MAFADI SOLAR POWER PLANT (RF) (PTY) LTD

TRAFFIC IMPACT ASSESSMENT FOR THE DEVELOPMENT OF THE MAFADI SOLAR POWER PLANT NEAR LOUIS TRICHARDT, LIMPOPO PROVINCE

32745.09C-REP-001-00

TRAFFIC IMPACT ASSESSMENT

NOVEMBER 2022

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EXECUTIVE SUMMARY

BVi Consulting Engineers Western Cape (Pty) Ltd was appointed by *Mafadi Solar Power Plant (RF) (Pty) Ltd* to conduct a Traffic and Transportation Assessment for the proposed development of the *Mafadi Solar Power Plant* on the Farm Langgedacht No. 1210 near Louis Trichardt, in the Limpopo Province. This specialist study forms part of the requirements for the environmental assessment.

For the traffic assessment, regional and local transport routes were investigated:

- For regional routes, haulage routes from various ports of entry (Durban Harbour and Saldanha Bay Harbour) were investigated. A regional route from Johannesburg has also been assessed and presented for the haulage of major electrical components.
- For the assessment of local routes, routes close to the site were assessed for impact of local trips on the local network.
- The existing traffic volumes on the transportation routes were sourced and used to calculate the current background traffic, the expected background traffic during construction and, thereby, the Level of Service. The number of trips generated from the construction period were estimated and the impact of these additional trips on the regional and local transport routes were also investigated.

The following conclusions were drawn from the study:

- The major traffic impact occurs during the construction phase of the project. The impact of the construction trip generation, on the predicted traffic volumes on the local and the regional transportation routes are expected to be low. Little to no mitigation measures for these routes due to the development will be necessary.
- The photovoltaic (PV) components will be delivered to site from two possible ports, either from Durban Harbour over a distance of 960 km or from Saldanha Bay Harbour over a distance of 1 970 km. The regional routes indicated in the analysis would need to be confirmed by freight carriers as suitable for the sensitive normal loads. The final decision on the selected route would be based on a combination of cost, distance and road condition at the time of transport.
- Transformer and substation components will be transported via abnormal loads. An abnormal load will necessitate an application for a permit. Only 1-2 abnormal load trips are expected for *Mafadi Solar Power Plant*. Abnormal load transportation is therefore considered to be isolated and would have a negligible impact on traffic over the construction phase of the project.
- In terms of impact on roads infrastructure:
    - A main access road has been presented for site access roads from the R36, along the eastern boundary of the site. This is a suitable location, due to its proximity to the N1 and it is at an existing access.
    - Access to a water source on the site is proposed to form part of an internal access road.
    - It is proposed that the access roads near the site be investigated for rehabilitation prior to construction and be maintained during construction in order to mitigate against the possibility of damaged goods due to poor road infrastructure.

- The site access point will likely need to be formalised, as a requirement as part of the wayleave approval of the local and provincial roads authorities.
- Adequate traffic accommodation signage must be erected and maintained on either side of the access throughout the construction period of the project.
- The construction and provision of internal roads that cross the Eskom servitude need to be according to Eskom wayleave requirements.

- In terms of impact on traffic:
  - The regional construction trips will be insignificant when compared to the Average Daily Traffic (ADT) and the development trips will not affect the existing Level of Service (LOS). It has been noted that the N1 in the region of the site is already at a low level of service, without the addition of the proposed development. Mitigation measures, such as staggered trips and reduced peak time travel are proposed if needed.
- In terms of cumulative impact:
  - The concurrent construction of other solar farms in a 30 km radius of the site is considered to have a low impact. Mitigation measures that may be considered include the staggering of trips at the site and the implementation of a roads maintenance programme.

The development of the *Mafadi Solar Power Plant* on the Farm Langgedacht No. 1210 near Louis Trichardt in the Limpopo Province can therefore be supported from a traffic engineering perspective.

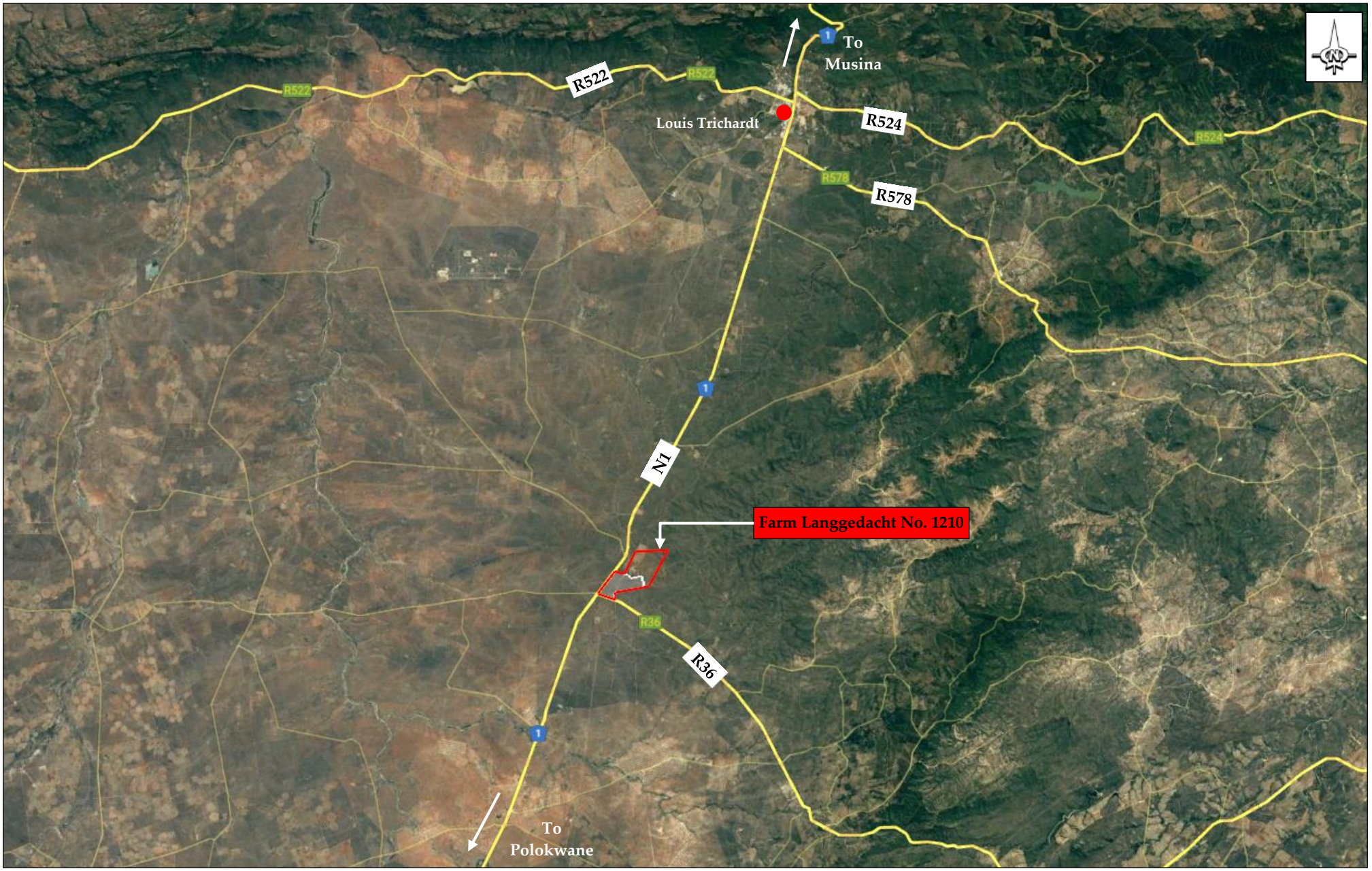
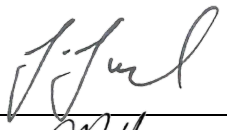
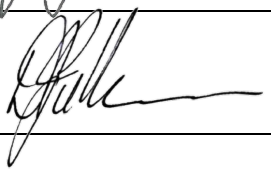


Figure 0.1: Locality plan - Mafadi Solar Power Plant

ISSUE AND REVISION RECORD

QUALITY APPROVAL

	CAPACITY	NAME	SIGNATURE	DATE
By author	Engineer	Lee-Ann Petersen Pr Eng: 20180198		30/11/2022
Checked by	Professional Engineering Technologist	Jacques Nel Pr Tech Eng: 200770131		30/11/2022
Approved by Design Centre Leader	Director	Dirk van der Merwe Pr Eng: 20120186		30/11/2022

This report has been prepared in accordance with BVi Consulting Engineers Quality Management System. BVi Consulting Engineers is ISO 9001: 2015 registered and certified by NQA Africa.

