	1:5 Year	1:10 Year	1:20 Year	1:50 Year	1:100 Year	1:200 Year
1 day	58	80	97	115	142	164	189
2 day	71	97	116	137	167	192	219
3 day	78	107	128	150	183	210	238
7 day	97	130	154	179	213	240	270

7 Flood Hydrology

The catchment area was delineated using the 1:50 000 topographical map together with the 5m contours and the survey data supplied by Reed Geomatics INC. Professional Land Surveyors. The hydrological and hydraulic parameters of all the catchments contributing towards the proposed site of development were calculated. Peak flow rates were determined along the tributary of Vaal River in the vicinity of the proposed development site. The magnitude of the flood peak depends on the catchment characteristics and the rainfall intensity. The SCS and Rational methods were used to calculate the peak flow rates taking into account possible maximum future development potential within the catchment. The average of the two methods was adopted and used in the HECRAS model. The land use for the area was based on the site visit, available land cover obtained from the topographical information, satellite images available on Google Earth as well as the relevant literature for the rational and SCS methods.

The hydrological model parameters included:

- Catchment slope, size and shape for each of the watercourse within the catchment. The watercourse was extended up to the origin of the catchment;
- Land-use information regarding current and potential future development conditions;
- Watercourse size and shape;
- Storm rainfall, estimated from the available daily rainfall records.

Suitable sub-catchments were delineated which were used as nodes in the hydraulic model.

The hydrological modelling included the following procedures

- The available rainfall records as obtained from Schulze were analysed to determine the relevant storm rainfall records using weighting where necessary;
- The flood peaks at each sub-catchment were determined with probabilities of exceedance of 1% (1:100 year event), 2% (1:50 year event using SCS and Rational methods;

Based on a hydrological study carried out for the catchment, peak flow rates for the catchment conditions are shown in Table 7-1 below.

Table 7-1: Summary of flood peaks (Future Development Conditions)

Rational Method				
River Segment	Catchment Area (km^2)	Flood Peaks (m^3/s)		
		1:20 Year	1:50 Year	1:100 Year
VT81	9.1	52.5	69.5	87.1
SCS Method				
River Segment	Catchment Area (km^2)	Flood Peaks (m^3/s)		
		1:20 Year	1:50 Year	1:100 Year
VT81	9.1	44.7	67.1	87.1
Adopted Flood Peaks(Average of Rational and SCS Methods)				
River Segment	Catchment Area (km^2)	Flood Peaks (m^3/s)		
		1:20 Year	1:50 Year	1:100 Year
VT81	9.1	48.6	68.3	87.1

8 HECRAS Model Compilation

The 1:50 and 1:100 year floodlines were determined along the Vaal River within the study area. The HECRAS model was used to estimate the expected high water levels and determine the corresponding floodline and the sizes of the culverts and channels that can handle the expected flow level. The Model is a standard back water model which has been widely used throughout the world. The basic computational procedure of HECRAS for steady and unsteady flow is based on the solution of the one-dimensional energy equation and wave equation respectively. Energy losses are evaluated by friction and contraction/expansion. The momentum equation may be used in situations where the water surface profile is rapidly varied. These situations include hydraulic jumps, hydraulics of bridges, and evaluating profiles at river confluences.

The model has been developed by the USA Army Corps of Engineers – Hydrologic Control Centre, and has successfully been used in South Africa. The following main parameters were established:

i) River cross sections.
ii) Sections at road, channels and dimensions of the bridges and culverts.
iii) River roughness (Depending on lining, vegetation).
iv) River slope.
v) Backwater levels from dams and any weirs within the river.
vi) Peak flow rates as determined in hydrology study.

The above input parameters were then entered into the HECRAS model which calculates the water levels at different sections along the river and the proposed channels. The model was run in both supercritical and sub critical mode thereby taking into account the proposed control structures which cause a damming up effect and flow restriction.

The detailed ground survey was entered into the HECRAS model. All “natural cross sections” were abstracted from the DEM (Digital Elevation Model).

The HECRAS model main parameters are summarized in Table 8-1below.

Table 8-1: HECRAS Model Main Parameters

Parameter	Average Value/Selection	Reason
Manning 'n'	0.045 (main flow channel)	Defined watercourse with vegetation
	0.045(floodplains)	Moderate to thick vegetation
Boundary conditions	Normal flow depth	Control structures present
Flow regime	Mixed flow	Slope and cross section changes requiring super and sub-critical flow regimes

The HECRAS model cross-sections were named in accordance with the defined River Referencing System (RRS) for Portions of the Remainder of Portion 2, Portion 4 and a Portion of the Remainder of Portion 7 of the Farm Grootverlangen 409-IS floodline study. Further details of the HECRAS model parameter files are given in Appendix A. The HECRAS model was then used in conjunction with the GIS program, Arc Map (With 3-D analyst and spatial analyst extensions). GIS was also used to create cross sections and other geometrical data for use in HECRAS and was used to export water surface data from HECRAS into a GIS data base.

Further details of the HECRAS model parameter files are given in **Appendix A.**

9 Findings of the Floodline Study

The 1:50 and 1:100 year floodlines were determined based on the HECRAS model and peak flow rates as given in Table 8-1 above for existing watercourse conditions.

Details of the HECRAS model output data are given in Appendix A.

The certified floodlines are shown on drawing 506887/35/04/001A in Appendix B below. From the floodline study, the following was observed:

- The proposed development site along the Vaal River tributary is affected by the 1:100 year floodlines.
- The 1:50 and the 1:100 year average flood depths and average flood velocities along the floodplains are shown below in Table 9-1and Table 9-2 respectively.

Details of the HECRAS model output data are given in Appendix A below.

Table 9-1: Summary of Average flood depths along floodplains

Chainage	Average Flood depths (m)			
	1:50 Year		1:100 Year	
	Hydr depth L	Hydr depth R	Hydr depth L	Hydr depth R
VT81	0.7	0.6	1.1	1.1

Table 9-2: Summary of Average flood velocity along floodplains

Chainage	Average Flood velocity (m/s)			
	1:50 Year		1:100 Year	
	Vel Left	Vel Right	Vel Left	Vel Right
VT81	0.4	0.5	0.4	0.5

From Table 9-1and Table 9-2, it is observed that the average flood velocity of the 1:100 year floodline is expected to be 0.4 m/s and 0.5 m/s along left and right river banks respectively. The flood depths around the same area are expected to be between 1.1m on both river banks. These flood depths are very high and may have negative impact on development that will be situated within the floodline.

10 Conclusions

The following is concluded:

- The proposed development site is affected by the 1:50 and 1:100 year floodlines.

11 Recommendations

The following is recommended:

- The floodline information to be used to ensure that no new development is situated within the 1:100 year floodline.
- The floodlines be revised should watercourse/control structures be modified in the future.
- If a need to retain the current locations of the affected stands arises, a flood hazard assessment is recommended to further analyse and categorise the risk associated with flooding in the affected areas. Based on this, relevant flood remedial measures to maximise the development potential of the sites and to also avoid possible liability claims against the Town or City Council can then be determined.
- Any specialist studies including the environmental compliance studies that might be needed must be done in consultation with relevant authorities

Prepared by

Tshilidzi Netshitangani

Reviewed by

Peter Shepherd, Partner

All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted professional engineering and environmental practices.

Appendices

Appendix A: Hecras Outputs

FLOODLINE:

WE HEREBY CERTIFY THAT IN TERMS OF SECTION 144 OF THE NATIONAL WATER ACT (ACT 36 OF 1998) FLOODLINES WITH EXPECTED FREQUENCIES OF 1:50 AND 1:100 YEAR ARE CORRECTLY INDICATED ON PLAN.

_ _ _ _ _ _ _ _ _ _ _ _ SIGN

_ _ _ _ _ _ _ _ _ _ _ _ DATE

NAME: _ _ _ _ _ _ _ _ _ _ _ _

Pr. Reg. No: _ _ _ _ _ _ _

REV	DR	CH	DATE	DESCRIPTION
REV	DR	CH	DATE	REV-NOTE

REFERENCE DRAWINGS

NOTES :

Datum: HARTEBEESHOEK 1994

Projection: TRANSVERSE MERCATOR

Central Meridian / Zone: LO 29

srk consulting

SRK Pretoria
Block A
Menlyn Woods Office Park
291 Sprite Avenue
Faerie Glen
0081Pretoria

PO Box 35290
Menlo Park
0102 South Africa

e-mail: pretoria@srk.co.za
www.srk.co.za

Tel: +27 012 361 9821
Fax: +27 086 570 9573

CESA

TITLE: PORTIONS OF THE REMAINDER OF PORTION 2, PORTION 4 AND A PORTION OF THE REMAINDER OF PORTION 7 OF THE FARM GROOTVERLANGEN 409-IS
1:50 & 1:100 YEAR FLOODLINES

CLIENT: SKY VILLAGE PROPERTIES CC

		DATE	CHECKED
DESIGNED	NETS	02 08 2016	SHEP
DRAWN	NETS	02 08 2016	SHEP
A2	SCALE :	1:500	

PROJECT NO.	SBU	DISP	DRG NO.	SHT	REV
506887	35	04	001	A01	0

Path: J:\506887_GROOT VERLANGEN\8GIS\GISPROJ\MXD\506887_Grootverlangen_floodlines.mxd

Appendix B: Drawings

SRK Report Distribution Record

Report No.	506887/1
Copy No.	

Name/Title	Company	Copy	Date	Authorised by
Chris Christodoulou	Sky Village Properties CC	1,2,3	July 2016	Peter Shepherd
Tshilidzi Netshitangani	SRK Consulting	4	July 2016	Peter Shepherd
Library	SRK Consulting	5	July 2016	Peter Shepherd

Approval Signature:

Appendix B3

Fauna and Flora Habitat Assessment

Ecological Scoping Assessment for the Remainder of Portion 2 of the Farm Grootverlangen 409 IS, Standerton, Mpumalanga

July 2016

Landscape Architects &
Environmental Consultants: Specialist Division
T: (+27)12 346 3810 I F: (+27) 86 570 5659 I E: corne@bokamoso.net; www.bokamoso.net.
36 Lebombo Street, Ashlea Gardens, Pretoria I P.O. Box 11375 Maroelana 0161

Report Author: Corné Niemandt

Reviewed by: Reinier F. Terblanche (Pr.Sci.Nat Reg. No. 400244/05)

Review of

Ecological Habitat Assessment for the Remainder of Portion 2 of the Farm Grootverlangen 409 IS, Standerton, Mpumalanga

Review: August 2016

Reviewer: Reinier F. Terblanche

(M.Sc, *Cum Laude*; Pr.Sci.Nat, Reg. No. 400244/05)

APPROACH OF REVIEWER TO ECOLOGICAL REVIEWS

Ecological studies and applied ecology comprise the consideration of a diversity of factors, even more so in South Africa with its exceptional high floral and faunal diversities, various soil types, geological formations and diversity of habitats in all its biomes. Therefore it would be easy to add onto or show gaps in any ecological impact assessment, rehabilitation actions or management plans stemming from ecological assessments. The approach followed here is to review the ecological study in a reasonable context and focus on the successful fulfillment of the aims of the study within the limits of cost and time.

ECOLOGICAL REVIEW: ECOLOGICAL HABITAT ASSESSMENT FOR THE REMAINDER OF PORTION 2 OF THE FARM GROOTVERLANGEN 409 IS, STANDERTON, MPUMALANGA

Findings of the review

- The report contains details of the expertise of the persons who prepared the report and a declaration that the person who prepared the report is acting independently.
- The aims of the report are clear.
- The report provides references and descriptions of the principles and guidelines to be taken into account for fauna habitat assessment.
- Acceptable methods and limitations have been given in detail to reach the goal of the assessment.
- Relevant laws and guidelines have been mentioned and integrated.
- The report gives a clear assessment of the status fauna at the site and also added an extensive literature survey and existing knowledge survey.
- The recommendations and the conclusion are consistent with the aims of the report.
- It is to be commended that the report is economical and practical so that it adds value to the team effort of addressing the management and future of the habitats at the site.

Overall the report appears to be relevant, detailed enough for the purposes of this study and complete and finally addressing the key issues at stake.

Reinier F. Terblanche

M.Sc. Ecology; Pr.Sci.Nat, Reg. No. 400244/05

Specialist

Specialist investigator: Mr. C. Niemandt (M.Sc. Plant Science)

Declaration of independence:

I, the above mentioned specialist investigator responsible for conducting this particular specialist flora study, declare that:

• I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP);

• At the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development, except for financial compensation for work done in a professional capacity;

• Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part;

• I declare that there are no circumstances that may compromise my objectivity in performing this specialist investigation. I do not necessarily object to or endorse the proposed development, but aim to present facts, findings and recommendations based on relevant professional experience, and scientific data;

• I do not have any influence over decisions made by the governing authorities;

• I have the necessary qualifications and guidance from professional experts (registered Pr. Nat. Sci.) in conducting specialist reports relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;

• This document and all information contained herein are and will remain the intellectual property of Bokamoso Environmental: Specialist Division. This document, in its entirety or any portion thereof, may not be altered in any manner or form, for any purpose without the specific and written consent of the respective specialist investigator.

Corné Niemandt

Table of Contents

1. INTRODUCTION

Bokamoso Environmental: Specialist Division was commissioned to conduct a flora and fauna habitat assessment for the proposed Standerton Shopping Mall development situated on the Remainder of Portion 2 of the Farm Grootverlangen 409 IS, Standerton, Mpumalanga.

This report is based on the flora and fauna species that could potentially be present on the study area as well as a site visit. The report acts as an overview of the probable and/or known occurrence of flora species and for the following faunal groups: Avifauna, Mammals, Reptiles and Amphibians. The primary focus of this report falls on threatened species and other species with conservation importance occurring on or near the study area to ensure that, should any such species exists, the appropriate actions are taken to guarantee the well-being of these species. Furthermore, the ecological status of the vegetation and sensitive habitats of the site were investigated.

2. OBJECTIVES OF THE STUDY

- To assess the habitat component of the study site and ecological status of the vegetation;
- To qualitatively and quantitatively assess the significance of fauna habitat components and current conservation status of the study area;
- To identify and list the plant species occurring on the site and indicate whether they are Threatened species;
- To provide a list of the different fauna groups which occur or might occur, and to identify species of conservation importance;
- Make recommendations if any Threatened species are found;
- To indicate ecological sensitive areas and habitat connectivity of the study area;
- To highlight the potential impacts of the proposed development on the flora and fauna of the study area; and
- Provide recommendations to mitigate negative impacts and enhance positive impacts should the proposed development be approved.

3. SCOPE OF THE STUDY

This report:

- Lists all plant species, including alien species, recorded during the site visit;
- Lists potential fauna species which might occur on the study area;
- Comments on ecological sensitive areas and habitat connectivity;
- Comments on impacts affecting the fauna and flora of the study area;
- Evaluates the conservation importance and significance of the study area with special emphasis on the status of threatened species; and
- Provides recommendations to mitigate negative impacts, should the proposed development be approved.

4. LIMITATIONS OF THIS STUDY

Even though considerable care is taken to ensure accuracy and professionalism of this ecological scoping assessment, environmental assessment studies are limited in scope, time and budget. Several years are needed to derive a 100% accurate report based on intensive field collecting and observations where all seasons are considered to account for fluctuating environmental conditions and migrations. Since environmental impact studies deal with dynamic natural systems additional information may come to light at a later stage.

The desktop study made up the largest part of the data used to conclude the distribution of Threatened species which were sourced by making use of the Animal Demography Unit: Virtual Museum data basis and SABAP2. Any limitations in the above mentioned data basis will in effect have implications on the findings and conclusion of this assessment.

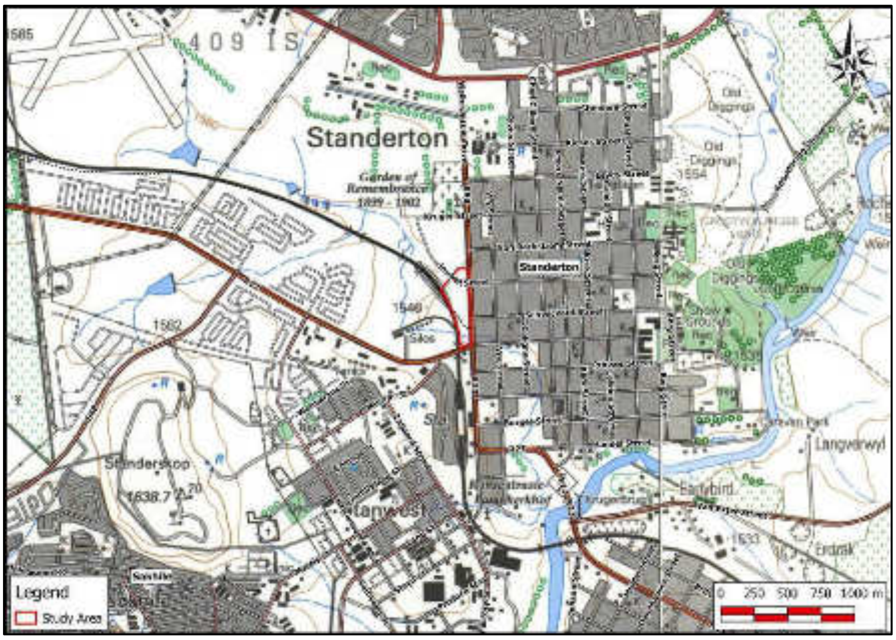
Furthermore, the site visit was conducted in a dry winter month, making sampling of fauna and flora species difficult and tedious. Therefore, the number and the types of species surveyed are potentially underestimated. Reliable deductions made on whether a species, more specifically a Threatened species, is present in the study area cannot be made at the time when this study was conducted.

Therefore, Bokamoso Environmental: Specialist Division cannot accept responsibilities for conclusions and mitigation measures made in good faith with the limited available information at the time of the directive. This report should be viewed and acted upon considering these limitations.

5. STUDY AREA

The proposed development of approx. 7.5 ha is situated in Standerton, Mpumalanga. The study area is located west of Walter Sisulu Drive (R546), north of the R23 and east of the Standerton railway line **(Figures 1 and 2).** It is within 700 m from the Standerton Train Station and within 600 m from the Standerton Police Station. On the study area is an abandoned shooting range of approx. one hectare, including the old clubhouse building towards the north west of the study area. Approximately 0.4 ha of the study area is bare ground, situated north and south of the watercourse.

Regional vegetation: The study area falls in the quarter degree square (QDS) 2629CC. The site falls within the Soweto Highveld Grassland vegetation unit (Mucina and Rutherford, 2006), which is considered Vulnerable according to the *National list of threatened terrestrial ecosystems for South Africa, 2011* (Government Gazette).



6. METHODS

Before conducting a site visit on the study area a desktop assessment was done to note the predominant flora and fauna species occurring on and in the surrounding extent of the study area. A list of expected species was compiled and used as a reference during the field survey to ensure that species that should theoretically occur were not overlooked. All distinct vegetation and fauna habitats were identified on site, after which each habitat was assessed to record the associated faunal species for each of the respective faunal group (Avifauna, Mammals, and Herpetofauna) present in that specific habitat. Moreover the 500 meters surrounding the study area were scanned for any additional faunal habitats.

The study area was visited on the 12th of July 2016 during which a plant species survey and fauna species survey was conducted as well as all the potential fauna habitats on the study area were identified. It should be noted that the site visit took place in the dry winter months where vegetation cover was sparse and species could not be properly identified. If on site, bulb species would not have been identified as they lose their foliage and flower parts during the dry winter months. Furthermore, many fauna species are inactive during this time period. Therefore, a full ecological study should be conducted in the correct season when it is possible to survey both flora and fauna species.

Desktop Survey

According to the Mpumalanga Biodiversity Conservation Plan: Terrestrial Biodiversity Assessment (2006), the study area is situated in a "No Natural Habitat Remaining" category with a Biodiversity Value of 6. Urban Development and Recreational Development is permitted within this category. There are, however, potential Threatened species that may occur in or adjacent the study area. (**Please Refer to Section: *Specific Requirements* below**).

Due to the fact that the majority of fauna species are either nocturnal, hibernators, secretive and/or seasonal it is increasingly difficult to confirm their presence or absence by means of actual observations alone. Therefore, a number of authoritative tomes such as field guides, databases and scientific literature were utilized to deduce the probable occurrence of mammal species. The Animal Demography Unit: Virtual Museum (http://vmus.adu.org.za/) was consulted to verify the records and occurrence of recorded mammal species within the QDS 2629CC. The Mpumalanga Tourism and Parks Agency was consulted about the types of studies that is required as well as potential Threatened species for the study area or surrounding area which might have relevance. A comprehensive list of probable fauna occurrence with reference to the study area was compiled on account of the well-known and documented distributions in South Africa, especially within Mpumalanga Province.

Specific Requirements

During the field survey attention was paid to note any signs of potential occurrence of threatened and sensitive species as well as species associated with wetlands and ridges. Species of concern (based on Mpumalanga guidelines) for this area include:

- African Grass-Owl (*Tyto capensis*) – Vulnerable
- Striped harlequin snake (*Homoroselaps dorsalis*) – Near Threatened
- Spotted harlequin snake (*Homoroselaps lacteus*) – Near Threatened
- *Gladiolus robertsoniae* – Near Threatened

7. RESULTS

Habitats Identified

Three habitats have been identified for sampling flora and fauna species, namely:

- Wetland (Drainage area);
- Degraded terrestrial; and
- Rocky ridge.

The dry winter season made it difficult to sample species in all three mentioned habitats (Refer to Figure 3 to 5). The Degraded terrestrial habitat has several alien plant species and rubbish dumping has been observed (Figure 6). A recent veld fire occurred throughout the site. The Wetland and Rocky ridge is regarded as sensitive with the possibility of finding sensitive and/or Threatened species.

Figure 3 Wetland habitat in dry winter period.

Figure 4 Wetland habitat in dry winter period.

Figure 5 Rocky ridge habitat.

Figure 6 Rubbish dumping in Degraded terrestrial habitat.

Plants

Table 1 provides a list of dominant species recorded during the site visit. Please take note that this is not a comprehensive species list for the study area. A recent veld fire and the dry winter conditions made it difficult to record plant species. Based on the site visit, the study area is mainly disturbed with several alien plant species. Four species are listed as Category 1b invaders and one Category 2 invader.

The study area is surrounded by urban development towards the east, south and west. Towards the west of the study area train tracks cause fragmentation of the vegetation type. Towards the north and north-west of the study area mixed land uses occur, including natural areas. There is thus limited connectivity with similar vegetation types in the surrounding area.

There may be potential suitable habitats on site for Red List plant species. Further studies are needed to confirm the presence of Red List species on site prior to any construction activities.

Table 1: List of plant species recorded during site visit

Species	Invasive Category
Araujia sericifera	**1b**
Celtis africana	
Cirsium vulgare	**1b**
Cynodon dactylon	
Cyperus fastigiatus	
Datura ferox	**1b**
Datura stramonium	**1b**
Digitaria eriantha	
Eragrostis sp.	
Gomphocarpus sp.	
Persicaria sp.	
Salix babylonica	**2**
Tagetes minuta	
Themeda triandra	
Vachellia karroo	

Mammals

Mammals' local occurrences are closely dependent on broadly defined habitat types, such as terrestrial, rock-dwelling, arboreal and wetland associated vegetation cover. Therefore, the presence of mammal species can be inferred by assessing the habitat types on site considering their known distribution ranges.

Twelve mammal species have been recorded for the QDS 2629CC (MammalMAP, 2016), this is however not representative of the area. No mammal species were recorded during the site visit. Special habitats such as wetland and ridges occur in or adjacent the study area, therefore, it is expected that some mammals could occupy the study area. Based on the limited information available and the dry winter month site visit, it is difficult to make valid deductions if any Threatened mammal species could occur in the study area. The wetland on site provides limited vegetation, however the season could underestimate the vegetation coverage. Sensitive mammal species such as vlei rats could utilize this habitat.

Reptiles

Eight reptile species have been recorded for the QDS 2629CC (ReptileMAP, 2016), this is however not representative of the area. No reptile species were observed during the site visit. Special habitats such as wetland and ridges occur in or adjacent the study area, therefore, it is expected that some reptiles could occupy the study area. Common species such as *Lamprophis capensis* (Brown House Snake), *Pseudaspis cana* (Mole Snake), *Dasypeltis scabra* (Common Egg Eater), *Hemachatus haemachatus* (Rinkhals), and *Trachylepis punctatissima* (Speckled Rock Skink) have been recorded within a 5 km radius from the study area.

The ridge habitat is particularly suitable as there are plenty of rocks and crevices to inhabit and rocks to bask in the sun. Some trees do occur on the study area which could favour arboreal species. Based on the limited information available and the dry winter month site visit, it is difficult to make valid deductions if any Threatened species could occur in the study area.

Amphibians

No amphibian species have been recorded for the QDS 2629CC (FrogMAP, 2016). No amphibian species were observed during the site visit. Common species such as *Xenopus laevis* (Common Platanna), *Amietia angolensis* (Common River Frog), *Cacosternum boettgeri* (Boettger's Caco), *Kassina senegalensis* (Bubbling Kassina), *Amietophrynus gutturalis* (Guttural Toad) and *Amietophrynus rangeri* (Raucous Toad) have been recorded within a 5 km radius from the study area. The watercourse in the study area provide suitable habitat for amphibian species, therefore, it is expected that some common species could utilize the study area. Based on the limited information available and the dry winter month site visit, it is difficult to make valid deductions if any Threatened species could occur in the study area.

Avifauna

A number of common bird species such as Guineafowl (*Numida meleagris*), doves (*Streptopelia* spp.), Lapwings (*Vanellus* spp.), Hadeda Ibis (*Bostrychia hagedash*), Common Fiscal (*Lanius collaris*), Karoo Thrush (*Turdus smithi*), Cape Glossy Starling (*Lamprotornis nitens*), Sparrows (*Passer* spp.) and Southern Masked-weaver (*Ploceus velatus*) were present in the study area. Shrubs and small trees provide suitable habitat for nesting (Figure 7). The study area provides sub-optimal habitat for threatened and near threatened bird species.

Other species such as Egyptian Goose (*Alopochen aegyptiacus*), Red-billed Teal (*Anas erythrorhyncha*), Yellow-billed Duck (*Anas undulata*), Reed Cormorant (*Phalacrocorax africanus*), Red-knobbed Coot (*Fulica cristata*) and Black-shouldered Kite (*Elanus caeruleus*) could potentially utilise the study area.

Figure 7 Nests recorded on study area.

8. OVERALL FINDINGS

There is a wetland and ridge habitat present in the study area, which are both considered sensitive. It is possible that Threatened species could occur on the ridge which forms part of the study area. Overall, the largest part of the study area is not sensitive with regards to fauna or flora species, as the study area has only sub-optimal habitat. However, the recommendations below should be followed before clearing and construction activities commence.

9. RECOMMENDATIONS AND MITIGATION MEASURES

The following should be part of the Environmental Management Programme (EMPr) and should be included as a condition should the competent authority grant Environmental Authorization:

- Prior to clearing and before construction activities commence, a specialist in the field of botany should scan the study area in the summer months during the flowering season (November-April) for potential Red List plant species.
- Prior to clearing and before construction activities commence, a specialist in the field of zoology should scan the study area in the summer months (when fauna species are active) for potential Red List fauna species.

The following general recommendations and mitigation measures are suggested for the study area:

- An appropriate management authority that must be contractually bound to implement the EMP and ROD during the constructional and operational phase of the development should be identified and informed of their responsibilities in terms of the EMP and ROD;

- Induction should be done for all civil contractors and for each building contractor prior to them commencing on site;
- Construction should be restricted to areas deemed to be of low ecological sensitivity;
- A pre- and post-construction alien and invasive control, monitoring and eradication programme must be implemented along with an ongoing programme to ensure persistence of indigenous species. A qualified botanist/ecologist should compile and supervise the implementation of this programme.
- Rehabilitation of natural vegetation should proceed in accordance with a rehabilitation plan compiled by a specialist registered in terms of the Natural Scientific Professions Act (No. 27 of 2003) in the field of Ecological Science.
- Where active rehabilitation or restoration is mandatory, it should make use of indigenous plant species native to the study area. The species selected should strive to represent habitat types typical of the ecological landscape prior to construction. As far as possible, indigenous plants naturally growing within the vicinity of the study area, but would otherwise be destroyed during construction, should be used for re-vegetation/landscaping purposes.
- It is strongly prohibited for Red List species to be relocated, but should be protected *in situ*. This means that if any Red List species is recorded at a site, the relevant buffers should be applied and no construction may take place within this area.
- If found on site, the persistence of Red List populations should be ensured and the mortality of individuals of all Red and Orange List species should be reduce which should form part of a monitoring programme. A qualified botanist/ecologist should compile and supervise the implementation of this programme;
- The contractor must ensure that no faunal species are trapped, killed or in any way disturbed during the constructional phase;
- To ensure minimal disturbance of faunal habitat it is recommended that construction should take place during winter, outside the reproductive season of the species present on site;
- Construction, vegetation clearing and top soil clearing should commence from a predetermined location and gradually commence to ensure that fauna present on the site have enough time to relocate;
- When construction is completed, disturbed areas should be rehabilitated using vegetation cleared prior to construction to ensure that the habitat stays intact and that faunal species present on the site before construction took place, return to the area.
- Construction activities at or close to wetlands, drainage lines and water bodies should be limited. A wetland specialist should be consulted with regards to a suitable buffer if deemed necessary;
- Engineering measures are recommended to lower the risk of spillages into any watercourses located in and surrounding the proposed development;
- A plan for the immediate rehabilitation of damage caused to wetlands should be compiled by a specialist registered in accordance with the Natural Scientific Professions Act (No. 27 of 2003) in the field of Ecological Science. This rehabilitation plan should form part of the EMP and a record book should be maintained on site to monitor and report on the implementation of the plan;

- No vehicles should be allowed to move in or through the watercourse and associated buffer zone. The area should be demarcated prior to construction;
- It is recommended that all concrete and cement works be restricted to areas of low ecological sensitivity and defined on site and clearly demarcated. Cement powder has a high alkalinity pH rating, which can contaminate and affect both soil and water pH dramatically. A shift in the pH can have serious consequences on the functioning of soil, vegetation and fauna;
- The open space system should be managed in accordance with an ecological management plan that complies with the Minimum Requirements for Ecological Management Plans and forms part of the EMP;
- The open space system should be fenced off prior to construction commencing (including site clearing and pegging). All construction-related impacts (including service roads, temporary housing, temporary ablution, disturbance of natural habitat, storing of equipment/building materials/vehicles or any other activity) should be excluded from the open space system;
- Access of vehicles to the open space system should be prevented and access of people should be controlled, both during the construction and operational phases;
- Forage and host plants required by pollinators should also be planted in landscaped areas;
- Where possible, indigenous trees naturally growing on the site should be retained as part of the landscaping. Measures to ensure that these trees survive the physical disturbance from the development should be implemented. A tree surgeon should be consulted in this regard;
- In order to minimize artificially generated surface storm water runoff, total sealing of paved areas such as parking lots, driveways, pavements and walkways should be avoided. Permeable material should rather be utilized for these purposes.

10. CONCLUSION

Based on this scoping assessment, the wetland and ridge area is regarded as sensitive habitat with the possibility of finding Threatened species. The recommendations made to scan the area before clearing and construction of any activities should not be taken lightly. If the ridge area is deemed sensitive, development should be excluded from both the ridge and watercourse on the study area. Appropriate storm water management should be implemented to ensure that the watercourse and associated habitat is not degraded. The remainder of the terrestrial habitat (excluding the ridge) is considered sub-optimal for fauna species, including small mammals, reptiles and birds. All alien species should be eradicated part of a management plan, especially Category 1 and 2 species.

11. LITERATURE SOURCES

ALEXANDER, G.J., MARAIS, J.A. 2007. Guide to the Reptiles of Southern Africa. Random House Struik, Cape Town. ISBN-13: 9781770073869.

ANIMAL DEMOGRAPHY UNIT. 2016. Virtual Museum. Accessed at http://vmus.adu.org.za/?vm.

BIRDLIFE SOUTH AFRICA. 2016. BirdLife South Africa official Checklist of Birds in South Africa 2016. http://www.birdlife.org.za/publications/checklists.

BROMILOW, C. 2010. *Problem plants of South Africa*. Briza Publications, Pretoria.

DU PREEZ, L., CARRUTHERS, V. A. 2009. Complete Guide to the Frogs of Southern Africa. Struik Nature, Cape Town.

FRIEDMAN, Y., DALY, B. 2004. Red data book of the mammals of South Africa: A conservation assessment. Johannesburg, CBSG-EWT

Germishuizen, G. and Meyer, N.L. 2003. Plants of southern Africa: an annotated checklist. Strelitzia 14, National Botanical Institute, Pretoria.

Government Gazette no. 34809. 9 December 2011. 1002 National Environmental Management: Biodiversity Act (1 0/2004): National list of ecosystems that are threatened and in need of protection. http://biodiversityadvisor.sanbi.org/wp-content/uploads/2012/10/20111209-National-Gazette-No-34809-of-09-December-2011-Volume-558.pdf.

Government Gazette no. 37885. 1 August 2014. R. 598 National Environmental Management: Biodiversity Act (10/2004): Alien and Invasive Species Regulations. www.gpwonline.co.za.

Koekemoer, M., Steyn, H.M. and Bester, S.P. 2014. Guide to Plant Families of southern Africa. Strelitzia 31. South African National Biodiversity Institute, Pretoria.

Lötter, M.C. and Ferrar, A.A. 2006. Mpumalanga Biodiversity Conservation Plan map. Mpumalanga Parks Board, Nelspruit.

MammalMAP. 2016. Virtual Museum of African Mammals. Accessed at http://mammalmap.adu.org.za/

MARAIS, J. 2004. 'n Volledige Gids tot die Slange van Suider-Afrika. Struik Uitgewers, Kaapstad.

Mucina, L. and Rutherford, M.C. 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Pfab, M.F. 2002. Priority ranking scheme for Red Data plants in Gauteng, South Africa. *South African Journal of Botany* **68**: 299-303.

Pfab, M.F. and Victor, J.E. 2002. Threatened plants of Gauteng, South Africa. *South African Journal of Botany* **68**: 370-375.

Pfab, M.F. 2014. *GDARD Requirements for Biodiversity Assessments*. Version 3. Gauteng Department of Agriculture and Rural Development: Nature Conservation Directorate.

Pooley, E. 1998. *A field to the wild flowers of Kwazulu-Natal and the eastern region*. Natal Flora Publications Trust, Durban.

Raimondo, D., Van Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C., Kamundi, D.A. and Manyama, P.A. 2009. *Red Data List of South African Plants*. Strelitzia 25, South African National Biodiversity Institute, Pretoria.

SOUTHERN AFRICAN BIRD ATLAS PROJECT 2. SOUTH AFRICA, LESOTHO, BOTSWANA, NAMIBIA, MOZAMBIQUE, SWAZILAND, ZIMBABWE, ZAMBIA. 2016. Animal Demography Unit. University of Cape Town. www.sabap2.adu.org.za.

STUART, C., AND STUART, M. 2015. Stuart's *Field Guide to Mammals of Southern Africa*. Struik Nature, South Africa.

TAYLOR, M.R., PEACOCK, F. & WANLESS, R.M. 2015. The 2015 Eskom Red Data Book of BIRDS of South Africa, Lesotho and Swaziland. BirdLife South Africa. Gauteng.

van Oudtshoorn, F. 2014. *Guide to grasses of southern Africa*. Briza Publications, Pretoria.

van Wyk, B. and Malan, S. 1998. *Field guide to the wildflowers of the Highveld*. Struik Publishers, Cape Town.

van Wyk, B. and van Wyk, P. 2013. *Field guide to trees of southern Africa*. Struik Publishers, Cape Town.

Appendix B4

Services Report

STANDERTON SHOPPING CENTRE
(To be Situated on the Remainder of Portion 2 of the Farm Grootverlangen 409 IS)
To be known as Standerton Extension 9

SERVICES REPORT

REPORT 2016-052-002 Rev A

AUGUST 2016

CLIENT: SKY VILLAGE PROPERTIES CC

PREPARED BY:
EDS Engineering Design Services (Pty) Ltd
881 Old Farm Road
Faerie Glen
P.O Box 34878
GLENSTANTIA
0010
Tel (012) 991 1205
Fax (012) 991 1373

EDS Engineering Design Services (Pty) Ltd
Old Farm Office Park, Block F
881 Old Farm Road
Faerie Glen
P.O Box 34878
GLENSTANTIA
0010
Tel (012) 991 1205
Fax (012) 991 1373

Report Information Sheet

Local Authority	:	Lekwa Local Municipality
Property Description IS	:	Remainder of Portion 2 of the Farm Grootverlangen 409
Development Type	:	Retail

Report compiled by

Name	:	Hanno Brynard
Signature	:	
Date	:	August 2016
Qualifications	:	B Eng (Civil), B Eng (Hons)(Transportation)

Report reviewed by

Name	:	Garnet van der Walt Pr.Eng
Signature	:	
Date	:	August 2016
Qualifications	:	B Eng (Civil), B Eng (Hons)(Transportation Pr.eng No. 990170

REMAINDER OF PORTION 2 OF THE FARM GROOTVERLANGEN 409 IS (STANDERTON EXTENSION 9) SERVICES REPORT

CONTENTS

1 INTRODUCTION AND BACKGROUND

EDS Engineering Design Services (Pty) Ltd has been appointed by Sky Village Properties CC to compile a services report for the proposed Standerton Shopping Centre on the Remainder of Portion 2 of the Farm Grootverlangen 409 IS, to be known as Standerton Extension 9

2 DETAILS OF THE APPLICATION

The approved set of conditions of establishment is included under ***Appendix A*** of this report.

The proposed township layout plan of the township is included under ***Appendix B.***

Standerton Extension 9, consist of two erven; Erf 1 with an area of 5.4123 Ha and allowed Floor Area Ratio of 0.4 as per conditions of establishment, and Erf 2 with an area of 0.9017 Ha and floor area ratio of 0.1 as per conditions of establishment. The total floor area for Standerton Extension 9 will be 22 551 m^2.The land will be zoned as per **Table 1**:

Table 1: Land Use

1	Use Zone	10: Special
2	Uses permitted	Shops, places of refreshment (including drive through facilities), banks, hotels, offices (including medical and dental suites), dry cleaners, laundromats, a gymnasium, vehicle sales marts and showrooms (including workshops), fitment centres, places of amusement, and wholesale trade.

3 DETAILS OF THE APPLICANT AND CONSULTANT

APPLICANT:

Sky Village Properties CC
P O Box 211
Secunda
2302

CONSULTING ENGINEER:

EDS Engineering Design Services (Pty) Ltd
PO Box 34878
GLENSTANTIA
0010

Contact: Mr. Hanno Brynard

Tel : (012) 991 1205
Fax: (012) 991 1373

4 DESCRIPTION OF SITE

4.1 Locality

The proposed development is located on the Remainder of Portion 2 of the Farm Grootverlangen 409 IS situated on the North-western corner of the intersection of the R 23 (Krog Street) and the R 546 (Walter Sisulu Drive)

See **Figure 1** for the Locality.

4.2 Topography of the site

Erf 1 has a relative even fall of 3.5% towards the south-east of the site, and drains naturally towards a stream on the south side of the property. The site is undeveloped and vegetated with veld grass. There is existing embankments used for an old abandoned shooting range on the northern part of the site. The railway line borders the site on the west, and is situated on an embankment.

Erf 2 falls to the north to the stream on the property

5 ROADS AND STORMWATER

5.1 Access to the road network

Access to Erf 1 will be a full acces from Schwikard Street and a full access from Joubert Street. Access to Erf 2 will be a marginal left in only from Krog street and a left in and left out access from Walter Sisulu Drive. The site accesses are further described in the Traffic Impact Study done by EDS Engineers. Please refer to **Figure 2**

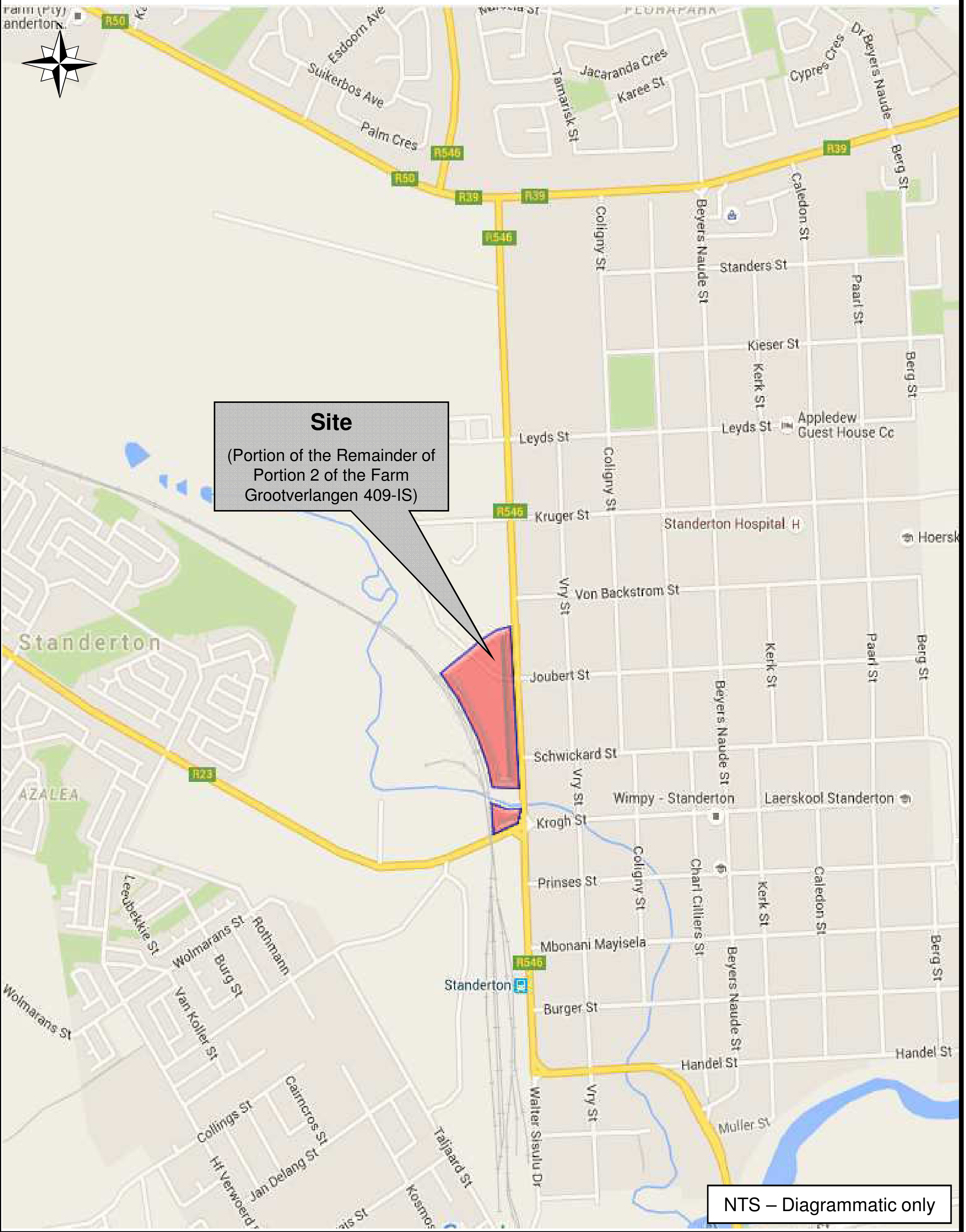
5.2 Internal Roads

The development will be served by internal parking roads, and service roads for the loading and offloading of goods as per the Architects layout. There are no public roads as part of the internal roads layout.