REVISION RECORD

REVISION NUMBER	OBJECTIVE	CHANGE	DATE
0	Issue to Client for review	None	30/11/2022

TRAFFIC IMPACT STUDY COVER PAGE

INFORMATION ITEM	DETAILS/ DESCRIPTION
Municipality Name	Makhado Local Municipality; Vhembe District Municipality.
Type of Assessment	Traffic Impact Assessment
Erf Numbers/ Farm Names	Langgedacht No. 1210 near Louis Trichardt
Date of Report	30 November 2022
Details of Assessor	DJP van der Merwe Pr Eng
Address	dirkvdm@bviwc.co.za

DJP van der Merwe Pr Eng

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CHAPTER 1 INTRODUCTION

1.1 TERMS OF REFERENCE

BVi Consulting Engineers Western Cape (Pty) Ltd was appointed by *Mafadi Solar Power Plant (RF) (Pty) Ltd* to conduct a traffic and transportation assessment for the proposed development of the *Mafadi Solar Power Plant* near Louis Trichardt in the Limpopo Province. This proposed development is made up of a photovoltaic (PV) solar energy facility (SEF) with a generation capacity of up to 150 MW. This specialist study forms part of the requirements for the environmental assessment process.

1.2 OBJECTIVES

The objectives of this specialist traffic and transportation study are as follows:

- To identify the most optimal shipping port(s) and assess feasible transport routes, route lengths and potential constraints for facility components;
- To determine the potential indirect, direct and cumulative risks/ impacts to receptors from a traffic and transportation perspective for this project;
- To propose mitigation measures for identified significant risks/ impacts and enhance positive risk/ impacts of the project; and
- To ensure that the project operations comply with relevant environmental standards, policies, laws and regulations in terms of traffic and transportation.

1.3 APPROACH AND METHODOLOGY

The traffic and transportation study deals with the traffic impact on the surrounding road network during three distinct phases: *construction phase*, *operational phase* and *decommissioning phase*. The study considered and assessed the following:

- Site layout, access points and internal roads assessment:
  - Description of the surrounding road network;
  - Description of site layout;
  - Assessment of proposed access points; and
  - Assessment of proposed internal roads.
- Traffic and transportation assessment:
  - Estimation of trip generation;
  - Discussion of potential traffic impacts;
  - Assessment of possible transportation routes; and
  - Assessment of construction, operational (maintenance) and decommissioning phases' vehicle trips.

1.4 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations apply to the traffic and transportation study:

- This study is based on the project information provided by the environmental consultants and project managers for the applicant, *Mafadi Solar Power Plant (RF) (Pty) Ltd*;
- According to Eskom specifications for power transformers, the following dimensional limitations need to be adhered to when transporting the transformers:
  - Height: 5 000 mm.
  - Width: 4 300 mm and
  - Length: 10 500 mm.
- Imported PV energy facility components would be transported from the most feasible port of entry;
- If any elements are manufactured within South Africa, these would be transported from their respective manufacturing centres, which would be either in the greater Johannesburg, Pinetown/Durban or Cape Town for the transformer, inverter and the support structures;
- Civil construction materials would be sourced from nearby towns where possible;
- All other construction materials, for concrete and wearing course, would be sourced from a local licensed quarry (off-site);
- Maximum vertical height clearances along the transportation route is 5.2 m for abnormal loads.

1.5 REFERENCE DOCUMENTATION

The following documents/sources were used in compiling this report and reference will be made where necessary:

- *Highway Capacity Manual (HCM) 6th Edition*, published by *Transportation Research Board*, October 2016.
- *TRH 11 – Dimensional and Mass Limitations and Other Requirements for Abnormal Load Vehicles*, published by Department of Transport (DoT), August 2009.
- *TMH 17, Volume 1 - South African Trip Data Manual*, published by the *Committee of Transport Officials (COTO)*, September 2012.
- *TRH 17 – Geometric Design of Rural Roads*, published by the *Department of Transport (DoT)*, 1988.
- *Environamics (2022)*: Project Description Document: The Development of the *Mafadi Solar Power Plant* near Louis Trichardt, Limpopo Province

CHAPTER 2 PROJECT PARTICULARS

2.1 PROJECT DESCRIPTION AND SITE LOCATION

The Applicant, *Mafadi Solar Power Plant (RF) (Pty) Ltd*, is proposing the construction of a photovoltaic (PV) solar energy facility (known as the *Mafadi Solar Power Plant*) located on a site along the National Route N1, approximately 70 km north of Polokwane / 37 km south of Louis Trichardt in the Limpopo Province. The solar PV facility will comprise several arrays of PV panels and associated infrastructure and will have a contracted capacity of up to 150 MW. The development area is situated within the *Makhado Local Municipality* within the *Vhembe District Municipality*.

The site for this development is located off Regional Road R36, east of the National Route N1. The location of the site is provided in *Figure 2.1* below.

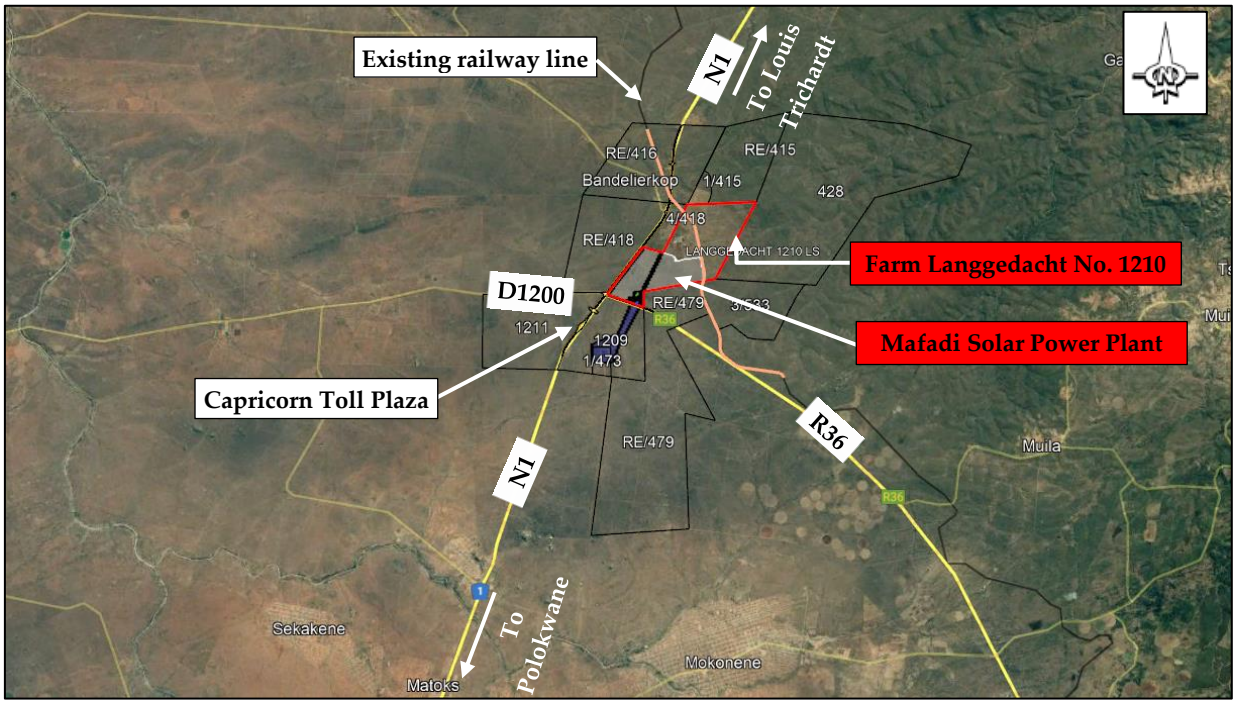


Figure 2.1: Locality of the *Mafadi Solar Power Plant* near the town of Louis Trichardt

The proposed *Mafadi Solar Power Plant* and associated infrastructure will be located on Farm Langgedacht No. 1210 near Louis Trichardt, in the Limpopo Province.