5.3 Stormwater

It is proposed that the retail centre be served by an internal piped stormwater system that discharges directly into the existing stormwater pipe system that runs in Walter Sisulu Drive.

The calculated run-off for the township are as indicated in **Table 2,** based on a Mean annual rainfall of 650mm.



PTN OF THE REM. OF PTN 2 OF THE FARM GROOTVERLANGEN 409-IS **Figure 1**

Locality Plan

PTN OF THE REM. OF PTN 2 OF THE FARM GROOTVERLANGEN 409-IS

Figure 2

Locations of the Proposed Site Access Points

Table 2: Estimated stormwater run-off

	Catchment length	Area	1:2 year run-off	1:5 year run-off	1:25 year run-off
Pre-development	470 m	62 900 m^2	0.605 m^3/s	0.895 m^3/s	1.738 m^3/s
Post-Development	470 m	62 900 m^2	0.796 m^3/s	1.136 m^3/s	2.131 m^3/s

A 750mm diameter concrete pipe will be required to convey the 1:5 year run-off from the developed site.

6 WATER AND SANITATION

6.1 Water

6.1.1 Water demand

The expected water demand is summarised in Table 3

Table 3: Expected water demand

	Gross Lettable Area (GLA)	Water Consumption Rate Kiloliter/100m²	Daily Consumption (Kiloliter/day)	Peak hour factor	Peak flow
Erf 1	21 652 m^2	0.6Kl/100m^2	129.9 Kl	3.6	5.4 l/s
Erf 2	902 m^2	0.6Kl/100m^2	5.4 Kl	3.6	0.225 l/s
Total			135.3 Kl		

A 63mm connection pipe is required for the domestic water demand for erf 1, and a 32mm for erf 2.

The expected fire demand for a moderate risk area is 25 l/s. A 140mm connection pipe will be sufficient to supply 30l/s domestic and fire water at 2.5m/s for erf 1, and a 110mm water connection pipe to provide 20l/s domestic and fire water to erf 2.
Refer to **Figure 3** for the proposed connection layout.

6.1.2 Estimated Cost

The expected cost for the water connection required for Standerton Extension 9 is summarised in **Table 4.**

Table 4: Estimated water connection cost

Pipe Size	Quantity	Rate R/m	Amount
160mm	40 m	R 550	R 22 000
110mm	160 m	R 320	R 51 200
160m road crossing	20 m	R 1000	R 20 000
Valves	2 No off	R 8000	R 16 000
			R 109 200

Amounts exclude VAT, connection fees and professional fees and are an order of magnitude estimate.

6.2 Sanitation

6.2.1 Sewer outflow

The estimated sewer outflow is summarised in Table 5

Table 5: Expected sewer outflow

	Gross Lettable Area (GLA)	Water Consumption Rate Kiloliter/100m^2	Daily Consumption (Kiloliter/day)	Peak hour factor	Peak flow
Erf 1	21 652 m^2	0.4Kl/100m^2	86.6 Kl	2.5	2.5 l/s
Erf 2	902 m^2	0.4Kl/100m^2	3.6 Kl	2.5	0.1 l/s
Total			90.2 Kl		2.6 l/s

It is proposed that the sewer connect to the existing sewer municipal system with a 160mm pipe. Refer to **Figure 2** for the proposed connection layout.

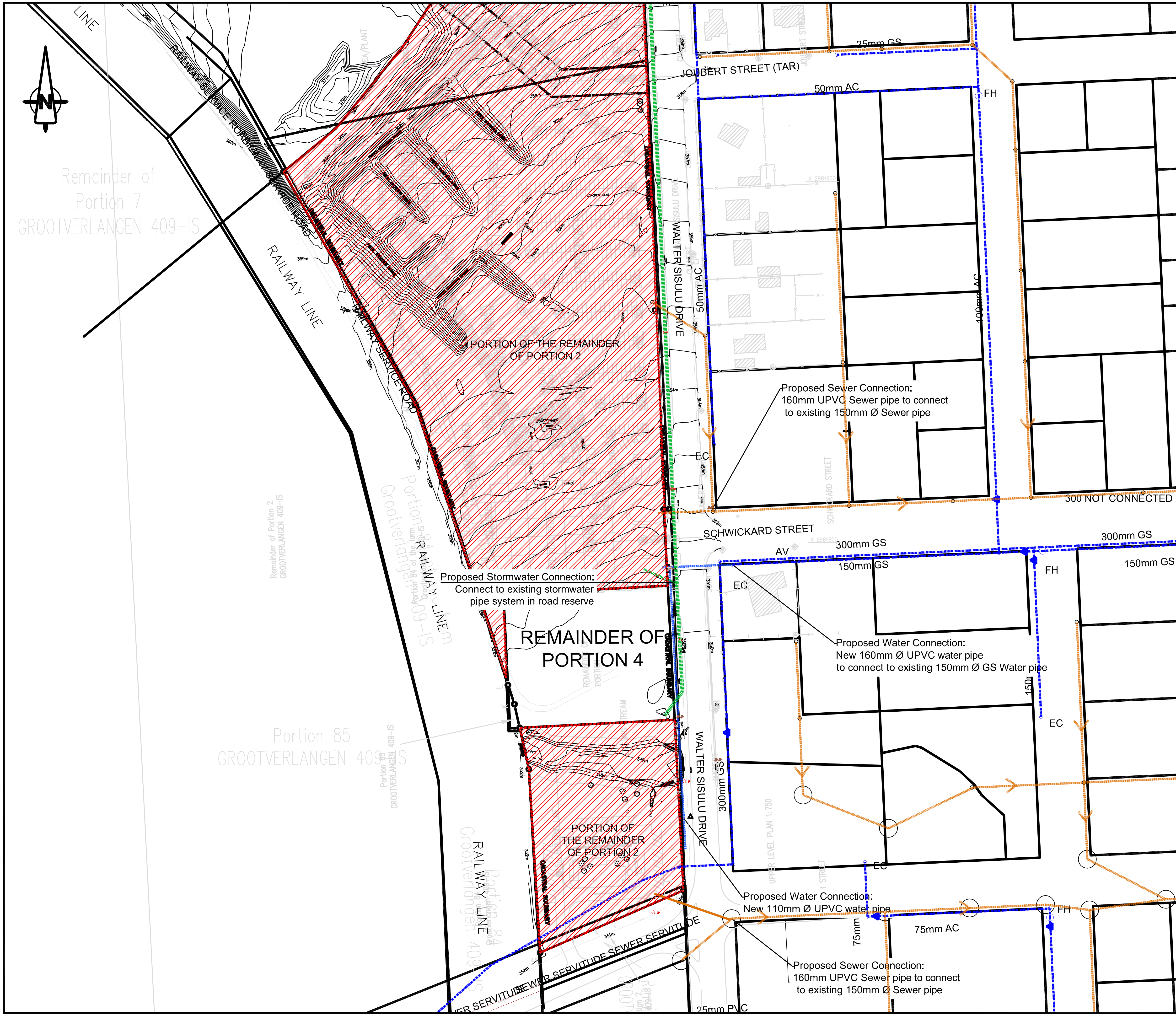
6.2.2 Estimate costs

The expected cost for the sewer connection required for Standerton Extension 9 is summarised in **Table 6.**

Table 6: Estimated sewer connection cost

Pipe Size	Quantity	Rate R/m	Amount
160mm	70 m	R 550	R 38 500
160m road crossing	40 m	R 1000	R 40 000
Manholes	4 No off	R 8000	R 32 000
			R 110 500

Amounts exclude VAT, connection fees and professional fees and are an order of magnitude estimate.



GENERAL NOTES:

1. REFER TO ALL RELEVANT DRAWINGS & SPECIFICATIONS, DO NOT SCALE ANY DIMENSIONS.
2. WHERE DISCREPANCIES OCCUR BETWEEN THE PROJECT DRAWINGS OR SPECIFICATIONS, THESE SHOULD BE REPORTED IMMEDIATELY TO THE PRINCIPAL AGENT.
3. ALL DIMENSIONS AND LEVELS TO BE CHECKED ON SITE AND CORRELATED WITH THE ARCHITECTS DRAWING BEFORE CONSTRUCTION COMMENCES.
4. ALL WATERPROOFING AND EARTH POISONING DETAILS TO BE IN ACCORDANCE WITH THE ARCHITECT'S SPECIFICATION AND INSTRUCTIONS.

Rev. No:	Date:	Revision Details:	By:
A	29/08/'16	Original	HJB

Client:

Architect:

edos
Structural, Civil & Transportation Engineers

Old Farm Office park
881 Old Farm Road
Faerie Glen
Pretoria
Tel: 012 991 1205
Fax: 012 991 1373
e-mail: info@edseng.co.za

Project:

REMAINDER OF PORTION 2 OF THE FARM GROOTVERLANGEN 409 IS

Description:

Services Connection Points Figure 3

Paper size:	Drawn:	Checked:	Designed:
A3	MS	HB	GvdW

Scale:	Project Number:	Drawing Number:	Revision:
1:200	2016-052	Figure 3	A

7 CONCLUSIONS AND RECOMMENDATIONS

The proposed Standerton shopping centre to be situated on Portion 2 and a portion of the Remainder of Portion 2 of the Farm Grootverlangen 409 IS, to be known as Standerton Extension 9 can be connected to the existing municipal water sanitation systems.

The Lekwa Municipality need to confirm if the municipal water and sanitation systems can supply the required amount of water required, and receive and treat the additional amount of sewage generated by the development.

8 APPENDIX A

Conditions of Establishment

DRAFT

STATEMENT OF CONDITIONS UNDER WHICH THE APPLICATION MADE BY THE LEKWA LOCAL MUNICIPALITY (HEREINAFTER REFERRED TO AS THE APPLICANT / TOWNSHIP OWNER) UNDER THE PROVISIONS OF SECTION 59 OF THE PROVISIONS OF THE SPATIAL PLANNING AND LAND USE MANAGEMENT BY-LAW, 2016 FOR LEKWA - FOR PERMISSION TO ESTABLISH A TOWNSHIP ON PORTIONS 151 AND 152 (PORTIONS OF THE REMAINDER OF POTION 2) OF THE FARM GROOTVERLANGEN 409 REGISTRATION DIVISION I.S, MPUMALANGA PROVINCE HAS BEEN GRANTED.

1. CONDITIONS TO BE COMPLIED WITH PRIOR TO THE OPENING OF THE TOWNSHIP REGISTER AND THE DECLARATION OF THE TOWNSHIP AS AN APPROVED TOWNSHIP.

1.1. GENERAL

The applicant shall satisfy the Lekwa Local Municipality (herein referred to as the Municipality) that:

1.1.1. The township owner shall, after approval of the General Plan of the township submit the relevant Amendment Scheme to the local authority for approval, in order that it can be published simultaneously with the declaration of the township as an approved township;

1.1.2. Satisfactory access is available to the township and that a public street system is available to all erven in the township, this shall include the allocation of street names for the township where necessary and such names shall be indicated on the General Plan of the Township, if applicable;

1.1.3. The name of the township as well as the street names (if applicable) have been approved by the Municipality;

1.1.4. A favourable geo-technical report has been submitted that determined the soil suitability of the land on which the township is to be established;

1.1.5. The township owner shall comply with the provisions of Sections 61, 62, 63, 122, 123 and 124 of the Spatial Planning and Land Use Management (SPLUM) By-Law for Lekwa, 2016.

2. CONDITIONS OF ESTABLISHMENT

2.1. NAME

The name of the township is Standerton Extension 9.

2.2. DESIGN

The township consists of erven, parks and streets as indicated on the approved layout plan of the township Layout No. MP.A02_2016-06-29_Standerton X 9.

2.3. PROVISION AND INSTALLATION OF SERVICES

The township owner shall make the necessary arrangements with the Municipality for the provision and installation of all engineering services of which the Municipality is the supplier as well as the construction of roads and stormwater drainage in and for the township, to the satisfaction of the local authority.

2.4. ELECTRICITY

If the Municipality is not the bulk supplier of electricity to or in the township, the township owner shall make the necessary arrangements with ESKOM, the licensed supplier of electricity in the township for the provision of electricity to the township.

2.5. ACCESS

Access to or egress from the township shall be provided to the satisfaction of the Municipality.

2.6. ACCEPTANCE AND DISPOSAL OF STORMWATER DRAINAGE

The township owner shall arrange for the stormwater drainage of the township to fit in with that of the adjacent roads and all stormwater running off or being diverted from the roads shall be received and disposed of.

2.7. REFUSE REMOVAL

The township owner shall provide sufficient refuse collection points in the township and shall make arrangement to the satisfaction of the Municipality for the removal of all refuse.

2.8. REMOVAL OR REPLACEMENT OF EXISTING SERVICES

If, by reason of the establishment of the township, it should be necessary to remove or replace any existing municipal, Telkom and/or Eskom services, the cost of such removal or replacement shall be borne by the township owner.

2.9. DEMOLITION OF BUILDINGS AND STRUCTURES

The township owner shall at his own expense cause all existing buildings and structures situated within the building line reserves, side spaces or over common boundaries to be demolished to the satisfaction of the local authority.

3. DISPOSAL OF EXISTING CONDITIONS OF TITLE

All erven shall be made subject to existing conditions of title and servitudes, if any:

3.1. EXCLUDING THE FOLLOWING WHICH DO NOT AFFECT THE TOWNSHIP DUE TO ITS LOCALITY:

In Title Deed ………….

3.2 INCLUDING THE FOLLOWING WHICH DOES AFFECT THE TOWNSHIP AND SHALL BE MADE APPLICABLE TO THE INDIVIDUAL ERVEN IN THE TOWNSHIP:

In Title Deed ………….

4. CONDITIONS OF TITLE

The erven shall be subject to the following conditions imposed by the local authority in terms of the provisions of Spatial Planning and Land Use Management (SPLUM) By-Law for Lekwa, 2016.

4.1. THE ERVEN SHALL BE SUBJECT TO THE FOLLOWING CONDITIONS IMPOSED BY THE LOCAL AUTHORITY IN TERMS OF THE PROVISIONS OF THE SPATIAL PLANNING AND LAND USE MANAGEMENT (SPLUM) BY-LAW FOR LEKWA, 2016.

4.1.1. ALL ERVEN

4.1.1.1. The erf is subject to a servitude, 2 m wide, in favour of the local authority, for sewerage and other municipal purposes, along any two boundaries thereof other than a street boundary, and in the case of a panhandle erf, an additional servitude for municipal purposes 2m wide across the access portion of the erf when required by the local authority: Provided that the local authority may dispense with any such servitude.

4.1.1.2. No building or other structure shall be erected within the aforesaid servitude area and no large-rooted trees shall be planted within the area of such servitude or within 2 m thereof.

4.1.1.3. The local authority shall be entitled to deposit temporarily on the land adjoining the aforesaid servitude such material as may be excavated by it during the course of the construction, maintenance or removal of such sewerage mains and other works as it, in its discretion, may deem necessary, and shall further be entitled to reasonable access to the said land for aforesaid purpose, subject to any damage done during the process of the construction, maintenance or removal of such sewerage mains and other works being made good by the local authority.

5. CONDITIONS TO BE INCORPORATED INTO THE TOWN PLANNING SCHEME IN TERMS OF THE SPATIAL PLANNING AND LAND USE MANAGEMENT (SPLUM) BY-LAW FOR LEKWA, 2016, IN ADDITION TO THE PROVISIONS OF STANDERTON TOWN PLANNING SCHEME1995.

ERF 1 STANDERTON EXTENSION 9

1	Use Zone	10: Special
2	Uses permitted	Shops, places of refreshment (including drive through facilities), banks, hotels, offices (including medical and dental suites), dry cleaners, laundromats, a gymnasium, vehicle sales marts and showrooms (including workshops), fitment centres, places of amusement, and wholesale trade.
3	Uses with consent	Any ancillary uses that the Municipality may permit
4	Uses not permitted	None
5	Definitions	As per scheme
6	Densities	NA.
7	Coverage	60%
8	Height	2 storeys: Provided that the Municipality may allow additional height for maintenance and mechanical equipment and services.
9	Floor area ratio	0.4
10	Site Development Plan and Landscape Development Plan	A site development plan and a landscape development plan, unless otherwise determined by the Municipality, compiled by a person suitably qualified to the satisfaction of the Municipality, shall be submitted to the Municipality in accordance with its requirements for approval prior to the submission of building plans. The landscaping, in terms of the landscape development plan, shall be completed by completion of the development or any phase thereof. The continued maintenance of the landscape development shall be to the satisfaction of the Municipality.

11	Building Lines	As per site development plan.
12	Parking requirements	Demarcated parking spaces, together with the necessary paved maneuvering space, shall be provided on the erf to the satisfaction of the Municipality.
14	Paving of traffic areas	All parts of the erf upon which motor vehicles are allowed to move or park, shall be provided with a permanent dust free surface, which surface shall be paved, drained and maintained to the satisfaction of the Municipality
15	Access to the erf	As per site development plan
16	Loading and off-loading facilities	As per site development plan.
17	Turning facilities	As per site development plan
18	Physical barriers	As per site development plan
19	Health measures	Any requirements for air pollution-, noise abatement- or health measures set by the Municipality shall be complied with to the satisfaction of the Municipality without any costs to the Municipality.
23	General In addition to the above conditions the erf and buildings thereon are further subject to the general provisions of the Town Planning Scheme.	

ERF 2 STANDERTON EXTENSION 9

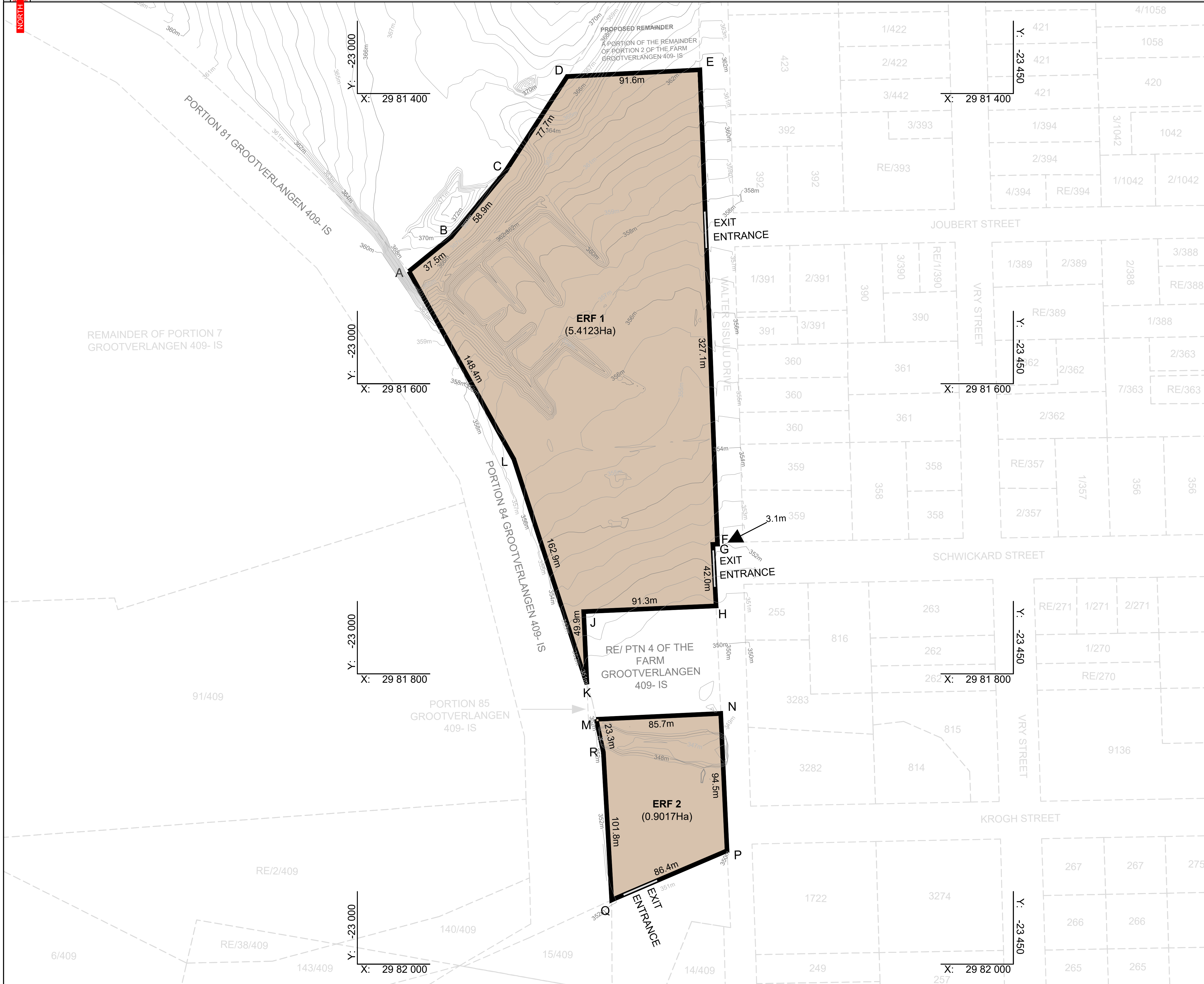
1. 1	Use Zone	10: Special
2	Uses permitted	Shops, places of refreshment (including drive through facilities), banks, hotels, offices (including medical and dental suites), dry cleaners, laundromats, a gymnasium, vehicle sales marts and showrooms (including workshops), fitment centres, places of amusement, and wholesale trade.
3	Uses with consent	Any ancillary uses that the Municipality may permit
4	Uses not permitted	None
5	Definitions	As per scheme
6	Densities	NA.
7	Coverage	60%

8	Height	2 storeys: Provided that the Municipality may allow additional height for maintenance and mechanical equipment and services.
9	Floor area ratio	0.1
10	Site Development Plan and Landscape Development Plan	A site development plan and a landscape development plan, unless otherwise determined by the Municipality, compiled by a person suitably qualified to the satisfaction of the Municipality, shall be submitted to the Municipality in accordance with its requirements for approval prior to the submission of building plans. The landscaping, in terms of the landscape development plan, shall be completed by completion of the development or any phase thereof. The continued maintenance of the landscape development shall be to the satisfaction of the Municipality.
11	Building Lines	As per site development plan
12	Parking requirements	Demarcated parking spaces, together with the necessary paved maneuvering space, shall be provided on the erf to the satisfaction of the Municipality.
14	Paving of traffic areas	All parts of the erf upon which motor vehicles are allowed to move or park, shall be provided with a permanent dust free surface, which surface shall be paved, drained and maintained to the satisfaction of the Municipality
15	Access to the erf	As per site development plan
16	Loading and off-loading facilities	As per site development plan.
17	Turning facilities	As per site development plan
18	Physical barriers	As per site development plan
19	Health measures	Any requirements for air pollution-, noise abatement- or health measures set by the Municipality shall be complied with to the satisfaction of the Municipality without any costs to the Municipality.
23	General In addition to the above conditions the erf and buildings thereon are further subject to the general provisions of the Town Planning Scheme.	

9 APPENDIX B

Township Layout Plan

PROPOSED TOWNSHIP LAYOUT PLAN: STANDERTON EXTENSION 9



BAR SCALE 1: 3 000 | 50m | 50m | 50m | 50m | 50m | 50m | 50m | 50m | 50m | 50m | 50m | 50m | 50m | 50m | 50m

TOWNSHIP DETAILS

TOWNSHIP NAME: STANDERTON EXTENSION 9

SITUATED ON: PORTIONS OF THE REMAINDER OF PORTION 2 OF THE FARM GROOTVERLANGEN 409- IS

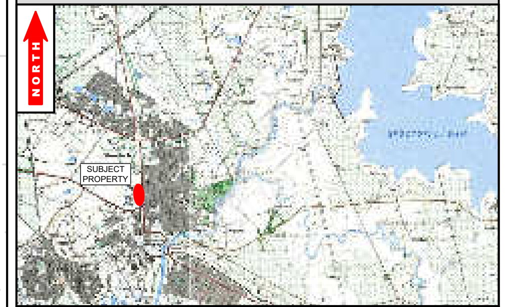
LOCAL AUTHORITY: LEKWA LOCAL MUNICIPALITY

PROVINCE: MPUMALANGA

SCALE: 1: 3 000

LOCALITY MAP

1 : 50 000



BAR SCALE 1: 200 000 | 1 000m | 1 000m | 1 000m | 1 000m | 1 000m | 1 000m

LEGEND

COLOUR NOTATION	USE ZONE	ZONING	ERF NUMBER	NO OF ERVEN	AREA IN Ha.	% OF AREA
	10	SPECIAL	1	1	5.4123	86
	10	SPECIAL	2	1	0.9017	14
TOTAL			-	2	6.3140	100

GENERAL NOTES

1. FIGURE A,B,C,D,E,F,G,H,J,K,L,A AND M,N,P,Q,R,M REPRESENTS THE OUTSIDE FIGURE OF THE PROPOSED STANDERTON EXTENSION 9, MEASURING ±6.3140Ha IN EXTENT.
2. THE CONTOURS ARE DRAWN IN 0.5m INTERVALS AND WAS SURVEYED BY REED GEOMATICS INC.
3. CONTOUR DATUM PLAN: MEAN SEA LEVEL (MSL).
4. CONTOUR SYSTEM: WGS 84.
5. CADASTRAL BOUNDARIES:
6. GEOTECHNICAL ZONES:
7. 1:50 YEAR FLOODLINE:
   1:100 YEAR FLOODLINE:
8. **ALL AREAS AND MEASUREMENTS INDICATED ARE APPROXIMATE AND SUBJECT TO FINAL SURVEY.**

GEOTECHNICAL ZONES

	NHBRC	CLASS	DESCRIPTION	TYPICAL SOIL PROFILES

GEOTECHNICAL NOTE

THIS IS TO CERTIFY THAT THE TOWNSHIP LAYOUT ON THIS PLAN IS IN ACCORDANCE WITH THE PROVISIONS AND RECOMMENDATIONS AS SET OUT IN THE GEOTECHNICAL INVESTIGATION FOR THE PROPOSED TOWNSHIP OF STANDERTON EXTENSION 9, REPORT No ___________, CONDUCTED BY .

NAME ______________ DATE ______________

SIGNATURE ______________ REG NO. ______________

FLOODLINE NOTE

IT IS HEREBY CERTIFIED THAT, IN TERMS OF THE PROVISIONS OF SECTION 144 OF THE NATIONAL WATER ACT, 1998 (ACT 36 OF 1998), THE AREA TAKEN UP BY THE PROPOSED TOWNSHIP DENOTED ON THE PLAN ENCLOSED HEREWITH IS AFFECTED BY A 1: 50 OR 1: 100 YEAR FLOOD LINE AND ARE CORRECTLY INDICATED ON THE PLAN.

NAME ______________ DATE ______________

SIGNATURE ______________ REG NO. ______________

DRAWING PARTICULARS

DESIGNED:	-
DRAWN:	K KRUGER
SCALE:	1: 2 500 (PAPER A3)
DATE:	2016-07-13
LAYOUT PLAN NO:	STDT X 9
DRAWING NUMBER:	MP.A03_2016-07-13_STANDERTON X 9

PLAN NO 7

DRAWING NO: MP.A03_2016-07-13_STANDERTON X 9

Appendix B5

Traffic Impact Assessment Report

STANDERTON MALL
(To be Situated on Portion of the Remainder of Portion 2 of the Farm Grootverlangen 409-IS)

TRAFFIC IMPACT STUDY

REPORT 2016-052

AUGUST 2016

CLIENT: SKY VILLAGE PROPERTIES CC

PREPARED BY:
EDS Engineering Design Services (Pty) Ltd
Old Farm Office Park, Block E & F
881 Old Farm Road
Faerie Glen
P.O Box 33920
GLENSTANTIA
0010
Tel (012) 991 1205
Fax (012) 991 1373

EDS Engineering Design Services (Pty) Ltd Reg. No: 2006/021564/07 VAT No: 4190230971
Directors: C.P. Bruyns Pr Eng M Eng (Structural), H.J. Fekken Pr Eng B Eng Hons (Structural),
P.G. Purchase Pr Eng M Eng (Transportation), G. van der Walt (Jnr) Pr Eng B Eng Hons (Transportation)
Associates: H.J. Brynard, G.D. Joubert Pr Eng, H.S. Steenkamp Pr Eng

EDS Engineering Design Services (Pty) Ltd
Old Farm Office Park, Block E & F
881 Old Farm Road
Faerie Glen
P.O Box 33920
GLENSTANTIA
0010
Tel (012) 991 1205
Fax (012) 991 1373

Traffic Impact Assessment Information Sheet

Local Authority : Lekwa Local Municipality

Property Description : Portion of the Remainder of Portion 2 of the Farm Grootverlangen 409-IS

Development Type : Retail

Authors of the report:

	Reviewed by	Compiled by
	Peter Purchase	Jonas Makala
Qualifications	M. Eng. (Transportation)	B Tech (Transportation)
ECSA Registration	Pr Eng : 980206	Pr Techni Eng : 201330047

Standerton Mall, to be situated on Portion of the Remainder of Portion 2 of the Farm Grootverlangen 409-IS

TRAFFIC IMPACT STUDY

Figures

Figures **Description**

Annexures

1 INTRODUCTION

1.1 Background

EDS Engineering Design Services (Pty) Ltd was appointed by Sky Village Properties Cc to undertake a Traffic Impact Assessment (TIA) in support of the proposed township establishment on Portion of the Remainder of Portion 2 of the Farm Grootverlangen 409-IS, Standerton, in the Mpumalanga Province.

It is envisaged to establish a new shopping centre to be known as Standerton Mall.

This study investigates the existing and future traffic flow conditions at the key intersections within the study area, it estimates the expected development trip generation whilst taking cognisance of the type of development proposed, it determines the anticipated traffic impact on the surrounding road network and determines whether it is necessary to implement any road and/or intersections improvements to mitigate the anticipated traffic impact.

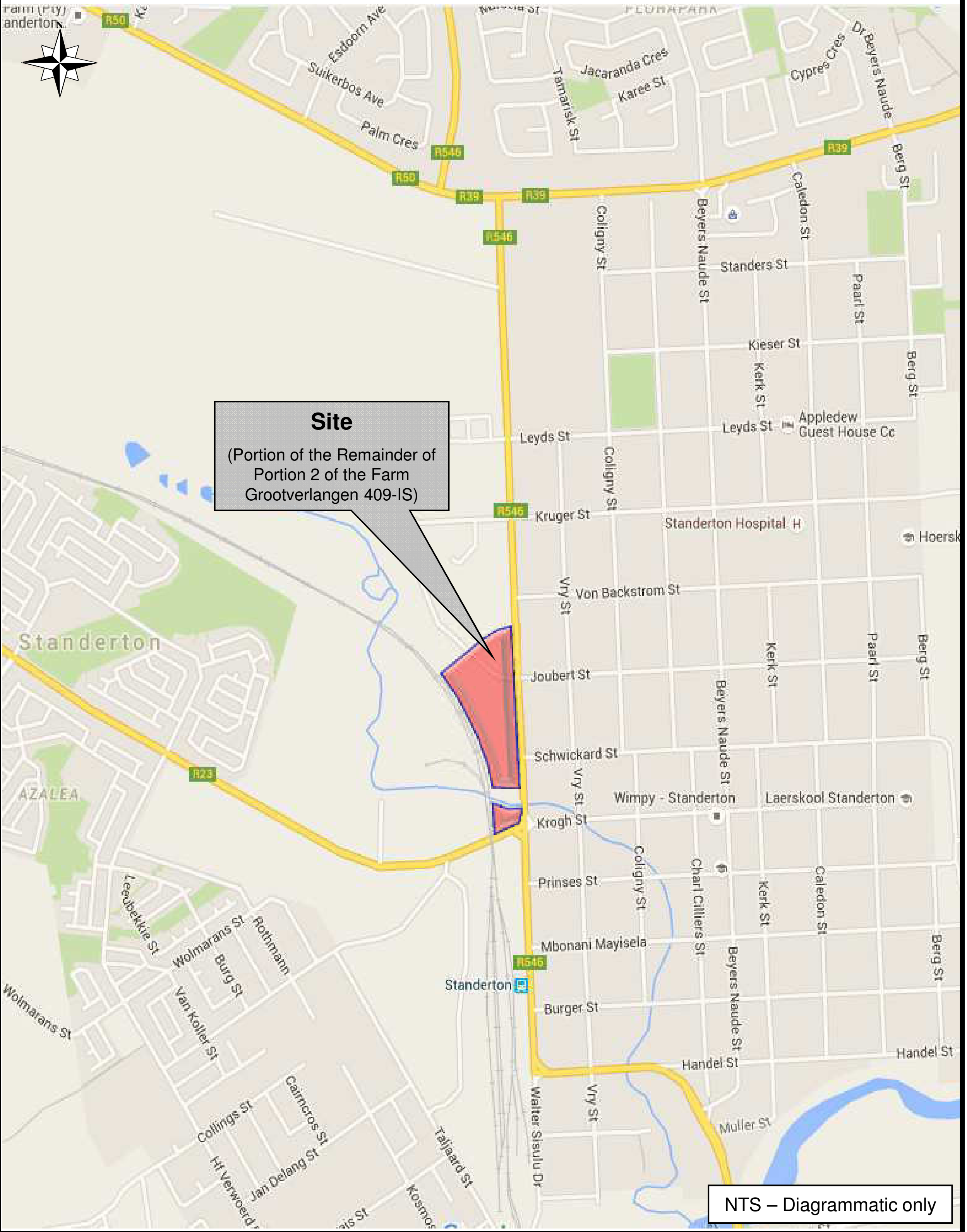
The study has been taken considering the requirements and guidelines as set out in the *TMH 16 Volume 2 (South African Traffic Impact and Site Impact Assessment Standards and Requirements Manual), COTO, Version 1 dated August 2012.*

Comments are also made in respect of the site access as well as the non-motorised & public transport in this study.

1.2 Site Location

The site is located in Standerton, within the jurisdiction of Lekwa Local Municipality.

Location of the site in relation to the surrounding road network is shown in **Figure 1.1.**



PTN OF THE REM. OF PTN 2 OF THE FARM GROOTVERLANGEN 409-IS **Figure 1.1**

Locality Plan

1.3 Methodology

The study methodology included:

- A site visit to observe current travel patterns, road geometry and to gain an understanding of the area.
- Consider relevant roads authority road network planning (if any).
- Assist client with advice on road planning impact and negotiations with authorities.
- Traffic counts at relevant intersections.
- Trip generation, distribution and assignment.
- Capacity analysis for the AM, PM, and SAT peak hour (as appropriate).
- Site access investigation (high level).
- Preparation of conceptual layouts indicating access requirements and intersection upgrades.
- All the findings, conclusions and recommendations will be captured in a report memorandum.

2 DATA COLLECTION

2.1 Traffic Counts

Manual traffic counts were conducted in July 2016 during the weekday morning and afternoon, as well as the Saturday peak periods. The counts were undertaken at the following key intersections within the study area;

- ✓ Beyers Naude Street / Krogh Street Intersection
- ✓ R23 / Minaar Street Intersection
- ✓ Walter Sisulu Drive / Schwickard Street Intersection
- ✓ Walter Sisulu Drive / Handel Street Intersection
- ✓ Walter Sisulu Drive / Joubert Street Intersection
- ✓ Walter Sisulu Drive / Krogh Street Intersection
- ✓ Walter Sisulu Drive / Kruger Street Intersection
- ✓ Walter Sisulu Drive / R39 Intersection

Locations of the intersections counted are depicted in **Figure 2.1**.

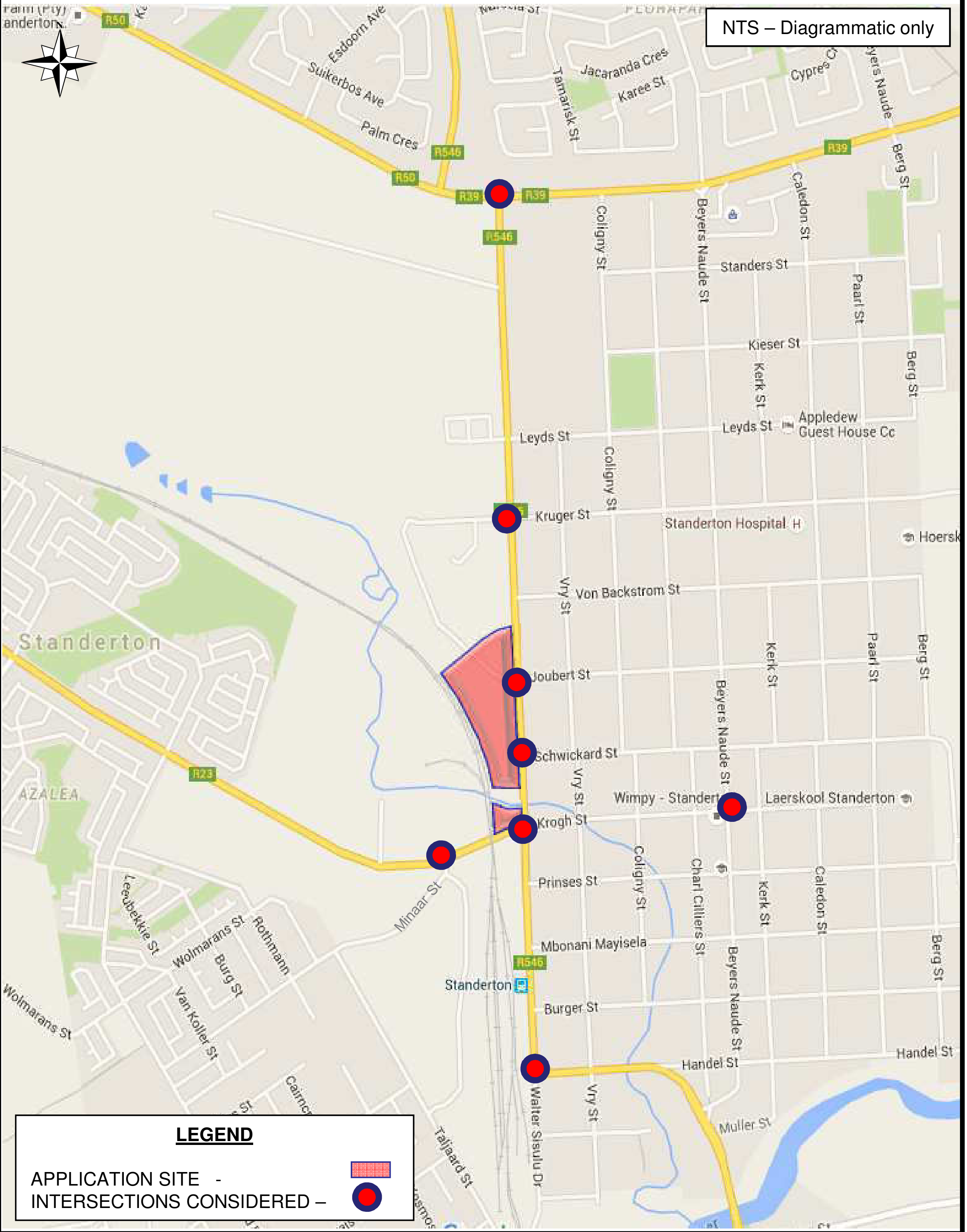
From the traffic counts undertaken, the busiest hour (peak hour) for each counted period was found to be as follows:

- Morning peak hour 07:00 – 08:00
- Afternoon peak hour 16:30 – 17:30
- Saturday peak hour 11:30 – 12:30

The existing weekday AM and PM as well as the Saturday peak hour traffic volumes at the counted intersections are summarised on **Figures 2.2, 2.3** and **2.4** respectively.

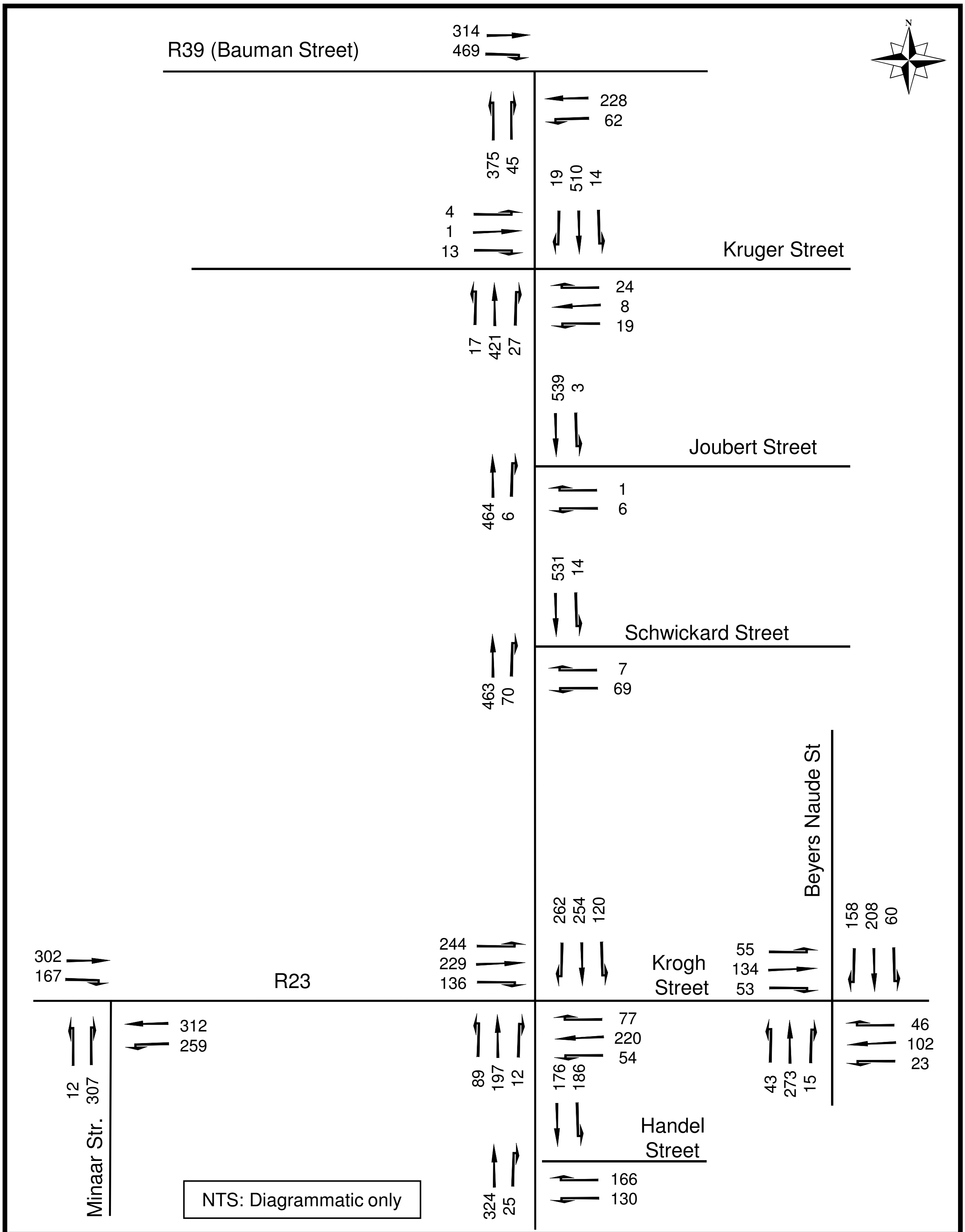
2.2 Intersections Layouts

The existing intersections` geometric layouts obtained on site during the site visit have been used for base case analysis in this study.