2.2 EXISTING TRANSPORT NETWORK

The site for this development is located off Regional Road R36. The R36 is a two-lane surfaced road with gravel shoulders and forms part of the southern boundary of the site. The R36 also falls under the authority of the *South African National Roads Agency Limited (SANRAL)* and seems to function as a Class R3 route.

The National Route 1 Section 28 (N1/28) lies along the western boundary of the site. The N1/28 is a two-lane surfaced road with 2 m – 2.5 m surfaced shoulders in the vicinity of the site and has a functional classification of Class R1.

To the north of the site, and along part of its north-eastern boundary, an existing railway line bounds the site.

2.3 PROPOSED SITE LAYOUT

The proposed layout and associated infrastructure of the proposed *Mafadi Solar Power Plant (SPP)* is considered for the estimation of construction and operational traffic. The *Mafadi SPP* will cover approximately 320 ha and the associated infrastructure is listed as follows:

- PV Panel Array - To produce up to 150 MW.
- Wiring to Inverters - Sections of the PV array will be wired to inverters.
- Connection to the grid - Connecting the array to the electrical grid requires transformation of the voltage from 480 V to 33 kV to 132 kV. An onsite substation will be required on the site to step the voltage up to 132 kV. It is expected that generation from the facility will connect to the national grid via the existing Eskom Tabor 275/132kV MTS Substation or via a Li-Lo line to the existing Louis Trichardt - Tabor 132kv Overhead Line or the Tabor - Flurian Tee 132kV Overhead Line..
- Electrical reticulation network – An internal electrical reticulation network will be required and will be lain.
- Supporting Infrastructure – The supporting infrastructure such as the auxiliary buildings and laydown areas will be situated in an area measuring up to 5 ha.
- Battery storage – A Battery Storage Facility (~40 000 m^2) with a maximum height of 8 m and a maximum volume of 1,740 m^3 of batteries and associated operational, safety and control infrastructure.
- Roads – Access will be obtained via the R36 regional road to the south of the site. An internal site road network will also be required to provide access to the solar field and associated infrastructure. The access road and internal roads will be constructed within a 25 m corridor.
- Fencing - For health, safety and security reasons, the facility will be required to be fenced off from the surrounding farm. Fencing with a height of 2.5 m will be used.

2.4 PROPOSED SITE ACCESS ROAD AND INTERNAL ROADS

The main site access is along the regional route R36 as follows:

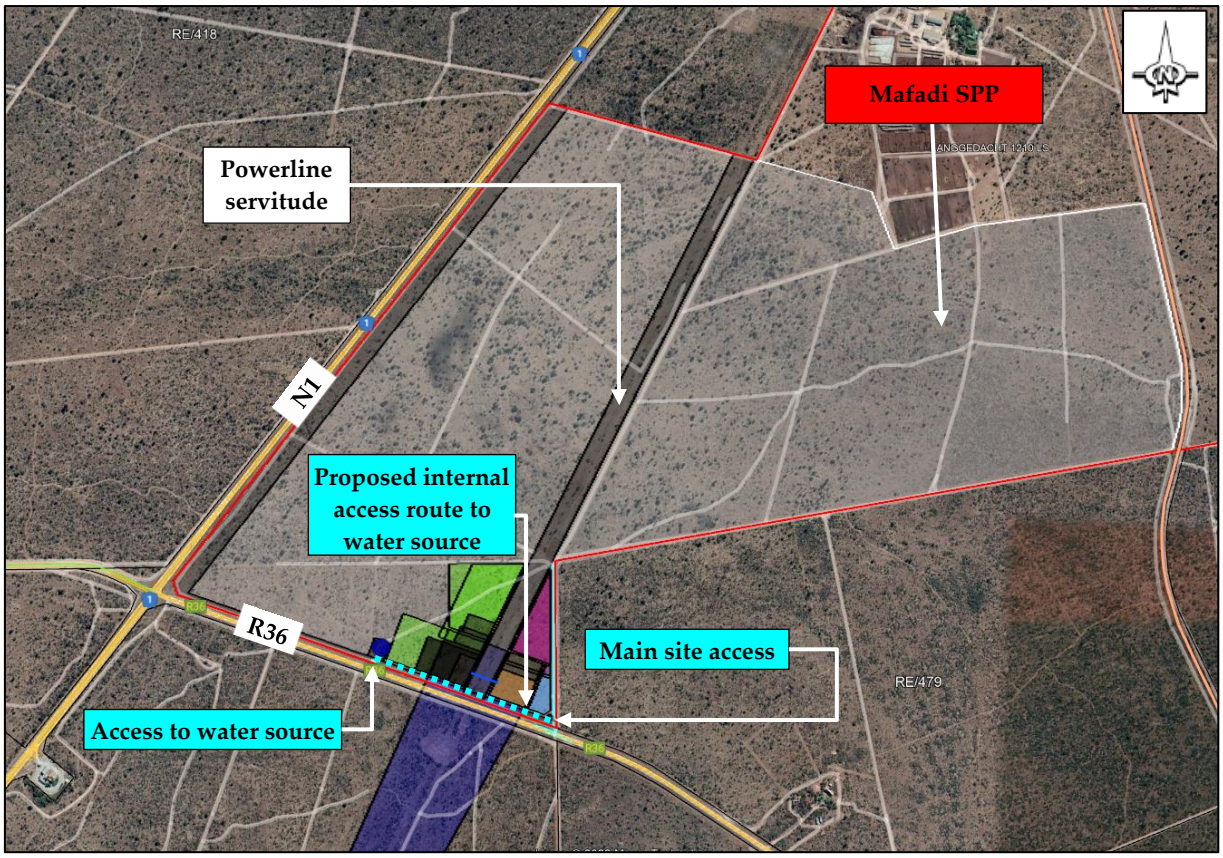


Figure 2.2: ***Mafadi SPP*** **and proposed site access road**

2.4.1 Main site access road

The main access to the site is proposed to be via an existing gravel access road, off the R36 on the eastern boundary of the site. From a transport engineering perspective, this access road width may be proposed to be 8 m wide. The intersection with the R36 will need to be formalised and upgraded to the required standard, as provided in *Appendix B* and may likely be a requirement as part of the wayleave approval of the provincial roads authority, *Roads Agency of Limpopo (RAL)* and the *South African National Roads Agency Limited (SANRAL)*. The location of the access is also the preferred location due to its proximity to the N1.

2.4.2 Access to water source

An access to a water source is also indicated on the development plan. This access would not be suitable for direct access from the R36. The site is allowed only one access to the greater road network (only along R36). Should an access to the water source be required, it is proposed that this be obtained internally, along the internal boundary of the site, as illustrated in *Figure 2.2* above. It should, however, be noted that this route would cross an *Eskom* powerline servitude, which cuts through the site from the southern boundary to the northern boundary as indicated in *Figure 2.2* above. Any construction in the vicinity of the servitude would have to be in line with the wayleave requirements.

2.4.3 Site access road: General

The existing access road will need to be investigated for rehabilitation prior to construction to cater for the construction vehicles navigating the road to the laydown areas on site. The full gravel access road will need to be suitably maintained. This process would also provide mitigation against the possibility of damaged goods due to poor road infrastructure. Re-gravelling may be necessary as a maintenance measure, from time to time, throughout the operational life of the solar power plant.

It must also be noted that adequate traffic accommodation signage must be erected and maintained on either side of the access throughout the construction phase of the plant, in accordance with the *South African Road Traffic Signs Manual, Vol 2, May 2012*.

2.4.4 Internal roads

It is proposed that the secondary internal roads be 4 m – 6 m wide. No internal layout of the proposed development is available yet, but a north-south, east-west grid layout of the internal roads is expected to gain access to panels for maintenance. From the technical information received (*Environamics, 2022*), the internal road network on *Mafadi Solar Power Plant* on Farm Langgedacht No. 1210 is assumed to be approximately 16 km.