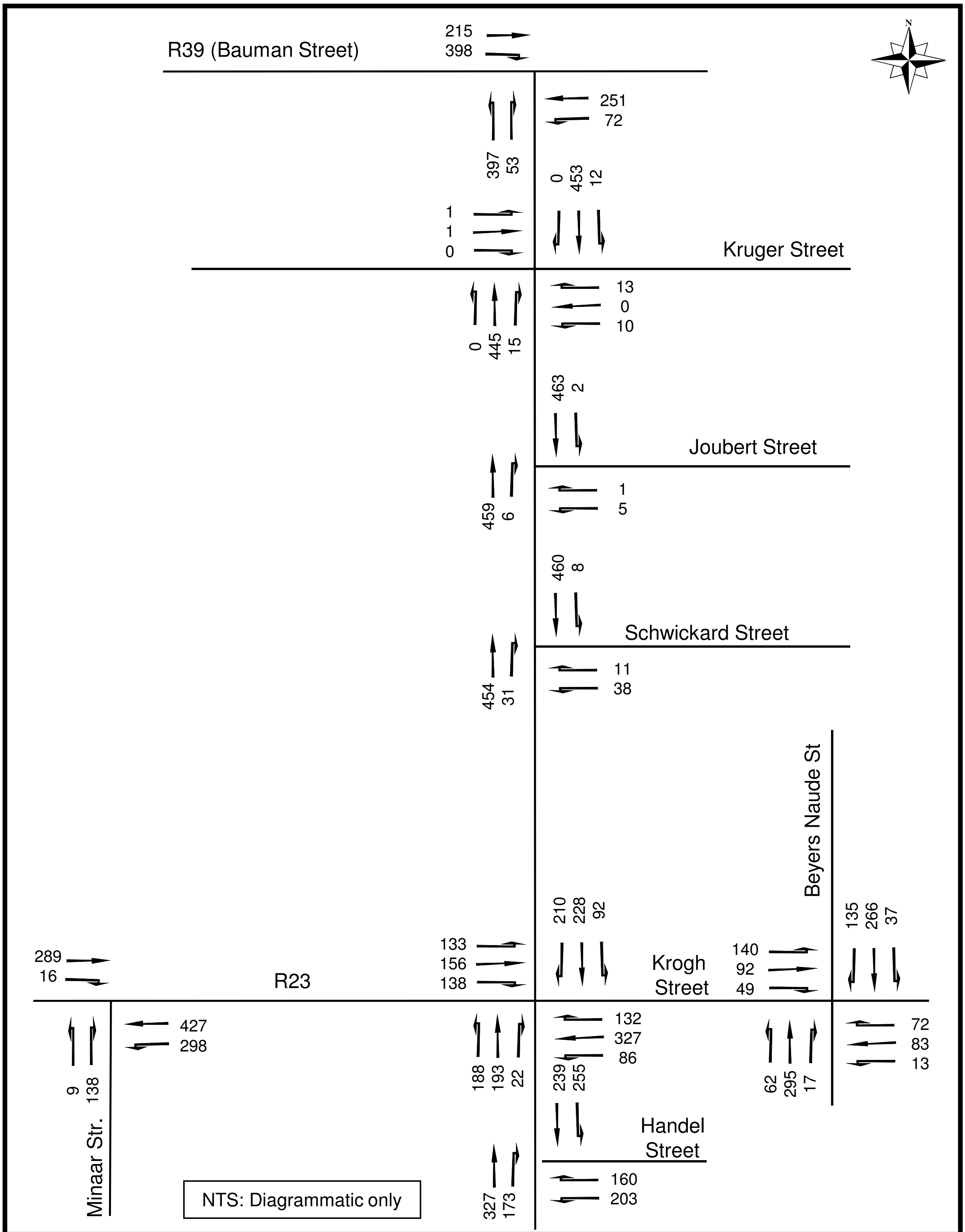
PTN OF THE REM. OF PTN 2 OF THE FARM GROOTVERLANGEN 409-IS **Figure 2.1**

Intersections Counted



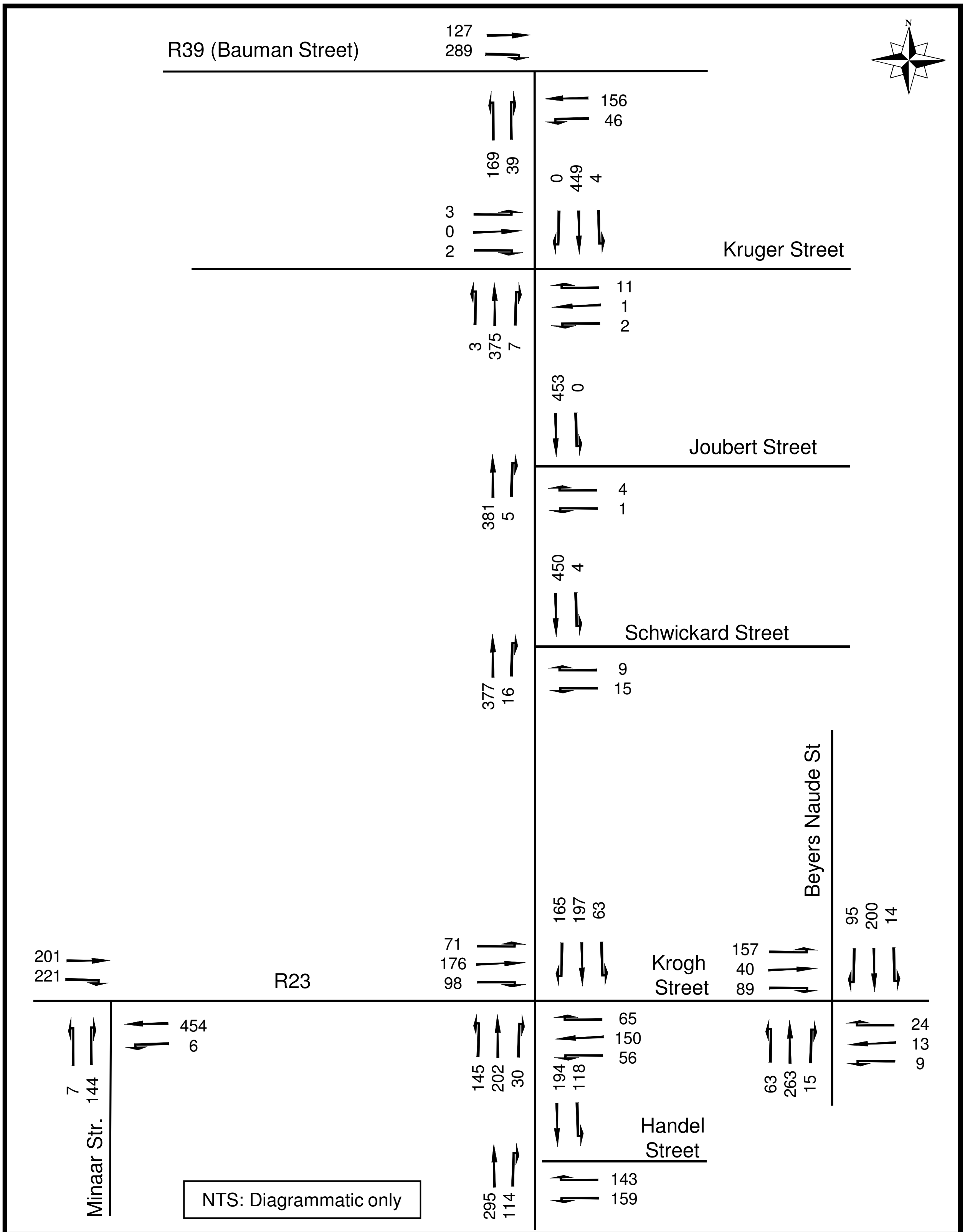
PTN OF THE REM. OF PTN 2 OF THE FARM GROOTVERLANGEN 409-IS **Figure 2.2**

Existing 2016 Weekday AM Peak Hour Traffic Flows (07:00 – 08:00)



PTN OF THE REM. OF PTN 2 OF THE FARM GROOTVERLANGEN 409-IS **Figure 2.3**

Existing 2016 Weekday PM Peak Hour Traffic Flows (16:30 – 17:30)



PTN OF THE REM. OF PTN 2 OF THE FARM GROOTVERLANGEN 409-IS **Figure 2.4**

Existing 2016 Saturday Peak Hour Traffic Flows (11:30 – 12:30)

3 PROPOSED DEVELOPMENT

3.1 Land Use

The site is currently a vacant land and currently zoned “Agricultural", according to the Standerton Town Planning Scheme, 1995. The township name is Standerton Extension 9.

The type of development proposed is retail, in the form of a shopping center and it will be known as Standerton Mall. Proposed near the Standerton Mall, on the separate erf, is a Fast Food outlet.

As can be seen in **Annexure A** (township layout plan) and **Annexure B** (site development plan), the site comprises two separate erven, namely;

- ✓ Erf 1 = A portion of Remainder of Portion 2 of the Farm Grootverlangen 409 IS, measuring some 5.4123ha in extent.

- ✓ Erf 2 = A portion of Remainder of Portion 2 of the Farm Grootverlangen 409 IS, measuring some 0.9017ha in extent.

It is envisaged to develop these two erven as follows;

- ✓ Erf 1: Shopping centre = ±19 459m²GLA
- ✓ Erf 2: Fast food outlet (drive-thru) = ±350m²GLA

The two erven are divided by a vacant land which is currently owned by municipality.

3.2 Parking Provision

It is recommended that minimum parking be provided to the satisfaction of Lekwa Local Municipality, and in accordance with *Standerton Town Planning Scheme 1995.*

The said document recommends the parking rate of 6 parking spaces per 100m²GLA for Shops and no provision for fast food / drive-in restaurants. It is considered appropriate to provide on-site public transport holding area to cater for public transport users and rather relax the shopping centre standard parking rate. This approach was discussed with the municipality and was considered acceptable to them.

Lekwa Local Municipality Town Planning Department confirmed that a reduced parking rate of 4 parking bays per 100m² leasable shop floor area will be allowed (i.e. 33.3% relaxation).

The *South African Parking Standard* also does not make provision for the fast food / drive-in restaurants land uses.

The following are the two South African documents found, whereby parking rates for fast food / drive-in restaurants land uses has been provided and are based on the surveys, namely;

- ✓ *Report On Parking Requirements For Selected Land Uses*, prepared for City Council of Pretoria by Jeffares & Green in June 1997.
- ✓ *Parking Requirements for the City of Tshwane* Document, prepared by Innovative Traffic Solutions (Pty) Ltd, in July 2001.

The respective documents recommend the following parking rates for fast food / drive-in restaurants land uses;

- ✓ 14 parking spaces per 100m²GLA
- ✓ 10 parking spaces per 100m²GLA or (0.32 parking spaces per seat or 10 parking spaces per 100m²GLA)

It is therefore recommended for the purpose of this traffic impact study that parking for the proposed fast food / drive-in restaurants land use be provided at *10 parking spaces per 100m²GLA* or to the satisfaction of Lekwa Local Municipality.

Table 3.1 provides calculations of the required parking supply.

Table 3.1: Parking Supply Requirements Calculations

Proposed Land Use	Land Use Extent	Parking Rates	Required Parking Supply
Shops / Shopping Centre	19 459m²GLA	4 spaces per 100m²GLA	779 bays
Fast Food / Drive-In Restaurants	350m²GLA	10 spaces per 100m²GLA	35 bays
Parking Supply Required			814 bays

With reference to the SDP (parking calculation) appended in **Annexure B**, it is envisaged to provide a total of 907 parking spaces (i.e. 866 on Erf 1 plus 41 on Erf 2), which is in excess of the minimum requirement of 814 parking spaces.

In addition, provision has also been made for a taxi holding area capable to accommodate up to 10 taxis on site.

It is therefore concluded that more than sufficient parking provision will be made on site.

4 SITE ACCESS

4.1 Liaisons with Roads Authorities

4.1.1 Local Municipality

The site was visited on the 28th June 2016 to obtain information necessary for compilation of this study. On the same day, EDS Traffic Engineers (Mr. Jonas Makala) had a meeting with Ms Zandile Precious Mgadi of Lekwa Local Municipality (Roads Department) to discuss the aspects of the traffic impact study, including inter alia the accessibility to the site.

Therefore the proposed site access arrangements in this study are in line with the discussions and in-principle agreement with the municipality.

4.1.2 SANRAL

On the 26th July 2016, EDS Traffic Engineers (Mr. Jonas Makala) also have had a meeting with Mr. Izak van der Linde of The South African National Roads Agency SOC Limited (SANRAL) to discuss the project and its anticipated impact on SANRAL`s roads, if any, as well as to obtain the in-principle support of the proposed site access.

Therefore the proposed site access arrangements in this study are in line with the discussions and in-principle agreement with SANRAL.

4.2 Proposed Site Access

With reference to **Figure 4.1**, locations of the proposed site access points as well as the type of accesses are shown.

The proposed shopping centre component on Erf 1 is planned to comprise two access points as briefly described below;

- ✓ *<u>Access 1:</u>* A full access is proposed off Walter Sisulu Drive, opposite Joubert Street to become the 4th leg at the existing T-intersection. The intersection will be signalised and exclusive turning lanes will be provided along Walter Sisulu Drive. The existing and proposed intersection geometry is shown schematically in **Figure 4.2**.
- ✓ *<u>Access 2:</u>* Another full access is also proposed off Walter Sisulu Drive, opposite Schwickard Street to become the 4th leg at the existing T-intersection. The intersection will be signalised and exclusive turning lanes will be provided along Walter Sisulu Drive. The existing and proposed intersection geometry is shown schematically in **Figure 4.3**.

The proposed fast food drive-thru component on Erf 2 is also planned to comprise two access points as briefly described below;

- ✓ *<u>Access 3:</u>* Another marginal access in the form of a left-in plus left-out is proposed off Walter Sisulu Drive. A kerbed median along Walter Sisulu Drive is proposed past this access to ensure that no illegal turning movements can occur at the access intersection as can be seen in **Figure 4.4.**

- ✓ *Access 4:* A marginal access in the form of a left-in only is proposed off the R23 Road. Lekwa Local Municipality and SANRAL confirmed that a section of the R23 to the west of the railway line falls within the jurisdiction of SANRAL, but a section where this access is proposed, is a municipal road.

  A dedicated short deceleration lane plus a kerbed median along the R23 are proposed to supplement this access as can be seen in **Figure 4.4.**

PTN OF THE REM. OF PTN 2 OF THE FARM GROOTVERLANGEN 409-IS **Figure 4.1**

Locations of the Proposed Site Access Points

Figure 4.2: Geometry – Walter Sisulu Drive / Schwickard Street / Site Access

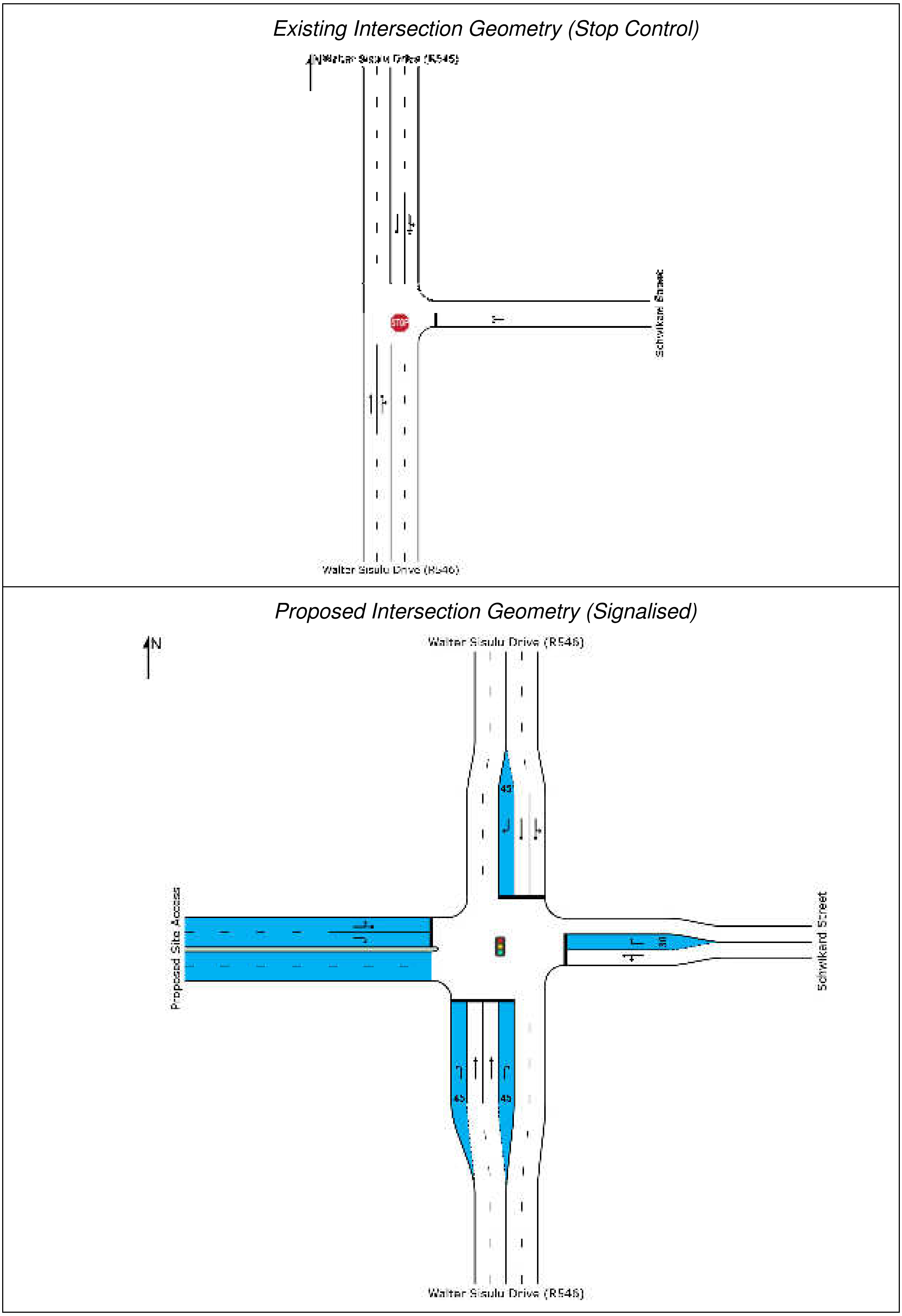
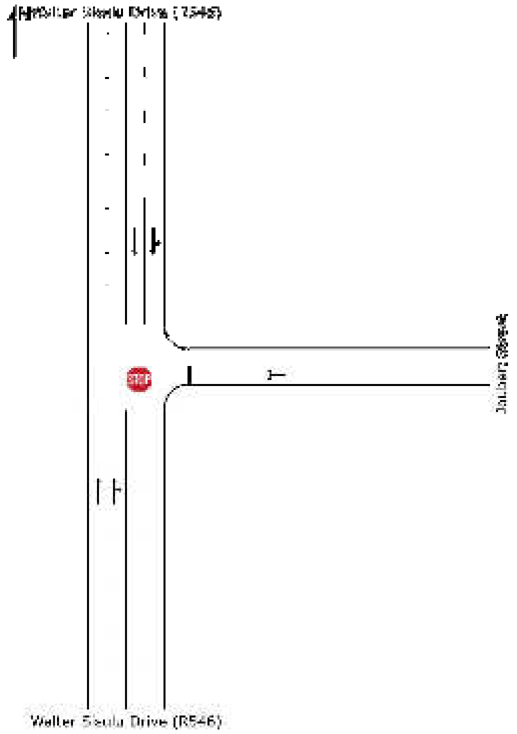
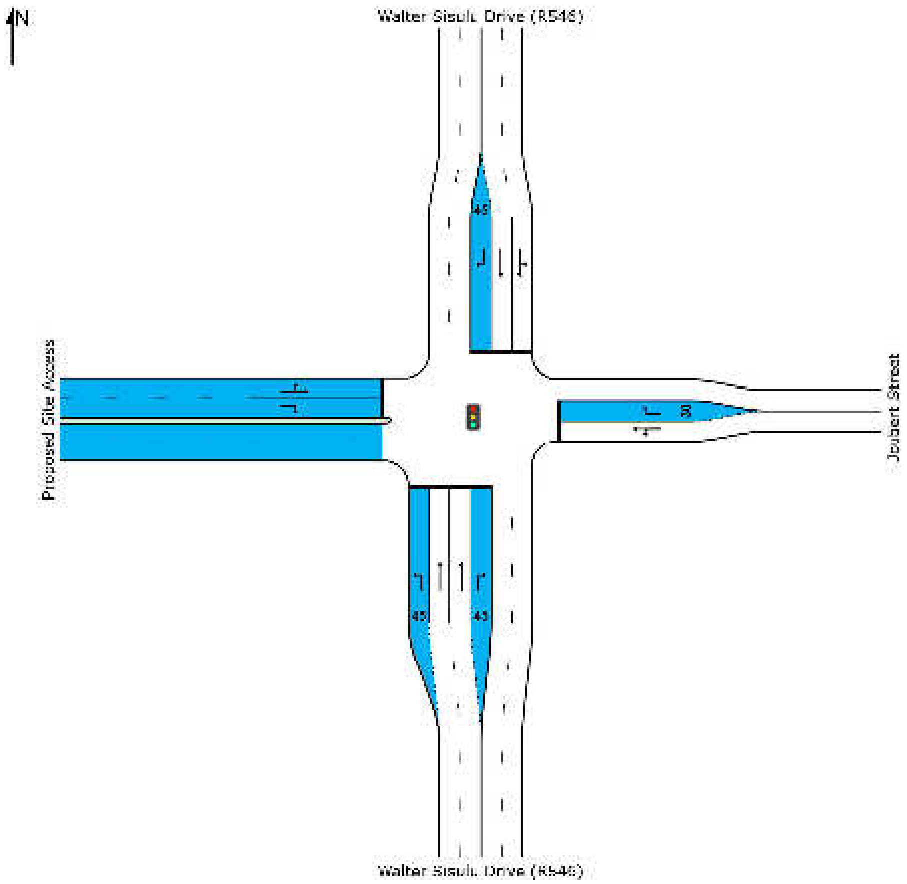


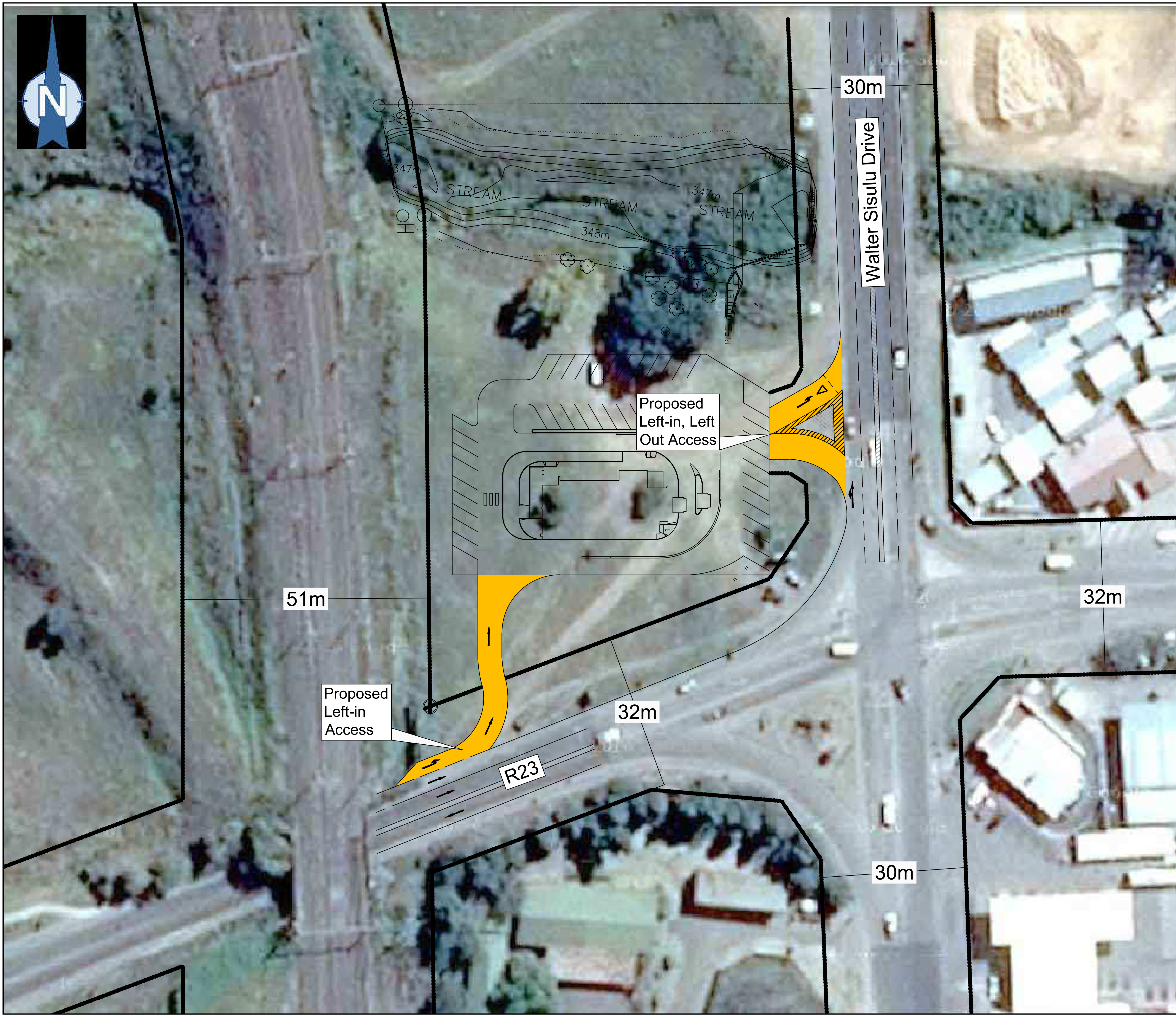
Figure 4.3: Geometry – Walter Sisulu Drive / Joubert Street / Site Access

Existing Intersection Geometry (Stop Control)



Proposed Intersection Geometry (Signalised)





GENERAL NOTES:
1. REFER TO ALL RELEVANT DRAWINGS & SPECIFICATIONS, DO NOT SCALE ANY DIMENSIONS.
2. WHERE DISCREPANCIES OCCUR BETWEEN THE PROJECT DRAWINGS OR SPECIFICATIONS, THESE SHOULD BE REPORTED IMMEDIATELY TO THE PRINCIPAL AGENT.
3. ALL DIMENSIONS AND LEVELS TO BE CHECKED ON SITE AND CORRELATED WITH THE ARCHITECTS DRAWING BEFORE CONSTRUCTION COMMENCES.
4. ALL WATERPROOFING AND EARTH POISONING DETAILS TO BE IN ACCORDANCE WITH THE ARCHITECT'S SPECIFICATION AND INSTRUCTIONS.

Rev. No:	Date:	Revision Details:	By:

Client:

Architect:

Structural, Civil & Transportation Engineers

Old Farm Office park
881 Old Farm Road
Faerie Glen
Pretoria

Tel: 012 991 1205
Fax: 012 991 1373
e-mail: info@edseng.co.za

Project:

Standerton Mall

Description:

Proposed Access to Erf 2

Paper size:	Drawn:	Checked:	Designed:
A3	J. Makala	P. Purchase	P. Purchase

Scale:	Project Number:	Drawing Number:	Revision:
1:750	2016-052	Figure 4.4	A

5 TRIP GENERATION

5.1 General

The *South* African *Trip Data Manual (TMH 17 – Volume 1 Dated September 2012)* has been used to determine the estimated development trip generation.

Table 5.1 below provides summary of development trip generation calculations and appended in **Annexure C** is the detailed calculations of the development trip generation calculations.

Table 5.1: Estimated Total Development Trip Generation

Land Use	AM Peak Hour			PM Peak Hour			Saturday Peak Hour		
	In	Out	Total	In	Out	Total	In	Out	Total
Retail Centre (19 459m²GLA)	86	47	133	377	377	754	499	499	998
Fast Food (350m²GLA)	44	36	80	49	40	89	49	49	98
Total Trips	***131***	***83***	***213***	***426***	***417***	***843***	***548***	***548***	***1 096***

The entire development (Erven 1 plus 2) is estimated to generate totals (in plus out) of approximately 213, 843 and 1 096 peak hour vehicular trips during the AM, PM and Saturday peak periods.

Figures 5.1, 5.2 and **5.3** summarise the estimated development trip distribution (total primary, pass-by & diverted).

5.2 Trip Distribution & Assignment

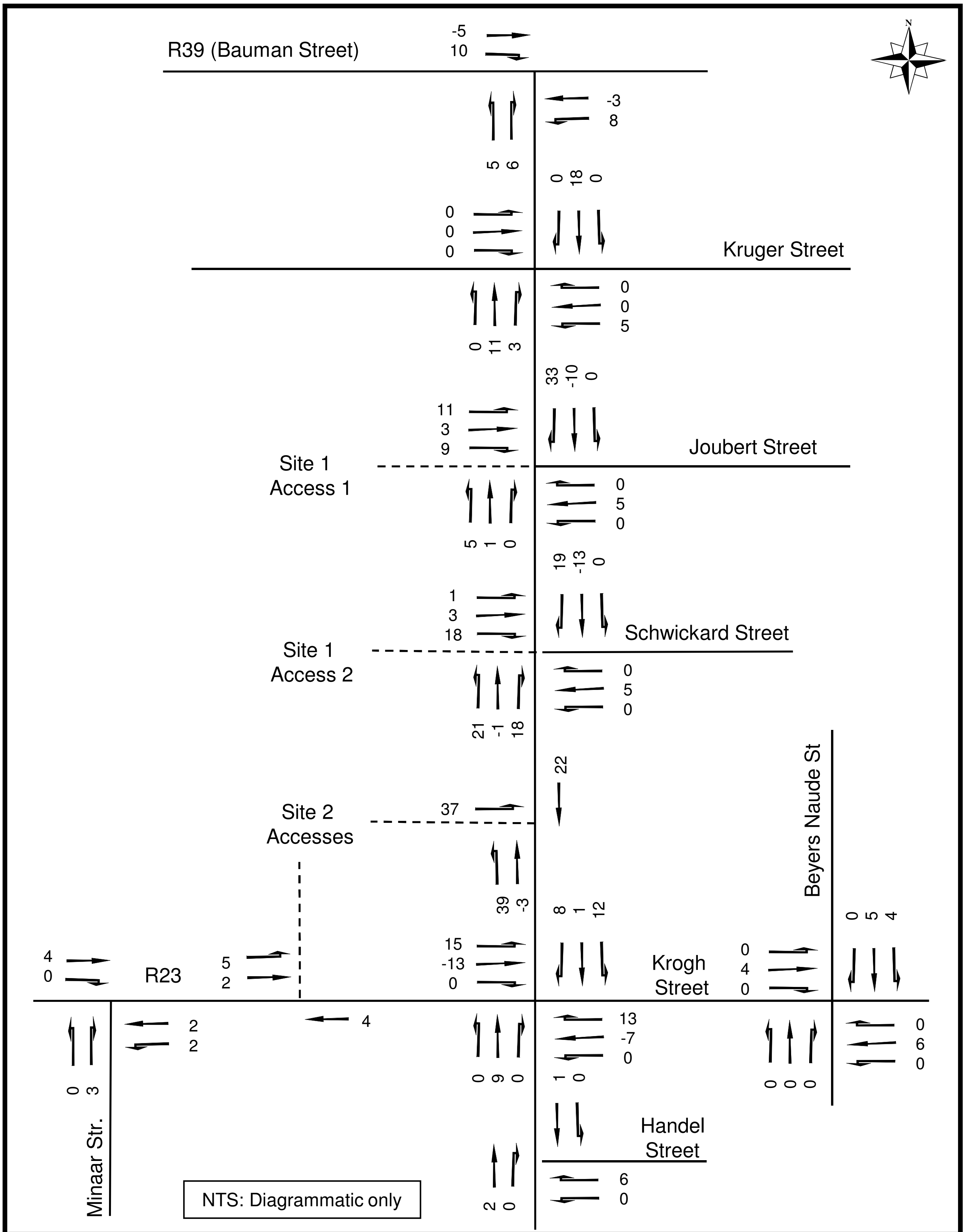
Assumptions on the expected trip distribution and assignment were based on the type of the development proposed, location of its access points relative to the surrounding roads network, anticipated origin and destination of trips as well as the existing traffic volumes and patterns in the area.

The *South African Traffic Impact and Site Traffic Assessment Manual (TMH 16 – Version 1.0 Volume 1 Dated August 2012)* indicates the type / level of traffic impact assessment required based on the trip generation threshold indicated in **Table 6.2** below.

Table 5.2: Warrants for Traffic Impact Assessments (TMH16 Volume 1)

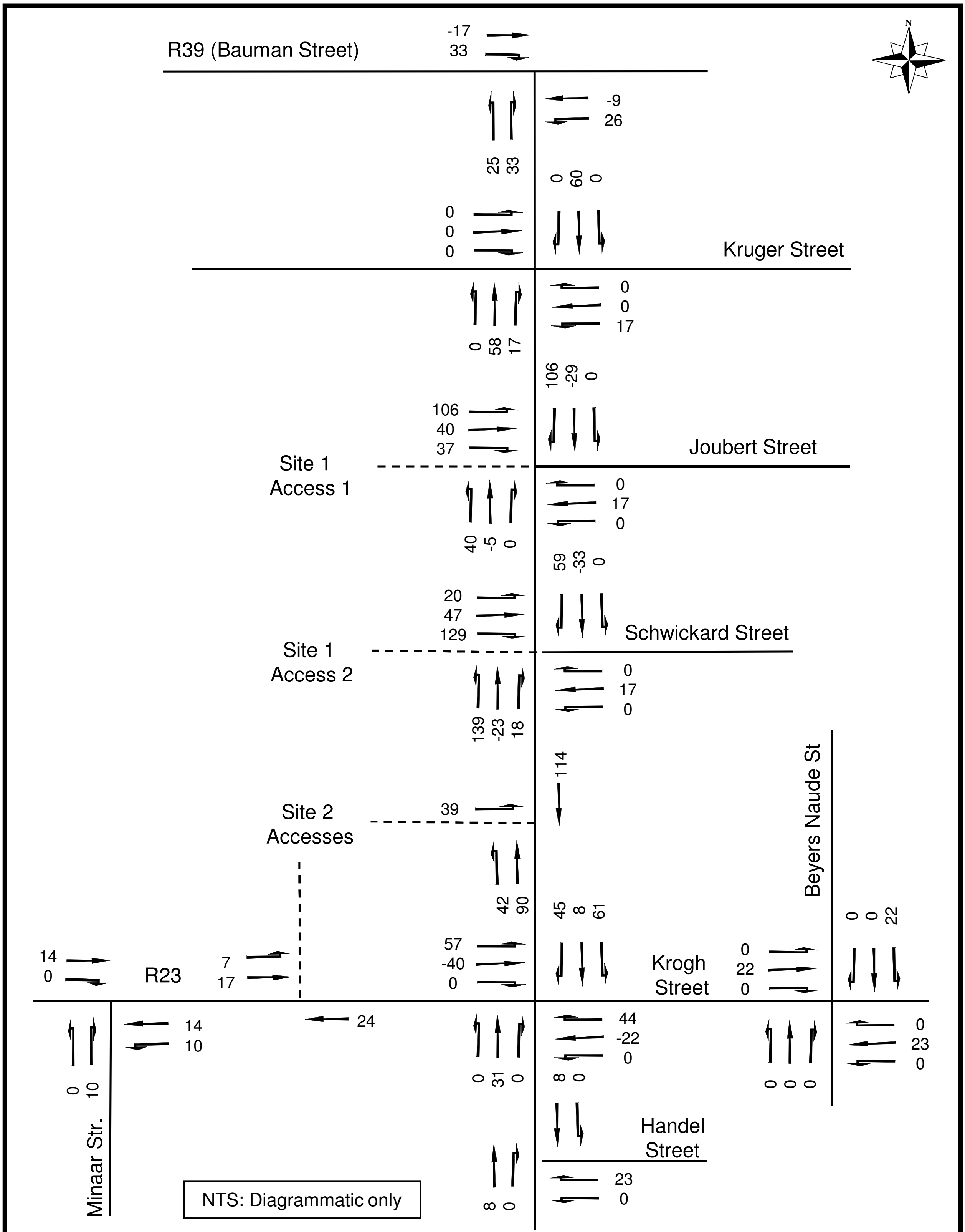
Threshold Value	Study Required
Less than 50 trips	Access Study*
More than 50 trips but less than 150 trips	Traffic Impact Statement
More than 150 trips	Traffic Impact Study

Note: * - At discretion of relative authority.



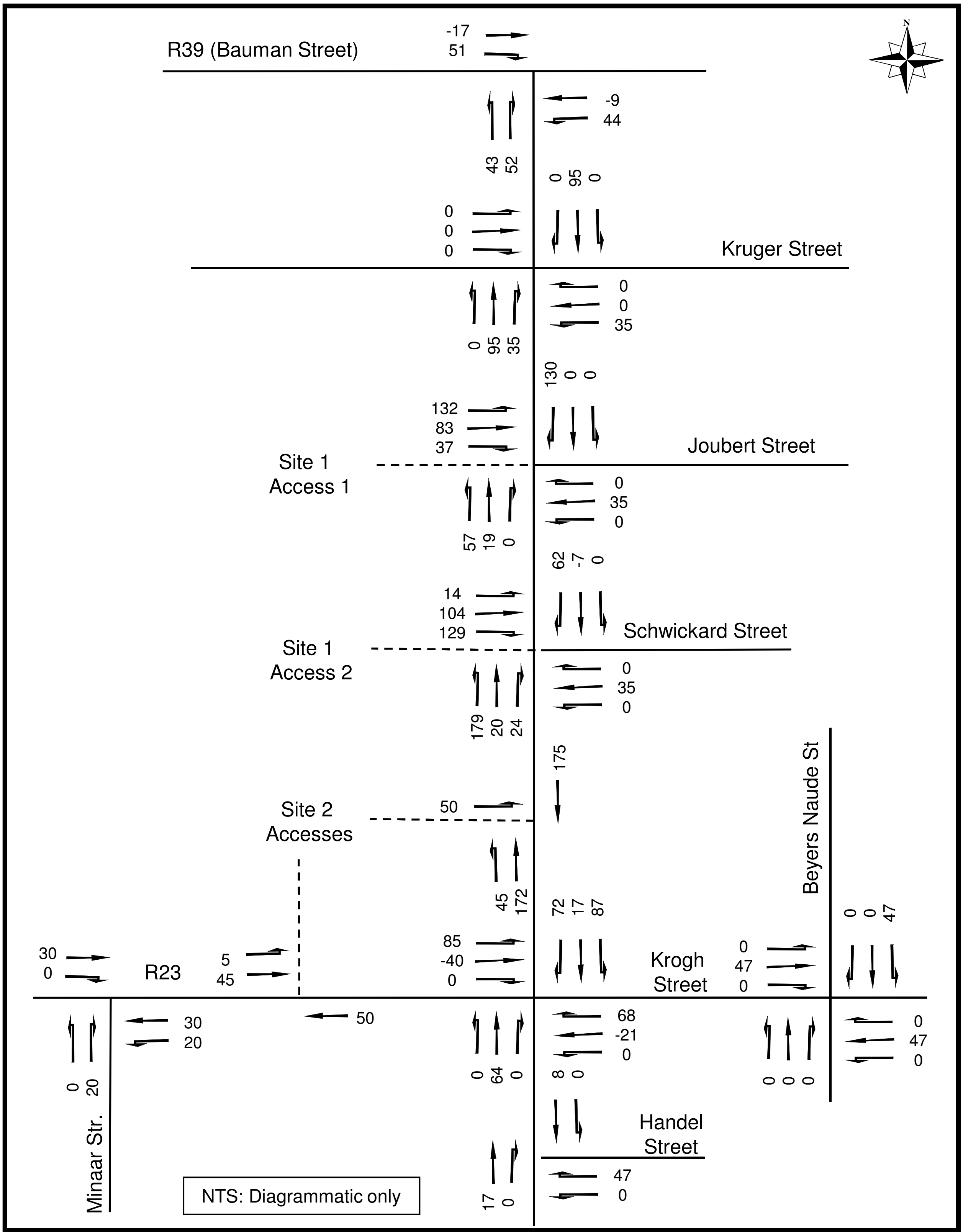
PTN OF THE REM. OF PTN 2 OF THE FARM GROOTVERLANGEN 409-IS **Figure 5.1**

Total Development Trip Distribution & Assignment – Weekday AM



PTN OF THE REM. OF PTN 2 OF THE FARM GROOTVERLANGEN 409-IS **Figure 5.2**

Total Development Trip Distribution & Assignment – Weekday PM



PTN OF THE REM. OF PTN 2 OF THE FARM GROOTVERLANGEN 409-IS **Figure 5.2**

Total Development Trip Distribution & Assignment – Saturday

6 TRAFFIC DEMAND

6.1 Horizon Year Traffic Demand

Requirements of the *TMH 16 Volume 2 (South African Traffic Impact and Site Impact Assessment Standards and Requirements Manual), COTO, Version 1 dated August 2012* are indicated in **Table 6.1** below.

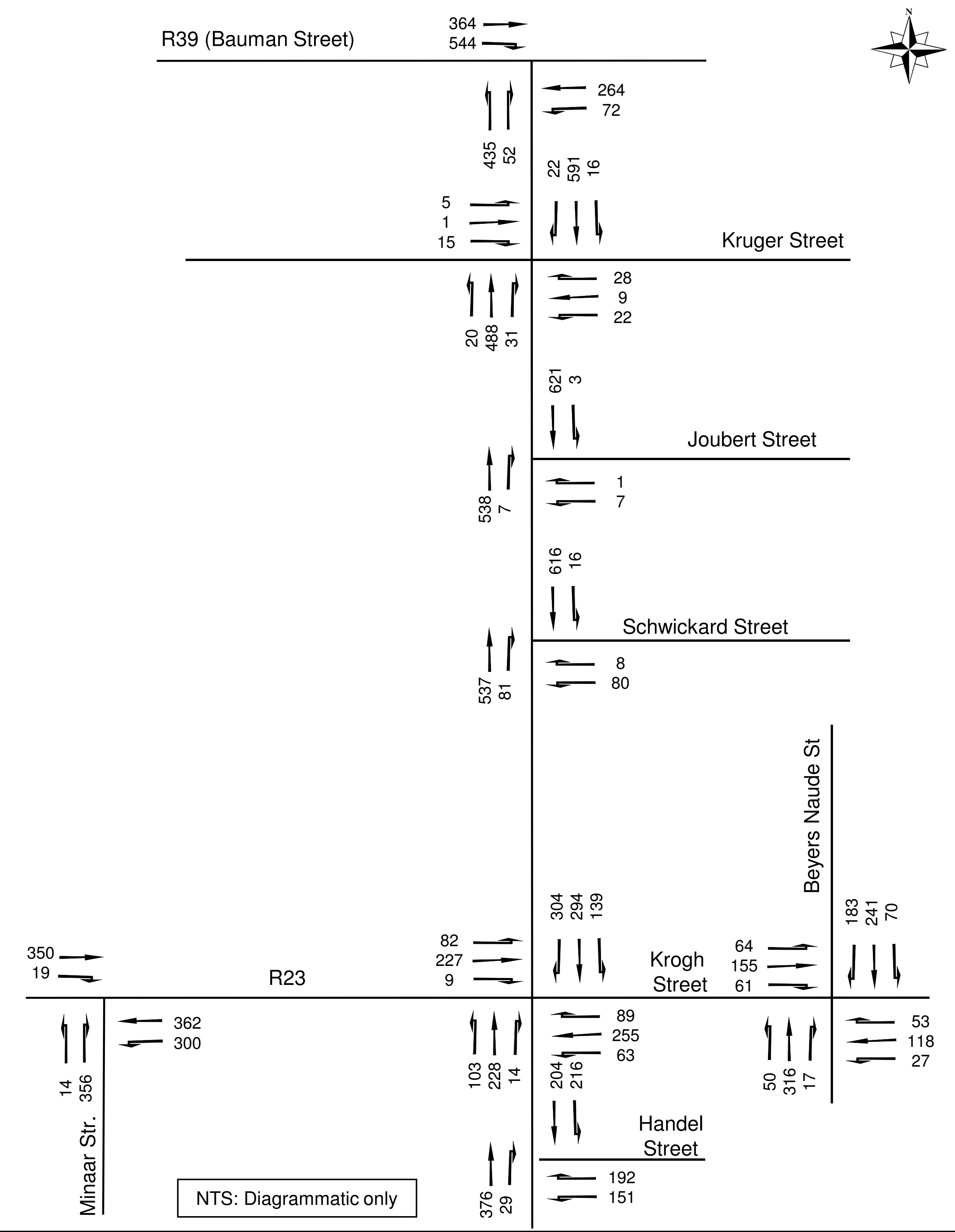
Table 6.1: Assessment Years for Traffic Studies (from TMH 16 Volume 2)

Type of Study	Assessment years to consider
Traffic Impact Statement (50-150 peak hour trips)	Base year; Any other year at discretion of responsible road authority.
Traffic Impact Study (150-2000 peak hour trips)	Base year; Five years after the base year; Any other year at discretion of responsible road authority.
Traffic Impact Study (> 2000 peak hour trips)	Base year; Ten years after the base year; Any other year at discretion of responsible road authority.
Multi – phase developments	Base year; Five years after the base year for developments < 2000 peak hour trips; Ten years after the base year for developments > 2000 peak hour trips; Any other year at discretion of responsible road authority.

The *TMH 16 Volume 2* suggests that for developments which generate more than 150 peak hour trips, it is necessary to escalate the existing traffic volumes to a future base. In this case a 5-year horizon has been used. In order to make provision for increase in the background traffic due to growth and increase in vehicle ownership, it is assumed that the background traffic (2016) would increase at an annual growth rate of 3,0% to the future 2021 base year. **Figures 6.1, 6.2** and **6.3** summarise estimated future 2021 background traffic.

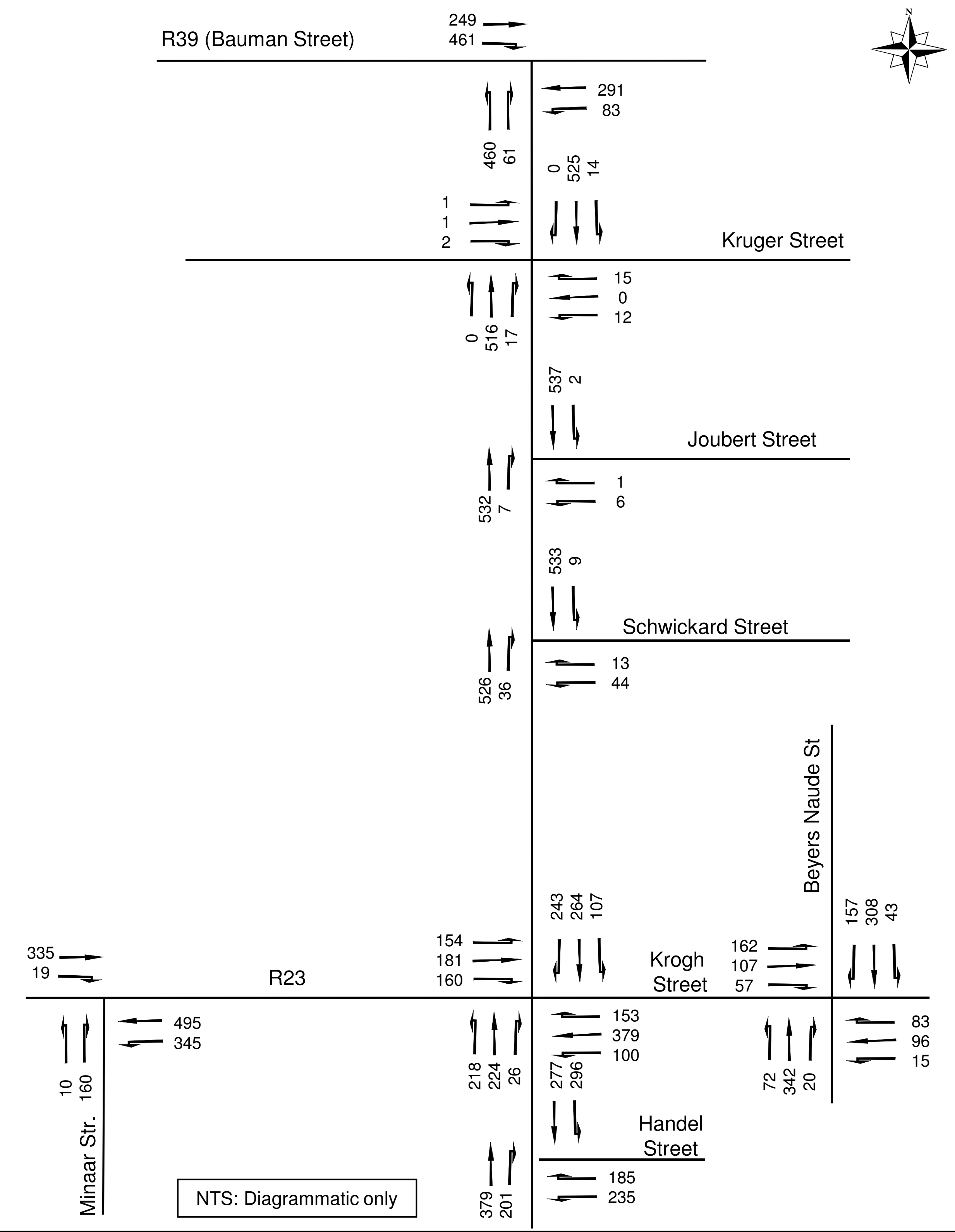
6.2 Total Future Traffic Demand

Total future traffic demand was obtained by adding the estimated development trips to the future background traffic (see **Figures 6.4, 6.5** and **6.6**).



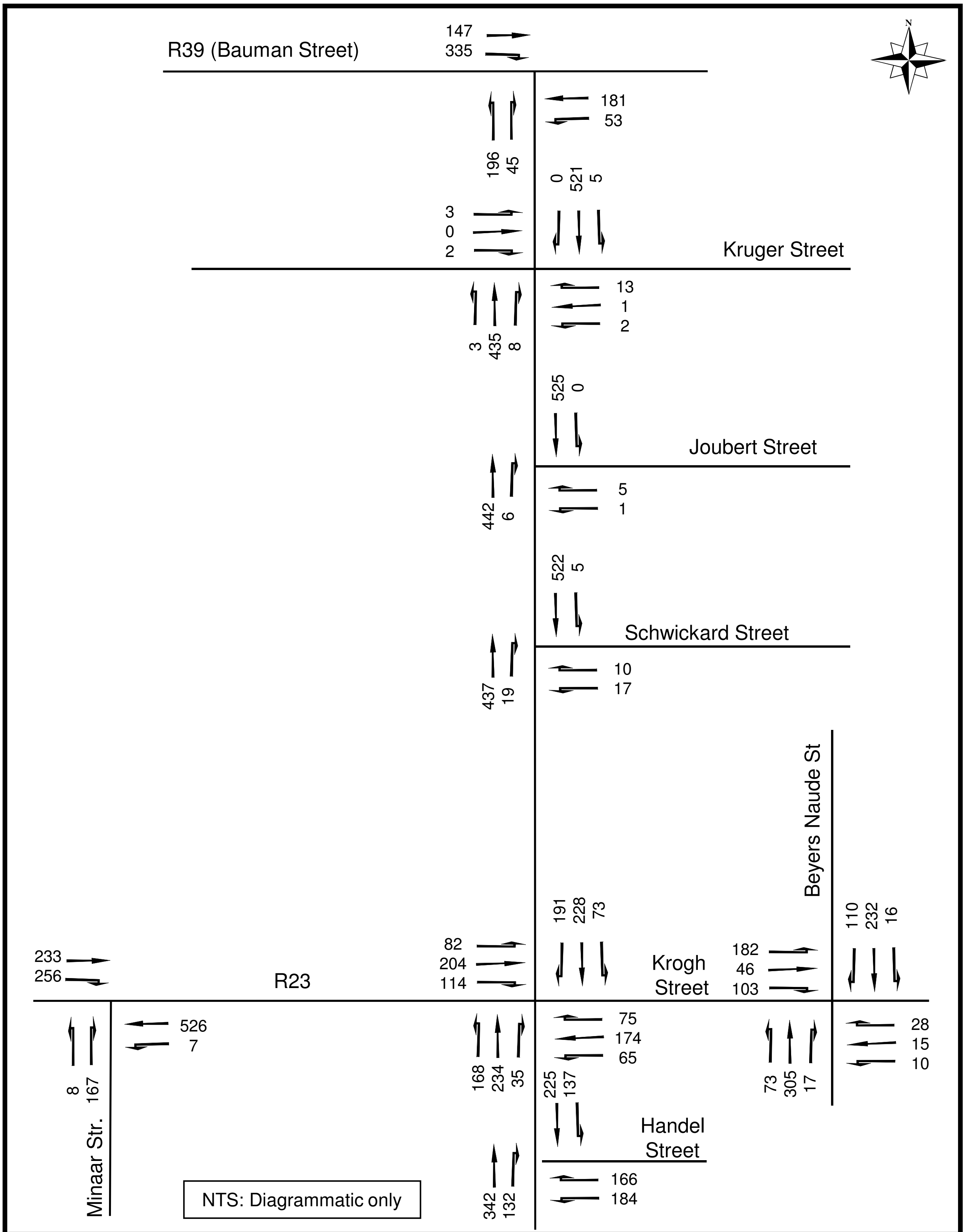
PTN OF THE REM. OF PTN 2 OF THE FARM GROOTVERLANGEN 409-IS **Figure 6.1**

Future 2021 Background Traffic Demand - AM Peak Hour



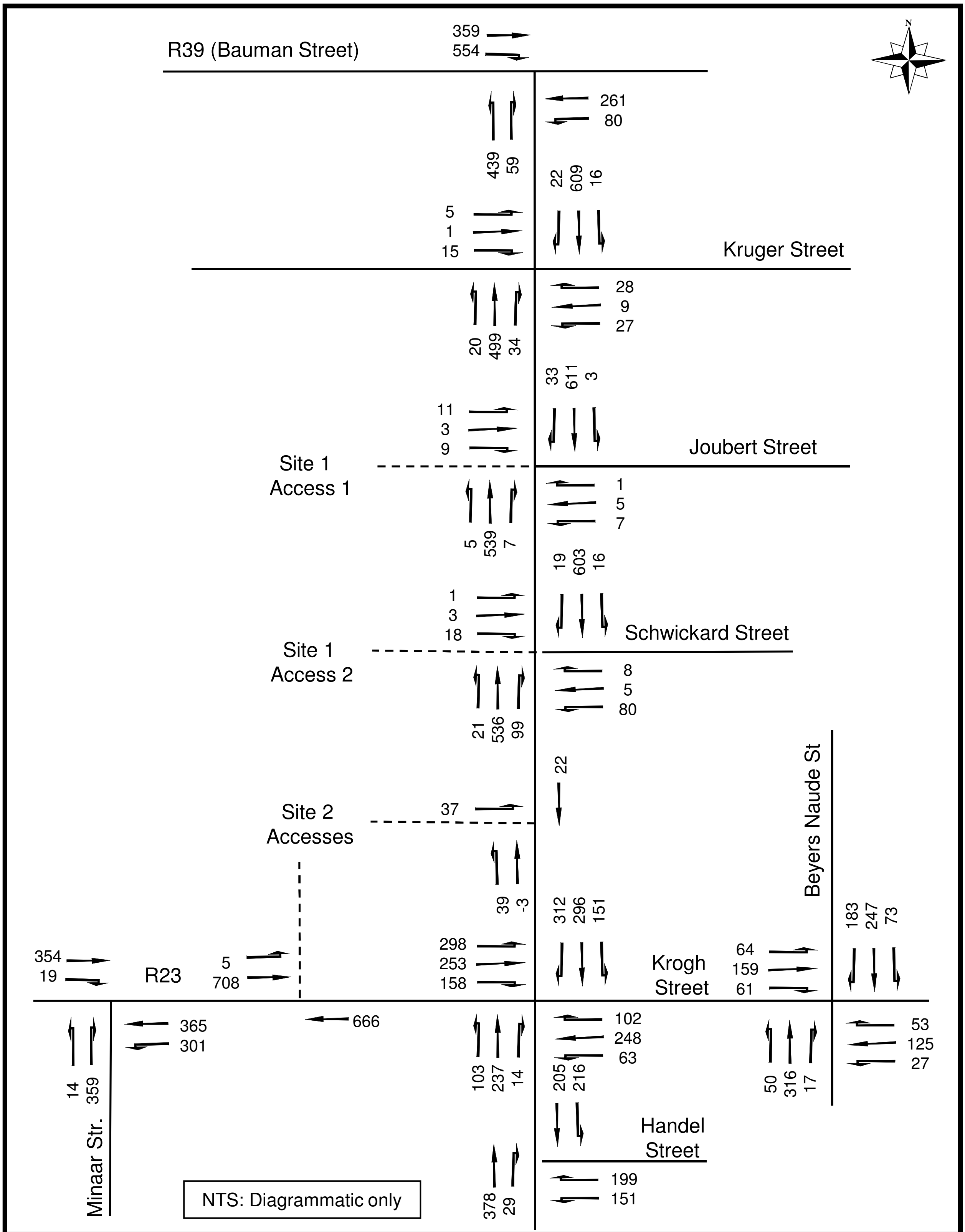
PTN OF THE REM. OF PTN 2 OF THE FARM GROOTVERLANGEN 409-IS **Figure 6.2**

Future 2021 Background Traffic Demand - PM Peak Hour



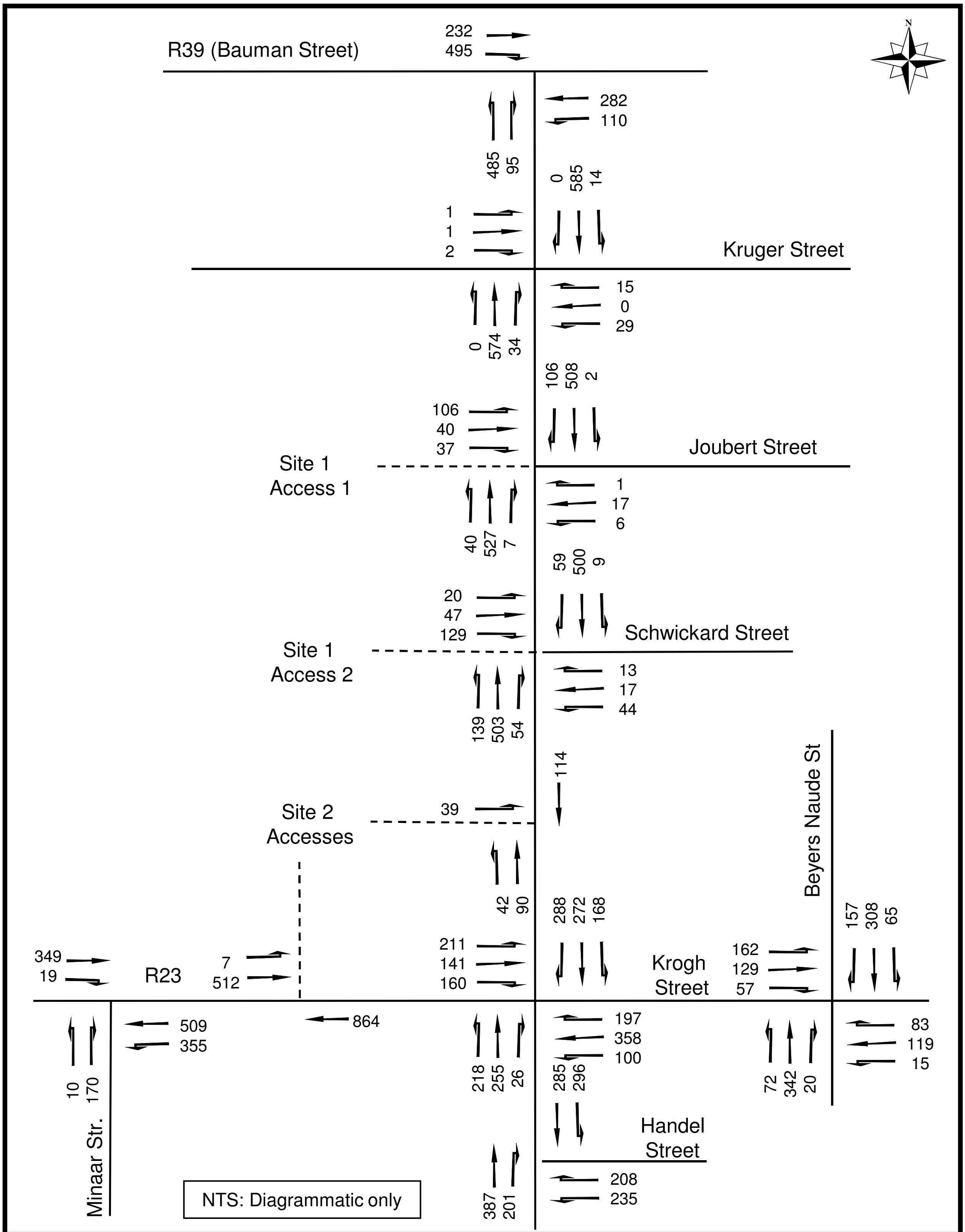
PTN OF THE REM. OF PTN 2 OF THE FARM GROOTVERLANGEN 409-IS **Figure 6.3**

Future 2021 Background Traffic Demand – Saturday Peak Hour



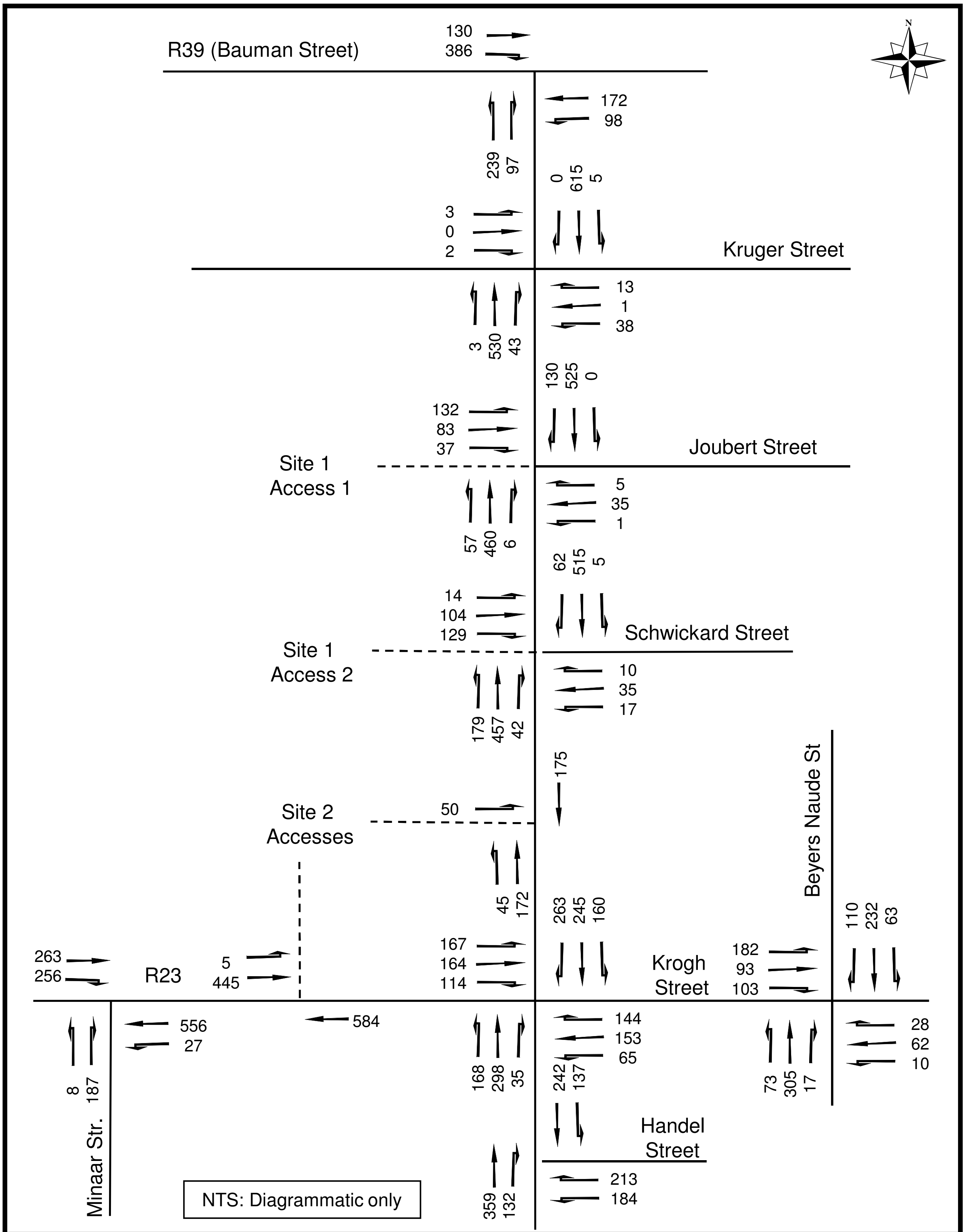
PTN OF THE REM. OF PTN 2 OF THE FARM GROOTVERLANGEN 409-IS **Figure 6.4**

Future 2021 Traffic Plus Development Trips - AM Peak Hour



PTN OF THE REM. OF PTN 2 OF THE FARM GROOTVERLANGEN 409-IS **Figure 6.5**

Future 2021 Traffic Plus Development Trips - PM Peak Hour



PTN OF THE REM. OF PTN 2 OF THE FARM GROOTVERLANGEN 409-IS **Figure 6.6**

Future 2021 Traffic Plus Development Trips – Saturday Peak Hour

7 DEFINITIONS RELEVANT TO CAPACITY ANALYSIS

The following definitions from the 2000 Highway Capacity Manual are used in this report. A revised LOS method for vehicles was introduced in HCM 2010 (TRB 2010). It offers an important variation on the Delay (HCM 2000) method in using both the average control delay and the v/c (demand volume / capacity) ratio, or degree of saturation for LOS determination.

Capacity
The maximum hourly rate at which vehicles can reasonably be expected to traverse a lane or roadway during a given period under prevailing traffic and control conditions.

Volume
The hourly rate of vehicle arrivals at an intersection.

Volume to capacity ratio (v/c)
Is the ratio of volume to capacity

Level of service
Level of service is defined in terms of delay. Delay is a measure of driver discomfort, frustration, fuel consumption and lost travel time. The levels of service for signalised and unsignalised intersections as defined in the Highway Capacity Manual are tabulated in **Table 7.1** below.

Table 7.1: Delay & v/c (HCM 2010) definitions for LOS Based on delay and v/c ratio

Level of Service for **v/c≤1.0**	Rating	Average delay per vehicle in seconds (d)			Level of Service for **v/c>1.0**
		Signals	“SIDRA Roundabout LOS” option	Priority Control *(HCM2010 default for roundabouts)*	All Intersection Types
A	Excellent	d ≤ 10	d ≤ 10	d ≤ 10	**F**
B	Very Good	10 < d ≤ 20	10 < d ≤ 20	10 < d ≤ 15	**F**
C	Good	20 < d ≤ 35	20 < d ≤ 35	15 < d ≤ 25	**F**
D	Acceptable	35 < d ≤ **55**	35 < d ≤ **50**	25 < d ≤ **35**	**F**
E	Poor	**55** < d ≤ 80	**50** < d ≤ 70	**35** < d ≤ 50	**F**
F	Very Poor	80 < d	70 < d	50 < d	**F**

Note: V/c (demand volume / capacity) ratio or degree of saturation: v/c > 1.0 represents oversaturated conditions.

An intersection is deemed to be operating acceptably at levels of service A to D. If an intersection operates at a level of service E or F or has a volume to capacity ratio higher than 0.95 the intersection is considered to be operating at capacity.

8 TRAFFIC IMPACT & CAPACITY ANALYSIS

8.1 Capacity Analysis

The traffic impact expected from the proposed development at the key intersections within the study area was determined using **Sidra Intersection 7**, a traffic engineering software package.

The weekday AM and PM peak hours as well as the Saturday Peak hour are considered the most critical peaks. Capacity analysis at the identified key intersections was undertaken for the following scenarios;

- *Scenario 1:* Existing 2016 background peak hour traffic flows (without development) – as per **Figures 2.2, 2.3 and 2.4.**
- *Scenario 2:* Future 2021 background traffic demand (without development) – as per **Figures 6.1, 6.2 and 6.3.**
- *Scenario 3:* Future 2021 background traffic with development trips – as per **Figures 6.4, 6.5 and 6.6.**

The key scenarios analysed would indicate intersections which might already have existing capacity problems where applicable, as well as upgrades that would be required to accommodate the future traffic demand.

Detailed results of Sidra Intersection Capacity Analysis are appended in **Annexure D.**

Notes:

1) *Only the **worst** levels of service (LOS), intersection delays and degree of saturation (v/c) are provided for the un-signalised intersections; and*
2) *The **overall** levels of service (LOS), intersection delays and degree of saturation (v/c) are provided for the signalised intersections in **Tables 8.1 to 8.7**.*

8.2 Road and/or Intersections Improvements

Given the type and extent of the development proposed, the expected peak trip generations and capacity analyses, roads and intersections upgrades required are briefly described below;

8.2.1 Beyers Naude Street / Krogh Street Intersection:

- Upgrades required by developer: - none
- Upgrades required by roads authority: - none

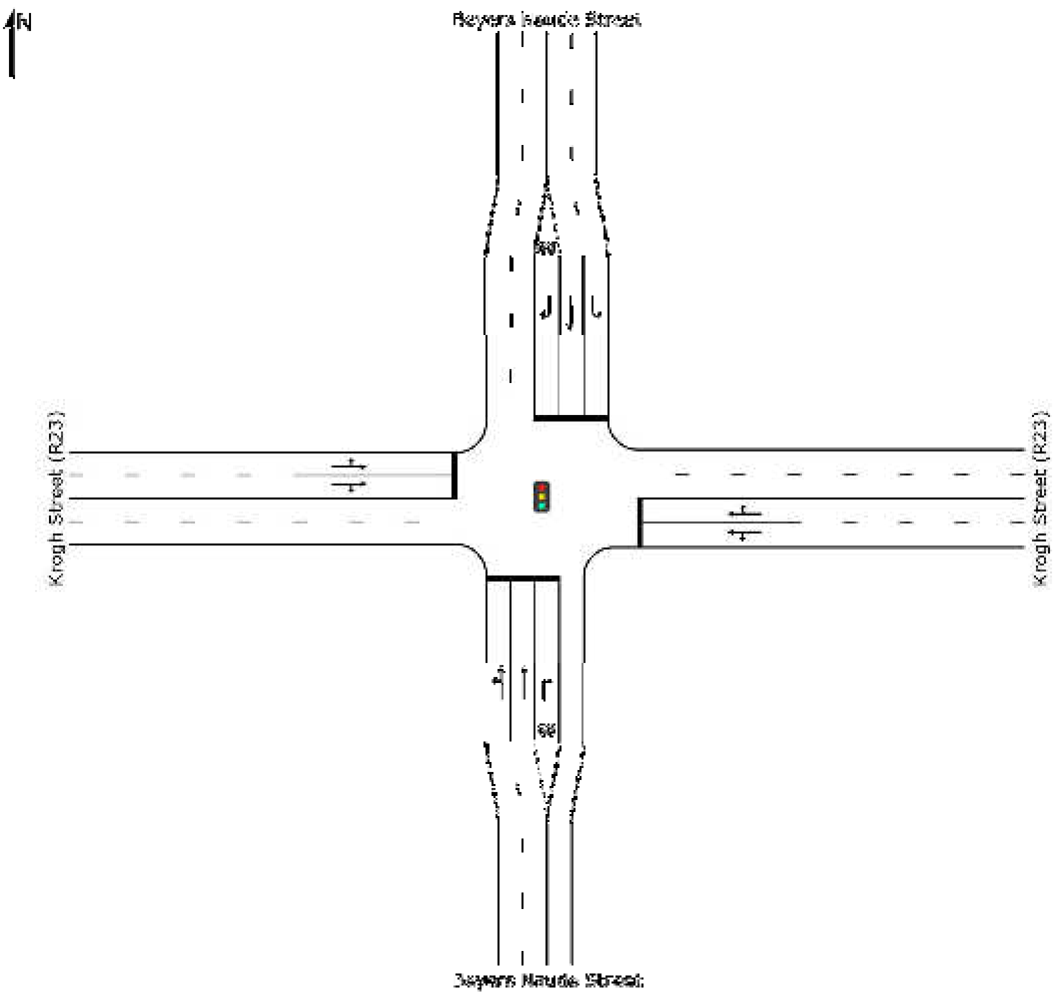
Table 8.1: Sidra Capacity Analysis Results Summarised

Description	Peak Period	Scenario Number 1 Signal control	 2 Signal control	 3 Signal control
Level of Service (LOS)	AM	B	B	B
	PM	B	B	B
	Sat.	B	B	B
Average Delays (sec.)	AM	15.0	15.4	15.4
	PM	15.5	15.9	16.1
	Sat.	15.9	16.2	17.0
Degree of Saturation (v/c)	AM	0.280	0.336	0.344
	PM	0.272	0.330	0.399
	Sat.	0.234	0.271	0.293
Concluding Remarks	The intersection currently operates acceptable during the peak periods and it has ample spare capacity to accommodate the future background as well as the development traffic impact.			

The existing intersection geometry is shown schematically in **Figure 8.1.**

Figure 8.1: Geometry - Beyers Naude Street / Krogh Street Intersection

Existing Intersection Geometry (Signalised)



Upgrades NOT Required

8.2.2 R23 / Minaar Street Intersection:

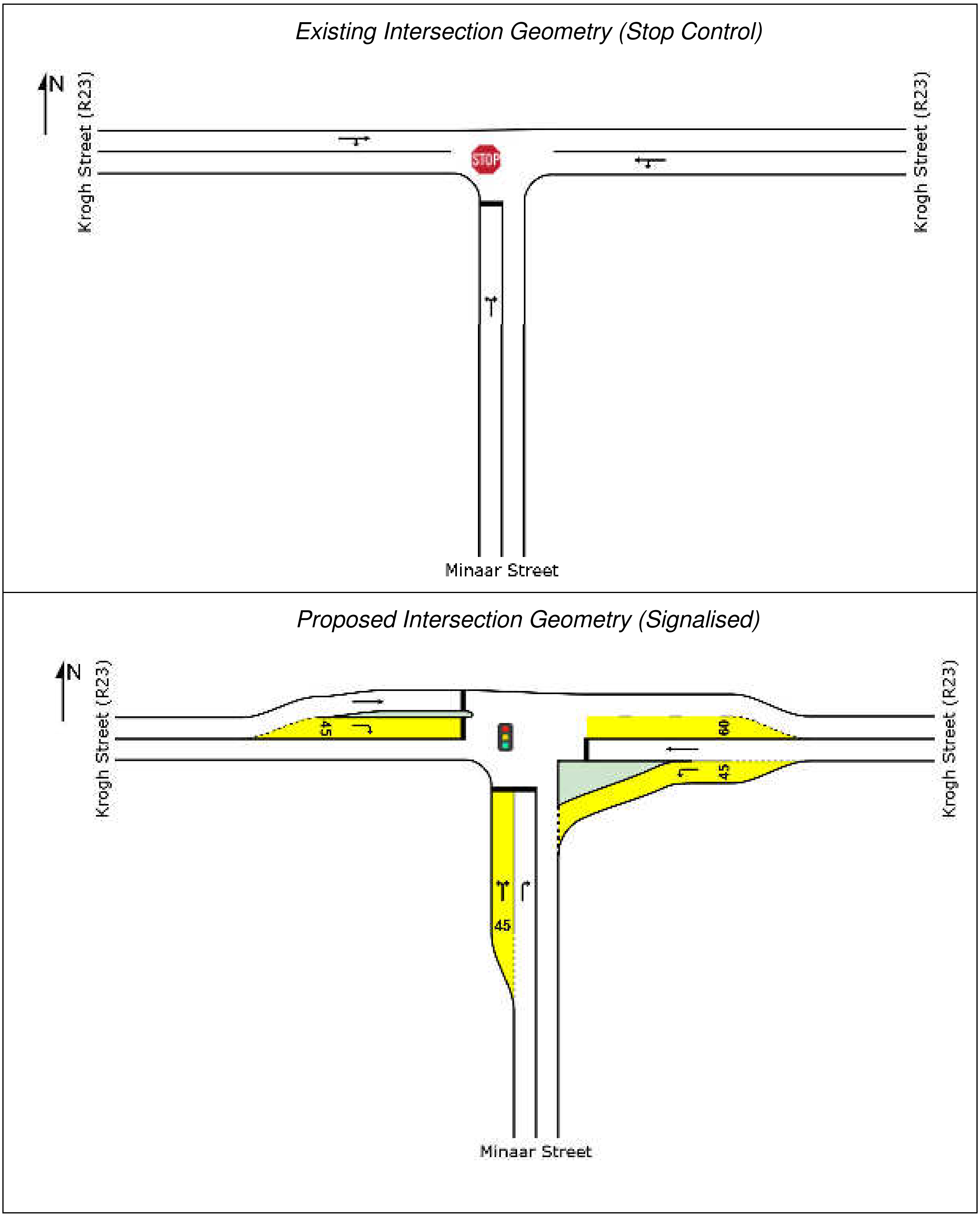
- Upgrades required by developer: - none
- Upgrades required by roads authority: - road widening and signalisation (warranted)

Table 8.2: Sidra Capacity Analysis Results Summarised

Description	Peak Period	Scenario Number 1 Stop control	2 Stop control	3 Signal control
Level of Service (LOS)	AM	C	F	B
	PM	C	D	A
	Sat.	C	D	B
Average Delays (sec.)	AM	22.1	66.6	14.1
	PM	19.1	27.7	9.2
	Sat.	18.5	25.7	11.3
Degree of Saturation (v/c)	AM	0.740	1.049	0.419
	PM	0.421	0.636	0.410
	Sat.	0.416	0.614	0.572
Concluding Remarks	The intersection currently operates acceptable during the peak periods, but the available spare capacity is not sufficient to cater for the future background traffic.			

The existing and proposed intersection geometry is shown schematically in **Figure 8.2.**

Figure 8.2: Geometry - R23 / Minaar Street Intersection



8.2.3 *Walter Sisulu Drive / Schwickard Street Intersection:*

- Upgrades required by developer: - Provide new site access, exclusive turning lanes on the main road and install traffic signals
- Upgrades required by roads authority: - none

Table 8.3: Sidra Capacity Analysis Results Summarised

Description	Peak Period	Scenario Number 1 Stop control	 2 Stop control	 3 Signal control
Level of Service (LOS)	**AM**	D	E	A
	PM	D	D	B
	Sat.	C	D	B
Average Delays (sec.)	**AM**	31.5	43.1	8.1
	PM	25.2	32.5	13.9
	Sat.	21.0	26.0	13.9
Degree of Saturation (v/c)	**AM**	0.148	0.176	0.255
	PM	0.132	0.153	0.278
	Sat.	0.123	0.143	0.282
Concluding Remarks	The intersection currently operates fairly acceptable during the peak periods. The shopping centre site is planned to gain access off Walter Sisulu Road, at this intersection and it will therefore become a 4-legged intersection.			

The existing and proposed intersection geometry is shown schematically in **Figure 4.2.**

8.2.4 *Walter Sisulu Drive / Handel Street Intersection:*

- Upgrades required by developer: - none
- Upgrades required by roads authority: - none

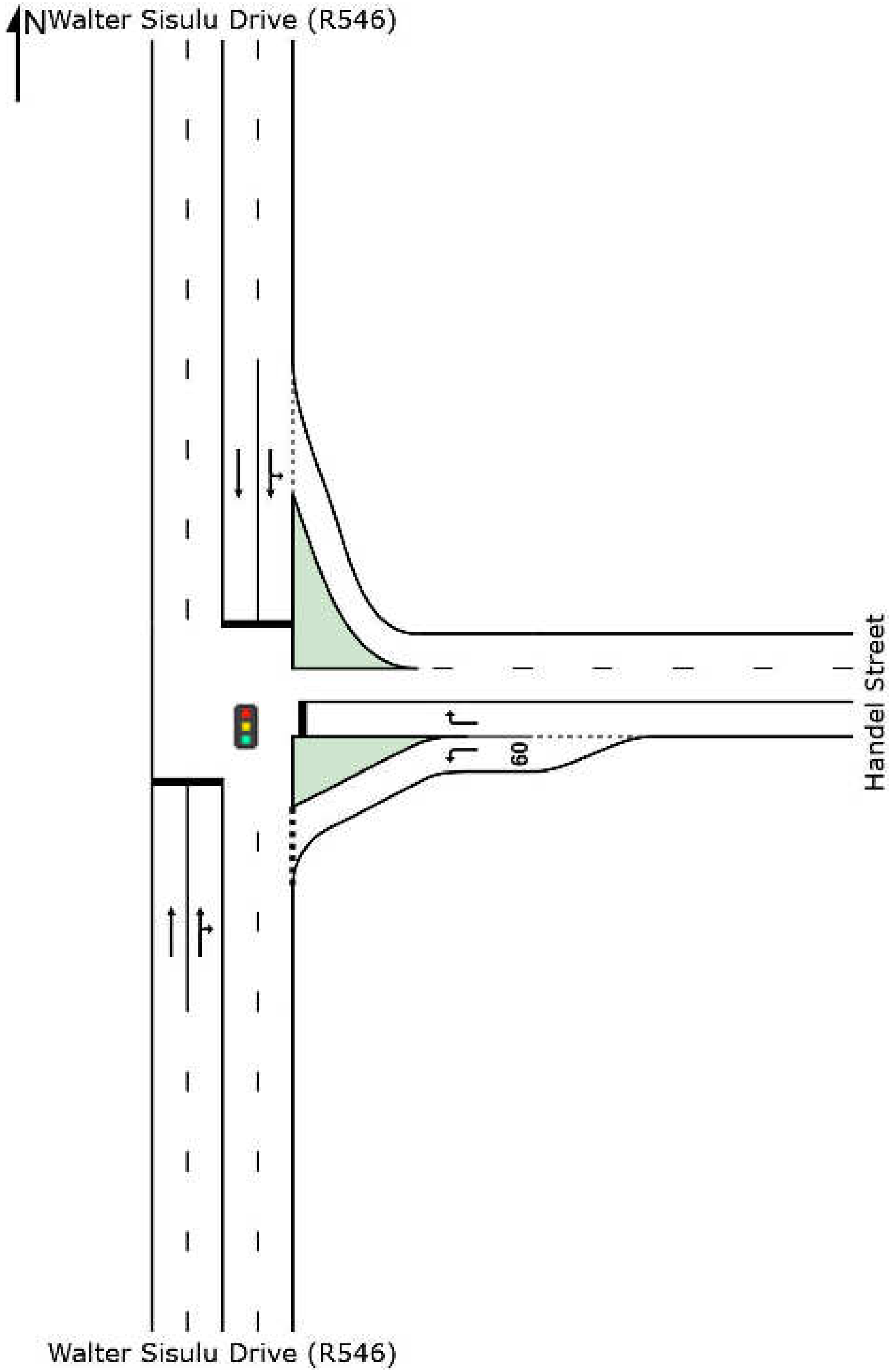
Table 8.4: Sidra Capacity Analysis Results Summarised

Description	Peak Period	Scenario Number 1 Signal control	 2 Signal control	 3 Signal control
Level of Service (LOS)	AM	B	B	B
	PM	B	B	B
	Sat.	B	B	B
Average Delays (sec.)	AM	12.9	13.0	13.4
	PM	11.2	11.2	12.2
	Sat.	11.9	12.2	13.6
Degree of Saturation (v/c)	AM	0.228	0.264	0.273
	PM	0.311	0.368	0.388
	Sat.	0.251	0.295	0.335
Concluding Remarks	The intersection currently operates acceptable during the peak periods and it has ample spare capacity to accommodate the future background as well as the development traffic impact.			

The existing intersection geometry is shown schematically in **Figure 8.3.**

Figure 8.3: Geometry - Walter Sisulu Drive / Handel Street Intersection

Existing Intersection Geometry (Signalised)



Upgrades NOT Required

8.2.5 Walter Sisulu Drive / Joubert Street Intersection:

- Upgrades required by developer: - Provide new site access, exclusive turning lanes on the main road and install traffic signals
- Upgrades required by roads authority: - none

Table 8.5: Sidra Capacity Analysis Results Summarised

Description		Scenario Number		
	Peak Period	1 Stop control	2 Stop control	3 Signal control
Level of Service (LOS)	AM	D	D	A
	PM	C	D	B
	Sat.	C	C	B
Average Delays (sec.)	AM	26.3	34.3	5.0
	PM	22.9	29.0	12.1
	Sat.	20.2	24.6	13.8
Degree of Saturation (v/c)	AM	0.147	0.169	0.237
	PM	0.126	0.146	0.263
	Sat.	0.123	0.142	0.340
Concluding Remarks	The intersection currently operates fairly acceptable during the peak periods. The shopping centre site is planned to gain another access off Walter Sisulu Road, at this intersection and it will therefore become a 4-legged intersection.			