CHAPTER 3 TRANSPORTATION ROUTES

3.1 OVERVIEW

Local and regional transportation routes are impacted by the proposed development. Due to the nature of the project, haulage routes from the port of entry for imported PV and related components as well as haulage along local routes for locally sourced construction materials is considered.

The bulk of the haulage would consist of normal heavy vehicles. Abnormal loads are foreseen for the transport of electrical components for the construction of the proposed transformers on the site. The impact of and requirements for abnormal loads are also highlighted.

3.2 LEGISLATION AND PERMIT REQUIREMENTS

The overarching environmental legislation for management of the environment in South Africa, is the *National Environmental Management Act, 1998 (Act 107 of 1998 "NEMA")*. Its foreword states that sustainable development requires the integration of social, economic, and environmental factors in the planning, implementation, and evaluation of environmental decisions to ensure that the development serves present and future generations. Traffic impacts are therefore an important aspect to consider in the decision-making process of developments.

3.2.1 Roads

The relevant legislation associated with the road (infrastructure), transportation and traffic include, inter alia:

- National Water Act (Act 36 of 1998), with regards to all crossings of water courses.
- National Road Traffic Act (Act 93 of 1996).
- National Road Traffic Regulations, 2000.
- Advertising on Road and Ribbon Development Act (Act 21 of 1940).
    - Section 9: Prohibition of erection of structures or construction of other things near intersections of certain roads, and
    - Section 10: Restriction of access to land through fence along certain roads.
- Roads Ordinance Act (Act 19 of 1976).
    - Section 13: Erection of gates across public roads and public paths.
    - Section 17: Erection of structures on or near public roads, and
    - Section 18: Access to and exit from certain public roads and public paths.

3.2.2 Vehicle dimensions

Regulations 221 to 230 of the *National Road Traffic Act* relates to vehicle dimensions. The most important points are summarised below.

- Regulation 221: Defines the legislation requirements regarding the overall length of vehicles. The following lengths shall not be exceeded:
  - Rigid vehicle: 12.5 m.
  - Articulated vehicle and semi-trailer: 18.5 m; and
  - Combination vehicle (interlinks, multiple trailers etc.): 22.0 m
- Regulation 223: Defines the legislation requirements regarding the overall width of vehicles. Vehicles with a gross mass of 12 000 kg or more, shall not exceed 2.6 m.
- Regulation 224: Define the legislation requirements regarding the overall height of a vehicle and transported load, which shall not exceed 4.3 m.
- Regulation 225: Defines the legislation requirements regarding the maximum turning radius and wheelbase, which shall not exceed 13.1 m or 10.0 m (semi-trailer) respectively.

3.2.3 Vehicle loads

Regulations 231 to 249 of the *National Road Traffic Act* relates to vehicle loads. The most important points are summarised below.

- Regulation 240: Defines the legislation requirements regarding the mass load carrying on roads.
- Regulation 241: Defines the legislation requirements regarding the mass load carrying capacity of bridges.

3.2.4 Abnormal load considerations

It is expected that the transformers will be transported with an abnormal load vehicle. Abnormal permits are required for vehicles exceeding the permissible maximum dimensions on road freight transport.

The *National Road Traffic Act (Act 93 of 1996)* and the *National Road Traffic Regulations (2000)* prescribed certain limitations on vehicle dimensions and axle and vehicle masses that a vehicle using a public road must comply with. Where the prescribed limitations are exceeded, these loads are then classified as an abnormal load. Provision for such abnormal vehicles and loads are made in *Section 81* of the *National Road Traffic Act*, as substituted by *Section 23* of the *National Road Traffic Amendment Act (Act 64 of 2008)*.

The requirements and procedures for transporting of abnormal loads are contained in the following two documents:

- *TRH 11: Dimensional and Mass Limitations and Other Requirements for Abnormal Load Vehicles*; and
- *COTO: Administrative Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads, Revision 2, March 2015*.

The specific permits and consents that may be required from the relevant authorities, for the transportation of abnormal loads, are summarised in *Table 3.1* below.

Table 3.1: Permits and consent requirements

PERMIT/ CONSENT TYPE	RELEVANT AUTHORITY	STRATEGY
Abnormal Load/Vehicle Permit in terms of *National Road Traffic Act 93 of 1996, Section 81*	*Department of Transport, Safety and Liaison: Northern Cape Province* *Department of Transport and Public Works: Western Cape Government* *Department of Transport: Kwa-Zulu Natal;* *Department Of Police, Roads And Transport – Free State Provincial Government;* *Department of Transport, Roads and Community Safety – Provincial Government Limpopo;* and *Gauteng: Department of Roads*	The freight contractor will obtain the necessary road transportation permits.
The *South African National Roads Agency Limited* and *National Roads Act, Act 7 of 1998*	*South African National Roads Agency SOC Limited (SANRAL)*	The freight contractor will obtain the necessary road transportation permits from SANRAL.

It should be noted that embargo days for transportation of abnormal loads generally coincide with public holidays, start and end of school holidays and extended year-end periods. These dates are updated regularly for each provincial roads department.

As discussed further in the report, the number of abnormal load trips per site is considered negligible (approximately 2 trips per transformer) and does not have an impact on traffic but the abovementioned permits will still be required. A permit is, however, required for each province that the transportation route traverses.

3.3 HAULAGE FROM PORTS OF ENTRY

The closest port of entry for consideration is the Durban Harbour. An alternative port of entry that has been considered is the Saldanha Bay Harbour. The distance from the Durban Harbour is approximately 960 km and from Saldanha Bay Harbour measures approximately 1 970 km.

3.3.1 Alternative 1: Port of Durban (960 km)

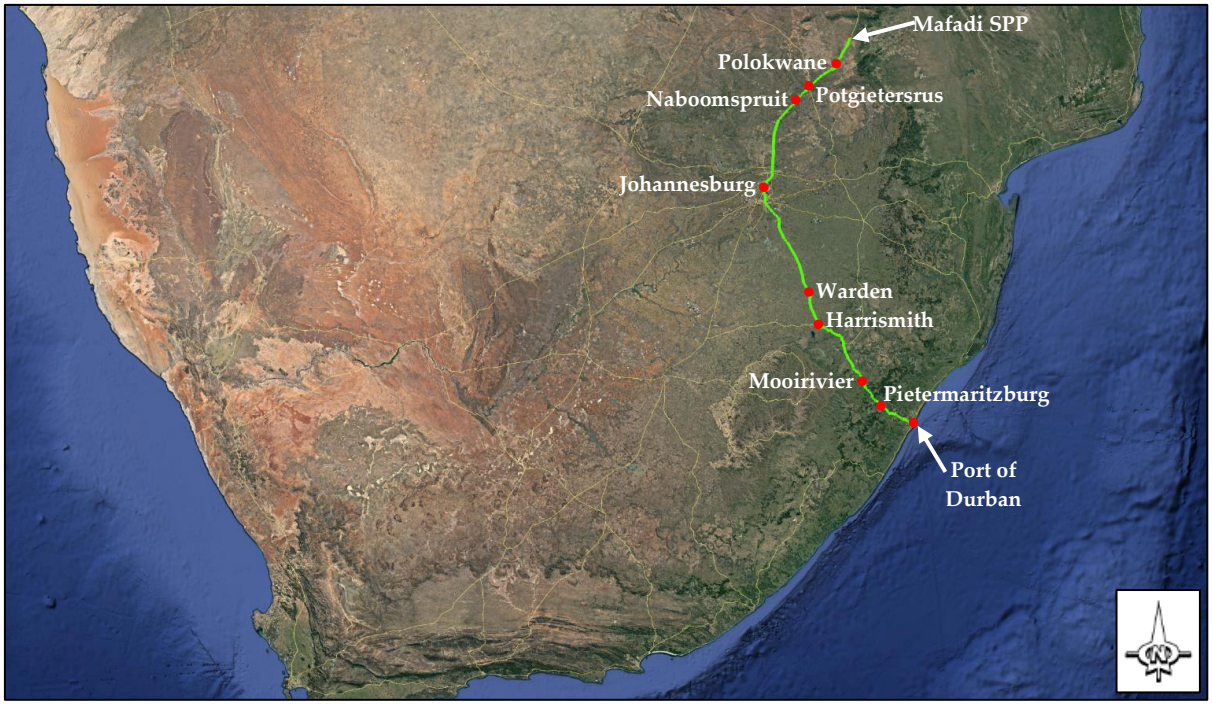


Figure 3.1: Transportation route (Port of Durban to *Mafadi SPP*)

The route overview shown in *Figure 3.1* is briefly described below:

- Travel north-west from the Port of Durban, via the N3, towards the Harrismith interchange.
- Continue north on the N3 towards and through the towns of Warden and Johannesburg.
- In Johannesburg continue further north onto the N1 and travel towards and through the towns of:
  - Naboomspruit;
  - Potgietersrus; and
  - Polokwane.
- The R36 to the Mafadi SPP is located approximately 70 km from the town of Polokwane and on the right-hand side of the N1.