The existing and proposed intersection geometry is shown schematically in **Figure 4.3.**

8.2.6 *Walter Sisulu Drive / Krogh Street Intersection:*

- Upgrades required by developer: - Lane remarking (exclusive right turning lanes along the main road) and signal optimisation
- Upgrades required by roads authority: - none

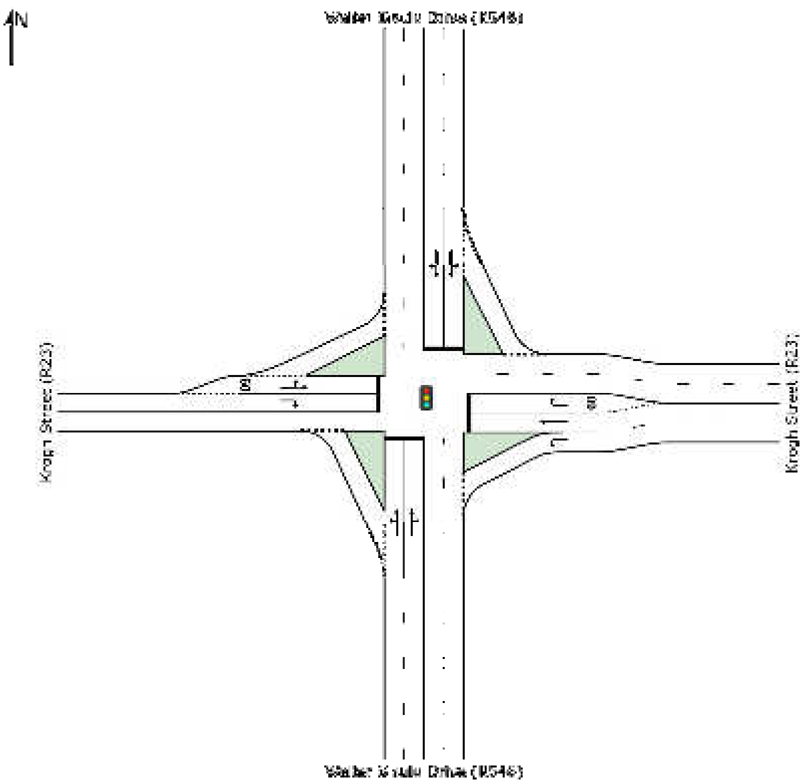
Table 8.6: Sidra Capacity Analysis Results Summarised

Description		Scenario Number		
	Peak Period	1 Signal control	2 Signal control	3 Signal control
Level of Service (LOS)	AM	C	C	C
	PM	B	B	C
	Sat.	B	B	C
Average Delays (sec.)	AM	20.4	28.4	22.5
	PM	17.5	18.6	24.9
	Sat.	15.8	16.4	23.0
Degree of Saturation (v/c)	AM	0.756	0.939	0.707
	PM	0.494	0.595	0.848
	Sat.	0.371	0.433	0.768
Concluding Remarks	The intersection currently operates acceptable during the peak periods, and it has ample spare capacity to continue doing so with the future background traffic. The intersection does not have sufficient spare capacity to also accommodate the anticipated development traffic impact.			

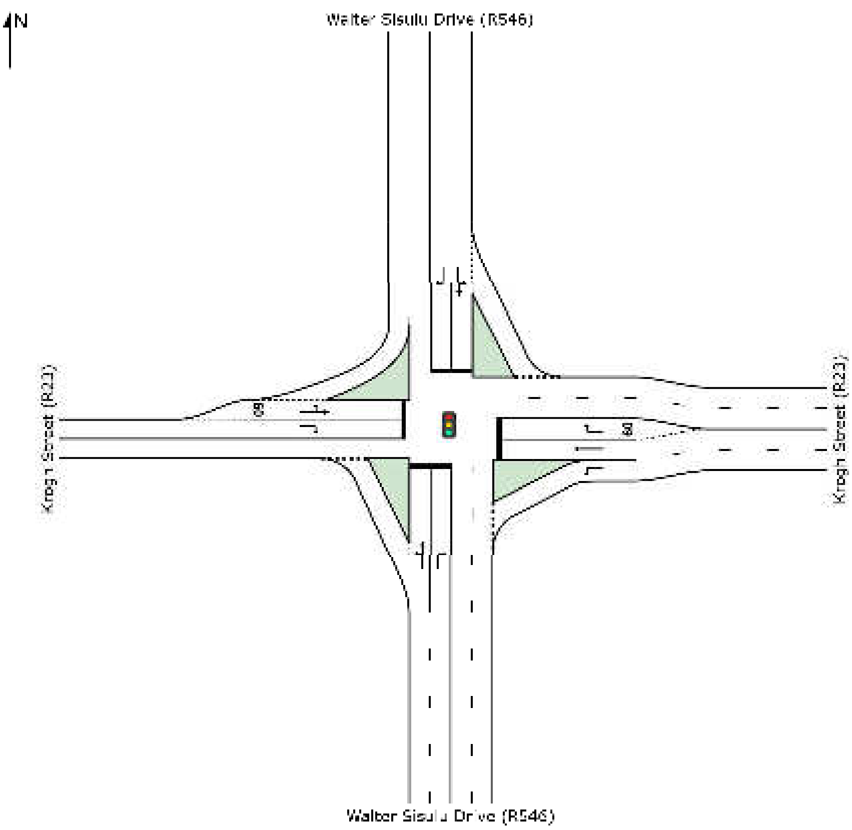
The existing and proposed intersection geometry is shown schematically in **Figure 8.4.**

Figure 8.4: Geometry - Walter Sisulu Drive / Krogh Street Intersection

Existing Intersection Geometry (Signalised)



Proposed Intersection Geometry (Signalised)



8.2.7 Walter Sisulu Drive / Kruger Street Intersection:

- Upgrades required by developer: - none
- Upgrades required by roads authority: - provision of exclusive turning lanes on the manor road and signalisation

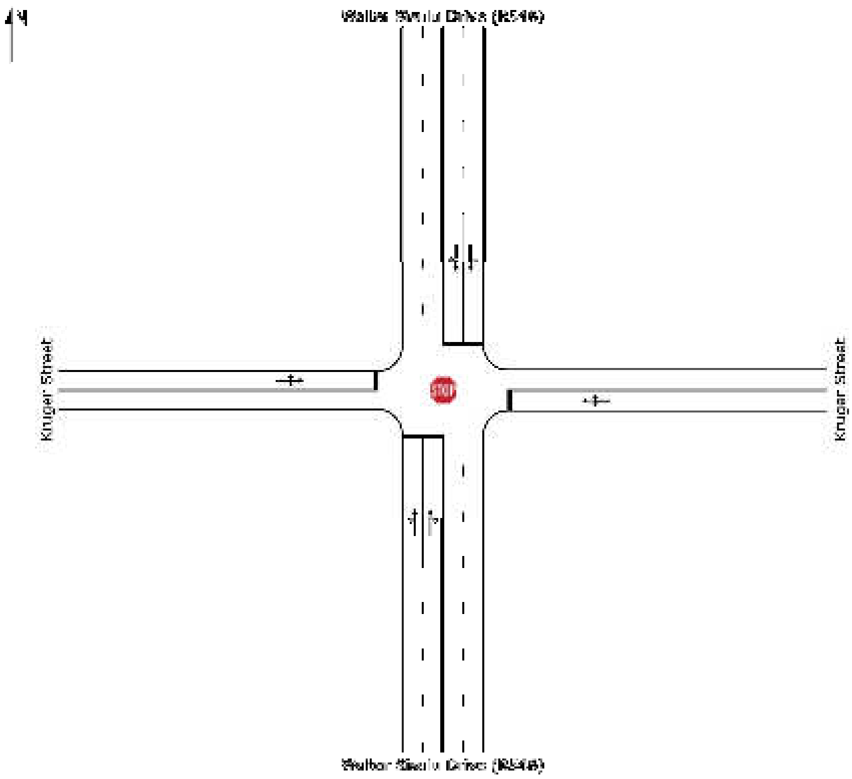
Table 8.7: Sidra Capacity Analysis Results Summarised

Description		**Scenario Number**		
	Peak Period	**1 Stop control**	**2 Signal control**	**3 Signal control**
Level of Service (LOS)	**AM**	F	A	A
	PM	F	A	A
	Sat.	E	A	A
Average Delays (sec.)	**AM**	66.5	6.3	6.4
	PM	366.0	4.9	5.4
	Sat.	40.4	4.6	5.7
Degree of Saturation (v/c)	**AM**	0.617	0.256	0.263
	PM	0.942	0.216	0.257
	Sat.	0.526	0.204	0.251
Concluding Remarks	This all-way stop controlled intersection already operates at congested levels of service during the peak periods. Signalisation (warranted) is considered a solution to this background capacity problem.			

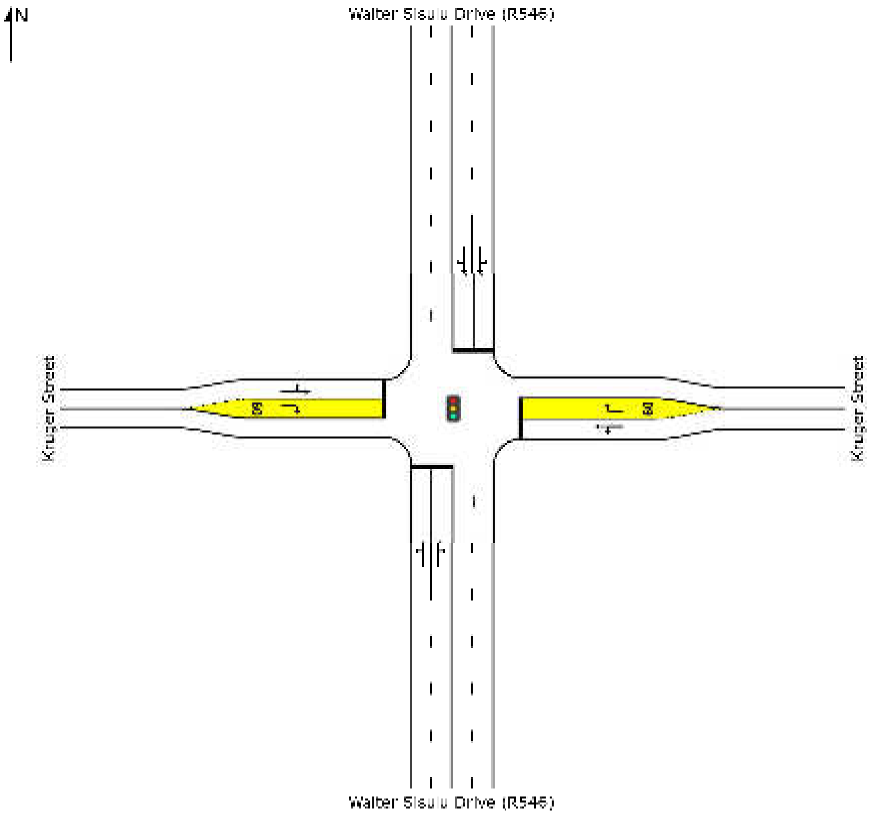
The existing and proposed intersection geometry is shown schematically in **Figure 8.5.**

Figure 8.5: Geometry - Walter Sisulu Drive / Kruger Street Intersection

Existing Intersection Geometry (Stop Control)



Proposed Intersection Geometry (Signalised)



8.2.8 *Walter Sisulu Drive / R39 Intersection:*

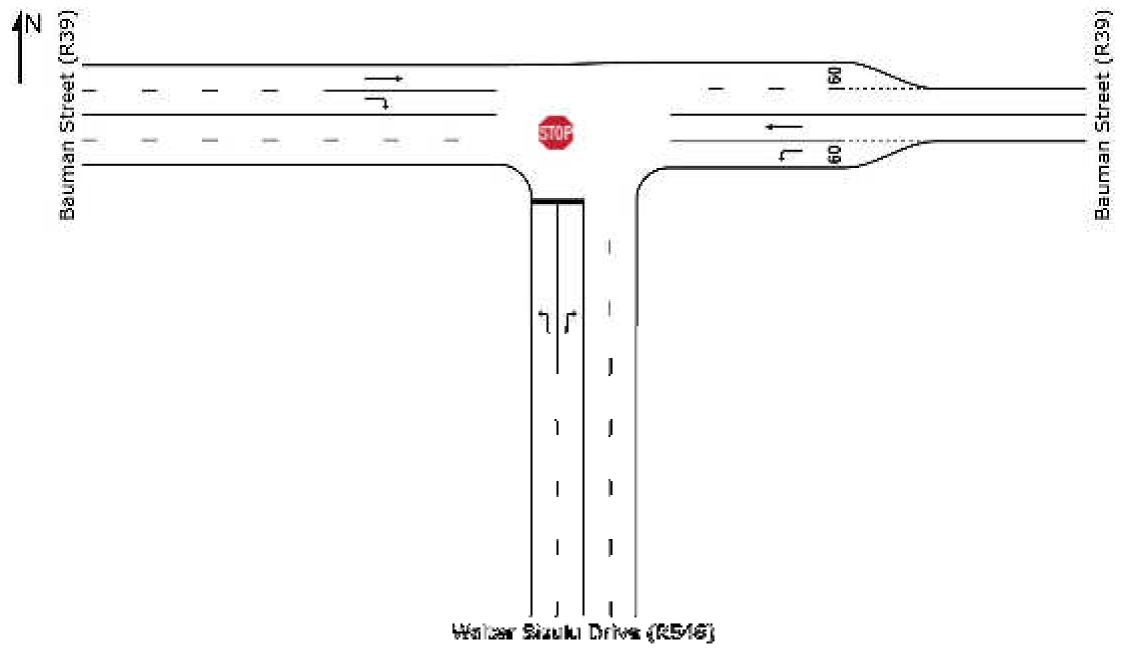
- Upgrades required by developer: - none
- Upgrades required by roads authority: - none at this stage – possible signalisation in the future only when warranted (currently not warranted)

Table 8.7: Sidra Capacity Analysis Results Summarised

Description	**Peak Period**	**Scenario Number** **1** **Stop control**	**2** **Stop control**	**3** **Stop control**
Level of Service (LOS)	**AM**	D	F	F
	PM	D	E	F
	Sat.	C	C	C
Average Delays (sec.)	**AM**	34.2	55.3	60.8
	PM	26.1	36.9	50.4
	Sat.	15.7	18.0	22.3
Degree of Saturation (v/c)	**AM**	0.433	0.526	0.580
	PM	0.472	0.577	0.664
	Sat.	0.178	0.213	0.348
Concluding Remarks	This intersection currently operates acceptable during the peak periods and it has ample spare capacity to accommodate the future background as well as the development traffic impact.			

The existing intersection geometry is shown schematically in **Figure 8.6.**

Figure 8.6: Geometry - Walter Sisulu Drive / R39 Intersection

Existing Intersection Geometry (Stop Control) 
Upgrades NOT Required

General note: It is recommended that the costs of roads upgrades requirements be offset against the payable bulk services contribution where applicable.

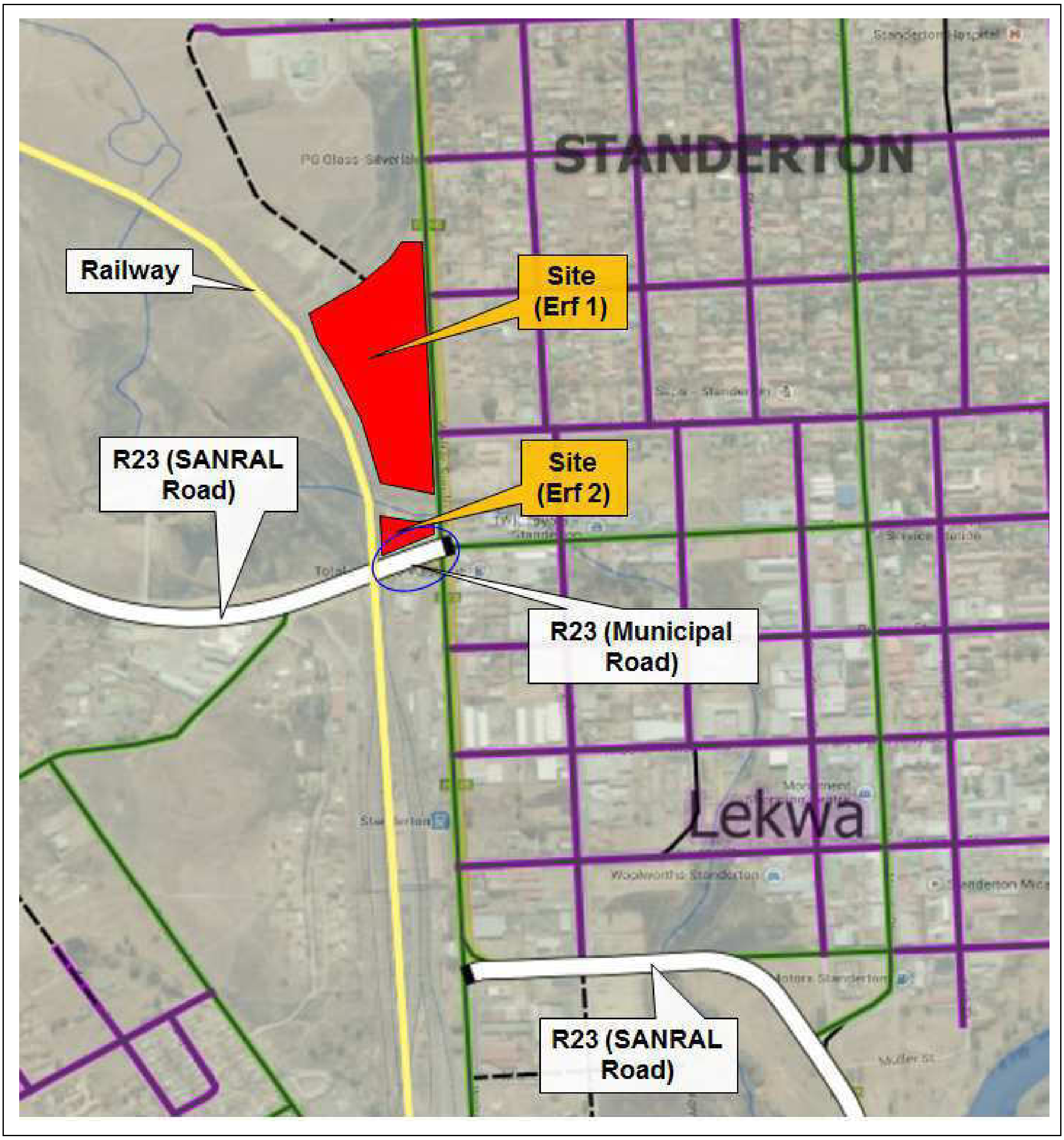
9 ROAD CLASSIFICATION PLAN

Appended in **Annexure E** is the roads classification map for the town of Standerton. Lekwa Municipality confirmed that there is no roads master plan or any future roads planning for the town of Standerton.

Important to note in this map is that there is a national road (R23) running in a north-west, south-east direction through the town of Standerton and just to the south of the proposed site.

Figure 9.1 depicts an extract of the roads classification map, whereby the site location is shown in relation to the R23 and all other roads in the immediate vicinity.

Figure 9.1: Extract Of the Standerton Roads Classification Map



The Erf 1 Site is bounded by the following;

- ✓ Class 4 District Collector Road (Walter Sisulu Drive) to the east (municipal road)
- ✓ Railway line to the west
- ✓ Stream to the south
- ✓ Vacant land to the north

The Erf 2 Site is bounded by the following;

- ✓ Stream to the north
- ✓ Class 4 District Collector Road (Walter Sisulu Drive) to the east (municipal road)
- ✓ National Road (R23) to the south (section of municipal road)
- ✓ Railway line to the west

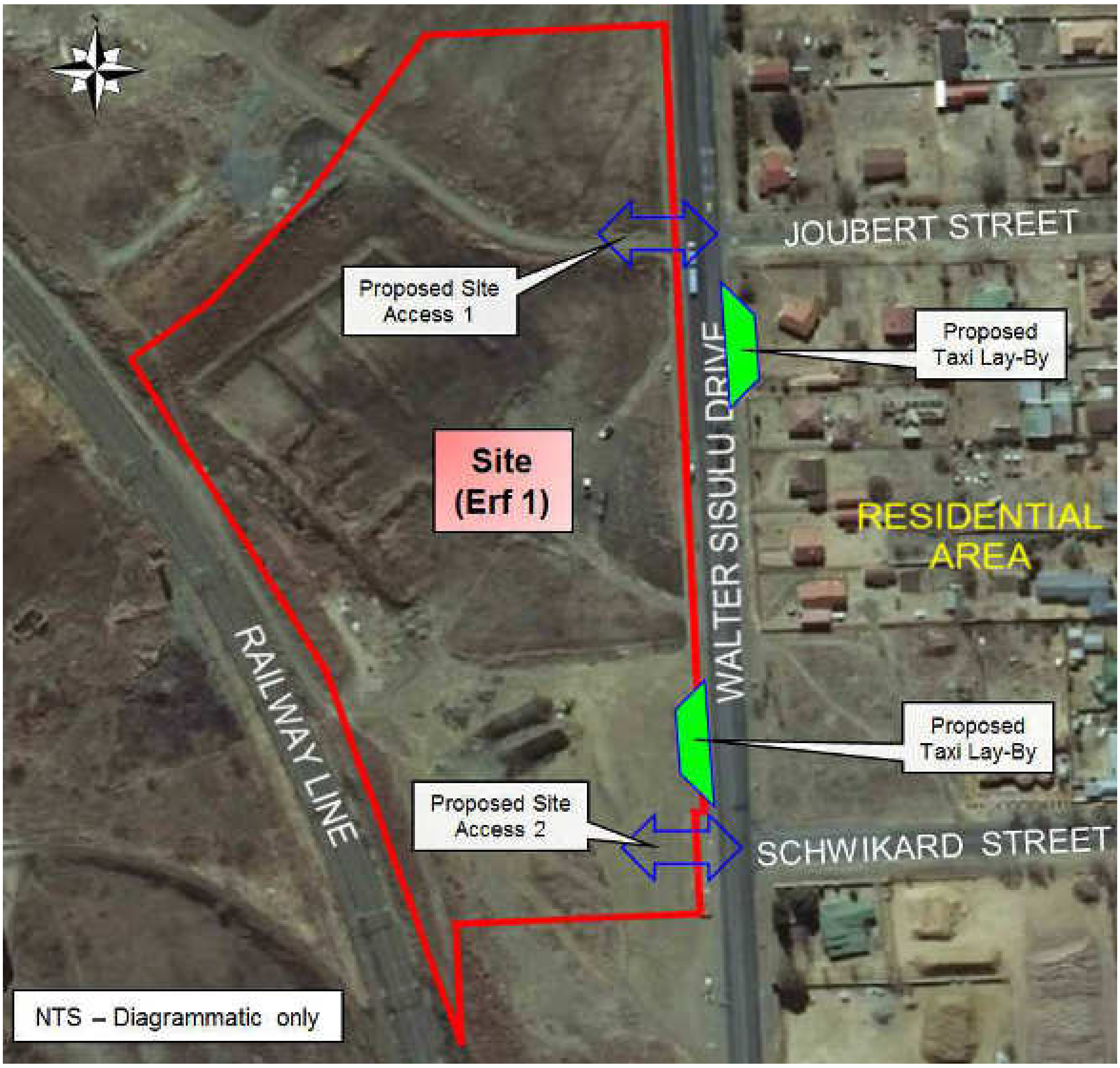
It is therefore concluded that the proposed site is well located within the existing roads network and would not interfere with any future roads planning. It is however recommended that the site erf boundary lines be excluded from the roads and railway reserves where applicable.

10 NON-MOTORISED & PUBLIC TRANSPORT

The site is located adjacent to Walter Sisulu Drive, one of the main public transport corridors in the area. Public transport is available in the form of minibus taxis, the most common form of public transport in the area. Being a public transport corridor, Walter Sisulu Drive, is one of the main roads in Standerton linking the northern and southern areas of the town with the advantage of passing through the CBD.

It is expected that the proposed shopping centre will result in jobs creation and generate the public transport users (i.e. employees who will depend on public transport to commute to work). Provision will be made for an on-site taxi holding area to cater for the non-motorised and public transport users. In addition, it is further proposed that two public transport lay-bys be provided along Walter Sisulu Drive, on the downstream sides of the site access intersections, to facilitate and ease the loading and offloading of passengers off-site (in the road reserve) – see **Figure 10.1**. Paved pedestrians walkways are also proposed along Walter Sisulu Drive, for the full length of the property frontage (both Site 1 and Site 2).

Figure 10.1: Location of the Proposed Public Transport Lay-Bys



11 CONCLUSIONS AND RECOMMENDATIONS

It is concluded and recommended from the investigations that;

- This Traffic Impact Assessment has been undertaken in support of the proposed township establishment on Portion of the Remainder of Portion 2 of the Farm Grootverlangen 409-IS, Standerton, in the Mpumalanga Province.
- The author of this study liaised with the affected roads` authorities prior compilation of this study.
- The township will comprise two separate erven and be developed as follows;
  - Erf 1: Shopping centre = ±19 459m²GLA
  - Erf 2: Fast food outlet (drive-thru) = ±350m²GLA
- This traffic study was conducted in terms of the requirements of *TMH 16 Volume 2 (South African Traffic Impact and Site Impact Assessment Standards and Requirements Manual)*, COTO, Version 1 dated August 2012.
- Manual traffic surveys were undertaken during the critical weekday morning and afternoon, as well as the Saturday peak periods at the key intersections within the study area.
- The *South African Trip Data Manual (TMH 17 – Volume 1 Dated September 2012)* has been used as a guideline to calculate the expected, estimated additional peak hour trip generation.
- The proposed development (two site collectively) is estimated to generate peak hour vehicular trips (in plus out incl. pass-by and diverted trips) of approximately 213, 843 and 1096 during the respective weekday AM, PM and Saturday peaks.
- Site access to be provided as discussed in this study.
- Parking to be provided as discussed in this study, and as agreed with the municipality.
- On-site public transport holding area to be provided.
- Two public transport lay-bys to be provided on the downstream sides of the proposed site access intersections (locations shown in **Figure 10.1**).
- Necessary roads and intersections upgrades to be undertaken as required, as discussed in Section 8 of this study.
- Construction costs of the public transport facilities and roads upgrades proposed, be offset against the payable bulk service contributions (if piratical and possible) where relevant.
- The proposed township establishment is supported from traffic and transportation engineering perspectives, and thus be approved by the roads authorities.

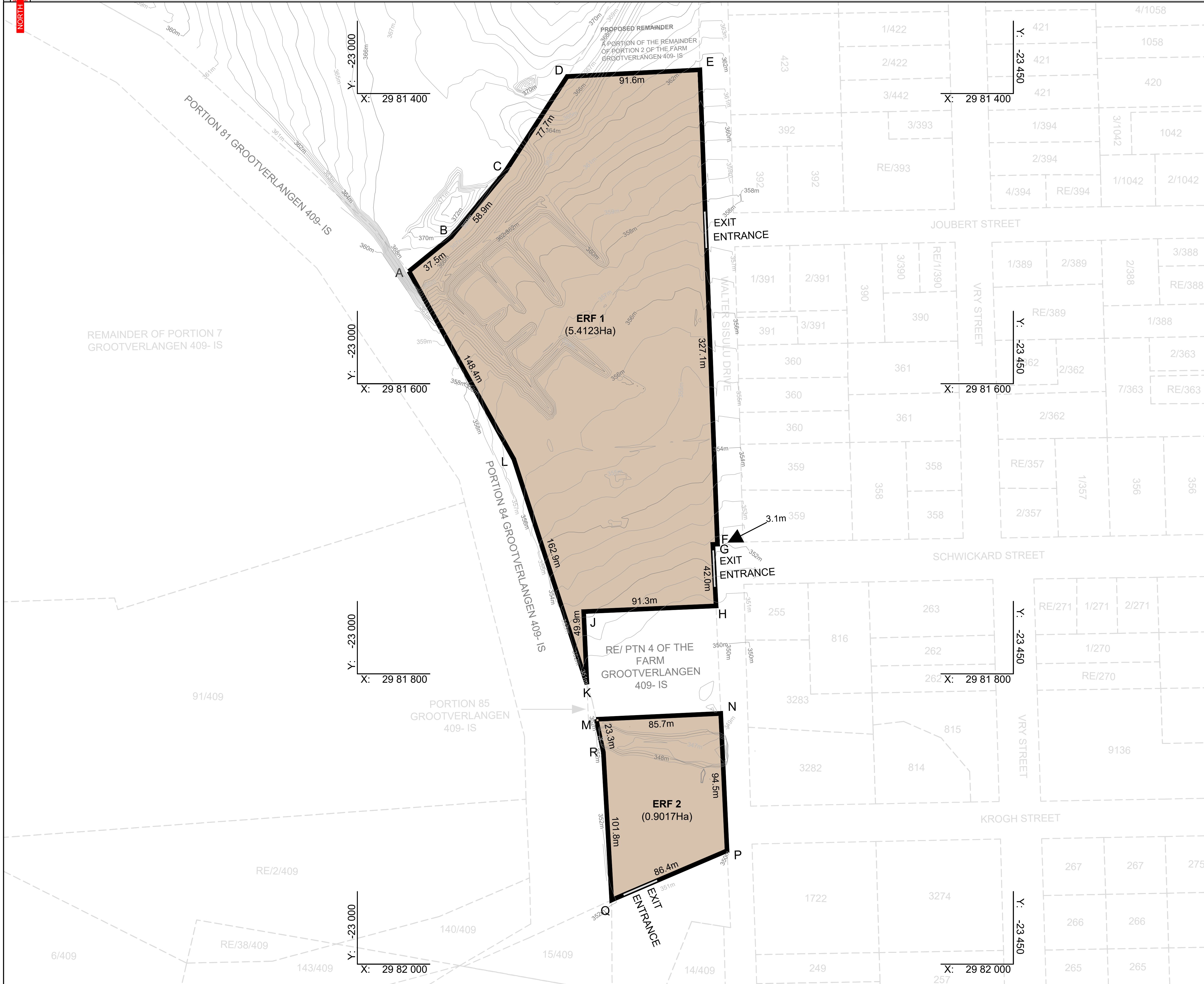
12 REFERENCES

1. Committee of Transport Officials (COTO) - *TMH16 Vol. 2 South African Traffic Impact and Site Impact Assessment Standards and Requirements Manual*, August 2012.
2. Committee of Transport Officials (COTO) - *TMH17 South Africa Trip Data Manual*, September 2012.
3. Committee of Transport Officials (COTO) – *TRH26 South Africa Road Classification and Access Management Manual (Version 1),* August 2012.
4. Committee of Transport Officials (COTO) - *TMH16 Vol. 1 South African Traffic Impact and Site Impact Assessment Manual*, August 2012.

Annexure A

Proposed Township Layout Plan

PROPOSED TOWNSHIP LAYOUT PLAN: STANDERTON EXTENSION 9



TOWNSHIP DETAILS

TOWNSHIP NAME: STANDERTON EXTENSION 9

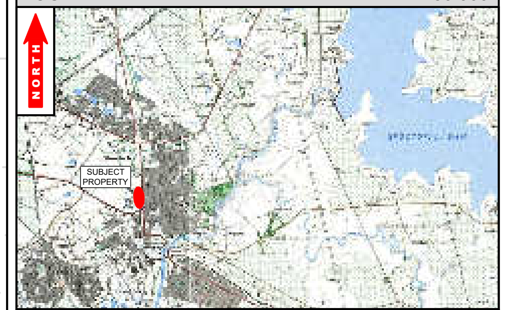
SITUATED ON: PORTIONS OF THE REMAINDER OF PORTION 2 OF THE FARM GROOTVERLANGEN 409- IS

LOCAL AUTHORITY: LEKWA LOCAL MUNICIPALITY

PROVINCE: MPUMALANGA

SCALE: 1: 3 000

LOCALITY MAP 1 : 50 000



BAR SCALE 1: 200 000	1 000m	1 000m	1 000m	1 000m	1 000m	1 000m

LEGEND

COLOUR NOTATION	USE ZONE	ZONING	ERF NUMBER	NO OF ERVEN	AREA IN Ha.	% OF AREA
	10	SPECIAL	1	1	5.4123	86
	10	SPECIAL	2	1	0.9017	14
TOTAL			-	2	6.3140	100

GENERAL NOTES

1. FIGURE A,B,C,D,E,F,G,H,J,K,L,A AND M,N,P,Q,R,M REPRESENTS THE OUTSIDE FIGURE OF THE PROPOSED STANDERTON EXTENSION 9, MEASURING ±6.3140Ha IN EXTENT.
2. THE CONTOURS ARE DRAWN IN 0.5m INTERVALS AND WAS SURVEYED BY REED GEOMATICS INC.
3. CONTOUR DATUM PLAN: MEAN SEA LEVEL (MSL).
4. CONTOUR SYSTEM: WGS 84.
5. CADASTRAL BOUNDARIES:
6. GEOTECHNICAL ZONES:
7. 1:50 YEAR FLOODLINE:
   1:100 YEAR FLOODLINE:
8. **ALL AREAS AND MEASUREMENTS INDICATED ARE APPROXIMATE AND SUBJECT TO FINAL SURVEY.**

GEOTECHNICAL ZONES

	NHBRC	CLASS	DESCRIPTION	TYPICAL SOIL PROFILES

GEOTECHNICAL NOTE

THIS IS TO CERTIFY THAT THE TOWNSHIP LAYOUT ON THIS PLAN IS IN ACCORDANCE WITH THE PROVISIONS AND RECOMMENDATIONS AS SET OUT IN THE GEOTECHNICAL INVESTIGATION FOR THE PROPOSED TOWNSHIP OF STANDERTON EXTENSION 9, REPORT No ____________, CONDUCTED BY .

NAME ____________ DATE ____________

SIGNATURE ____________ REG NO. ____________

FLOODLINE NOTE

IT IS HEREBY CERTIFIED THAT, IN TERMS OF THE PROVISIONS OF SECTION 144 OF THE NATIONAL WATER ACT, 1998 (ACT 36 OF 1998), THE AREA TAKEN UP BY THE PROPOSED TOWNSHIP DENOTED ON THE PLAN ENCLOSED HEREWITH IS AFFECTED BY A 1: 50 OR 1: 100 YEAR FLOOD LINE AND ARE CORRECTLY INDICATED ON THE PLAN.

NAME ____________ DATE ____________

SIGNATURE ____________ REG NO. ____________

DRAWING PARTICULARS

DESIGNED:	-
DRAWN:	K KRUGER
SCALE:	1: 2 500 (PAPER A3)
DATE:	2016-07-13
LAYOUT PLAN NO:	STDT X 9
DRAWING NUMBER:	MP.A03_2016-07-13_STANDERTON X 9

DRAWING NO: MP.A03_2016-07-13_STANDERTON X 9

PLAN NO 7

Annexure B

Proposed Site Development Plan (SDP)

standerton proposed retail development

TOWN PLANNING CONDITIONS

SITE NAMES	- ERF 1 STANDERTON EXTENSION 5 &
	- ERF 2 STANDERTON EXTENSION 9
SITE AREA	- ERF 1 - 5.4173 Ha
	ERF 2 - 0.8017 HA
ZONING	- ERF 1 - 'SPECIAL'
	- ERF 2 - 'SPECIAL'
F.A.R.	- ERF 1 - 0.4
	- ERF 2 - 0.1
PARKING	
- ERF 1	- 5 spaces/100sq.m.G.L.A WHICH MAY BE RELAXED BY DOX WITH APPROVAL AND WITH THE PROVISO THAT AN ON-SITE TAXI HOLDING AREA IS PROVIDED i.e.5.5spaces/100sq.m.GLA
- ERF 2	- 5 spaces/100sq.m.GLA
BUILDING LINES	- 5m TO WALTER SISULU DRIVE & REMAINDER OF PORTION GROOTVERLANGEN 409-IS 15m TO PORTION 84 OF THE FARM GROOTVERLANGEN 409-IS 3m ELSEWHERE

PROPOSED NEW DEVELOPMENT

ALLOWANCES	ALLOWABLE	ACTUAL
COVERAGE		
- ERF 1	80%	43.80% (23 720sq.m.)
- ERF 2	80%	4.21% (+/-380sq.m.)
HEIGHT		
- ERF 1	2 STOREYS	2 STOREYS
- ERF 2	2 STOREYS	1 STOREY
F.A.R.		
- ERF 1	0.4	0.38 (19 450sq.m.)
- ERF 2	0.1	0.04 (380sq.m.)

SCHEDULE OF AREAS G.L.A. :-

ERF 1	
SUPERMARKET	- 3 305 sq.m.
LARGE SHOP	- 1 132 sq.m.
FASHION	- 2 010sq.m.
SATELLITE SHOPS & FOOD	- 11 440 sq.m.
VALUE RETAIL	- 772 sq.m.
TOTAL	- 18 458 sq.m.
ERF 2	
FAST FOOD DRIVE THRU'	- +/-350sq.m.
TOTAL	- +/-350sq.m.
GRAND TOTAL	- 18 808sq.m.

PARKING CALCULATION :-

PARKING PROVIDED	
ERF 1	
OPEN PARKING	- [illegible] spaces
COVERED	- [illegible] spaces
TOTAL	- [illegible] spaces
i.e.4.43spaces/100sq.m. GLA	
TAXI HOLDING AREA	10 taxis
ERF 2	
OPEN PARKING	- 45 spaces
TOTAL	- 45 spaces
i.e.11.7spaces/100sq.m.GLA	

development plan

ARCHITECTURE

Annexure C

Detailed Calculations of Development Trips Generation

TMH17 VOL. 1 - SOUTH AFRICAN TRIP DATA MANUAL - COTO

Project name: Standerton Mall
Project number : 2016-052

Ref No.	Land Use Type	Size	Unit (m^2 GLA)	AM Rate	PM Rate	Sat Rate	Size Adj. Factor	Trip Generation Adjustment Factors: Low Veh. Ownership	Transit Corridor	Combined Fact. (P_c)	Directional split: AM Peak In	AM Peak Out	PM Peak In	PM Peak Out	Sat Peak In	Sat Peak Out	Peak Hour	% Primary Trips	% Passer By Trips	% Diverted Trips
820	Retail Centre	19 459,00	100	0,60	3,40	4,50	1,91	0,30	0,15	0,41	65%	35%	50%	50%	50%	50%	PM	40%	40%	20%
																	Sat.	65%	20%	15%
933	Fast Food	350,00	100	45,00	50,00	55,00	1,00	0,40	0,15	0,49	55%	45%	55%	45%	50%	50%	PM	23%	52%	25%
																	Sat.	23%	52%	25%
Total Trip Generation																				

Ref No.	Land Use Type	Total Trips Generated: AM Peak In	AM Peak Out	AM Peak Total	PM Peak In	PM Peak Out	PM Peak Total	Sat Peak In	Sat Peak Out	Sat Peak Total	Primary Trips Generated: AM Peak In	AM Peak Out	AM Peak Total	PM Peak In	PM Peak Out	PM Peak Total	Sat Peak In	Sat Peak Out	Sat Peak Total
820	Retail Centre	86	47	133	377	377	754	499	499	998	35	19	53	151	151	301	324	324	648
933	Fast Food	44	36	80	49	40	89	49	49	98	10	8	18	11	9	21	11	11	23
Total Trip Generation		***131***	***83***	***213***	***426***	***417***	***843***	***548***	***548***	***1096***	***45***	***27***	***72***	***162***	***160***	***322***	***336***	***336***	***671***

Ref No.	Land Use Type	Passer By Trips Generated: AM Peak In	AM Peak Out	AM Peak Total	PM Peak In	PM Peak Out	PM Peak Total	Sat Peak In	Sat Peak Out	Sat Peak Total	Diverted Trips Generated: AM Peak In	AM Peak Out	AM Peak Total	PM Peak In	PM Peak Out	PM Peak Total	Sat Peak In	Sat Peak Out	Sat Peak Total
820	Retail Centre	35	19	53	151	151	301	100	100	200	17	9	27	75	75	151	75	75	150
933	Fast Food	23	19	42	26	21	46	26	26	51	11	9	20	12	10	22	12	12	25
Total Trip Generation		***58***	***37***	***95***	***176***	***172***	***348***	***125***	***125***	***251***	***28***	***18***	***47***	***88***	***85***	***173***	***87***	***87***	***174***

P1

Calculation of the Size Adj. Fact.	
GLA	19 459,00
	1,00
A	6,00
B	3 500,00

Annexure D

Outputs of the SIDRA 7 Intersection Capacity Analyses at the following

- ✓ Beyers Naude Street / Krogh Street Intersection
- ✓ R23 / Minaar Street Intersection
- ✓ Walter Sisulu Drive / Schwickard Street Intersection
- ✓ Walter Sisulu Drive / Handel Street Intersection
- ✓ Walter Sisulu Drive / Joubert Street Intersection
- ✓ Walter Sisulu Drive / Krogh Street Intersection
- ✓ Walter Sisulu Drive / Kruger Street Intersection
- ✓ Walter Sisulu Drive / R39 Intersection

MOVEMENT SUMMARY

Site: v [Existing 2016 AM Peak Hour Traffic Flows]

Krogh Street (R23) / Beyers Naude Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Beyers Naude Street											
1	L2	45	2,0	0,151	13,1	LOS B	2,6	18,7	0,50	0,49	50,9
2	T1	287	2,0	0,151	7,5	LOS A	2,7	18,9	0,50	0,44	52,9
3	R2	16	2,0	0,026	14,0	LOS B	0,3	1,8	0,50	0,66	47,5
Approach		348	2,0	0,151	8,5	LOS A	2,7	18,9	0,50	0,46	52,4
East: Krogh Street (R23)											
4	L2	24	2,0	0,198	26,2	LOS C	2,9	20,4	0,80	0,66	43,2
5	T1	107	2,0	0,198	21,3	LOS C	2,9	20,4	0,80	0,67	43,6
6	R2	48	2,0	0,198	29,0	LOS C	2,0	14,2	0,83	0,71	40,9
Approach		180	2,0	0,198	24,0	LOS C	2,9	20,4	0,81	0,68	42,8
North: Beyers Naude Street											
7	L2	63	2,0	0,060	12,6	LOS B	0,9	6,7	0,47	0,67	48,5
8	T1	219	2,0	0,197	7,7	LOS A	3,6	25,5	0,51	0,43	53,2
9	R2	166	2,0	0,280	15,0	LOS B	3,1	22,2	0,57	0,73	47,0
Approach		448	2,0	0,280	11,1	LOS B	3,6	25,5	0,53	0,57	50,1
West: Krogh Street (R23)											
10	L2	58	2,0	0,267	26,7	LOS C	3,9	27,5	0,81	0,70	42,5
11	T1	141	2,0	0,267	21,6	LOS C	3,9	27,5	0,82	0,71	43,1
12	R2	56	2,0	0,267	27,8	LOS C	3,1	21,8	0,83	0,71	41,9
Approach		255	2,0	0,267	24,1	LOS C	3,9	27,5	0,82	0,71	42,7
All Vehicles		1232	2,0	0,280	15,0	LOS B	3,9	27,5	0,62	0,59	47,8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Existing 2016 PM Peak Hour Traffic Flows]

Krogh Street (R23) / Beyers Naude Street Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Beyers Naude Street											
1	L2	65	2,0	0,184	14,8	LOS B	3,3	23,5	0,55	0,55	49,5
2	T1	311	2,0	0,184	9,2	LOS A	3,4	24,0	0,55	0,50	51,6
3	R2	18	2,0	0,035	16,9	LOS B	0,3	2,4	0,57	0,67	45,8
Approach		394	2,0	0,184	10,5	LOS B	3,4	24,0	0,55	0,51	50,9
East: Krogh Street (R23)											
4	L2	14	2,0	0,159	23,6	LOS C	2,5	17,5	0,74	0,61	44,9
5	T1	87	2,0	0,159	18,1	LOS B	2,5	17,5	0,74	0,61	45,9
6	R2	76	2,0	0,215	27,6	LOS C	2,1	14,8	0,81	0,75	40,7
Approach		177	2,0	0,215	22,6	LOS C	2,5	17,5	0,77	0,67	43,5
North: Beyers Naude Street											
7	L2	39	2,0	0,040	14,0	LOS B	0,6	4,5	0,50	0,67	47,7
8	T1	280	2,0	0,272	9,8	LOS A	5,3	37,4	0,59	0,50	51,7
9	R2	142	2,0	0,272	17,3	LOS B	2,9	21,0	0,63	0,74	45,7
Approach		461	2,0	0,272	12,5	LOS B	5,3	37,4	0,59	0,59	49,4
West: Krogh Street (R23)											
10	L2	147	2,0	0,263	24,4	LOS C	4,0	28,8	0,78	0,75	42,2
11	T1	97	2,0	0,263	19,0	LOS B	4,0	28,8	0,77	0,69	44,4
12	R2	52	2,0	0,263	24,6	LOS C	3,5	24,9	0,77	0,68	43,9
Approach		296	2,0	0,263	22,7	LOS C	4,0	28,8	0,78	0,72	43,2
All Vehicles		1327	2,0	0,272	15,5	LOS B	5,3	37,4	0,65	0,61	47,4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Existing 2016 Sat. Peak Hour Traffic Flows]

Krogh Street (R23) / Beyers Naude Street Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Beyers Naude Street											
1	L2	66	2,0	0,189	17,1	LOS B	3,4	23,9	0,61	0,60	47,8
2	T1	277	2,0	0,189	11,5	LOS B	3,4	24,4	0,61	0,54	49,9
3	R2	16	2,0	0,031	18,7	LOS B	0,3	2,3	0,62	0,67	44,8
Approach		359	2,0	0,189	12,9	LOS B	3,4	24,4	0,61	0,56	49,3
East: Krogh Street (R23)											
4	L2	9	2,0	0,032	19,8	LOS B	0,5	3,5	0,65	0,56	46,1
5	T1	14	2,0	0,032	14,3	LOS B	0,5	3,5	0,65	0,56	47,2
6	R2	25	2,0	0,059	23,2	LOS C	0,6	4,3	0,71	0,69	42,8
Approach		48	2,0	0,059	20,0	LOS C	0,6	4,3	0,68	0,63	44,6
North: Beyers Naude Street											
7	L2	15	2,0	0,017	16,0	LOS B	0,3	1,9	0,55	0,65	46,4
8	T1	211	2,0	0,230	11,8	LOS B	4,3	30,3	0,63	0,52	50,3
9	R2	100	2,0	0,208	19,4	LOS B	2,2	15,6	0,66	0,73	44,5
Approach		325	2,0	0,230	14,3	LOS B	4,3	30,3	0,63	0,59	48,2
West: Krogh Street (R23)											
10	L2	165	2,0	0,234	21,3	LOS C	3,8	27,4	0,71	0,75	43,5
11	T1	42	2,0	0,229	15,8	LOS B	3,2	22,6	0,71	0,70	45,4
12	R2	94	2,0	0,229	21,4	LOS C	3,2	22,6	0,71	0,70	44,6
Approach		301	2,0	0,234	20,6	LOS C	3,8	27,4	0,71	0,73	44,1
All Vehicles		1034	2,0	0,234	15,9	LOS B	4,3	30,3	0,65	0,62	47,1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 AM Peak Hour Traffic Flows]

Krogh Street (R23) / Beyers Naude Street Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Beyers Naude Street											
1	L2	53	2,0	0,170	12,7	LOS B	3,0	21,2	0,49	0,49	51,2
2	T1	333	2,0	0,170	7,1	LOS A	3,0	21,5	0,49	0,44	53,2
3	R2	18	2,0	0,031	14,1	LOS B	0,3	2,1	0,50	0,66	47,5
Approach		403	2,0	0,170	8,2	LOS A	3,0	21,5	0,49	0,46	52,7
East: Krogh Street (R23)											
4	L2	28	2,0	0,250	27,4	LOS C	3,5	25,3	0,82	0,68	42,7
5	T1	124	2,0	0,250	22,5	LOS C	3,5	25,3	0,83	0,69	43,0
6	R2	56	2,0	0,250	31,2	LOS C	2,3	16,4	0,87	0,73	39,8
Approach		208	2,0	0,250	25,5	LOS C	3,5	25,3	0,84	0,70	42,1
North: Beyers Naude Street											
7	L2	74	2,0	0,068	12,2	LOS B	1,1	7,6	0,45	0,67	48,8
8	T1	254	2,0	0,223	7,4	LOS A	4,1	29,2	0,51	0,43	53,5
9	R2	193	2,0	0,335	15,4	LOS B	3,8	26,8	0,59	0,74	46,8
Approach		520	2,0	0,335	11,0	LOS B	4,1	29,2	0,53	0,58	50,2
West: Krogh Street (R23)											
10	L2	67	2,0	0,336	28,0	LOS C	4,8	34,3	0,85	0,73	41,9
11	T1	163	2,0	0,336	23,2	LOS C	4,8	34,3	0,85	0,73	42,3
12	R2	64	2,0	0,336	30,0	LOS C	3,6	25,5	0,87	0,74	40,8
Approach		295	2,0	0,336	25,8	LOS C	4,8	34,3	0,85	0,73	41,9
All Vehicles		1426	2,0	0,336	15,4	LOS B	4,8	34,3	0,63	0,59	47,5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 PM Peak Hour Traffic Flows]

Krogh Street (R23) / Beyers Naude Street Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Beyers Naude Street											
1	L2	76	2,0	0,208	14,4	LOS B	3,8	26,9	0,55	0,55	49,7
2	T1	360	2,0	0,208	8,8	LOS A	3,9	27,4	0,55	0,50	51,9
3	R2	21	2,0	0,043	17,0	LOS B	0,4	2,9	0,58	0,68	45,7
Approach		457	2,0	0,208	10,1	LOS B	3,9	27,4	0,55	0,51	51,2
East: Krogh Street (R23)											
4	L2	16	2,0	0,192	24,6	LOS C	2,9	21,0	0,77	0,63	44,3
5	T1	101	2,0	0,192	19,1	LOS B	2,9	21,0	0,77	0,63	45,3
6	R2	87	2,0	0,279	29,8	LOS C	2,5	18,0	0,85	0,76	39,8
Approach		204	2,0	0,279	24,1	LOS C	2,9	21,0	0,80	0,69	42,7
North: Beyers Naude Street											
7	L2	45	2,0	0,045	13,5	LOS B	0,7	5,1	0,49	0,67	47,9
8	T1	324	2,0	0,307	9,4	LOS A	6,1	43,1	0,58	0,50	52,0
9	R2	165	2,0	0,330	17,8	LOS B	3,6	25,3	0,65	0,75	45,4
Approach		535	2,0	0,330	12,4	LOS B	6,1	43,1	0,60	0,59	49,4
West: Krogh Street (R23)											
10	L2	171	2,0	0,322	25,6	LOS C	4,9	35,2	0,81	0,77	41,6
11	T1	113	2,0	0,322	20,8	LOS C	4,9	35,2	0,82	0,72	43,4
12	R2	60	2,0	0,322	26,5	LOS C	4,3	30,3	0,82	0,71	42,8
Approach		343	2,0	0,322	24,2	LOS C	4,9	35,2	0,81	0,74	42,4
All Vehicles		1539	2,0	0,330	15,9	LOS B	6,1	43,1	0,66	0,61	47,2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 Sat. Peak Hour Traffic Flows]

Krogh Street (R23) / Beyers Naude Street Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Beyers Naude Street											
1	L2	77	2,0	0,219	17,3	LOS B	4,0	28,2	0,62	0,61	47,7
2	T1	321	2,0	0,219	11,7	LOS B	4,0	28,8	0,62	0,55	49,8
3	R2	18	2,0	0,037	19,4	LOS B	0,4	2,7	0,63	0,68	44,4
Approach		416	2,0	0,219	13,1	LOS B	4,0	28,8	0,62	0,57	49,1
East: Krogh Street (R23)											
4	L2	11	2,0	0,036	19,9	LOS B	0,6	4,0	0,65	0,56	46,2
5	T1	16	2,0	0,036	14,3	LOS B	0,6	4,0	0,65	0,56	47,2
6	R2	29	2,0	0,073	24,1	LOS C	0,7	5,1	0,73	0,70	42,4
Approach		56	2,0	0,073	20,5	LOS C	0,7	5,1	0,69	0,63	44,3
North: Beyers Naude Street											
7	L2	17	2,0	0,019	16,0	LOS B	0,3	2,2	0,55	0,65	46,4
8	T1	244	2,0	0,266	12,0	LOS B	5,0	35,9	0,64	0,54	50,1
9	R2	116	2,0	0,257	20,5	LOS C	2,7	19,0	0,69	0,75	44,0
Approach		377	2,0	0,266	14,8	LOS B	5,0	35,9	0,65	0,61	47,9
West: Krogh Street (R23)											
10	L2	192	2,0	0,271	21,6	LOS C	4,5	32,3	0,73	0,76	43,4
11	T1	48	2,0	0,266	16,1	LOS B	3,7	26,5	0,72	0,71	45,2
12	R2	108	2,0	0,266	21,7	LOS C	3,7	26,5	0,72	0,71	44,5
Approach		348	2,0	0,271	20,9	LOS C	4,5	32,3	0,72	0,74	44,0
All Vehicles		1197	2,0	0,271	16,2	LOS B	5,0	35,9	0,67	0,63	46,9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 AM Peak Hour Traffic Flows + development]

Krogh Street (R23) / Beyers Naude Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Beyers Naude Street											
1	L2	53	2,0	0,175	13,2	LOS B	3,1	22,0	0,50	0,50	50,9
2	T1	333	2,0	0,175	7,6	LOS A	3,1	22,3	0,50	0,45	52,8
3	R2	18	2,0	0,032	14,6	LOS B	0,3	2,2	0,51	0,66	47,1
Approach		403	2,0	0,175	8,7	LOS A	3,1	22,3	0,50	0,47	52,3
East: Krogh Street (R23)											
4	L2	28	2,0	0,244	26,6	LOS C	3,6	25,5	0,81	0,67	43,1
5	T1	132	2,0	0,244	21,7	LOS C	3,6	25,5	0,82	0,68	43,4
6	R2	56	2,0	0,244	30,3	LOS C	2,4	16,8	0,86	0,73	40,3
Approach		216	2,0	0,244	24,6	LOS C	3,6	25,5	0,83	0,69	42,5
North: Beyers Naude Street											
7	L2	77	2,0	0,073	12,7	LOS B	1,2	8,3	0,47	0,68	48,5
8	T1	260	2,0	0,234	7,9	LOS A	4,4	31,1	0,53	0,45	53,1
9	R2	193	2,0	0,344	16,0	LOS B	3,9	27,6	0,61	0,74	46,4
Approach		529	2,0	0,344	11,6	LOS B	4,4	31,1	0,55	0,59	49,8
West: Krogh Street (R23)											
10	L2	67	2,0	0,324	27,2	LOS C	4,8	34,1	0,83	0,72	42,3
11	T1	167	2,0	0,324	22,3	LOS C	4,8	34,1	0,84	0,72	42,8
12	R2	64	2,0	0,324	29,1	LOS C	3,6	25,4	0,85	0,73	41,3
Approach		299	2,0	0,324	24,8	LOS C	4,8	34,1	0,84	0,72	42,3
All Vehicles		1447	2,0	0,344	15,4	LOS B	4,8	34,1	0,64	0,60	47,5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 PM Peak Hour Traffic Flows + development]

Krogh Street (R23) / Beyers Naude Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Beyers Naude Street											
1	L2	76	2,0	0,214	15,0	LOS B	3,9	27,8	0,56	0,56	49,4
2	T1	360	2,0	0,214	9,4	LOS A	4,0	28,3	0,56	0,51	51,4
3	R2	21	2,0	0,045	17,6	LOS B	0,4	2,9	0,59	0,68	45,4
Approach		457	2,0	0,214	10,7	LOS B	4,0	28,3	0,57	0,53	50,8
East: Krogh Street (R23)											
4	L2	16	2,0	0,222	24,1	LOS C	3,5	25,1	0,76	0,63	44,7
5	T1	125	2,0	0,222	18,5	LOS B	3,5	25,1	0,76	0,63	45,7
6	R2	87	2,0	0,274	28,9	LOS C	2,5	17,7	0,84	0,76	40,1
Approach		228	2,0	0,274	22,9	LOS C	3,5	25,1	0,79	0,68	43,3
North: Beyers Naude Street											
7	L2	68	2,0	0,070	14,2	LOS B	1,1	8,1	0,51	0,68	47,5
8	T1	324	2,0	0,315	10,0	LOS B	6,3	44,5	0,60	0,52	51,5
9	R2	165	2,0	0,339	18,5	LOS B	3,7	26,0	0,67	0,75	45,1
Approach		558	2,0	0,339	13,0	LOS B	6,3	44,5	0,61	0,61	48,9
West: Krogh Street (R23)											
10	L2	171	2,0	0,330	24,9	LOS C	5,2	37,2	0,80	0,76	42,1
11	T1	136	2,0	0,330	20,0	LOS C	5,2	37,2	0,81	0,72	43,8
12	R2	60	2,0	0,330	25,8	LOS C	4,4	31,7	0,81	0,70	43,3
Approach		366	2,0	0,330	23,3	LOS C	5,2	37,2	0,80	0,73	42,9
All Vehicles		1609	2,0	0,339	16,1	LOS B	6,3	44,5	0,67	0,62	47,1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 Sat. Peak Hour Traffic Flows + development]

Krogh Street (R23) / Beyers Naude Street Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Beyers Naude Street											
1	L2	77	2,0	0,241	19,3	LOS B	4,3	30,6	0,67	0,64	46,5
2	T1	321	2,0	0,241	13,8	LOS B	4,4	31,2	0,67	0,59	48,4
3	R2	18	2,0	0,043	21,6	LOS C	0,4	2,9	0,68	0,68	43,2
Approach		416	2,0	0,241	15,1	LOS B	4,4	31,2	0,67	0,60	47,8
East: Krogh Street (R23)											
4	L2	11	2,0	0,081	18,3	LOS B	1,4	9,6	0,62	0,52	48,0
5	T1	65	2,0	0,081	13,1	LOS B	1,4	9,6	0,63	0,54	48,6
6	R2	29	2,0	0,081	21,2	LOS C	0,9	6,1	0,68	0,66	44,5
Approach		105	2,0	0,081	15,9	LOS B	1,4	9,6	0,64	0,57	47,3
North: Beyers Naude Street											
7	L2	66	2,0	0,084	18,3	LOS B	1,3	9,5	0,62	0,70	45,1
8	T1	244	2,0	0,293	14,1	LOS B	5,5	39,0	0,69	0,58	48,7
9	R2	116	2,0	0,285	22,8	LOS C	2,9	20,5	0,74	0,76	42,8
Approach		426	2,0	0,293	17,1	LOS B	5,5	39,0	0,70	0,65	46,4
West: Krogh Street (R23)											
10	L2	192	2,0	0,288	19,7	LOS B	5,1	36,3	0,69	0,73	44,9
11	T1	98	2,0	0,288	15,5	LOS B	5,1	36,3	0,72	0,71	45,5
12	R2	108	2,0	0,288	21,9	LOS C	4,1	29,1	0,73	0,70	44,5
Approach		398	2,0	0,288	19,2	LOS B	5,1	36,3	0,71	0,72	44,9
All Vehicles		1345	2,0	0,293	17,0	LOS B	5,5	39,0	0,69	0,65	46,4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vv [Existing 2016 AM Peak Hour Traffic Flows]

Krogh Street (R23) / Minaar Street Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Minaar Street											
1	L2	13	2,0	0,740	15,9	LOS C	5,1	36,5	0,85	1,28	44,0
3	R2	323	2,0	0,740	22,1	LOS C	5,1	36,5	0,85	1,28	43,7
Approach		336	2,0	0,740	21,9	LOS C	5,1	36,5	0,85	1,28	43,7
East: Krogh Street (R23)											
4	L2	273	2,0	0,316	5,6	LOS A	0,0	0,0	0,00	0,27	56,0
5	T1	328	2,0	0,316	0,0	LOS A	0,0	0,0	0,00	0,27	57,5
Approach		601	2,0	0,316	2,6	NA	0,0	0,0	0,00	0,27	56,8
West: Krogh Street (R23)											
11	T1	318	2,0	0,174	0,0	LOS A	0,0	0,0	0,00	0,03	59,7
12	R2	17	2,0	0,174	5,5	LOS A	0,0	0,0	0,00	0,03	57,4
Approach		335	2,0	0,174	0,3	NA	0,0	0,0	0,00	0,03	59,6
All Vehicles		1272	2,0	0,740	7,1	NA	5,1	36,5	0,22	0,47	53,3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vv [Existing 2016 PM Peak Hour Traffic Flows]

Krogh Street (R23) / Minaar Street Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Minaar Street											
1	L2	9	2,0	0,421	12,6	LOS B	1,7	12,3	0,78	1,08	45,7
3	R2	145	2,0	0,421	19,1	LOS C	1,7	12,3	0,78	1,08	45,3
Approach		155	2,0	0,421	18,7	LOS C	1,7	12,3	0,78	1,08	45,4
East: Krogh Street (R23)											
4	L2	314	2,0	0,401	5,6	LOS A	0,0	0,0	0,00	0,24	56,1
5	T1	449	2,0	0,401	0,1	LOS A	0,0	0,0	0,00	0,24	57,7
Approach		763	2,0	0,401	2,3	NA	0,0	0,0	0,00	0,24	57,1
West: Krogh Street (R23)											
11	T1	304	2,0	0,167	0,0	LOS A	0,0	0,0	0,00	0,03	59,7
12	R2	17	2,0	0,167	5,5	LOS A	0,0	0,0	0,00	0,03	57,4
Approach		321	2,0	0,167	0,3	NA	0,0	0,0	0,00	0,03	59,6
All Vehicles		1239	2,0	0,421	3,9	NA	1,7	12,3	0,10	0,29	55,9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Site: vv [Existing 2016 Sat. Peak Hour Traffic Flows]

Krogh Street (R23) / Minaar Street Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Minaar Street											
1	L2	7	2,0	0,416	12,7	LOS B	1,7	12,3	0,77	1,08	46,0
3	R2	152	2,0	0,416	18,5	LOS C	1,7	12,3	0,77	1,08	45,6
Approach		159	2,0	0,416	18,2	LOS C	1,7	12,3	0,77	1,08	45,7
East: Krogh Street (R23)											
4	L2	6	2,0	0,249	5,6	LOS A	0,0	0,0	0,00	0,01	58,1
5	T1	478	2,0	0,249	0,0	LOS A	0,0	0,0	0,00	0,01	59,9
Approach		484	2,0	0,249	0,1	NA	0,0	0,0	0,00	0,01	59,9
West: Krogh Street (R23)											
11	T1	212	2,0	0,237	0,0	LOS A	0,0	0,0	0,00	0,32	57,3
12	R2	233	2,0	0,237	5,5	LOS A	0,0	0,0	0,00	0,32	55,1
Approach		444	2,0	0,237	2,9	NA	0,0	0,0	0,00	0,32	56,1
All Vehicles		1087	2,0	0,416	3,9	NA	1,7	12,3	0,11	0,29	55,8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vv [Futute 2021 AM Peak Hour Traffic Flows]

Krogh Street (R23) / Minaar Street Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Minaar Street											
1	L2	15	2,0	1,049	57,4	LOS F	17,4	124,2	1,00	2,11	28,7
3	R2	375	2,0	1,049	66,6	LOS F	17,4	124,2	1,00	2,11	28,6
Approach		389	2,0	1,049	66,3	LOS F	17,4	124,2	1,00	2,11	28,6
East: Krogh Street (R23)											
4	L2	316	2,0	0,367	5,6	LOS A	0,0	0,0	0,00	0,27	55,9
5	T1	381	2,0	0,367	0,0	LOS A	0,0	0,0	0,00	0,27	57,5
Approach		697	2,0	0,367	2,6	NA	0,0	0,0	0,00	0,27	56,8
West: Krogh Street (R23)											
11	T1	368	2,0	0,202	0,0	LOS A	0,0	0,0	0,00	0,03	59,7
12	R2	20	2,0	0,202	5,5	LOS A	0,0	0,0	0,00	0,03	57,4
Approach		388	2,0	0,202	0,3	NA	0,0	0,0	0,00	0,03	59,6
All Vehicles		1475	2,0	1,049	18,8	NA	17,4	124,2	0,26	0,69	45,5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Site: vv [Futute 2021 PM Peak Hour Traffic Flows]

Krogh Street (R23) / Minaar Street Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Minaar Street											
1	L2	11	2,0	0,636	17,6	LOS C	2,9	20,9	0,89	1,16	41,4
3	R2	168	2,0	0,636	27,7	LOS D	2,9	20,9	0,89	1,16	41,2
Approach		179	2,0	0,636	27,1	LOS D	2,9	20,9	0,89	1,16	41,2
East: Krogh Street (R23)											
4	L2	363	2,0	0,464	5,6	LOS A	0,0	0,0	0,00	0,24	56,1
5	T1	521	2,0	0,464	0,1	LOS A	0,0	0,0	0,00	0,24	57,7
Approach		884	2,0	0,464	2,4	NA	0,0	0,0	0,00	0,24	57,0
West: Krogh Street (R23)											
11	T1	353	2,0	0,194	0,0	LOS A	0,0	0,0	0,00	0,03	59,7
12	R2	20	2,0	0,194	5,5	LOS A	0,0	0,0	0,00	0,03	57,4
Approach		373	2,0	0,194	0,3	NA	0,0	0,0	0,00	0,03	59,5
All Vehicles		1436	2,0	0,636	4,9	NA	2,9	20,9	0,11	0,30	55,0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vv [Futute 2021 Sat. Peak Hour Traffic Flows]

Krogh Street (R23) / Minaar Street Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Minaar Street											
1	L2	8	2,0	0,614	17,1	LOS C	2,9	20,3	0,88	1,16	42,3
3	R2	176	2,0	0,614	25,7	LOS D	2,9	20,3	0,88	1,16	42,0
Approach		184	2,0	0,614	25,3	LOS D	2,9	20,3	0,88	1,16	42,0
East: Krogh Street (R23)											
4	L2	7	2,0	0,289	5,6	LOS A	0,0	0,0	0,00	0,01	58,1
5	T1	554	2,0	0,289	0,0	LOS A	0,0	0,0	0,00	0,01	59,9
Approach		561	2,0	0,289	0,1	NA	0,0	0,0	0,00	0,01	59,8
West: Krogh Street (R23)											
11	T1	245	2,0	0,275	0,0	LOS A	0,0	0,0	0,00	0,32	57,2
12	R2	269	2,0	0,275	5,5	LOS A	0,0	0,0	0,00	0,32	55,1
Approach		515	2,0	0,275	2,9	NA	0,0	0,0	0,00	0,32	56,1
All Vehicles		1260	2,0	0,614	4,9	NA	2,9	20,3	0,13	0,30	54,9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Futute 2021 AM Peak Hour Traffic Flows + Upgrades]

Krogh Street (R23) / Minaar Street Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Minaar Street											
1	L2	15	2,0	0,402	22,6	LOS C	7,2	51,3	0,77	0,79	42,9
3	R2	375	2,0	0,402	22,0	LOS C	7,2	51,3	0,75	0,77	43,0
Approach		389	2,0	0,402	22,1	LOS C	7,2	51,3	0,75	0,77	43,0
East: Krogh Street (R23)											
4	L2	316	2,0	0,211	6,1	LOS A	1,0	6,8	0,19	0,60	53,5
5	T1	381	2,0	0,416	13,1	LOS B	8,6	61,1	0,70	0,61	49,3
Approach		697	2,0	0,416	10,0	LOS A	8,6	61,1	0,47	0,60	51,2
West: Krogh Street (R23)											
11	T1	368	2,0	0,406	13,1	LOS B	8,3	58,8	0,70	0,60	49,4
12	R2	20	2,0	0,052	22,4	LOS C	0,5	3,3	0,69	0,69	42,8
Approach		388	2,0	0,406	13,6	LOS B	8,3	58,8	0,70	0,61	49,0
All Vehicles		1475	2,0	0,416	14,1	LOS B	8,6	61,1	0,60	0,65	48,2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Futute 2021 PM Peak Hour Traffic Flows + Upgrades]

Krogh Street (R23) / Minaar Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Minaar Street											
1	L2	11	2,0	0,383	33,5	LOS C	4,1	29,2	0,92	0,78	38,0
3	R2	168	2,0	0,383	33,1	LOS C	4,1	29,2	0,91	0,77	38,1
Approach		179	2,0	0,383	33,1	LOS C	4,1	29,2	0,91	0,77	38,1
East: Krogh Street (R23)											
4	L2	363	2,0	0,256	6,1	LOS A	1,2	8,3	0,19	0,60	53,5
5	T1	521	2,0	0,399	5,5	LOS A	7,9	56,5	0,48	0,43	55,0
Approach		884	2,0	0,399	5,8	LOS A	7,9	56,5	0,36	0,50	54,4
West: Krogh Street (R23)											
11	T1	353	2,0	0,273	4,9	LOS A	4,8	34,2	0,43	0,37	55,5
12	R2	20	2,0	0,040	13,2	LOS B	0,3	2,2	0,47	0,66	48,0
Approach		373	2,0	0,273	5,4	LOS A	4,8	34,2	0,43	0,39	55,0
All Vehicles		1436	2,0	0,399	9,1	LOS A	7,9	56,5	0,45	0,50	51,8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Futute 2021 Sat. Peak Hour Traffic Flows + Upgrades]

Krogh Street (R23) / Minaar Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Minaar Street											
1	L2	8	2,0	0,513	37,1	LOS D	4,5	32,2	0,97	0,79	36,6
3	R2	176	2,0	0,513	36,5	LOS D	4,5	32,2	0,96	0,77	36,7
Approach		184	2,0	0,513	36,6	LOS D	4,5	32,2	0,96	0,77	36,7
East: Krogh Street (R23)											
4	L2	7	2,0	0,007	8,0	LOS A	0,1	0,4	0,33	0,59	52,3
5	T1	554	2,0	0,399	4,3	LOS A	7,5	53,4	0,43	0,38	56,1
Approach		561	2,0	0,399	4,3	LOS A	7,5	53,4	0,43	0,39	56,0
West: Krogh Street (R23)											
11	T1	245	2,0	0,178	3,5	LOS A	2,7	19,3	0,35	0,30	56,8
12	R2	269	2,0	0,524	14,1	LOS B	5,4	38,6	0,61	0,76	47,4
Approach		515	2,0	0,524	9,0	LOS A	5,4	38,6	0,48	0,54	51,5
All Vehicles		1260	2,0	0,524	11,0	LOS B	7,5	53,4	0,53	0,51	50,3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Futute 2021 AM Peak Hour Traffic Flows + Upgrades + Development]

Krogh Street (R23) / Minaar Street Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Minaar Street											
1	L2	15	2,0	0,405	22,6	LOS C	7,3	51,8	0,77	0,79	42,8
3	R2	378	2,0	0,405	22,1	LOS C	7,3	51,8	0,75	0,77	43,0
Approach		393	2,0	0,405	22,1	LOS C	7,3	51,8	0,75	0,77	43,0
East: Krogh Street (R23)											
4	L2	317	2,0	0,212	6,1	LOS A	1,0	6,9	0,19	0,60	53,5
5	T1	384	2,0	0,419	13,2	LOS B	8,7	61,8	0,70	0,61	49,3
Approach		701	2,0	0,419	10,0	LOS A	8,7	61,8	0,47	0,60	51,2
West: Krogh Street (R23)											
11	T1	373	2,0	0,411	13,1	LOS B	8,4	59,6	0,70	0,60	49,4
12	R2	20	2,0	0,052	22,4	LOS C	0,5	3,3	0,69	0,69	42,8
Approach		393	2,0	0,411	13,6	LOS B	8,4	59,6	0,70	0,61	49,0
All Vehicles		1486	2,0	0,419	14,1	LOS B	8,7	61,8	0,60	0,65	48,2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Futute 2021 PM Peak Hour Traffic Flows + Upgrades + Development]

Krogh Street (R23) / Minaar Street Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Minaar Street											
1	L2	11	2,0	0,406	33,7	LOS C	4,4	31,1	0,93	0,78	37,9
3	R2	179	2,0	0,406	33,2	LOS C	4,4	31,1	0,91	0,77	38,0
Approach		189	2,0	0,406	33,2	LOS C	4,4	31,1	0,91	0,77	38,0
East: Krogh Street (R23)											
4	L2	374	2,0	0,264	6,1	LOS A	1,2	8,6	0,19	0,60	53,5
5	T1	536	2,0	0,410	5,6	LOS A	8,2	58,7	0,49	0,43	55,0
Approach		909	2,0	0,410	5,8	LOS A	8,2	58,7	0,37	0,50	54,4
West: Krogh Street (R23)											
11	T1	367	2,0	0,284	5,0	LOS A	5,1	36,0	0,43	0,38	55,5
12	R2	20	2,0	0,041	13,2	LOS B	0,3	2,2	0,47	0,66	48,0
Approach		387	2,0	0,284	5,4	LOS A	5,1	36,0	0,44	0,39	55,0
All Vehicles		1486	2,0	0,410	9,2	LOS A	8,2	58,7	0,45	0,51	51,7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Futute 2021 Sat. Peak Hour Traffic Flows + Upgrades + Development]

Krogh Street (R23) / Minaar Street Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Minaar Street											
1	L2	8	2,0	0,572	37,5	LOS D	5,1	36,3	0,98	0,80	36,5
3	R2	197	2,0	0,572	36,9	LOS D	5,1	36,3	0,96	0,78	36,6
Approach		205	2,0	0,572	36,9	LOS D	5,1	36,3	0,96	0,78	36,6
East: Krogh Street (R23)											
4	L2	28	2,0	0,028	8,4	LOS A	0,3	1,8	0,35	0,62	52,0
5	T1	585	2,0	0,421	4,4	LOS A	8,1	57,7	0,44	0,39	56,0
Approach		614	2,0	0,421	4,6	LOS A	8,1	57,7	0,44	0,40	55,8
West: Krogh Street (R23)											
11	T1	277	2,0	0,201	3,5	LOS A	3,1	22,2	0,36	0,30	56,7
12	R2	269	2,0	0,551	14,9	LOS B	5,7	40,6	0,64	0,77	47,0
Approach		546	2,0	0,551	9,1	LOS A	5,7	40,6	0,50	0,54	51,4
All Vehicles		1365	2,0	0,572	11,3	LOS B	8,1	57,7	0,54	0,51	50,1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Existing 2016 AM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Bauman Street (R39) Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	395	2,0	0,433	10,5	LOS B	2,6	18,5	0,47	0,94	50,7
3	R2	47	2,0	0,296	34,2	LOS D	1,0	7,4	0,88	1,03	38,5
Approach		442	2,0	0,433	13,0	LOS B	2,6	18,5	0,51	0,95	49,0
East: Bauman Street (R39)											
4	L2	65	2,0	0,035	5,6	LOS A	0,0	0,0	0,00	0,58	53,5
5	T1	240	2,0	0,123	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
Approach		305	2,0	0,123	1,2	NA	0,0	0,0	0,00	0,12	58,5
West: Bauman Street (R39)											
11	T1	331	2,0	0,172	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
12	R2	494	2,0	0,270	5,6	LOS A	0,0	0,0	0,00	0,57	53,5
Approach		824	2,0	0,270	3,4	NA	0,0	0,0	0,00	0,34	55,9
All Vehicles		1572	2,0	0,433	5,7	NA	2,6	18,5	0,14	0,47	54,2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Existing 2016 PM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Bauman Street (R39) Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	418	2,0	0,472	11,1	LOS B	3,1	22,3	0,51	0,97	50,3
3	R2	56	2,0	0,256	26,1	LOS D	0,9	6,6	0,83	1,03	42,1
Approach		474	2,0	0,472	12,8	LOS B	3,1	22,3	0,55	0,98	49,2
East: Bauman Street (R39)											
4	L2	76	2,0	0,041	5,6	LOS A	0,0	0,0	0,00	0,58	53,5
5	T1	264	2,0	0,136	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
Approach		340	2,0	0,136	1,3	NA	0,0	0,0	0,00	0,13	58,4
West: Bauman Street (R39)											
11	T1	226	2,0	0,118	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
12	R2	419	2,0	0,229	5,6	LOS A	0,0	0,0	0,00	0,57	53,5
Approach		645	2,0	0,229	3,6	NA	0,0	0,0	0,00	0,37	55,6
All Vehicles		1459	2,0	0,472	6,1	NA	3,1	22,3	0,18	0,51	53,9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Site: vvvv [Existing 2016 Sat. Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Bauman Street (R39) Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	178	2,0	0,178	9,1	LOS A	0,7	5,1	0,31	0,89	51,4
3	R2	41	2,0	0,106	15,7	LOS C	0,4	2,7	0,63	1,00	47,6
Approach		219	2,0	0,178	10,3	LOS B	0,7	5,1	0,37	0,91	50,7
East: Bauman Street (R39)											
4	L2	48	2,0	0,026	5,6	LOS A	0,0	0,0	0,00	0,58	53,5
5	T1	164	2,0	0,084	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
Approach		213	2,0	0,084	1,3	NA	0,0	0,0	0,00	0,13	58,4
West: Bauman Street (R39)											
11	T1	134	2,0	0,069	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
12	R2	304	2,0	0,166	5,6	LOS A	0,0	0,0	0,00	0,57	53,5
Approach		438	2,0	0,166	3,9	NA	0,0	0,0	0,00	0,40	55,4
All Vehicles		869	2,0	0,178	4,9	NA	0,7	5,1	0,09	0,46	54,8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Future 2021 AM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Bauman Street (R39) Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	458	2,0	0,526	11,7	LOS B	3,9	28,1	0,55	1,01	50,0
3	R2	55	2,0	0,501	55,3	LOS F	1,8	13,0	0,94	1,07	31,6
Approach		513	2,0	0,526	16,3	LOS C	3,9	28,1	0,59	1,01	47,0
East: Bauman Street (R39)											
4	L2	76	2,0	0,041	5,6	LOS A	0,0	0,0	0,00	0,58	53,5
5	T1	278	2,0	0,143	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
Approach		354	2,0	0,143	1,2	NA	0,0	0,0	0,00	0,12	58,5
West: Bauman Street (R39)											
11	T1	383	2,0	0,199	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
12	R2	573	2,0	0,313	5,6	LOS A	0,0	0,0	0,00	0,57	53,5
Approach		956	2,0	0,313	3,4	NA	0,0	0,0	0,00	0,34	55,9
All Vehicles		1822	2,0	0,526	6,6	NA	3,9	28,1	0,17	0,49	53,5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Site: vvvv [Future 2021 PM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Bauman Street (R39) Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	484	2,0	0,577	12,6	LOS B	4,7	33,8	0,60	1,06	49,4
3	R2	64	2,0	0,399	36,9	LOS E	1,5	10,7	0,90	1,06	37,5
Approach		548	2,0	0,577	15,4	LOS C	4,7	33,8	0,64	1,06	47,7
East: Bauman Street (R39)											
4	L2	87	2,0	0,047	5,6	LOS A	0,0	0,0	0,00	0,58	53,5
5	T1	306	2,0	0,157	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
Approach		394	2,0	0,157	1,2	NA	0,0	0,0	0,00	0,13	58,4
West: Bauman Street (R39)											
11	T1	262	2,0	0,136	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
12	R2	485	2,0	0,265	5,6	LOS A	0,0	0,0	0,00	0,57	53,5
Approach		747	2,0	0,265	3,6	NA	0,0	0,0	0,00	0,37	55,6
All Vehicles		1689	2,0	0,577	6,9	NA	4,7	33,8	0,21	0,54	53,3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Future 2021 Sat. Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Bauman Street (R39) Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	206	2,0	0,213	9,3	LOS A	0,9	6,2	0,34	0,89	51,3
3	R2	47	2,0	0,145	18,0	LOS C	0,5	3,7	0,70	1,00	46,3
Approach		254	2,0	0,213	10,9	LOS B	0,9	6,2	0,41	0,91	50,3
East: Bauman Street (R39)											
4	L2	56	2,0	0,030	5,6	LOS A	0,0	0,0	0,00	0,58	53,5
5	T1	191	2,0	0,098	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
Approach		246	2,0	0,098	1,3	NA	0,0	0,0	0,00	0,13	58,4
West: Bauman Street (R39)											
11	T1	155	2,0	0,080	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
12	R2	353	2,0	0,193	5,6	LOS A	0,0	0,0	0,00	0,57	53,5
Approach		507	2,0	0,193	3,9	NA	0,0	0,0	0,00	0,40	55,4
All Vehicles		1007	2,0	0,213	5,0	NA	0,9	6,2	0,10	0,46	54,7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Site: vvvv [Future 2021 AM Peak Hour Traffic Flows + Development]

Walter Sisulu Drive (R546) / Bauman Street (R39) Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	462	2,0	0,529	11,7	LOS B	4,0	28,5	0,55	1,01	50,0
3	R2	62	2,0	0,580	60,8	LOS F	2,2	15,7	0,95	1,10	30,1
Approach		524	2,0	0,580	17,5	LOS C	4,0	28,5	0,60	1,02	46,4
East: Bauman Street (R39)											
4	L2	84	2,0	0,046	5,6	LOS A	0,0	0,0	0,00	0,58	53,5
5	T1	275	2,0	0,141	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
Approach		359	2,0	0,141	1,3	NA	0,0	0,0	0,00	0,14	58,3
West: Bauman Street (R39)											
11	T1	378	2,0	0,196	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
12	R2	583	2,0	0,318	5,6	LOS A	0,0	0,0	0,00	0,57	53,5
Approach		961	2,0	0,318	3,4	NA	0,0	0,0	0,00	0,35	55,9
All Vehicles		1844	2,0	0,580	7,0	NA	4,0	28,5	0,17	0,50	53,2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Future 2021 PM Peak Hour Traffic Flows + Development]

Walter Sisulu Drive (R546) / Bauman Street (R39) Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	511	2,0	0,601	12,7	LOS B	5,3	37,6	0,61	1,07	49,3
3	R2	100	2,0	0,664	50,4	LOS F	3,0	21,5	0,94	1,16	32,9
Approach		611	2,0	0,664	18,9	LOS C	5,3	37,6	0,67	1,08	45,6
East: Bauman Street (R39)											
4	L2	116	2,0	0,063	5,6	LOS A	0,0	0,0	0,00	0,58	53,5
5	T1	297	2,0	0,153	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
Approach		413	2,0	0,153	1,6	NA	0,0	0,0	0,00	0,16	58,0
West: Bauman Street (R39)											
11	T1	244	2,0	0,127	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
12	R2	521	2,0	0,285	5,6	LOS A	0,0	0,0	0,00	0,57	53,5
Approach		765	2,0	0,285	3,8	NA	0,0	0,0	0,00	0,39	55,4
All Vehicles		1788	2,0	0,664	8,4	NA	5,3	37,6	0,23	0,57	52,1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Site: vvvv [Future 2021 Sat. Peak Hour Traffic Flows + Development]

Walter Sisulu Drive (R546) / Bauman Street (R39) Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	252	2,0	0,257	9,3	LOS A	1,1	7,8	0,35	0,89	51,3
3	R2	102	2,0	0,348	22,3	LOS C	1,5	10,5	0,78	1,06	43,9
Approach		354	2,0	0,348	13,0	LOS B	1,5	10,5	0,47	0,94	49,0
East: Bauman Street (R39)											
4	L2	103	2,0	0,056	5,6	LOS A	0,0	0,0	0,00	0,58	53,5
5	T1	181	2,0	0,093	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
Approach		284	2,0	0,093	2,0	NA	0,0	0,0	0,00	0,21	57,5
West: Bauman Street (R39)											
11	T1	137	2,0	0,071	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
12	R2	406	2,0	0,222	5,6	LOS A	0,0	0,0	0,00	0,57	53,5
Approach		543	2,0	0,222	4,2	NA	0,0	0,0	0,00	0,43	55,0
All Vehicles		1181	2,0	0,348	6,3	NA	1,5	10,5	0,14	0,53	53,6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Existing 2016 AM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Handel Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	341	2,0	0,225	13,0	LOS B	4,1	29,2	0,65	0,56	49,2
3	R2	26	2,0	0,225	18,6	LOS B	3,7	26,3	0,65	0,57	47,8
Approach		367	2,0	0,225	13,4	LOS B	4,1	29,2	0,65	0,56	49,1
East: Handel Street											
4	L2	137	2,0	0,102	6,4	LOS A	0,6	4,3	0,21	0,61	53,4
6	R2	175	2,0	0,228	19,9	LOS B	3,9	27,6	0,68	0,74	44,3
Approach		312	2,0	0,228	14,0	LOS B	3,9	27,6	0,48	0,68	47,9
North: Walter Sisulu Drive (R546)											
7	L2	196	2,0	0,187	11,0	LOS B	3,0	21,5	0,43	0,63	51,2
8	T1	185	2,0	0,187	11,8	LOS B	3,3	23,8	0,61	0,54	49,9
Approach		381	2,0	0,187	11,4	LOS B	3,3	23,8	0,52	0,59	50,6
All Vehicles		1060	2,0	0,228	12,9	LOS B	4,1	29,2	0,55	0,61	49,3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Existing 2016 PM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Handel Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	344	2,0	0,311	8,9	LOS A	6,1	43,8	0,57	0,50	52,2
3	R2	182	2,0	0,311	16,4	LOS B	3,8	27,1	0,61	0,73	46,4
Approach		526	2,0	0,311	11,5	LOS B	6,1	43,8	0,59	0,58	50,1
East: Handel Street											
4	L2	214	2,0	0,174	6,6	LOS A	1,1	8,1	0,25	0,62	53,3
6	R2	168	2,0	0,303	26,3	LOS C	4,5	32,1	0,81	0,77	41,1
Approach		382	2,0	0,303	15,3	LOS B	4,5	32,1	0,50	0,69	47,2
North: Walter Sisulu Drive (R546)											
7	L2	268	2,0	0,208	7,9	LOS A	2,7	19,3	0,29	0,59	53,4
8	T1	252	2,0	0,208	7,7	LOS A	3,8	27,3	0,51	0,46	52,9
Approach		520	2,0	0,208	7,8	LOS A	3,8	27,3	0,39	0,53	53,2
All Vehicles		1428	2,0	0,311	11,2	LOS B	6,1	43,8	0,49	0,59	50,3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Existing 2016 Sat. Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Handel Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	311	2,0	0,251	9,7	LOS A	4,8	33,9	0,58	0,52	51,3
3	R2	120	2,0	0,251	15,9	LOS B	3,3	23,7	0,59	0,66	47,6
Approach		431	2,0	0,251	11,5	LOS B	4,8	33,9	0,58	0,56	50,2
East: Handel Street											
4	L2	167	2,0	0,130	6,3	LOS A	0,7	4,7	0,20	0,60	53,5
6	R2	151	2,0	0,248	24,3	LOS C	3,8	27,1	0,77	0,76	42,1
Approach		318	2,0	0,248	14,8	LOS B	3,8	27,1	0,47	0,68	47,4
North: Walter Sisulu Drive (R546)											
7	L2	124	2,0	0,153	11,8	LOS B	2,5	17,6	0,45	0,59	51,4
8	T1	204	2,0	0,153	8,4	LOS A	2,7	19,4	0,52	0,48	52,1
Approach		328	2,0	0,153	9,7	LOS A	2,7	19,4	0,49	0,52	51,8
All Vehicles		1077	2,0	0,251	11,9	LOS B	4,8	33,9	0,52	0,58	49,8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 AM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Handel Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	396	2,0	0,262	13,3	LOS B	4,9	34,7	0,67	0,57	49,0
3	R2	31	2,0	0,262	18,9	LOS B	4,3	30,9	0,67	0,59	47,6
Approach		426	2,0	0,262	13,7	LOS B	4,9	34,7	0,67	0,57	48,9
East: Handel Street											
4	L2	159	2,0	0,121	6,6	LOS A	0,8	5,7	0,24	0,61	53,4
6	R2	202	2,0	0,264	20,2	LOS C	4,6	32,5	0,70	0,75	44,2
Approach		361	2,0	0,264	14,2	LOS B	4,6	32,5	0,49	0,69	47,8
North: Walter Sisulu Drive (R546)											
7	L2	227	2,0	0,217	10,7	LOS B	3,4	24,5	0,42	0,63	51,5
8	T1	215	2,0	0,217	11,9	LOS B	3,9	28,0	0,62	0,55	49,8
Approach		442	2,0	0,217	11,3	LOS B	3,9	28,0	0,52	0,59	50,6
All Vehicles		1229	2,0	0,264	13,0	LOS B	4,9	34,7	0,56	0,62	49,2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 PM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Handel Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	399	2,0	0,359	8,7	LOS A	7,3	52,2	0,58	0,50	52,5
3	R2	212	2,0	0,362	16,7	LOS B	4,4	31,4	0,63	0,75	46,1
Approach		611	2,0	0,362	11,5	LOS B	7,3	52,2	0,60	0,59	50,1
East: Handel Street											
4	L2	247	2,0	0,208	6,6	LOS A	1,4	9,8	0,26	0,62	53,3
6	R2	195	2,0	0,368	27,5	LOS C	5,4	38,6	0,84	0,78	40,6
Approach		442	2,0	0,368	15,8	LOS B	5,4	38,6	0,52	0,69	46,8
North: Walter Sisulu Drive (R546)											
7	L2	312	2,0	0,235	7,7	LOS A	3,0	21,6	0,28	0,59	53,6
8	T1	292	2,0	0,235	7,3	LOS A	4,4	31,3	0,50	0,46	53,2
Approach		603	2,0	0,235	7,5	LOS A	4,4	31,3	0,39	0,53	53,4
All Vehicles		1656	2,0	0,368	11,2	LOS B	7,3	52,2	0,50	0,60	50,3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 Sat. Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Handel Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	360	2,0	0,295	10,1	LOS B	5,8	41,2	0,60	0,54	51,0
3	R2	139	2,0	0,295	16,8	LOS B	4,0	28,3	0,62	0,68	47,0
Approach		499	2,0	0,295	12,0	LOS B	5,8	41,2	0,61	0,58	49,8
East: Handel Street											
4	L2	194	2,0	0,153	6,4	LOS A	0,9	6,4	0,23	0,61	53,4
6	R2	175	2,0	0,287	24,6	LOS C	4,5	32,0	0,78	0,77	41,9
Approach		368	2,0	0,287	15,0	LOS B	4,5	32,0	0,49	0,69	47,3
North: Walter Sisulu Drive (R546)											
7	L2	144	2,0	0,177	11,9	LOS B	2,9	20,8	0,46	0,60	51,3
8	T1	237	2,0	0,177	8,5	LOS A	3,2	22,9	0,53	0,49	52,0
Approach		381	2,0	0,177	9,8	LOS A	3,2	22,9	0,50	0,53	51,7
All Vehicles		1248	2,0	0,295	12,2	LOS B	5,8	41,2	0,54	0,59	49,6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 AM Peak Hour Traffic Flows + Development]