3.3.2 Alternative 2: Port of Saldanha (1 970 km)

Figure 3.2: Transportation route (Port of Saldanha to *Mafadi SPP*)

The route overview shown in *Figure 3.2* is briefly described below:

- Travel from the Port of Saldanha to Moorreesburg via the R45 and the R311 towards and through the town of Hopefield.
- Turn left onto the N7 and travel towards and through the towns of:
  - Moorreesburg;
  - Piketberg;
  - Citrusdal;
  - Clanwilliam; and
  - Vanrhynsdorp.
- At Vanrhynsdorp turn right onto the R27 and travel north towards and through the towns of:
  - Nieuwoudtville;
  - Calvinia;
  - Brandvlei;
  - Kenhardt; and
  - Neilersdrift.
- Once through the town of Neilersdrift, turn right onto the N14.
- Continue on the N14 and travel north-east towards and through the towns of:
  - Upington;
  - Olifantshoek;
  - Kuruman; and
  - Vryburg.
- Continue north-east on the N14 and R52 towards and through the town of Lichtenburg.

- Travel east towards and through Johannesburg and then turn left onto the N1.
- Continue north on the N1 and travel towards and through the towns of:
  - Potgietersrus; and
  - Polokwane.
- The R36 to the Mafadi SPP is located approximately 70 km from the town of Polokwane and on the right-hand side of the N1.

3.3.3 Recommended port of entry

In terms of transport and traffic impact, the recommended port of entry is considered to be Durban Harbour. It is currently the largest harbour in South Africa and is the closest harbour to the site. It is recognised that effort is being made to shift cargo from Durban Harbour to Richards Bay Harbour and East London Harbour. The Durban Harbour is proposed as the preferred harbour along the eastern coast.

Saldanha Bay Harbour is considered a suitable option on the western coast. The route has been analysed and shows routes along national roads, catering for freight transport.

The regional routes indicated in the analysis would need to be confirmed by freight carriers as suitable for the sensitive normal loads and for any abnormal loads. The final decision on the selected route would be based on a combination of cost, distance and road condition at the time of transport.

3.4 HAULAGE OF TRANSFORMER AND SUBSTATION COMPONENTS

Transformer and substation components are envisaged to form part of the regional trips. It is anticipated that these components would be imported and transported from the preferred harbour (Saldanha or Durban Harbour) as abnormal loads. It would very likely be assembled in Johannesburg and transported to the *Mafadi SPP*, also requiring abnormal load transport. The distance from Johannesburg to *Mafadi SPP* is approximately 240 km along the N14.

It should be noted that only 1-2 abnormal load trips are expected for *Mafadi SPP*. Abnormal load transportation is therefore considered to be isolated and would have a negligible impact on traffic over the construction phase of the project. As indicated in *Section 3.2.4*, the abnormal load will still necessitate the application of an abnormal load permit for each province that the route traverses.

The route from Johannesburg to the site traverses the *Gauteng Province* and the *Limpopo Province*, as indicated in *Figure 3.2*. It should be noted that this is a general route description highlighting the N14 regional route, as location of suppliers is not yet established.

3.5 HAULAGE OF OTHER PLANT, CONSTRUCTION MATERIAL AND EQUIPMENT

In addition to transporting the specialised equipment, the normal civil engineering construction materials, plant and equipment will need to be transported to the site (e.g. sand, stone, cement, gravel, water, compaction equipment, concrete mixers, etc.). The transport of these items will generally be conducted with normal heavy loads vehicles.

Cement will be sourced from local manufacturers in nearby towns. All other civil construction materials, needed for concrete and wearing course, will be obtained from a local licensed quarry off-site. These trips can be classified as local trips as vehicles will not be travelling over a very long distance.

3.6 TRANSPORT OF CONSTRUCTION PERSONNEL

It is anticipated that construction personnel and labour would originate from neighbouring towns such as Louis Trichardt and Ga Pasha. These trips can be classified as local trips as vehicles will not be travelling over a very long distance.

3.7 ROUTE CLEARANCE

The vehicles used to transport the photovoltaic equipment are standard container trucks. The transformers will be transported as abnormal loads. At this stage of the project, the routes and areas for clearance cannot be established and should be confirmed with the freight carriers in later stage of the project. However, no new obstacles (e.g. low overhead services, cattle grids, narrow bridges, etc.) are expected for abnormal load haulage as similar projects in close proximity to the proposed development may have previously cleared areas along transport routes.

3.8 SUMMARY

It is anticipated that the solar panel technology and larger electrical components would be imported and arrive via ship at marine ports of entry. Haulage routes from two ports of entry, namely Saldanha Bay Harbour and Durban Harbour, were identified and assessed. The final decision on the selected route would be based on a combination of cost, distance and road condition at the time of transport.

Minimal abnormal load trips for transformers would be required for the project. It is anticipated that this would require haulage from the port of entry to the manufacturing site (possibly Johannesburg) before being hauled to site. These are considered to induce minimal impact on traffic over the course of the construction period but will require the necessary permits for abnormal load transport.

The materials required for site, including the solar panel technology, would require transport by normal heavy vehicle loads. As discussed in *Section 2.4*, it is proposed that the access roads

to the site be investigated for rehabilitation prior to construction and be maintained during construction in order to mitigate against the possibility of damaged goods due to poor road infrastructure.

CHAPTER 4 BACKGROUND TRAFFIC VOLUMES

4.1 OVERVIEW

Background traffic volumes were determined for the study network near the site, as well as along the transportation routes. These traffic volumes were acquired to determine what the existing traffic conditions are like in the absence of the proposed solar power plant.

Various traffic recording stations on major roadways, along transportation routes, were identified and are provided in the sub-chapters below. The traffic count data was mainly sourced from temporary counting stations, for which approximately one week of traffic data was recorded. Where available, permanent counting stations provided historic data over multiple years, indicating trends in traffic growth at those locations.

The traffic data available is only up until December 2019. The period for traffic assessment was selected as four years as it is estimated that approvals, planning and design phases would take 2-3 years and the construction phase, which would generate the highest number of trips for the project, would occur during year 4. Therefore, the existing traffic volumes for the years 2020 to 2022 for current estimated traffic volumes and to 2026 for the four-year horizon for traffic assessment were predicted as described below.

4.2 REGIONAL TRAFFIC

4.2.1 Alternative 1: Port of Durban to *Mafadi SPP*

The following traffic recording stations were identified along the Durban route:

Table 4.1: Traffic recording stations (Port of Durban route)

SITE IDENTIFIER	LOCATION	ROUTE	NO. OF LANES	2019 AVERAGE DAILY TRAFFIC (ADT)	2019 AVERAGE DAILY TRUCK TRAFFIC (ADTT) (% OF ADT)
1990 - Estcourt I/C	Southern side of Giants Castle I/C	N3	6	17 611	7 487 (42.5%)
3024 - N3TC Harrismith WIM	Between Harrismith and Warden	N3	4	12 542	4 833 (38.5%)
846 - Reitz I/C	Southern side of Reitz I/C	N3	6	10 933	4 526 (41.4%)
3025 - N3TC Wilge WIM	Between Villiers and Frankfort I/C	N3	4	11 767	4 548 (38.7%)
672 - Contantia	Southern side of Naboomspruit I/C	N1	6	17 072	3 542 (20.7%)

From *Table 4.1* it can be seen that heavy vehicles contribute between 20% and 43% to the total traffic volumes along the Durban transportation route.