Walter Sisulu Drive (R546) / Handel Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	398	2,0	0,273	14,0	LOS B	5,0	35,9	0,69	0,59	48,6
3	R2	31	2,0	0,273	19,6	LOS B	4,5	31,9	0,69	0,60	47,2
Approach		428	2,0	0,273	14,4	LOS B	5,0	35,9	0,69	0,59	48,5
East: Handel Street											
4	L2	159	2,0	0,120	6,6	LOS A	0,8	5,7	0,24	0,61	53,4
6	R2	209	2,0	0,264	19,5	LOS B	4,6	33,0	0,68	0,75	44,5
Approach		368	2,0	0,264	13,9	LOS B	4,6	33,0	0,49	0,69	48,0
North: Walter Sisulu Drive (R546)											
7	L2	227	2,0	0,222	11,6	LOS B	3,8	26,9	0,46	0,65	50,9
8	T1	216	2,0	0,222	12,5	LOS B	4,0	28,5	0,64	0,57	49,3
Approach		443	2,0	0,222	12,1	LOS B	4,0	28,5	0,55	0,61	50,1
All Vehicles		1240	2,0	0,273	13,4	LOS B	5,0	35,9	0,58	0,62	48,9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 PM Peak Hour Traffic Flows + Development]

Walter Sisulu Drive (R546) / Handel Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	407	2,0	0,386	10,0	LOS A	8,0	57,2	0,62	0,54	51,6
3	R2	212	2,0	0,388	18,8	LOS B	4,8	34,1	0,69	0,76	44,9
Approach		619	2,0	0,388	13,0	LOS B	8,0	57,2	0,64	0,62	49,1
East: Handel Street											
4	L2	247	2,0	0,207	6,8	LOS A	1,5	10,8	0,27	0,63	53,1
6	R2	219	2,0	0,377	26,0	LOS C	5,9	42,2	0,82	0,79	41,2
Approach		466	2,0	0,377	15,8	LOS B	5,9	42,2	0,53	0,70	46,8
North: Walter Sisulu Drive (R546)											
7	L2	312	2,0	0,251	8,7	LOS A	3,7	26,5	0,34	0,61	52,9
8	T1	300	2,0	0,251	8,4	LOS A	4,8	33,9	0,54	0,49	52,3
Approach		612	2,0	0,251	8,5	LOS A	4,8	33,9	0,44	0,55	52,6
All Vehicles		1697	2,0	0,388	12,2	LOS B	8,0	57,2	0,54	0,62	49,6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 Sat. Peak Hour Traffic Flows + Development]

Walter Sisulu Drive (R546) / Handel Street Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	378	2,0	0,335	12,2	LOS B	6,6	47,3	0,66	0,58	49,6
3	R2	139	2,0	0,335	18,9	LOS B	4,5	31,9	0,68	0,70	45,8
Approach		517	2,0	0,335	14,0	LOS B	6,6	47,3	0,66	0,62	48,5
East: Handel Street											
4	L2	194	2,0	0,152	6,4	LOS A	0,9	6,4	0,23	0,61	53,4
6	R2	224	2,0	0,326	22,7	LOS C	5,5	39,4	0,76	0,77	42,9
Approach		418	2,0	0,326	15,2	LOS B	5,5	39,4	0,51	0,70	47,2
North: Walter Sisulu Drive (R546)											
7	L2	144	2,0	0,202	13,9	LOS B	3,5	25,1	0,53	0,62	50,0
8	T1	255	2,0	0,202	10,3	LOS B	3,7	26,4	0,59	0,53	50,6
Approach		399	2,0	0,202	11,6	LOS B	3,7	26,4	0,57	0,56	50,4
All Vehicles		1334	2,0	0,335	13,6	LOS B	6,6	47,3	0,59	0,63	48,6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vv [Existing 2016 AM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Joubert Street Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	488	2,0	0,127	0,0	LOS A	0,0	0,0	0,00	0,01	59,9
3	R2	6	2,0	0,127	5,6	LOS A	0,0	0,0	0,00	0,02	57,9
Approach		495	2,0	0,127	0,1	NA	0,0	0,0	0,00	0,01	59,9
East: Joubert Street											
4	L2	6	2,0	0,013	9,5	LOS A	0,0	0,3	0,45	0,84	49,6
6	R2	1	2,0	0,013	26,3	LOS D	0,0	0,3	0,45	0,84	49,5
Approach		7	2,0	0,013	11,9	LOS B	0,0	0,3	0,45	0,84	49,6
North: Walter Sisulu Drive (R546)											
7	L2	3	2,0	0,147	5,6	LOS A	0,0	0,0	0,00	0,01	58,2
8	T1	567	2,0	0,147	0,0	LOS A	0,0	0,0	0,00	0,00	59,9
Approach		571	2,0	0,147	0,0	NA	0,0	0,0	0,00	0,00	59,9
All Vehicles		1073	2,0	0,147	0,1	NA	0,0	0,3	0,00	0,01	59,8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Site: vv [Existing 2016 PM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Joubert Street Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	483	2,0	0,126	0,0	LOS A	0,0	0,0	0,00	0,01	59,9
3	R2	6	2,0	0,126	5,6	LOS A	0,0	0,0	0,00	0,02	57,9
Approach		489	2,0	0,126	0,1	NA	0,0	0,0	0,00	0,01	59,9
East: Joubert Street											
4	L2	5	2,0	0,011	9,3	LOS A	0,0	0,3	0,42	0,84	49,8
6	R2	1	2,0	0,011	22,9	LOS C	0,0	0,3	0,42	0,84	49,7
Approach		6	2,0	0,011	11,6	LOS B	0,0	0,3	0,42	0,84	49,8
North: Walter Sisulu Drive (R546)											
7	L2	2	2,0	0,126	5,6	LOS A	0,0	0,0	0,00	0,01	58,2
8	T1	487	2,0	0,126	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
Approach		489	2,0	0,126	0,0	NA	0,0	0,0	0,00	0,00	59,9
All Vehicles		985	2,0	0,126	0,1	NA	0,0	0,3	0,00	0,01	59,8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vv [Existing 2016 Sat. Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Joubert Street Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	401	2,0	0,105	0,0	LOS A	0,0	0,0	0,00	0,01	59,9
3	R2	5	2,0	0,105	5,5	LOS A	0,0	0,0	0,00	0,02	57,9
Approach		406	2,0	0,105	0,1	NA	0,0	0,0	0,00	0,01	59,9
East: Joubert Street											
4	L2	1	2,0	0,018	9,2	LOS A	0,1	0,4	0,65	0,92	46,0
6	R2	4	2,0	0,018	20,2	LOS C	0,1	0,4	0,65	0,92	45,9
Approach		5	2,0	0,018	18,0	LOS C	0,1	0,4	0,65	0,92	45,9
North: Walter Sisulu Drive (R546)											
7	L2	1	2,0	0,123	5,6	LOS A	0,0	0,0	0,00	0,00	58,2
8	T1	477	2,0	0,123	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
Approach		478	2,0	0,123	0,0	NA	0,0	0,0	0,00	0,00	60,0
All Vehicles		889	2,0	0,123	0,2	NA	0,1	0,4	0,00	0,01	59,8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Site: vv [Future 2021 AM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Joubert Street Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	566	2,0	0,148	0,0	LOS A	0,0	0,0	0,00	0,01	59,9
3	R2	7	2,0	0,148	5,6	LOS A	0,0	0,0	0,00	0,02	57,9
Approach		574	2,0	0,148	0,1	NA	0,0	0,0	0,00	0,01	59,9
East: Joubert Street											
4	L2	7	2,0	0,017	9,8	LOS A	0,1	0,4	0,50	0,85	49,1
6	R2	1	2,0	0,017	34,3	LOS D	0,1	0,4	0,50	0,85	48,9
Approach		8	2,0	0,017	12,9	LOS B	0,1	0,4	0,50	0,85	49,1
North: Walter Sisulu Drive (R546)											
7	L2	3	2,0	0,169	5,6	LOS A	0,0	0,0	0,00	0,01	58,2
8	T1	654	2,0	0,169	0,0	LOS A	0,0	0,0	0,00	0,00	59,9
Approach		657	2,0	0,169	0,0	NA	0,0	0,0	0,00	0,00	59,9
All Vehicles		1239	2,0	0,169	0,2	NA	0,1	0,4	0,00	0,01	59,8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vv [Future 2021 PM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Joubert Street Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	560	2,0	0,146	0,0	LOS A	0,0	0,0	0,00	0,01	59,9
3	R2	7	2,0	0,146	5,6	LOS A	0,0	0,0	0,00	0,02	57,9
Approach		567	2,0	0,146	0,1	NA	0,0	0,0	0,00	0,01	59,9
East: Joubert Street											
4	L2	6	2,0	0,014	9,5	LOS A	0,0	0,3	0,46	0,84	49,4
6	R2	1	2,0	0,014	29,0	LOS D	0,0	0,3	0,46	0,84	49,3
Approach		7	2,0	0,014	12,3	LOS B	0,0	0,3	0,46	0,84	49,4
North: Walter Sisulu Drive (R546)											
7	L2	2	2,0	0,146	5,6	LOS A	0,0	0,0	0,00	0,00	58,2
8	T1	565	2,0	0,146	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
Approach		567	2,0	0,146	0,0	NA	0,0	0,0	0,00	0,00	59,9
All Vehicles		1142	2,0	0,146	0,1	NA	0,0	0,3	0,00	0,01	59,8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Site: vv [Future 2021 Sat. Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Joubert Street Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	465	2,0	0,120	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
3	R2	1	2,0	0,120	5,6	LOS A	0,0	0,0	0,00	0,00	58,0
Approach		466	2,0	0,120	0,0	NA	0,0	0,0	0,00	0,00	60,0
East: Joubert Street											
4	L2	1	2,0	0,028	9,5	LOS A	0,1	0,6	0,74	0,96	43,9
6	R2	5	2,0	0,028	24,6	LOS C	0,1	0,6	0,74	0,96	43,8
Approach		6	2,0	0,028	22,1	LOS C	0,1	0,6	0,74	0,96	43,8
North: Walter Sisulu Drive (R546)											
7	L2	1	2,0	0,142	5,6	LOS A	0,0	0,0	0,00	0,00	58,2
8	T1	553	2,0	0,142	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
Approach		554	2,0	0,142	0,0	NA	0,0	0,0	0,00	0,00	60,0
All Vehicles		1026	2,0	0,142	0,2	NA	0,1	0,6	0,00	0,01	59,8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvv [Future 2021 AM Peak Hour Traffic Flows + Development]

Walter Sisulu Drive (R546) / Joubert Street / Site Access Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	5	2,0	0,004	8,9	LOS A	0,1	0,4	0,31	0,61	51,1
2	T1	567	2,0	0,208	3,9	LOS A	3,4	24,0	0,37	0,32	56,4
3	R2	7	2,0	0,014	10,4	LOS B	0,1	0,6	0,37	0,62	50,0
Approach		580	2,0	0,208	4,1	LOS A	3,4	24,0	0,37	0,33	56,2
East: Joubert Street											
4	L2	7	2,0	0,043	33,1	LOS C	0,4	2,7	0,87	0,65	39,1
5	T1	5	2,0	0,043	27,6	LOS C	0,4	2,7	0,87	0,65	39,9
6	R2	1	2,0	0,004	32,6	LOS C	0,0	0,2	0,86	0,59	38,5
Approach		14	2,0	0,043	30,9	LOS C	0,4	2,7	0,87	0,64	39,4
North: Walter Sisulu Drive (R546)											
7	L2	3	2,0	0,237	9,6	LOS A	3,9	28,0	0,38	0,34	54,7
8	T1	643	2,0	0,237	4,0	LOS A	3,9	28,0	0,38	0,33	56,3
9	R2	35	2,0	0,061	10,2	LOS B	0,4	3,0	0,37	0,65	50,1
Approach		681	2,0	0,237	4,4	LOS A	3,9	28,0	0,38	0,35	55,9
West: Proposed Site Access											
10	L2	12	2,0	0,051	33,2	LOS C	0,4	3,1	0,88	0,67	38,6
11	T1	3	2,0	0,051	27,7	LOS C	0,4	3,1	0,88	0,67	39,4
12	R2	9	2,0	0,037	33,3	LOS C	0,3	2,0	0,87	0,67	38,5
Approach		24	2,0	0,051	32,5	LOS C	0,4	3,1	0,87	0,67	38,6
All Vehicles		1299	2,0	0,237	5,0	LOS A	3,9	28,0	0,39	0,35	55,3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvv [Future 2021 PM Peak Hour Traffic Flows + Development]

Walter Sisulu Drive (R546) / Joubert Street / Site Access Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	42	2,0	0,042	13,5	LOS B	0,7	4,7	0,49	0,67	48,0
2	T1	555	2,0	0,263	9,2	LOS A	5,0	35,8	0,57	0,48	52,2
3	R2	7	2,0	0,017	16,3	LOS B	0,1	1,0	0,55	0,64	46,4
Approach		604	2,0	0,263	9,5	LOS A	5,0	35,8	0,56	0,50	51,8
East: Joubert Street											
4	L2	6	2,0	0,040	23,5	LOS C	0,6	4,1	0,72	0,57	44,6
5	T1	18	2,0	0,040	17,9	LOS B	0,6	4,1	0,72	0,57	45,6
6	R2	1	2,0	0,003	26,3	LOS C	0,0	0,2	0,76	0,60	41,2
Approach		25	2,0	0,040	19,7	LOS B	0,6	4,1	0,72	0,57	45,1
North: Walter Sisulu Drive (R546)											
7	L2	2	2,0	0,254	14,7	LOS B	4,8	34,5	0,56	0,48	50,9
8	T1	535	2,0	0,254	9,1	LOS A	4,8	34,5	0,56	0,48	52,2
9	R2	112	2,0	0,263	18,0	LOS B	2,4	16,9	0,64	0,74	45,3
Approach		648	2,0	0,263	10,6	LOS B	4,8	34,5	0,58	0,52	50,9
West: Proposed Site Access											
10	L2	112	2,0	0,263	25,2	LOS C	4,0	28,4	0,79	0,73	42,4
11	T1	42	2,0	0,263	19,6	LOS B	4,0	28,4	0,79	0,73	43,3
12	R2	39	2,0	0,084	24,1	LOS C	1,0	6,8	0,73	0,70	42,6
Approach		193	2,0	0,263	23,7	LOS C	4,0	28,4	0,78	0,73	42,6
All Vehicles		1471	2,0	0,263	12,1	LOS B	5,0	35,8	0,60	0,54	49,8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvv [Future 2021 Sat. Peak Hour Traffic Flows + Development]

Walter Sisulu Drive (R546) / Joubert Street / Site Access Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	60	2,0	0,065	15,2	LOS B	1,0	7,5	0,54	0,68	46,9
2	T1	484	2,0	0,249	10,7	LOS B	4,7	33,6	0,61	0,51	51,0
3	R2	6	2,0	0,016	18,1	LOS B	0,1	0,9	0,59	0,65	45,3
Approach		551	2,0	0,249	11,3	LOS B	4,7	33,6	0,60	0,53	50,5
East: Joubert Street											
4	L2	1	2,0	0,055	21,4	LOS C	0,8	6,0	0,68	0,52	46,5
5	T1	37	2,0	0,055	15,8	LOS B	0,8	6,0	0,68	0,52	47,6
6	R2	5	2,0	0,015	25,9	LOS C	0,1	0,9	0,75	0,65	41,4
Approach		43	2,0	0,055	17,2	LOS B	0,8	6,0	0,69	0,53	46,7
North: Walter Sisulu Drive (R546)											
7	L2	1	2,0	0,285	16,5	LOS B	5,5	39,2	0,62	0,53	49,6
8	T1	553	2,0	0,285	11,0	LOS B	5,5	39,2	0,62	0,53	50,8
9	R2	137	2,0	0,329	19,8	LOS B	3,2	22,5	0,69	0,76	44,4
Approach		691	2,0	0,329	12,7	LOS B	5,5	39,2	0,63	0,57	49,4
West: Proposed Site Access											
10	L2	139	2,0	0,340	23,5	LOS C	5,7	40,8	0,77	0,73	43,5
11	T1	87	2,0	0,340	17,9	LOS B	5,7	40,8	0,77	0,73	44,5
12	R2	39	2,0	0,076	21,8	LOS C	0,9	6,3	0,69	0,69	43,7
Approach		265	2,0	0,340	21,4	LOS C	5,7	40,8	0,76	0,72	43,9
All Vehicles		1549	2,0	0,340	13,8	LOS B	5,7	40,8	0,65	0,58	48,6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Existing 2016 AM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Krogh Street (R23) Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	94	2,0	0,231	17,0	LOS B	2,5	18,0	0,74	0,70	47,4
2	T1	207	2,0	0,231	13,8	LOS B	4,0	28,5	0,70	0,60	48,3
3	R2	13	2,0	0,231	20,0	LOS B	4,0	28,5	0,69	0,58	47,5
Approach		314	2,0	0,231	15,0	LOS B	4,0	28,5	0,71	0,63	48,0
East: Krogh Street (R23)											
4	L2	57	2,0	0,052	7,3	LOS A	0,4	2,5	0,31	0,62	52,9
5	T1	232	2,0	0,278	14,0	LOS B	5,1	36,7	0,69	0,58	48,8
6	R2	81	2,0	0,179	23,3	LOS C	2,0	14,1	0,74	0,74	42,5
Approach		369	2,0	0,278	15,0	LOS B	5,1	36,7	0,64	0,62	47,8
North: Walter Sisulu Drive (R546)											
7	L2	126	2,0	0,628	24,4	LOS C	10,6	75,1	0,88	0,80	44,4
8	T1	267	2,0	0,628	18,8	LOS B	10,6	75,1	0,88	0,80	44,9
9	R2	276	2,0	0,756	35,1	LOS D	9,7	69,4	0,97	0,91	37,4
Approach		669	2,0	0,756	26,6	LOS C	10,6	75,1	0,92	0,85	41,4
West: Krogh Street (R23)											
10	L2	257	2,0	0,685	21,1	LOS C	12,1	86,5	0,86	0,84	45,6
11	T1	241	2,0	0,685	15,5	LOS B	12,1	86,5	0,86	0,84	46,1
12	R2	143	2,0	0,320	23,6	LOS C	3,7	26,0	0,77	0,77	42,2
Approach		641	2,0	0,685	19,6	LOS B	12,1	86,5	0,84	0,82	45,0
All Vehicles		1994	2,0	0,756	20,4	LOS C	12,1	86,5	0,81	0,76	44,6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Existing 2016 PM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Krogh Street (R23) Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	198	2,0	0,259	10,2	LOS B	2,1	14,9	0,55	0,69	51,1
2	T1	203	2,0	0,259	12,0	LOS B	4,5	31,7	0,65	0,58	49,5
3	R2	23	2,0	0,259	18,3	LOS B	4,5	31,7	0,65	0,57	48,4
Approach		424	2,0	0,259	11,5	LOS B	4,5	31,7	0,60	0,63	50,2
East: Krogh Street (R23)											
4	L2	91	2,0	0,084	7,5	LOS A	0,5	3,7	0,33	0,63	52,8
5	T1	344	2,0	0,442	16,6	LOS B	8,7	61,6	0,78	0,66	47,2
6	R2	139	2,0	0,276	23,3	LOS C	3,5	24,7	0,75	0,76	42,6
Approach		574	2,0	0,442	16,8	LOS B	8,7	61,6	0,70	0,68	46,7
North: Walter Sisulu Drive (R546)											
7	L2	97	2,0	0,462	20,1	LOS C	7,8	55,2	0,77	0,71	47,0
8	T1	240	2,0	0,462	14,5	LOS B	7,8	55,2	0,77	0,71	47,5
9	R2	221	2,0	0,494	25,8	LOS C	6,2	44,0	0,84	0,80	41,3
Approach		558	2,0	0,494	19,9	LOS B	7,8	55,2	0,80	0,75	44,8
West: Krogh Street (R23)											
10	L2	140	2,0	0,487	19,9	LOS B	6,6	47,3	0,82	0,76	46,5
11	T1	164	2,0	0,487	14,3	LOS B	6,6	47,3	0,82	0,76	47,0
12	R2	145	2,0	0,440	29,3	LOS C	4,3	30,6	0,87	0,79	39,6
Approach		449	2,0	0,487	20,9	LOS C	6,6	47,3	0,83	0,77	44,2
All Vehicles		2005	2,0	0,494	17,5	LOS B	8,7	61,6	0,74	0,71	46,2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Existing 2016 Sat. Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Krogh Street (R23) Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	153	2,0	0,255	12,8	LOS B	3,0	21,2	0,61	0,68	49,9
2	T1	213	2,0	0,255	11,5	LOS B	4,3	30,3	0,64	0,60	49,4
3	R2	32	2,0	0,255	18,2	LOS B	4,3	30,3	0,65	0,58	48,3
Approach		397	2,0	0,255	12,5	LOS B	4,3	30,3	0,63	0,62	49,5
East: Krogh Street (R23)											
4	L2	59	2,0	0,051	6,7	LOS A	0,3	1,9	0,25	0,61	53,3
5	T1	158	2,0	0,203	14,8	LOS B	3,5	25,2	0,69	0,56	48,3
6	R2	68	2,0	0,148	23,1	LOS C	1,7	11,8	0,73	0,73	42,7
Approach		285	2,0	0,203	15,1	LOS B	3,5	25,2	0,61	0,61	47,7
North: Walter Sisulu Drive (R546)											
7	L2	66	2,0	0,351	18,2	LOS B	5,7	40,6	0,71	0,65	48,3
8	T1	207	2,0	0,351	12,6	LOS B	5,7	40,6	0,71	0,65	48,9
9	R2	174	2,0	0,371	23,4	LOS C	4,5	31,7	0,77	0,78	42,5
Approach		447	2,0	0,371	17,6	LOS B	5,7	40,6	0,73	0,70	46,1
West: Krogh Street (R23)											
10	L2	75	2,0	0,370	19,8	LOS B	5,6	40,1	0,75	0,69	47,1
11	T1	185	2,0	0,370	14,1	LOS B	5,6	40,1	0,75	0,69	47,7
12	R2	103	2,0	0,219	22,8	LOS C	2,5	17,9	0,73	0,75	42,6
Approach		363	2,0	0,370	17,8	LOS B	5,6	40,1	0,74	0,71	46,0
All Vehicles		1493	2,0	0,371	15,8	LOS B	5,7	40,6	0,68	0,66	47,3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 AM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Krogh Street (R23) Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	108	2,0	0,260	17,3	LOS B	2,9	20,3	0,76	0,71	47,2
2	T1	240	2,0	0,260	13,0	LOS B	4,6	32,8	0,68	0,60	48,8
3	R2	15	2,0	0,260	18,9	LOS B	4,6	32,8	0,67	0,57	48,2
Approach		363	2,0	0,260	14,5	LOS B	4,6	32,8	0,71	0,63	48,3
East: Krogh Street (R23)											
4	L2	66	2,0	0,063	8,0	LOS A	0,5	3,4	0,37	0,63	52,4
5	T1	268	2,0	0,345	15,9	LOS B	6,4	45,8	0,74	0,62	47,6
6	R2	94	2,0	0,243	26,9	LOS C	2,5	18,1	0,81	0,75	40,8
Approach		428	2,0	0,345	17,1	LOS B	6,4	45,8	0,70	0,65	46,6
North: Walter Sisulu Drive (R546)											
7	L2	146	2,0	0,751	29,0	LOS C	14,1	100,5	0,95	0,91	42,1
8	T1	309	2,0	0,751	23,4	LOS C	14,1	100,5	0,95	0,91	42,5
9	R2	320	2,0	0,939	54,0	LOS D	15,0	106,6	1,00	1,09	31,3
Approach		776	2,0	0,939	37,1	LOS D	15,0	106,6	0,97	0,98	37,0
West: Krogh Street (R23)											
10	L2	298	2,0	0,882	37,0	LOS D	21,4	152,3	1,00	1,10	38,1
11	T1	279	2,0	0,882	31,4	LOS C	21,4	152,3	1,00	1,10	38,5
12	R2	166	2,0	0,432	26,9	LOS C	4,7	33,4	0,84	0,79	40,7
Approach		743	2,0	0,882	32,6	LOS C	21,4	152,3	0,96	1,03	38,8
All Vehicles		2311	2,0	0,939	28,4	LOS C	21,4	152,3	0,87	0,88	40,7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 PM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Krogh Street (R23) Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	229	2,0	0,313	10,6	LOS B	2,4	17,4	0,59	0,71	50,7
2	T1	236	2,0	0,313	13,1	LOS B	5,5	39,4	0,68	0,61	48,8
3	R2	27	2,0	0,313	19,3	LOS B	5,5	39,4	0,69	0,60	47,8
Approach		493	2,0	0,313	12,3	LOS B	5,5	39,4	0,64	0,65	49,6
East: Krogh Street (R23)											
4	L2	105	2,0	0,105	8,5	LOS A	0,8	5,6	0,42	0,65	52,0
5	T1	399	2,0	0,513	17,2	LOS B	10,4	74,0	0,81	0,70	46,8
6	R2	161	2,0	0,336	24,5	LOS C	4,2	29,9	0,78	0,77	42,0
Approach		665	2,0	0,513	17,6	LOS B	10,4	74,0	0,74	0,71	46,3
North: Walter Sisulu Drive (R546)											
7	L2	113	2,0	0,535	21,2	LOS C	9,5	67,6	0,80	0,74	46,3
8	T1	278	2,0	0,535	15,5	LOS B	9,5	67,6	0,80	0,74	46,9
9	R2	256	2,0	0,595	27,5	LOS C	7,6	53,9	0,89	0,82	40,6
Approach		646	2,0	0,595	21,2	LOS C	9,5	67,6	0,84	0,77	44,1
West: Krogh Street (R23)											
10	L2	162	2,0	0,564	21,5	LOS C	8,3	59,1	0,85	0,79	45,5
11	T1	191	2,0	0,564	15,9	LOS B	8,3	59,1	0,85	0,79	46,1
12	R2	168	2,0	0,575	31,4	LOS C	5,3	37,9	0,92	0,81	38,7
Approach		521	2,0	0,575	22,7	LOS C	8,3	59,1	0,87	0,80	43,3
All Vehicles		2325	2,0	0,595	18,6	LOS B	10,4	74,0	0,77	0,74	45,6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 Sat. Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Krogh Street (R23) Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	177	2,0	0,304	13,1	LOS B	3,5	25,0	0,64	0,69	49,6
2	T1	246	2,0	0,304	12,4	LOS B	5,2	37,2	0,68	0,62	48,8
3	R2	37	2,0	0,304	19,2	LOS B	5,2	37,2	0,68	0,60	47,7
Approach		460	2,0	0,304	13,2	LOS B	5,2	37,2	0,66	0,65	49,0
East: Krogh Street (R23)											
4	L2	68	2,0	0,062	7,0	LOS A	0,4	2,5	0,28	0,62	53,1
5	T1	183	2,0	0,235	15,0	LOS B	4,2	29,6	0,70	0,58	48,1
6	R2	79	2,0	0,181	24,1	LOS C	2,0	14,1	0,75	0,74	42,2
Approach		331	2,0	0,235	15,5	LOS B	4,2	29,6	0,63	0,62	47,5
North: Walter Sisulu Drive (R546)											
7	L2	77	2,0	0,398	18,4	LOS B	6,7	47,9	0,71	0,66	48,2
8	T1	240	2,0	0,398	12,8	LOS B	6,7	47,9	0,71	0,66	48,8
9	R2	201	2,0	0,433	23,9	LOS C	5,3	37,8	0,79	0,79	42,2
Approach		518	2,0	0,433	17,9	LOS B	6,7	47,9	0,74	0,71	45,9
West: Krogh Street (R23)											
10	L2	86	2,0	0,430	20,6	LOS C	6,9	48,9	0,77	0,71	46,6
11	T1	215	2,0	0,430	15,0	LOS B	6,9	48,9	0,77	0,71	47,2
12	R2	120	2,0	0,267	23,9	LOS C	3,0	21,7	0,76	0,76	42,1
Approach		421	2,0	0,430	18,7	LOS B	6,9	48,9	0,77	0,73	45,5
All Vehicles		1729	2,0	0,433	16,4	LOS B	6,9	48,9	0,71	0,68	46,9

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 AM Peak Hour Traffic Flows + Development]

Walter Sisulu Drive (R546) / Krogh Street (R23) Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	108	2,0	0,268	17,9	LOS B	3,0	21,1	0,78	0,72	46,8
2	T1	249	2,0	0,268	13,1	LOS B	4,8	34,2	0,69	0,60	48,7
3	R2	15	2,0	0,268	18,9	LOS B	4,8	34,2	0,67	0,57	48,1
Approach		373	2,0	0,268	14,8	LOS B	4,8	34,2	0,71	0,63	48,1
East: Krogh Street (R23)											
4	L2	66	2,0	0,063	8,0	LOS A	0,5	3,4	0,37	0,63	52,4
5	T1	261	2,0	0,336	15,8	LOS B	6,2	44,3	0,74	0,62	47,7
6	R2	107	2,0	0,267	27,0	LOS C	2,9	20,8	0,81	0,76	40,8
Approach		435	2,0	0,336	17,4	LOS B	6,2	44,3	0,70	0,66	46,4
North: Walter Sisulu Drive (R546)											
7	L2	159	2,0	0,818	33,2	LOS C	16,1	115,0	0,98	0,99	40,1
8	T1	312	2,0	0,818	27,6	LOS C	16,1	115,0	0,98	0,99	40,5
9	R2	328	2,0	1,017	74,1	LOS E	18,2	129,8	1,00	1,20	26,7
Approach		799	2,0	1,017	47,8	LOS D	18,2	129,8	0,99	1,08	33,4
West: Krogh Street (R23)											
10	L2	314	2,0	0,908	41,4	LOS D	22,9	162,9	1,00	1,14	36,4
11	T1	266	2,0	0,908	35,8	LOS D	22,9	162,9	1,00	1,14	36,7
12	R2	166	2,0	0,426	26,8	LOS C	4,7	33,3	0,84	0,79	40,7
Approach		746	2,0	0,908	36,2	LOS D	22,9	162,9	0,96	1,06	37,4
All Vehicles		2353	2,0	1,017	33,3	LOS C	22,9	162,9	0,88	0,92	38,6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 PM Peak Hour Traffic Flows + Development]

Walter Sisulu Drive (R546) / Krogh Street (R23) Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	229	2,0	0,324	11,6	LOS B	2,9	20,5	0,64	0,72	50,1
2	T1	268	2,0	0,324	12,1	LOS B	6,0	42,7	0,66	0,59	49,5
3	R2	27	2,0	0,324	18,1	LOS B	6,0	42,7	0,66	0,58	48,6
Approach		525	2,0	0,324	12,2	LOS B	6,0	42,7	0,65	0,65	49,7
East: Krogh Street (R23)											
4	L2	105	2,0	0,103	8,3	LOS A	0,7	5,2	0,40	0,65	52,2
5	T1	377	2,0	0,522	18,7	LOS B	10,2	72,4	0,83	0,71	45,9
6	R2	207	2,0	0,429	25,9	LOS C	5,7	40,5	0,83	0,79	41,3
Approach		689	2,0	0,522	19,3	LOS B	10,2	72,4	0,76	0,73	45,2
North: Walter Sisulu Drive (R546)											
7	L2	177	2,0	0,677	22,8	LOS C	12,3	87,8	0,89	0,81	45,1
8	T1	286	2,0	0,677	17,2	LOS B	12,3	87,8	0,89	0,81	45,6
9	R2	303	2,0	0,751	32,9	LOS C	10,5	74,5	0,96	0,91	38,3
Approach		766	2,0	0,751	24,7	LOS C	12,3	87,8	0,91	0,85	42,3
West: Krogh Street (R23)											
10	L2	222	2,0	0,673	21,7	LOS C	8,6	61,5	0,91	0,85	45,0
11	T1	148	2,0	0,673	16,1	LOS B	8,6	61,5	0,91	0,85	45,5
12	R2	168	2,0	0,612	33,7	LOS C	5,6	39,5	0,95	0,83	37,8
Approach		539	2,0	0,673	23,9	LOS C	8,6	61,5	0,92	0,84	42,6
All Vehicles		2520	2,0	0,751	20,4	LOS C	12,3	87,8	0,82	0,77	44,5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 Sat. Peak Hour Traffic Flows + Development]

Walter Sisulu Drive (R546) / Krogh Street (R23) Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	177	2,0	0,333	15,2	LOS B	4,2	29,9	0,71	0,71	48,4
2	T1	314	2,0	0,333	11,5	LOS B	6,2	44,0	0,66	0,61	49,6
3	R2	37	2,0	0,333	17,5	LOS B	6,2	44,0	0,65	0,58	48,8
Approach		527	2,0	0,333	13,2	LOS B	6,2	44,0	0,68	0,64	49,1
East: Krogh Street (R23)											
4	L2	68	2,0	0,060	7,0	LOS A	0,4	2,8	0,28	0,62	53,1
5	T1	161	2,0	0,232	17,1	LOS B	3,9	27,7	0,74	0,60	46,9
6	R2	152	2,0	0,352	26,9	LOS C	4,2	29,8	0,83	0,78	40,9
Approach		381	2,0	0,352	19,2	LOS B	4,2	29,8	0,69	0,67	45,2
North: Walter Sisulu Drive (R546)											
7	L2	168	2,0	0,606	21,1	LOS C	10,5	74,9	0,84	0,78	46,0
8	T1	258	2,0	0,606	15,5	LOS B	10,5	74,9	0,84	0,78	46,6
9	R2	277	2,0	0,679	29,5	LOS C	8,8	62,8	0,92	0,86	39,7
Approach		703	2,0	0,679	22,4	LOS C	10,5	74,9	0,87	0,81	43,5
West: Krogh Street (R23)											
10	L2	176	2,0	0,612	22,6	LOS C	8,3	59,3	0,88	0,82	44,8
11	T1	173	2,0	0,612	17,0	LOS B	8,3	59,3	0,88	0,82	45,3
12	R2	120	2,0	0,291	26,4	LOS C	3,2	23,1	0,81	0,77	40,9
Approach		468	2,0	0,612	21,5	LOS C	8,3	59,3	0,86	0,81	43,9
All Vehicles		2080	2,0	0,679	19,3	LOS B	10,5	74,9	0,79	0,74	45,2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 AM Peak Hour Traffic Flows + Development + Upgrades]

Walter Sisulu Drive (R546) / Krogh Street (R23) Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	108	2,0	0,669	30,6	LOS C	10,3	73,5	0,92	0,87	41,4
2	T1	249	2,0	0,669	24,9	LOS C	10,3	73,5	0,92	0,87	41,8
3	R2	15	2,0	0,042	25,5	LOS C	0,4	2,6	0,75	0,68	41,7
Approach		373	2,0	0,669	26,6	LOS C	10,3	73,5	0,92	0,87	41,7
East: Krogh Street (R23)											
4	L2	66	2,0	0,068	9,2	LOS A	0,7	4,9	0,41	0,64	51,4
5	T1	261	2,0	0,587	26,7	LOS C	8,2	58,4	0,94	0,79	41,7
6	R2	107	2,0	0,293	30,4	LOS C	3,1	22,3	0,87	0,77	39,3
Approach		435	2,0	0,587	25,0	LOS C	8,2	58,4	0,84	0,76	42,3
North: Walter Sisulu Drive (R546)											
7	L2	159	2,0	0,630	22,2	LOS C	12,0	85,7	0,85	0,79	45,6
8	T1	312	2,0	0,630	16,6	LOS B	12,0	85,7	0,85	0,79	46,1
9	R2	328	2,0	0,707	31,2	LOS C	10,7	76,3	0,95	0,87	39,0
Approach		799	2,0	0,707	23,7	LOS C	12,0	85,7	0,89	0,83	42,8
West: Krogh Street (R23)											
10	L2	314	2,0	0,633	19,5	LOS B	14,6	103,9	0,79	0,76	47,0
11	T1	266	2,0	0,633	13,9	LOS B	14,6	103,9	0,79	0,76	47,1
12	R2	166	2,0	0,354	20,0	LOS B	3,6	25,4	0,85	0,77	44,1
Approach		746	2,0	0,633	17,6	LOS B	14,6	103,9	0,80	0,76	46,3
All Vehicles		2353	2,0	0,707	22,5	LOS C	14,6	103,9	0,86	0,80	43,6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 PM Peak Hour Traffic Flows + Development + Upgrades]

Walter Sisulu Drive (R546) / Krogh Street (R23) Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	229	2,0	0,826	34,1	LOS C	16,9	120,3	0,97	1,04	39,4
2	T1	268	2,0	0,826	28,5	LOS C	16,9	120,3	0,97	1,04	39,8
3	R2	27	2,0	0,065	21,8	LOS C	0,6	4,5	0,68	0,69	43,5
Approach		525	2,0	0,826	30,6	LOS C	16,9	120,3	0,95	1,02	39,8
East: Krogh Street (R23)											
4	L2	105	2,0	0,097	8,1	LOS A	0,9	6,4	0,36	0,64	52,2
5	T1	377	2,0	0,848	34,9	LOS C	14,4	102,6	1,00	1,00	38,2
6	R2	207	2,0	0,565	32,4	LOS C	6,5	46,6	0,94	0,81	38,5
Approach		689	2,0	0,848	30,1	LOS C	14,4	102,6	0,88	0,89	39,9
North: Walter Sisulu Drive (R546)											
7	L2	177	2,0	0,569	18,7	LOS B	10,6	75,5	0,78	0,74	47,5
8	T1	286	2,0	0,569	13,1	LOS B	10,6	75,5	0,78	0,74	48,1
9	R2	303	2,0	0,627	27,7	LOS C	9,0	64,4	0,90	0,83	40,5
Approach		766	2,0	0,627	20,2	LOS C	10,6	75,5	0,83	0,78	44,6
West: Krogh Street (R23)											
10	L2	222	2,0	0,436	19,6	LOS B	8,6	61,5	0,72	0,72	46,7
11	T1	148	2,0	0,436	14,0	LOS B	8,6	61,5	0,72	0,72	46,8
12	R2	168	2,0	0,523	23,6	LOS C	4,0	28,4	0,96	0,79	42,2
Approach		539	2,0	0,523	19,3	LOS B	8,6	61,5	0,80	0,74	45,3
All Vehicles		2520	2,0	0,848	24,9	LOS C	16,9	120,3	0,86	0,85	42,3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: v [Future 2021 Sat. Peak Hour Traffic Flows + Development + Upgrades]