4.2.2 Alternative 2: Port of Saldanha to *Mafadi SPP*

The following traffic recording stations were identified along the Saldanha route:

Table 4.2: Traffic recording stations (Port of Saldanha route)

SITE IDENTIFIER	LOCATION	ROUTE	NO. OF LANES	2019 AVERAGE DAILY TRAFFIC (ADT)	2019 AVERAGE DAILY TRUCK TRAFFIC (ADTT) (% OF ADT)
5014 - Piketberg	Between Moorreesburg and Piketberg	N7	2	4462	921 (20.6%)
5015 - Citrusdal	Between Citrusdal and Clanwilliam	N7	2	3439	759 (22.1%)
1304 - Calvinia West (R27)	Between Niewoudtville and Calvinia	R27	2	765	200 (26.1%)
1302 - Keimoes	Between Upington and Keimoes	N14	2	3454	439 (12.7%)
1303 - Uptington East	Between Upington and Olifanthoek	N14	2	1597	381 (23.8%)

From the table above it can be seen that heavy vehicles contribute between 12% and 26% to the total traffic volumes along the Saldanha transportation route.

4.3 LOCAL TRAFFIC

The following traffic station data was acquired from SANRAL for the main routes in the region of the site. The closest available sites were for short-term counts recorded in 2019.

Table 4.3: Traffic recording stations near development site

SITE IDENTIFIER	LOCATION	ROUTE	NO. OF LANES	2019 AVERAGE DAILY TRAFFIC (ADT)	2019 AVERAGE DAILY TRUCK TRAFFIC (ADTT) (% OF ADT)
2082 - Capricorn Plaza 1	North of Capricorn toll Plaza	N1	2	8 583	1 669 (19.4%)

The surveyed traffic data above has been used to estimate current day 2022 average daily traffic and for the 4-year horizon background daily traffic.

4.4 CAPACITY ANALYSIS

The following capacity analysis considers only the background traffic, without the additional traffic due to the development.

The *TRH 17* document was consulted to determine whether the capacities of the above-mentioned roadways would be exceeded within the near future. The capacity analysis results are indicated in *Table 4.4* below.

The estimated background traffic for the current year (2022) and for the horizon year (2026) was determined according to the available data. The historic data for the regional traffic was used with a linear trendline analysis to estimate the background traffic for the current year (2022) and horizon year (2026). The local traffic was escalated with 1.0% per annum to estimate the background traffic for the same years. The predicted traffic volumes for the year 2026 is provided in the table below. See *Appendix A* for graphical illustration.

Table 4.4: Capacity analysis (background traffic)

SITE IDENTIFIER	ROUTE	2022 ADT (vpd)	2022 LEVEL OF SERVICE (LOS)	2026 ADT (vpd)	2026 LEVEL OF SERVICE (LOS)
REGIONAL TRAFFIC – DURBAN ROUTE					
1990*	N3	17105	B	17105	B
3024*	N3	12382	A	12382	A
846*	N3	10565	A	10565	A
3025*	N3	11714	A	11714	A
672	N1	18368	A	19131	A
REGIONAL TRAFFIC – SALDANHA ROUTE					
5014	N7	5071	C	5686	D
5015	N7	3621	C	3834	C
1304	R27	851	A	898	A
1302	N14	3625	C	3764	C
1303	N14	1726	B	1829	B
LOCAL TRAFFIC					
2082	N1	9389	E	10445	E

The stations SITE ID 1990, 846 and 672 consist of three lanes in each direction. LOS assessed as 4-lane freeway.
*Trendline indicated negative growth. Zero change in traffic was therefore selected instead of decreased traffic.

From the table above it is concluded that the Level of Service of the assessed roadways are not degraded in terms of average daily traffic volumes due to background traffic within the assessment period. The station indicating the local traffic is, however, already at a low level of service, without the impact of the development. The trips generated by the proposed development and the impact they would have on the road network are assessed in the following chapter.

CHAPTER 5 TRIP GENERATION

5.1 OVERVIEW

The proposed *Mafadi SPP* will generate additional traffic on the surrounding road network in three (3) distinct phases, namely: *construction*, *operational* and *decommissioning* phases. These three phases will generate traffic consecutively and not simultaneously, and therefore will be considered separately from each other.

5.2 CONSTRUCTION PHASE

Trips generated during the construction phase will primarily comprise of transporting equipment, energy facility components, personnel, construction and other facility materials. These trips will comprise of normal, medium and heavy vehicles.

The following assumptions were made in order to calculate trips generated during the construction phase of the project:

- It is estimated that the construction period will last approximately two years, with twenty-two (22) working days per month. This results in approximately 500 working days over the construction period (considering provision for builders' holidays).
- The *Mafadi SPP* will most likely be constructed from components that will be shipped to South Africa via the Port of Durban. These components will be transported to site via road transport using medium and heavy vehicles.
    - The solar energy facility will generate approximately up to 150 MW electrical power.
    - Approximately 341 000 PV modules of approximately 300 – 550 W each will be delivered to site. Approximately 660 of these 300 – 550 W units can fit into one (1) container (30 units per pallet; 22 pallets per container). This results in approximately 520 container loads in total being delivered to site.
- Other plant, materials and equipment will be sourced from the nearest towns. An average of 200 -300 trips per 7MW is assumed. For this site, this has been assumed to be 40 trips per MW. This results in approximately 6 000 trips over the 24-month construction period.

Another contributor to trips generated during the construction phase will be daily commuters/ workers. The following assumptions were made in this regard:

- The construction labour force will be mostly local.
- It is assumed that approximately 300 staff members/workers will be on site.
    - Based on the composition it is assumed that 10% of the staff members will make use of private or company vehicles (cars and LDVs). These staff members will travel from their permanent or temporary residences to site on a daily basis.
    - It is assumed that the remainder of the staff members (90%) will be transported to site with 15-seater minibus-taxis. The quantities of these vehicles will fluctuate and will depend on the number of labourers, costs, routes and operating hours.

The table below summarises the estimated total trips that will be generated during the construction phase of the project:

Table 5.1: Trip generation (construction phase)

TRANSPORT TYPE	PARAMETER	AVERAGE DAILY TRAFFIC	MONTHLY TRAFFIC	TOTAL TRIPS (2yrs)
Normal heavy load (solar panels)	660 panels per container	1.1	24	520
Normal heavy load (construction materials)	40 trips/MW	12	264	6 000
LDVs and cars (Staff)	300 staff	48	1 056	24 000
TOTAL TRIPS FOR CONSTRUCTION PERIOD		**61**	**1 344**	**30 520**

It can be seen from the table above that the construction phase of *Mafadi SPP* will generate approximately **30 520** trips over the two-year period.

5.3 OPERATIONAL PHASE

The following assumptions were made with regards to the trip generation during the operational phase of the solar power plant:

- The *Mafadi SPP* will be in operation between twenty (20) and thirty (30) years.
- The solar energy facility will be in operation seven (7) days a week and personnel will therefore operate according to shifts.
- The operational team will consist of approximately fifty (50) people:

The traffic impact during the operational phase will therefore be insignificant, as approximately only fifty (50) people will work at the solar power plant.

5.4 DECOMMISSIONING PHASE

The decommissioning phase will start at the end of the *Mafadi SPP* lifetime (20 – 30 years). It is assumed that the decommissioning phase will last approximately six (6) months, involving a team of fifty (50) workers. As per the operational phase, the traffic impact will be insignificant.

CHAPTER 6 TRAFFIC IMPACT ASSESSMENT

6.1 OVERVIEW

The expected effects of traffic that would be generated by the proposed *Mafadi SPP* analysed as follows:

- The background traffic volumes were determined for the study network near the site, as well as along the transportation routes (Refer to *Chapter 4: Background Traffic Volumes*).
- The existing traffic volumes for the years 2020 to 2026 were predicted and were based on trendline analyses or annual escalation as indicated.
- Construction phase traffic (site-generated trips) were estimated for the proposed solar power plant.
- The construction phase traffic is then added to the 2026 background traffic volumes to determine the total traffic conditions with the solar power plant completed.

The sub-chapters below provide the impact the development of the solar power plant will have on the transportation routes and local traffic respectively.