Walter Sisulu Drive (R546) / Krogh Street (R23) Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	177	2,0	0,768	27,5	LOS C	15,2	108,0	0,94	0,91	42,7
2	T1	314	2,0	0,768	21,8	LOS C	15,2	108,0	0,94	0,91	43,2
3	R2	37	2,0	0,079	20,5	LOS C	0,8	5,8	0,66	0,69	44,2
Approach		527	2,0	0,768	23,6	LOS C	15,2	108,0	0,92	0,89	43,1
East: Krogh Street (R23)											
4	L2	68	2,0	0,063	7,4	LOS A	0,4	2,7	0,33	0,63	52,8
5	T1	161	2,0	0,207	14,8	LOS B	3,6	25,7	0,69	0,57	48,3
6	R2	152	2,0	0,361	22,5	LOS C	3,6	25,8	0,87	0,77	43,0
Approach		381	2,0	0,361	16,6	LOS B	3,6	25,8	0,70	0,66	46,7
North: Walter Sisulu Drive (R546)											
7	L2	168	2,0	0,496	18,5	LOS B	8,6	61,1	0,71	0,73	47,6
8	T1	258	2,0	0,496	12,9	LOS B	8,6	61,1	0,71	0,73	48,1
9	R2	277	2,0	0,597	27,4	LOS C	8,2	58,1	0,89	0,82	40,6
Approach		703	2,0	0,597	20,0	LOS B	8,6	61,1	0,78	0,77	44,7
West: Krogh Street (R23)											
10	L2	176	2,0	0,767	35,2	LOS D	12,2	86,7	0,98	0,92	39,2
11	T1	173	2,0	0,767	29,5	LOS C	12,2	86,7	0,98	0,92	39,3
12	R2	120	2,0	0,383	32,0	LOS C	3,7	26,1	0,90	0,78	38,5
Approach		468	2,0	0,767	32,3	LOS C	12,2	86,7	0,96	0,89	39,1
All Vehicles		2080	2,0	0,768	23,0	LOS C	15,2	108,0	0,84	0,81	43,2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvv [Existing 2016 AM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Kruger Street Intersection
Stop (All-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	18	2,0	0,538	18,5	LOS C	2,7	19,4	0,94	1,48	46,4
2	T1	443	2,0	0,538	18,6	LOS C	2,7	19,4	0,95	1,48	46,0
3	R2	28	2,0	0,538	19,1	LOS C	2,7	19,4	0,96	1,48	45,9
Approach		489	2,0	0,538	18,6	LOS C	2,7	19,4	0,95	1,48	46,0
East: Kruger Street											
4	L2	20	2,0	0,005	8,1	LOS A	0,0	0,0	0,00	1,00	51,7
5	T1	8	2,0	0,005	7,9	LOS A	0,0	0,0	0,00	1,00	51,7
6	R2	25	2,0	0,005	7,9	LOS A	0,0	0,0	0,00	1,00	51,6
Approach		54	2,0	0,005	8,0	LOS A	0,0	0,0	0,00	1,00	51,7
North: Walter Sisulu Drive (R546)											
7	L2	15	2,0	0,617	21,3	LOS C	3,5	25,1	0,97	1,56	44,9
8	T1	537	2,0	0,617	21,4	LOS C	3,5	25,1	0,97	1,56	44,5
9	R2	20	2,0	0,617	22,0	LOS C	3,5	25,1	0,98	1,56	44,3
Approach		572	2,0	0,617	21,4	LOS C	3,5	25,1	0,97	1,56	44,5
West: Kruger Street											
10	L2	4	2,0	0,243	66,5	LOS F	0,9	6,7	1,00	1,29	28,8
11	T1	1	2,0	0,243	66,3	LOS F	0,9	6,7	1,00	1,29	28,7
12	R2	14	2,0	0,243	66,3	LOS F	0,9	6,7	1,00	1,29	28,7
Approach		19	2,0	0,243	66,4	LOS F	0,9	6,7	1,00	1,29	28,7
All Vehicles		1134	2,0	0,617	20,3	LOS C	3,5	25,1	0,92	1,50	45,0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvv [Existing 2016 PM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Kruger Street Intersection
Stop (All-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	1	2,0	0,497	16,6	LOS C	2,4	16,9	0,92	1,45	47,6
2	T1	468	2,0	0,497	16,5	LOS C	2,4	16,9	0,93	1,45	47,2
3	R2	16	2,0	0,497	17,0	LOS C	2,4	16,9	0,93	1,45	47,1
Approach		485	2,0	0,497	16,5	LOS C	2,4	16,9	0,93	1,45	47,2
East: Kruger Street											
4	L2	11	2,0	0,942	366,1	LOS F	4,5	32,3	1,00	1,41	8,6
5	T1	1	2,0	0,942	365,9	LOS F	4,5	32,3	1,00	1,41	8,6
6	R2	14	2,0	0,942	365,9	LOS F	4,5	32,3	1,00	1,41	8,6
Approach		25	2,0	0,942	366,0	LOS F	4,5	32,3	1,00	1,41	8,6
North: Walter Sisulu Drive (R546)											
7	L2	13	2,0	0,509	17,0	LOS C	2,5	17,5	0,92	1,46	47,3
8	T1	477	2,0	0,509	17,0	LOS C	2,5	17,6	0,93	1,46	47,0
9	R2	1	2,0	0,509	17,4	LOS C	2,5	17,6	0,94	1,46	46,9
Approach		491	2,0	0,509	17,0	LOS C	2,5	17,6	0,93	1,46	47,0
West: Kruger Street											
10	L2	1	2,0	0,102	103,1	LOS F	0,4	2,6	1,00	1,25	22,3
11	T1	1	2,0	0,102	102,9	LOS F	0,4	2,6	1,00	1,25	22,3
12	R2	2	2,0	0,102	102,9	LOS F	0,4	2,6	1,00	1,25	22,3
Approach		4	2,0	0,102	103,0	LOS F	0,4	2,6	1,00	1,25	22,3
All Vehicles		1005	2,0	0,942	25,9	LOS D	4,5	32,3	0,93	1,45	42,1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvv [Existing 2016 Sat. Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Kruger Street Intersection
Stop (All-Way)

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
Movement Performance - Vehicles											
South: Walter Sisulu Drive (R546)											
1	L2	3	2,0	0,455	16,5	LOS C	2,1	14,7	0,92	1,42	47,7
2	T1	395	2,0	0,455	16,4	LOS C	2,1	14,8	0,93	1,42	47,3
3	R2	7	2,0	0,455	16,8	LOS C	2,1	14,8	0,94	1,41	47,2
Approach		405	2,0	0,455	16,4	LOS C	2,1	14,8	0,93	1,42	47,3
East: Kruger Street											
4	L2	2	2,0	0,123	40,4	LOS E	0,4	3,2	1,00	1,26	36,2
5	T1	1	2,0	0,123	40,2	LOS E	0,4	3,2	1,00	1,26	36,2
6	R2	12	2,0	0,123	40,2	LOS E	0,4	3,2	1,00	1,26	36,2
Approach		15	2,0	0,123	40,2	LOS E	0,4	3,2	1,00	1,26	36,2
North: Walter Sisulu Drive (R546)											
7	L2	4	2,0	0,526	18,2	LOS C	2,6	18,6	0,94	1,47	46,7
8	T1	473	2,0	0,526	18,2	LOS C	2,6	18,6	0,95	1,47	46,3
9	R2	1	2,0	0,526	18,6	LOS C	2,6	18,6	0,95	1,47	46,2
Approach		478	2,0	0,526	18,2	LOS C	2,6	18,6	0,95	1,47	46,3
West: Kruger Street											
10	L2	3	2,0	0,001	8,1	LOS A	0,0	0,0	0,00	1,00	51,7
11	T1	1	2,0	0,001	7,9	LOS A	0,0	0,0	0,00	1,00	51,6
12	R2	2	2,0	0,001	7,9	LOS A	0,0	0,0	0,00	1,00	51,6
Approach		6	2,0	0,001	8,0	LOS A	0,0	0,0	0,00	1,00	51,7
All Vehicles		904	2,0	0,526	17,7	LOS C	2,6	18,6	0,94	1,44	46,6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Existing 2016 AM Peak Hour Traffic Flows + Upgrades]

Walter Sisulu Drive (R546) / Kruger Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	18	2,0	0,195	9,4	LOS A	3,1	22,1	0,37	0,34	54,6
2	T1	443	2,0	0,195	3,9	LOS A	3,1	22,1	0,37	0,35	55,9
3	R2	28	2,0	0,195	9,5	LOS A	2,6	18,8	0,37	0,36	54,4
Approach		489	2,0	0,195	4,4	LOS A	3,1	22,1	0,37	0,35	55,8
East: Kruger Street											
4	L2	20	2,0	0,096	33,6	LOS C	0,9	6,1	0,89	0,69	38,6
5	T1	8	2,0	0,096	28,0	LOS C	0,9	6,1	0,89	0,69	39,4
6	R2	25	2,0	0,095	33,7	LOS C	0,8	5,4	0,89	0,71	37,8
Approach		54	2,0	0,096	32,8	LOS C	0,9	6,1	0,89	0,70	38,4
North: Walter Sisulu Drive (R546)											
7	L2	15	2,0	0,219	9,5	LOS A	3,6	25,4	0,38	0,34	54,6
8	T1	537	2,0	0,219	4,0	LOS A	3,6	25,4	0,38	0,35	56,0
9	R2	20	2,0	0,219	9,5	LOS A	3,3	23,4	0,38	0,35	54,5
Approach		572	2,0	0,219	4,3	LOS A	3,6	25,4	0,38	0,35	55,9
West: Kruger Street											
10	L2	4	2,0	0,018	32,8	LOS C	0,2	1,1	0,87	0,63	38,7
11	T1	1	2,0	0,018	27,3	LOS C	0,2	1,1	0,87	0,63	39,5
12	R2	14	2,0	0,055	33,5	LOS C	0,4	2,9	0,88	0,68	37,9
Approach		19	2,0	0,055	33,0	LOS C	0,4	2,9	0,87	0,67	38,2
All Vehicles		1134	2,0	0,219	6,2	LOS A	3,6	25,4	0,41	0,37	54,3

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Existing 2016 PM Peak Hour Traffic Flows + Upgrades]

Walter Sisulu Drive (R546) / Kruger Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	1	2,0	0,186	9,4	LOS A	2,9	20,9	0,37	0,31	54,9
2	T1	468	2,0	0,186	3,9	LOS A	2,9	20,9	0,37	0,32	56,3
3	R2	16	2,0	0,186	9,4	LOS A	2,7	19,3	0,37	0,34	54,7
Approach		485	2,0	0,186	4,0	LOS A	2,9	20,9	0,37	0,32	56,2
East: Kruger Street											
4	L2	11	2,0	0,040	33,1	LOS C	0,3	2,4	0,87	0,67	38,4
5	T1	1	2,0	0,040	27,5	LOS C	0,3	2,4	0,87	0,67	39,1
6	R2	14	2,0	0,051	33,3	LOS C	0,4	2,9	0,88	0,68	38,0
Approach		25	2,0	0,051	33,0	LOS C	0,4	2,9	0,88	0,68	38,2
North: Walter Sisulu Drive (R546)											
7	L2	13	2,0	0,181	9,4	LOS A	2,8	20,3	0,37	0,33	54,7
8	T1	477	2,0	0,181	3,8	LOS A	2,8	20,3	0,37	0,32	56,3
9	R2	1	2,0	0,181	9,4	LOS A	2,8	20,2	0,37	0,31	54,9
Approach		491	2,0	0,181	4,0	LOS A	2,8	20,3	0,37	0,32	56,3
West: Kruger Street											
10	L2	1	2,0	0,007	32,6	LOS C	0,1	0,4	0,86	0,58	39,5
11	T1	1	2,0	0,007	27,0	LOS C	0,1	0,4	0,86	0,58	40,3
12	R2	2	2,0	0,008	32,7	LOS C	0,1	0,4	0,86	0,62	38,2
Approach		4	2,0	0,008	31,2	LOS C	0,1	0,4	0,86	0,60	39,0
All Vehicles		1005	2,0	0,186	4,9	LOS A	2,9	20,9	0,38	0,33	55,5

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Existing 2016 Sat. Peak Hour Traffic Flows + Upgrades]

Walter Sisulu Drive (R546) / Kruger Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	3	2,0	0,152	9,3	LOS A	2,3	16,7	0,36	0,31	54,9
2	T1	395	2,0	0,152	3,7	LOS A	2,3	16,7	0,36	0,31	56,4
3	R2	7	2,0	0,152	9,3	LOS A	2,2	16,0	0,36	0,31	54,9
Approach		405	2,0	0,152	3,9	LOS A	2,3	16,7	0,36	0,31	56,4
East: Kruger Street											
4	L2	2	2,0	0,011	32,7	LOS C	0,1	0,7	0,86	0,60	39,1
5	T1	1	2,0	0,011	27,1	LOS C	0,1	0,7	0,86	0,60	39,9
6	R2	12	2,0	0,044	33,3	LOS C	0,3	2,5	0,87	0,68	38,0
Approach		15	2,0	0,044	32,7	LOS C	0,3	2,5	0,87	0,66	38,3
North: Walter Sisulu Drive (R546)											
7	L2	4	2,0	0,176	9,4	LOS A	2,8	19,7	0,36	0,32	54,8
8	T1	473	2,0	0,176	3,8	LOS A	2,8	19,7	0,36	0,31	56,4
9	R2	1	2,0	0,176	9,4	LOS A	2,8	19,6	0,36	0,31	54,9
Approach		478	2,0	0,176	3,9	LOS A	2,8	19,7	0,36	0,31	56,4
West: Kruger Street											
10	L2	3	2,0	0,014	32,8	LOS C	0,1	0,9	0,87	0,62	38,9
11	T1	1	2,0	0,014	27,2	LOS C	0,1	0,9	0,87	0,62	39,6
12	R2	2	2,0	0,008	32,7	LOS C	0,1	0,4	0,86	0,62	38,2
Approach		6	2,0	0,014	31,8	LOS C	0,1	0,9	0,86	0,62	38,8
All Vehicles		904	2,0	0,176	4,6	LOS A	2,8	19,7	0,37	0,32	55,8

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Future 2021 AM Peak Hour Traffic Flows + Upgrades]

Walter Sisulu Drive (R546) / Kruger Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	21	2,0	0,229	9,6	LOS A	3,8	26,7	0,38	0,35	54,5
2	T1	514	2,0	0,229	4,0	LOS A	3,8	26,7	0,38	0,36	55,8
3	R2	33	2,0	0,229	9,6	LOS A	3,1	22,2	0,38	0,37	54,3
Approach		567	2,0	0,229	4,5	LOS A	3,8	26,7	0,38	0,36	55,7
East: Kruger Street											
4	L2	23	2,0	0,111	33,7	LOS C	1,0	7,0	0,89	0,70	38,6
5	T1	9	2,0	0,111	28,1	LOS C	1,0	7,0	0,89	0,70	39,3
6	R2	29	2,0	0,112	33,8	LOS C	0,9	6,4	0,89	0,71	37,8
Approach		62	2,0	0,112	32,9	LOS C	1,0	7,0	0,89	0,70	38,3
North: Walter Sisulu Drive (R546)											
7	L2	17	2,0	0,256	9,7	LOS A	4,3	30,5	0,39	0,36	54,5
8	T1	622	2,0	0,256	4,1	LOS A	4,3	30,5	0,39	0,36	55,9
9	R2	23	2,0	0,256	9,7	LOS A	3,9	27,8	0,39	0,36	54,4
Approach		662	2,0	0,256	4,4	LOS A	4,3	30,5	0,39	0,36	55,8
West: Kruger Street											
10	L2	5	2,0	0,022	32,9	LOS C	0,2	1,3	0,87	0,64	38,6
11	T1	1	2,0	0,022	27,3	LOS C	0,2	1,3	0,87	0,64	39,4
12	R2	16	2,0	0,065	34,5	LOS C	0,5	3,4	0,89	0,69	37,5
Approach		22	2,0	0,065	33,8	LOS C	0,5	3,4	0,89	0,67	37,8
All Vehicles		1314	2,0	0,256	6,3	LOS A	4,3	30,5	0,42	0,38	54,2

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Future 2021 PM Peak Hour Traffic Flows + Upgrades]

Walter Sisulu Drive (R546) / Kruger Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	1	2,0	0,216	9,5	LOS A	3,5	25,0	0,38	0,32	54,8
2	T1	543	2,0	0,216	4,0	LOS A	3,5	25,0	0,38	0,34	56,2
3	R2	18	2,0	0,216	9,5	LOS A	3,2	22,8	0,38	0,35	54,6
Approach		562	2,0	0,216	4,1	LOS A	3,5	25,0	0,38	0,34	56,1
East: Kruger Street											
4	L2	13	2,0	0,047	33,2	LOS C	0,4	2,9	0,88	0,67	38,3
5	T1	1	2,0	0,047	27,6	LOS C	0,4	2,9	0,88	0,67	39,0
6	R2	16	2,0	0,059	33,4	LOS C	0,5	3,4	0,88	0,69	37,9
Approach		29	2,0	0,059	33,1	LOS C	0,5	3,4	0,88	0,68	38,1
North: Walter Sisulu Drive (R546)											
7	L2	15	2,0	0,210	9,5	LOS A	3,4	24,1	0,37	0,34	54,6
8	T1	553	2,0	0,210	3,9	LOS A	3,4	24,1	0,37	0,33	56,2
9	R2	1	2,0	0,210	9,5	LOS A	3,4	24,0	0,37	0,32	54,8
Approach		568	2,0	0,210	4,1	LOS A	3,4	24,1	0,37	0,33	56,2
West: Kruger Street											
10	L2	1	2,0	0,007	32,6	LOS C	0,1	0,4	0,86	0,58	39,5
11	T1	1	2,0	0,007	27,0	LOS C	0,1	0,4	0,86	0,58	40,3
12	R2	2	2,0	0,008	32,7	LOS C	0,1	0,4	0,86	0,62	38,2
Approach		4	2,0	0,008	31,2	LOS C	0,1	0,4	0,86	0,60	39,0
All Vehicles		1164	2,0	0,216	4,9	LOS A	3,5	25,0	0,39	0,34	55,4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Future 2021 Sat. Peak Hour Traffic Flows + Upgrades]

Walter Sisulu Drive (R546) / Kruger Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	3	2,0	0,177	9,4	LOS A	2,8	19,8	0,36	0,31	54,9
2	T1	458	2,0	0,177	3,8	LOS A	2,8	19,8	0,36	0,32	56,3
3	R2	8	2,0	0,177	9,4	LOS A	2,6	18,8	0,36	0,32	54,8
Approach		469	2,0	0,177	4,0	LOS A	2,8	19,8	0,36	0,32	56,3
East: Kruger Street											
4	L2	2	2,0	0,011	32,7	LOS C	0,1	0,7	0,86	0,60	39,1
5	T1	1	2,0	0,011	27,1	LOS C	0,1	0,7	0,86	0,60	39,9
6	R2	14	2,0	0,051	33,3	LOS C	0,4	2,9	0,88	0,68	38,0
Approach		17	2,0	0,051	32,9	LOS C	0,4	2,9	0,87	0,67	38,2
North: Walter Sisulu Drive (R546)											
7	L2	5	2,0	0,204	9,5	LOS A	3,3	23,4	0,37	0,33	54,8
8	T1	548	2,0	0,204	3,9	LOS A	3,3	23,4	0,37	0,32	56,3
9	R2	1	2,0	0,204	9,5	LOS A	3,3	23,3	0,37	0,32	54,9
Approach		555	2,0	0,204	4,0	LOS A	3,3	23,4	0,37	0,32	56,3
West: Kruger Street											
10	L2	3	2,0	0,014	32,8	LOS C	0,1	0,9	0,87	0,62	38,9
11	T1	1	2,0	0,014	27,2	LOS C	0,1	0,9	0,87	0,62	39,6
12	R2	2	2,0	0,008	32,7	LOS C	0,1	0,4	0,86	0,62	38,2
Approach		6	2,0	0,014	31,8	LOS C	0,1	0,9	0,86	0,62	38,8
All Vehicles		1047	2,0	0,204	4,6	LOS A	3,3	23,4	0,38	0,33	55,7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Future 2021 AM Peak Hour Traffic Flows + Upgrades + Development]

Walter Sisulu Drive (R546) / Kruger Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	21	2,0	0,237	9,6	LOS A	3,9	27,9	0,38	0,36	54,5
2	T1	525	2,0	0,237	4,0	LOS A	3,9	27,9	0,38	0,37	55,8
3	R2	36	2,0	0,237	9,6	LOS A	3,2	22,7	0,38	0,38	54,2
Approach		582	2,0	0,237	4,6	LOS A	3,9	27,9	0,38	0,37	55,7
East: Kruger Street											
4	L2	28	2,0	0,129	33,8	LOS C	1,2	8,2	0,89	0,71	38,4
5	T1	9	2,0	0,129	28,3	LOS C	1,2	8,2	0,89	0,71	39,2
6	R2	29	2,0	0,112	33,8	LOS C	0,9	6,4	0,89	0,71	37,8
Approach		67	2,0	0,129	33,0	LOS C	1,2	8,2	0,89	0,71	38,2
North: Walter Sisulu Drive (R546)											
7	L2	17	2,0	0,263	9,7	LOS A	4,4	31,6	0,39	0,36	54,5
8	T1	641	2,0	0,263	4,1	LOS A	4,4	31,6	0,39	0,36	55,9
9	R2	23	2,0	0,263	9,7	LOS A	4,0	28,8	0,39	0,37	54,4
Approach		681	2,0	0,263	4,4	LOS A	4,4	31,6	0,39	0,36	55,8
West: Kruger Street											
10	L2	5	2,0	0,022	32,9	LOS C	0,2	1,3	0,87	0,64	38,6
11	T1	1	2,0	0,022	27,3	LOS C	0,2	1,3	0,87	0,64	39,4
12	R2	16	2,0	0,066	34,5	LOS C	0,5	3,4	0,89	0,69	37,5
Approach		22	2,0	0,066	33,8	LOS C	0,5	3,4	0,89	0,67	37,8
All Vehicles		1353	2,0	0,263	6,4	LOS A	4,4	31,6	0,42	0,39	54,1

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Future 2021 PM Peak Hour Traffic Flows + Upgrades + Development]

Walter Sisulu Drive (R546) / Kruger Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	1	2,0	0,257	9,7	LOS A	4,3	30,8	0,39	0,34	54,7
2	T1	604	2,0	0,257	4,1	LOS A	4,3	30,8	0,39	0,36	56,0
3	R2	36	2,0	0,257	9,7	LOS A	3,6	25,8	0,39	0,38	54,2
Approach		641	2,0	0,257	4,4	LOS A	4,3	30,8	0,39	0,36	55,8
East: Kruger Street											
4	L2	31	2,0	0,108	33,7	LOS C	1,0	6,8	0,89	0,71	38,0
5	T1	1	2,0	0,108	28,1	LOS C	1,0	6,8	0,89	0,71	38,7
6	R2	16	2,0	0,059	33,4	LOS C	0,5	3,4	0,88	0,69	37,9
Approach		47	2,0	0,108	33,5	LOS C	1,0	6,8	0,89	0,70	38,0
North: Walter Sisulu Drive (R546)											
7	L2	15	2,0	0,233	9,6	LOS A	3,8	27,3	0,38	0,35	54,6
8	T1	616	2,0	0,233	4,0	LOS A	3,8	27,3	0,38	0,34	56,2
9	R2	1	2,0	0,233	9,6	LOS A	3,8	27,2	0,38	0,33	54,8
Approach		632	2,0	0,233	4,1	LOS A	3,8	27,3	0,38	0,34	56,1
West: Kruger Street											
10	L2	1	2,0	0,007	32,6	LOS C	0,1	0,4	0,86	0,58	39,5
11	T1	1	2,0	0,007	27,0	LOS C	0,1	0,4	0,86	0,58	40,3
12	R2	2	2,0	0,009	33,7	LOS C	0,1	0,4	0,88	0,62	37,8
Approach		4	2,0	0,009	31,7	LOS C	0,1	0,4	0,87	0,60	38,8
All Vehicles		1324	2,0	0,257	5,4	LOS A	4,3	30,8	0,41	0,36	55,0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvvv [Future 2021 Sat. Peak Hour Traffic Flows + Upgrades + Development]

Walter Sisulu Drive (R546) / Kruger Street Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	3	2,0	0,251	9,6	LOS A	4,2	29,9	0,39	0,34	54,7
2	T1	558	2,0	0,251	4,2	LOS A	4,2	29,9	0,40	0,37	55,7
3	R2	45	2,0	0,251	10,1	LOS B	3,4	24,4	0,40	0,41	53,7
Approach		606	2,0	0,251	4,7	LOS A	4,2	29,9	0,40	0,37	55,6
East: Kruger Street											
4	L2	40	2,0	0,141	33,9	LOS C	1,3	8,9	0,90	0,72	37,9
5	T1	1	2,0	0,141	28,3	LOS C	1,3	8,9	0,90	0,72	38,6
6	R2	14	2,0	0,051	33,3	LOS C	0,4	2,9	0,88	0,68	38,0
Approach		55	2,0	0,141	33,7	LOS C	1,3	8,9	0,89	0,71	37,9
North: Walter Sisulu Drive (R546)											
7	L2	5	2,0	0,241	9,6	LOS A	4,0	28,4	0,39	0,34	54,7
8	T1	647	2,0	0,241	4,0	LOS A	4,0	28,4	0,39	0,34	56,2
9	R2	1	2,0	0,241	9,6	LOS A	4,0	28,3	0,39	0,33	54,8
Approach		654	2,0	0,241	4,1	LOS A	4,0	28,4	0,39	0,34	56,2
West: Kruger Street											
10	L2	3	2,0	0,014	32,8	LOS C	0,1	0,9	0,87	0,62	38,9
11	T1	1	2,0	0,014	27,2	LOS C	0,1	0,9	0,87	0,62	39,6
12	R2	2	2,0	0,009	33,7	LOS C	0,1	0,4	0,88	0,62	37,8
Approach		6	2,0	0,014	32,2	LOS C	0,1	0,9	0,87	0,62	38,6
All Vehicles		1321	2,0	0,251	5,7	LOS A	4,2	29,9	0,41	0,37	54,7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vv [Existing 2016 AM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Schwikard Street Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	487	2,0	0,145	0,0	LOS A	0,0	0,0	0,00	0,07	59,4
3	R2	74	2,0	0,145	5,6	LOS A	0,0	0,0	0,00	0,16	56,7
Approach		561	2,0	0,145	0,7	NA	0,0	0,0	0,00	0,08	59,0
East: Schwikard Street											
4	L2	73	2,0	0,128	9,6	LOS A	0,5	3,2	0,45	0,90	49,8
6	R2	7	2,0	0,128	31,5	LOS D	0,5	3,2	0,45	0,90	49,7
Approach		80	2,0	0,128	11,7	LOS B	0,5	3,2	0,45	0,90	49,8
North: Walter Sisulu Drive (R546)											
7	L2	15	2,0	0,148	5,6	LOS A	0,0	0,0	0,00	0,03	58,0
8	T1	559	2,0	0,148	0,0	LOS A	0,0	0,0	0,00	0,01	59,8
Approach		574	2,0	0,148	0,2	NA	0,0	0,0	0,00	0,02	59,8
All Vehicles		1215	2,0	0,148	1,2	NA	0,5	3,2	0,03	0,10	58,7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Site: vv [Existing 2016 PM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Schwikard Street Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	478	2,0	0,132	0,0	LOS A	0,0	0,0	0,00	0,04	59,7
3	R2	33	2,0	0,132	5,6	LOS A	0,0	0,0	0,00	0,08	57,4
Approach		511	2,0	0,132	0,4	NA	0,0	0,0	0,00	0,04	59,5
East: Schwikard Street											
4	L2	40	2,0	0,099	9,4	LOS A	0,3	2,4	0,46	0,89	49,0
6	R2	12	2,0	0,099	25,2	LOS D	0,3	2,4	0,46	0,89	48,9
Approach		52	2,0	0,099	12,9	LOS B	0,3	2,4	0,46	0,89	49,0
North: Walter Sisulu Drive (R546)											
7	L2	8	2,0	0,127	5,6	LOS A	0,0	0,0	0,00	0,02	58,1
8	T1	484	2,0	0,127	0,0	LOS A	0,0	0,0	0,00	0,01	59,9
Approach		493	2,0	0,127	0,1	NA	0,0	0,0	0,00	0,01	59,9
All Vehicles		1055	2,0	0,132	0,9	NA	0,3	2,4	0,02	0,07	59,0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vv [Existing 2016 Sat. Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Schwikard Street Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	397	2,0	0,107	0,0	LOS A	0,0	0,0	0,00	0,02	59,8
3	R2	17	2,0	0,107	5,5	LOS A	0,0	0,0	0,00	0,05	57,6
Approach		414	2,0	0,107	0,2	NA	0,0	0,0	0,00	0,02	59,7
East: Schwikard Street											
4	L2	16	2,0	0,055	9,3	LOS A	0,2	1,3	0,48	0,89	48,5
6	R2	9	2,0	0,055	21,0	LOS C	0,2	1,3	0,48	0,89	48,4
Approach		25	2,0	0,055	13,7	LOS B	0,2	1,3	0,48	0,89	48,5
North: Walter Sisulu Drive (R546)											
7	L2	4	2,0	0,123	5,6	LOS A	0,0	0,0	0,00	0,01	58,2
8	T1	474	2,0	0,123	0,0	LOS A	0,0	0,0	0,00	0,01	59,9
Approach		478	2,0	0,123	0,1	NA	0,0	0,0	0,00	0,01	59,9
All Vehicles		917	2,0	0,123	0,5	NA	0,2	1,3	0,01	0,04	59,4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Site: vv [Future 2021 AM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Schwikard Street Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	565	2,0	0,168	0,0	LOS A	0,0	0,0	0,00	0,07	59,4
3	R2	85	2,0	0,168	5,6	LOS A	0,0	0,0	0,00	0,16	56,7
Approach		651	2,0	0,168	0,7	NA	0,0	0,0	0,00	0,08	59,0
East: Schwikard Street											
4	L2	84	2,0	0,176	10,0	LOS A	0,6	4,4	0,52	0,91	49,0
6	R2	8	2,0	0,176	43,1	LOS E	0,6	4,4	0,52	0,91	48,9
Approach		93	2,0	0,176	13,0	LOS B	0,6	4,4	0,52	0,91	49,0
North: Walter Sisulu Drive (R546)											
7	L2	17	2,0	0,171	5,6	LOS A	0,0	0,0	0,00	0,03	58,0
8	T1	648	2,0	0,171	0,0	LOS A	0,0	0,0	0,00	0,01	59,8
Approach		665	2,0	0,171	0,2	NA	0,0	0,0	0,00	0,02	59,8
All Vehicles		1408	2,0	0,176	1,3	NA	0,6	4,4	0,03	0,10	58,6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vv [Future 2021 PM Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Schwikard Street Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	554	2,0	0,153	0,0	LOS A	0,0	0,0	0,00	0,04	59,6
3	R2	38	2,0	0,153	5,6	LOS A	0,0	0,0	0,00	0,08	57,4
Approach		592	2,0	0,153	0,4	NA	0,0	0,0	0,00	0,04	59,5
East: Schwikard Street											
4	L2	46	2,0	0,142	9,6	LOS A	0,5	3,4	0,53	0,90	47,9
6	R2	14	2,0	0,142	32,5	LOS D	0,5	3,4	0,53	0,90	47,7
Approach		60	2,0	0,142	14,8	LOS B	0,5	3,4	0,53	0,90	47,8
North: Walter Sisulu Drive (R546)											
7	L2	9	2,0	0,147	5,6	LOS A	0,0	0,0	0,00	0,02	58,1
8	T1	561	2,0	0,147	0,0	LOS A	0,0	0,0	0,00	0,01	59,9
Approach		571	2,0	0,147	0,1	NA	0,0	0,0	0,00	0,01	59,9
All Vehicles		1222	2,0	0,153	1,0	NA	0,5	3,4	0,03	0,07	59,0

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Site: vv [Future 2021 Sat. Peak Hour Traffic Flows]

Walter Sisulu Drive (R546) / Schwikard Street Intersection
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
2	T1	460	2,0	0,124	0,0	LOS A	0,0	0,0	0,00	0,02	59,8
3	R2	20	2,0	0,124	5,6	LOS A	0,0	0,0	0,00	0,05	57,6
Approach		480	2,0	0,124	0,2	NA	0,0	0,0	0,00	0,03	59,7
East: Schwikard Street											
4	L2	18	2,0	0,075	9,5	LOS A	0,2	1,8	0,55	0,90	47,4
6	R2	11	2,0	0,075	26,0	LOS D	0,2	1,8	0,55	0,90	47,3
Approach		28	2,0	0,075	15,6	LOS C	0,2	1,8	0,55	0,90	47,3
North: Walter Sisulu Drive (R546)											
7	L2	5	2,0	0,143	5,6	LOS A	0,0	0,0	0,00	0,01	58,1
8	T1	549	2,0	0,143	0,0	LOS A	0,0	0,0	0,00	0,01	59,9
Approach		555	2,0	0,143	0,1	NA	0,0	0,0	0,00	0,01	59,9
All Vehicles		1063	2,0	0,143	0,6	NA	0,2	1,8	0,01	0,04	59,4

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvv [Future 2021 AM Peak Hour Traffic Flows + Development]

Walter Sisulu Drive (R546) / Schwikard Street / Proposed Site Access Intersection
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	22	2,0	0,018	9,9	LOS A	0,3	1,8	0,36	0,63	50,3
2	T1	564	2,0	0,221	5,1	LOS A	3,8	27,3	0,43	0,37	55,3
3	R2	104	2,0	0,216	12,7	LOS B	1,7	12,0	0,49	0,70	48,5
Approach		691	2,0	0,221	6,4	LOS A	3,8	27,3	0,43	0,42	54,0
East: Schwikard Street											
4	L2	84	2,0	0,241	31,7	LOS C	2,6	18,9	0,88	0,75	38,9
5	T1	5	2,0	0,241	26,1	LOS C	2,6	18,9	0,88	0,75	39,6
6	R2	8	2,0	0,026	30,2	LOS C	0,2	1,7	0,83	0,66	39,4
Approach		98	2,0	0,241	31,3	LOS C	2,6	18,9	0,88	0,74	39,0
North: Walter Sisulu Drive (R546)											
7	L2	17	2,0	0,255	10,8	LOS B	4,5	32,3	0,44	0,40	53,5
8	T1	635	2,0	0,255	5,3	LOS A	4,6	32,4	0,44	0,39	55,1
9	R2	20	2,0	0,038	11,8	LOS B	0,3	2,0	0,43	0,65	49,1
Approach		672	2,0	0,255	5,6	LOS A	4,6	32,4	0,44	0,40	54,9
West: Proposed Site Access											
10	L2	1	2,0	0,011	29,8	LOS C	0,1	0,8	0,82	0,56	41,5
11	T1	3	2,0	0,011	24,2	LOS C	0,1	0,8	0,82	0,56	42,3
12	R2	19	2,0	0,073	32,8	LOS C	0,6	4,0	0,87	0,69	38,7
Approach		23	2,0	0,073	31,5	LOS C	0,6	4,0	0,86	0,67	39,3
All Vehicles		1483	2,0	0,255	8,1	LOS A	4,6	32,4	0,47	0,44	52,7

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvv [Future 2021 PM Peak Hour Traffic Flows + Development]

Walter Sisulu Drive (R546) / Schwikard Street / Proposed Site Access Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	146	2,0	0,158	15,8	LOS B	2,7	19,3	0,57	0,72	46,6
2	T1	529	2,0	0,272	10,9	LOS B	5,2	37,2	0,62	0,52	50,9
3	R2	57	2,0	0,139	19,0	LOS B	1,2	8,6	0,64	0,71	44,8
Approach		733	2,0	0,272	12,5	LOS B	5,2	37,2	0,61	0,57	49,5
East: Schwikard Street											
4	L2	46	2,0	0,096	21,7	LOS C	1,5	10,4	0,70	0,67	44,1
5	T1	18	2,0	0,096	16,2	LOS B	1,5	10,4	0,70	0,67	45,1
6	R2	14	2,0	0,028	22,1	LOS C	0,3	2,2	0,69	0,67	43,2
Approach		78	2,0	0,096	20,5	LOS C	1,5	10,4	0,69	0,67	44,2
North: Walter Sisulu Drive (R546)											
7	L2	9	2,0	0,276	16,5	LOS B	5,3	37,7	0,62	0,53	49,5
8	T1	526	2,0	0,276	10,9	LOS B	5,3	37,8	0,62	0,53	50,8
9	R2	62	2,0	0,168	19,3	LOS B	1,4	9,6	0,65	0,72	44,6
Approach		598	2,0	0,276	11,9	LOS B	5,3	37,8	0,62	0,55	50,1
West: Proposed Site Access											
10	L2	21	2,0	0,104	21,8	LOS C	1,6	11,5	0,70	0,60	45,4
11	T1	49	2,0	0,104	16,2	LOS B	1,6	11,5	0,70	0,60	46,5
12	R2	136	2,0	0,278	24,0	LOS C	3,5	24,6	0,77	0,76	42,6
Approach		206	2,0	0,278	21,9	LOS C	3,5	24,6	0,74	0,70	43,7
All Vehicles		1615	2,0	0,278	13,9	LOS B	5,3	37,8	0,63	0,58	48,6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: vvv [Future 2021 Sat. Peak Hour Traffic Flows + Development]

Walter Sisulu Drive (R546) / Schwikard Street / Proposed Site Access Intersection
Signals - Fixed Time Isolated   Cycle Time = 70 seconds (User-Given Cycle Time)

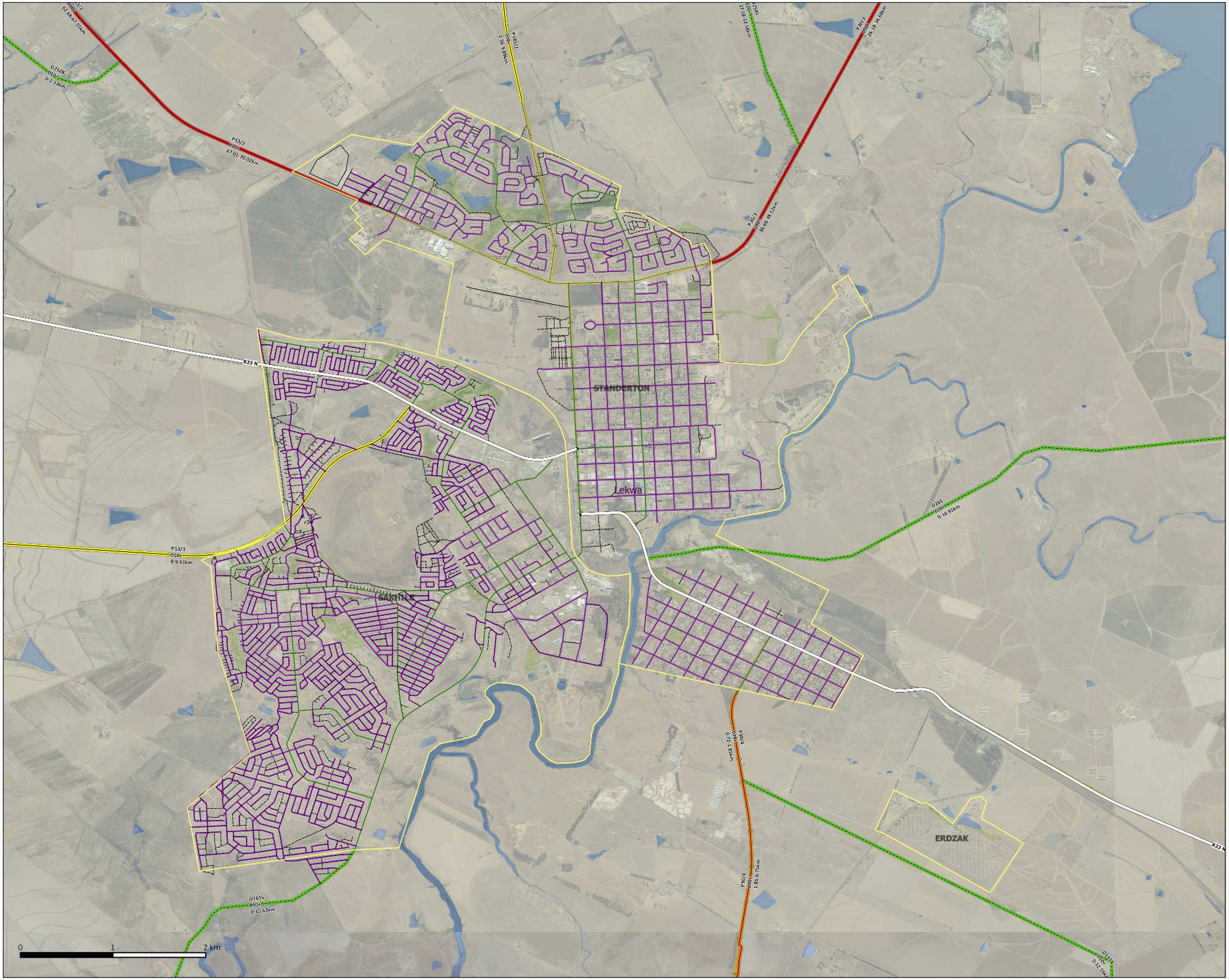
Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total	Demand Flows HV	Deg. Satn	Average Delay	Level of Service	95% Back of Queue Vehicles	95% Back of Queue Distance	Prop. Queued	Effective Stop Rate	Average Speed
		veh/h	%	v/c	sec		veh	m		per veh	km/h
South: Walter Sisulu Drive (R546)											
1	L2	188	2,0	0,204	16,0	LOS B	3,6	25,5	0,59	0,73	46,4
2	T1	481	2,0	0,247	10,7	LOS B	4,7	33,3	0,61	0,51	51,0
3	R2	44	2,0	0,110	18,8	LOS B	0,9	6,6	0,63	0,70	44,9
Approach		714	2,0	0,247	12,6	LOS B	4,7	33,3	0,60	0,58	49,3
East: Schwikard Street											
4	L2	18	2,0	0,080	21,6	LOS C	1,2	8,8	0,69	0,59	45,4
5	T1	37	2,0	0,080	16,0	LOS B	1,2	8,8	0,69	0,59	46,5
6	R2	11	2,0	0,024	23,6	LOS C	0,3	1,8	0,71	0,66	42,5
Approach		65	2,0	0,080	18,8	LOS B	1,2	8,8	0,69	0,60	45,5
North: Walter Sisulu Drive (R546)											
7	L2	5	2,0	0,282	16,5	LOS B	5,4	38,7	0,62	0,53	49,5
8	T1	542	2,0	0,282	11,0	LOS B	5,4	38,7	0,62	0,53	50,8
9	R2	65	2,0	0,173	18,7	LOS B	1,4	9,9	0,63	0,72	44,9
Approach		613	2,0	0,282	11,8	LOS B	5,4	38,7	0,62	0,55	50,1
West: Proposed Site Access											
10	L2	15	2,0	0,182	22,3	LOS C	2,9	20,9	0,72	0,60	45,7
11	T1	109	2,0	0,182	16,8	LOS B	2,9	20,9	0,72	0,60	46,7
12	R2	136	2,0	0,273	24,0	LOS C	3,4	24,5	0,76	0,75	42,6
Approach		260	2,0	0,273	20,9	LOS C	3,4	24,5	0,75	0,68	44,4
All Vehicles		1652	2,0	0,282	13,9	LOS B	5,4	38,7	0,64	0,58	48,6

Site Level of Service (LOS) Method: Delay (SIDRA). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

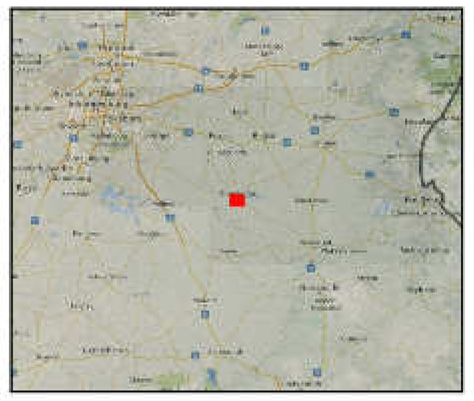
Annexure E

Roads Classification Map (Standerton)



Mpumalanga Department of Public Works, Roads and Transport

RCAM Classification for Desktop study Standerton Area



Local Minicipalities

Towns

National Roads

Subsidy roads

Provincial roads

Paved

Gravel

Municipal roads

Paved

Gravel

RISFSA class

1. Primary Distributor
2. Regional Distributor
3. District Distributor
4. District Collectors
5. Access Roads

W E S

Lidwala
Specialist Solutions

MAP PRODUCED BY: LIDWALA CONSULTING ENGINEERS
MAP PREPARED BY: Diego Madanga
DATE MAP PRODUCED: 2015-08-06
CHECKED BY: Katie Sassenburg
PROJECTION: GCS WGS 1984
DATUM: WGS 84
SRS: Geographic Coordinate System