6.2 ASSESSMENT OF IMPACTS ON REGIONAL TRANSPORTATION ROUTES

The trips generated by this development were evaluated in relation to the number of trips needed to change the Level of Service (LOS) on a portion of the rural highway and the ultimate capacity of two-lane highways.

As seen in Chapter 5, the traffic impact of the delivery and construction trips on the Saldanha and Durban routes are minimal, with average additional traffic of 1 trip per day from the ports of entry over the duration of the project, and 12 trips per day for normal heavy vehicles for construction materials.

These construction trips will be insignificant when compared to the Average Daily Traffic (ADT) and will not affect the existing Level of Service (LOS). It can therefore be concluded that, in terms of estimated traffic volumes, no mitigation measures will be necessary along the regional routes due to the proposed development.

6.3 ASSESSMENT OF IMPACTS ON LOCAL TRAFFIC

The capacity of a two-lane highway is 3200 vehicles per hour (vph), under ideal conditions, *HCM 6th Edition Chapter 15: Two Lane Highways*. The ideal conditions referred to is the absence of any restrictive geometry, traffic, or environmental factors.

From traffic count data and Level of Service calculations, the N1 near to development site is currently constrained. The table below indicates the effect of the commuter trips on the N1 volumes near the site.

Table 6.1: Traffic impact on routes near the site (commuter trips)

SITE ID	ROUTE	2026 ADT (vpd)	2026 LOS WITHOUT DEVELOPMENT	CONSTRUCTION TRIPS (vpd)	TOTAL TRIPS (vpd)	2026 LOS WITH DEVELOPMENT
2082	N1	10445	LOS E	61	**10506**	**LOS E**

While the low level of service is on the margin of acceptable level of service, the estimated additional traffic generated by the development, when travelling to/from the *Mafadi SPP*, does not influence the level of service and can be accommodated on the existing road network. Mitigation measures would not be required to due to the development's generated traffic.

From a traffic point of view, it was found that the total daily construction traffic will be low and will not significantly influence the surrounding communities.

CHAPTER 7 CUMULATIVE IMPACT ASSESSMENT

7.1 OVERVIEW

The EIA Regulations (as amended in 2017) determine that cumulative impacts, "*in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to the existing and reasonably foreseeable impacts eventuating from similar or diverse activities*." The cumulative impact of the proposed development has been assessed in terms of the cumulative impact of the implementation of the *Mafadi SPP* together with similar solar farm developments within a 30 km radius.

7.2 CUMULATIVE IMPACT – SOLAR FARM DEVELOPMENTS IN 30km RADIUS

Table 7.2 below provides a summary of other renewable energy projects that have been identified for the cumulative impact assessment, within a 30 km radius from the development site. The premise for the assessment is that these projects would be constructed during the same period as the *Mafadi SPP*. While this is unlikely, all these projects are included in the cumulative trip generation and subsequently the cumulative impact assessment.

The construction trips for *Mafadi SPP*, as presented in *Section 5.2 above*, are presented below for ease of reference:

Table 7.1: Summary of construction trips for *Mafadi SPP*

TRANSPORT TYPE	AVERAGE DAILY TRAFFIC	PROPORTION (%)
Regional traffic - Normal heavy load (solar panels)	1.1	2%
Regional traffic - Normal heavy load (construction materials)	12	19%
Local traffic - LDVs and cars (Staff)	48	79%
TOTAL TRIPS FOR CONSTRUCTION PERIOD	**61**	**100%**

The expected trip generation presented in the following table has been based on the proportional number of PV panels requiring transport from a port of entry, and therefore the number of trips, in comparison to the design MW capacity of the *Mafadi SPP*.

Table 7.2: Additional solar power projects (within 30 km radius from study area)

NO.	PROJECT NAME	DISTANCE FROM STUDY AREA (km)	CAPACITY (MW)	EXPECTED TOTAL DAILY CONSTRUCTION TRIPS
1	Portion of Farm Boschhoek 428 LS	12.3 km	50 MW	53
TOTAL CUMULATIVE DAILY TRIPS OVER CONSTRUCTION PERIOD				**53**

Considering the proportion of regional and local trips of the *Mafadi SPP*, the cumulative regional daily trips could be estimated as 19% of the 53 total trips. This results in an additional 10 regional trips for the additional solar power project considered in the cumulative impact analysis. In comparison to the average daily traffic estimated without the development traffic (year 2026), this cumulative additional traffic is deemed to be a low negative impact on regional routes during a scenario of concurrent construction.

The local daily trips could be estimated as 81% of the 53 trips; resulting in 43 local trips for the additional solar power project considered above. This is deemed to be a low negative impact on the local routes as the local route in the area is the National Route 1, which is designed to carry high volumes of traffic.

This cumulative impact is considered in the overall impact assessment in *CHAPTER 8* overleaf.

CHAPTER 8 IMPACT ASSESSMENT SUMMARY

8.1 OVERVIEW

The impact of the proposed development has been assessed in terms of traffic as shown below. For the environmental impact reporting requirements, the traffic impact of the proposed development is presented in terms of the assessment methodology described in *Appendix C* of this report.

8.2 IMPACT ASSESSMENT – CONSTRUCTION PHASE REGIONAL TRAFFIC

In terms of traffic and transport, the impact that the proposed development has during the construction phase is as follows:

Table 8.1: Impact assessment – construction phase regional traffic

CRITERIA	DESCRIPTION AND/OR RATING
Nature	Increased traffic on regional haulage routes: The haulage routes for light and heavy vehicles include regional routes that would be impacted by the construction of the development. The delivery of imported construction materials to site would likely originate from Johannesburg and Durban Harbour, as discussed in the preceding chapters, slightly increasing the average daily traffic of the routes used over the construction period.
Geographical Extent	The regional traffic will affect routes from the ports of entry, which fall outside the development area's location, the Limpopo Province, which therefore requires interprovincial travel. The impact is therefore classified as "National". *Rating – 4*
Probability	The solar equipment cannot be transported without the regional trips. The impact is therefore classified as "Definite". *Rating – 4*
Duration	The duration of the construction of the solar power plant is estimated to be two years, with the transporting of equipment along regional routes occurring in less than the two-year period. The impact is therefore classified as "Short term". *Rating – 1*
Intensity / Magnitude	The average daily regional traffic added to the regional road network due to the construction of the *Mafadi SPP* is barely perceptible in relation to the general traffic expected on those routes. The impact is therefore classified as "Low". *Rating – 1*
Reversibility	The transport of equipment/material along the regional routes for the construction phase will cease after the construction period. The impact is therefore classified as "Completely reversible". *Rating – 1*

<table>
<tr><th>CRITERIA</th><th>DESCRIPTION AND/OR RATING</th></tr>
<tr><td>Irreplaceable Loss of Resources</td><td>No irreplaceable loss of resources will occur due to the regional traffic. The impact is therefore classified as “No Loss”.
Rating – 1</td></tr>
<tr><td>Cumulative Effect</td><td>There is a small possibility that one additional solar plant will be constructed over the same period. This will have moderate to minor cumulative effects on the existing traffic volumes. The impact is therefore classified as “Low cumulative”.
Rating – 2</td></tr>
<tr><td>Significance
The calculation of the significance of an impact uses the following formula:
(Extent + probability + duration
+ reversibility
+ irreplaceability
+ cumulative effect)
x magnitude/intensity.</td><td>Therefore, the Impact Significance Rating = 13

<table><tr><th>Points</th><th>Impact significance rating</th><th>Description</th></tr><tr><td>6 to 28</td><td>Negative low impact</td><td>The anticipated impact will have negligible negative effects and will require little to no mitigation.</td></tr></table></td></tr>
<tr><td>Possible Mitigation Measures</td><td>The impact of the increased traffic on regional routes can be mitigated by staggering trips and scheduling so that peak hour traffic in local towns is not impacted by construction traffic.</td></tr>
<tr><td>Post-mitigation Rating</td><td>Negative low impact</td></tr>
</table>

8.3 IMPACT ASSESSMENT – CONSTRUCTION PHASE LOCAL TRAFFIC

Table 8.2: Impact assessment – construction phase local traffic

<table>
<tr><th>CRITERIA</th><th>DESCRIPTION AND/OR RATING</th></tr>
<tr><td>Nature</td><td><u>Increased traffic on local routes:</u>
In general, approximately only 10% of daily traffic could be attributed to peak hour volumes. The increased traffic on the local routes may add to local congestion in the neighbouring towns. This would only be slightly noticeable if construction traffic passes through the local town during peak periods. The N1 is considered a local route for the site and is already at a low level of service.</td></tr>
<tr><td>Geographical Extent</td><td>The local traffic will affect routes from surrounding towns. The impact is therefore classified as “Local”.
Rating – 2</td></tr>
<tr><td>Probability</td><td>The transport of staff during construction will likely impact the local traffic, depending on the various locations staff are sourced from. The impact is therefore classified as “Probable”.
Rating – 3</td></tr>
<tr><td>Duration</td><td>The duration of the construction of the solar power plant is estimated to be two years, with the increased local traffic occurring over that period. The impact is therefore classified as “Short term”.
Rating – 1</td></tr>
<tr><td>Intensity / Magnitude</td><td>The average daily local traffic added to the local road network due to the construction of the Mafadi SPP is barely perceptible in relation to the general traffic expected on those routes. The additional impact is therefore classified as “Low”.
Rating – 1</td></tr>
<tr><td>Reversibility</td><td>The increased local traffic for the construction phase will cease after the construction period. The impact is therefore classified as “Completely reversible”.
Rating – 1</td></tr>
<tr><td>Irreplaceable Loss of Resources</td><td>No irreplaceable loss of resources will occur due to the local traffic. The impact is therefore classified as “No Loss”.
Rating – 1</td></tr>
<tr><td>Cumulative Effect</td><td>There is a small possibility that the additional solar plant may be constructed over the same period. This may have moderate to minor cumulative effects on the existing traffic volumes. The impact is therefore classified as “Medium cumulative”.
Rating – 3</td></tr>
<tr><td>Significance
The calculation of the significance of an impact uses the following formula:
(Extent + probability + duration
+ reversibility
+ irreplaceability</td><td>Therefore, the Impact Significance Rating = 11
<table>
<tr><th>Points</th><th>Impact significance rating</th><th>Description</th></tr>
<tr><td>6 to 28</td><td>Negative low impact</td><td>The anticipated impact will have negligible negative effects and will require little to no mitigation.</td></tr>
</table>
</td></tr>
</table>

CRITERIA	DESCRIPTION AND/OR RATING
+ cumulative effect) x magnitude/intensity.	
Possible Mitigation Measures	The impact of the increased traffic on local routes can be mitigated by staggering trips and scheduling so that peak hour traffic in local towns is not impacted by construction traffic.
Post-mitigation Rating	Negative low impact

8.4 IMPACT ASSESSMENT – CONSTRUCTION PHASE SITE ROADS INFRASTRUCTURE

Table 8.3: Impact assessment – construction phase site roads infrastructure

CRITERIA	DESCRIPTION AND/OR RATING
Nature	Construction and maintenance of gravel roads in vicinity of the site: The construction traffic accessing the site would be traveling along roads that are proposed to be unsurfaced for the development. The movement of heavy vehicles along the gravel roads, especially close to the boundaries of the site, may cause excessive dust in the area. Deterioration of gravel roads may also occur after wet seasons, leading to poor road conditions for transportation on site.
Geographical Extent	The gravel roads affected will be those on site. The impact is therefore classified as "Local". *Rating – 2*
Probability	The deterioration of the gravel roads is likely, with the constant use during the construction period. The impact is therefore classified as "Probable". *Rating – 3*
Duration	The duration of the construction of the solar power plant is estimated to be two years, with the construction traffic occurring over that period. The impact is therefore classified as "Short term". *Rating – 1*
Intensity/ Magnitude	The average daily construction traffic of 61 vehicles per day is considered a low volume for a gravel road. The impact is therefore classified as "Low". *Rating – 1*
Reversibility	The traffic for the construction phase will cease after the construction period. The condition of the road is expected to have slight deterioration, compared to a newly constructed gravel road but a maintenance schedule will control the rate of deterioration. The impact is therefore classified as "Partly reversible". *Rating – 2*
Irreplaceable Loss of Resources	Marginal irreplaceable loss of resources may occur due to poor quality site roads. The impact is therefore classified as "Marginal Loss". *Rating – 2*
Cumulative Effect	There is a small possibility that surrounding properties may also need to use the gravel access roads, to a certain point. This may have insignificant

<table>
<tr><th>CRITERIA</th><th>DESCRIPTION AND/OR RATING</th></tr>
<tr><td></td><td>cumulative effects on the condition of the road. The impact is therefore classified as “Low cumulative”.
Rating – 2</td></tr>
<tr><td>Significance
The calculation of the significance of an impact uses the following formula:
(Extent + probability + duration
+ reversibility
+ irreplaceability
+ cumulative effect)
x magnitude/intensity.</td><td>Therefore, the Impact Significance Rating = 12
<table>
<tr><th>Points</th><th>Impact significance rating</th><th>Description</th></tr>
<tr><td>6 to 28</td><td>Negative low impact</td><td>The anticipated impact will have negligible negative effects and will require little to no mitigation.</td></tr>
</table></td></tr>
<tr><td>Possible Mitigation Measures</td><td>Maintenance to lower order roads can be incorporated into the schedule, especially the maintenance of the road accessing the site. The site access road would require construction at the start of the construction project, in order to safely transport the sensitive cargo through the site. A gravel roads maintenance programme for the gravel roads on site is recommended.</td></tr>
<tr><td>Post-mitigation Rating</td><td>Negative low impact</td></tr>
</table>

8.5 IMPACT ASSESSMENT – OPERATIONAL PHASE TRAFFIC

Table 8.4: Impact assessment – operational phase traffic

CRITERIA	DESCRIPTION AND/OR RATING
Nature	<u>Increased traffic during operational phase:</u> The traffic will increase slightly, in comparison to traffic without the development, due to the employees on site during the operational phase.
Geographical Extent	Depending on staff/vendor origin, the operational phase traffic will affect routes in surrounding towns. The impact is therefore classified as “Local”. *Rating – 2*
Probability	Increase in traffic during operational phase may occur. The impact is therefore classified as “Possible”. *Rating – 3*
Duration	The duration of the operational phase of the solar power plant is estimated to be 20 – 30 years. The impact is therefore classified as “Long term”. *Rating – 3*
Intensity/ Magnitude	The traffic expected on site during the operational phase is barely perceptible. The impact is therefore classified as “Low”. *Rating – 1*
Reversibility	The operational phase traffic volumes will no longer be required once the facility reaches the end of its life. The impact is therefore classified as “Completely reversible”. *Rating – 1*

<table>
<tr><th>CRITERIA</th><th>DESCRIPTION AND/OR RATING</th></tr>
<tr><td>Irreplaceable Loss of Resources</td><td>No irreplaceable loss of resources will occur due to the operational traffic. The impact is therefore classified as “No Loss”.
Rating – 1</td></tr>
<tr><td>Cumulative Effect</td><td>There is a small possibility that surrounding similar projects may also be operational at the same time. Operational traffic is minimal; this may have negligible cumulative effects on the cumulative traffic on the local road (N1). The impact is therefore classified as “Negligible cumulative”.
Rating – 1</td></tr>
<tr><td>Significance
The calculation of the significance of an impact uses the following formula:
(Extent + probability + duration
+ reversibility
+ irreplaceability
+ cumulative effect)
x magnitude/intensity.</td><td>Therefore, the Impact Significance Rating = 11

<table><tr><th>Points</th><th>Impact significance rating</th><th>Description</th></tr><tr><td>6 to 28</td><td>Negative low impact</td><td>The anticipated impact will have negligible negative effects and will require little to no mitigation.</td></tr></table></td></tr>
<tr><td>Possible Mitigation Measures</td><td>The impact of the increased traffic during the operational phase is negligible due to the expected number of employees. The shift work provides a mitigation and reduces the expected number of employees, especially during peak hours. The magnitude of the increased traffic is relatively small and is not likely to change during the operational phase of the development. These trips will become part of the network trips due to the development.</td></tr>
<tr><td>Post-mitigation Rating</td><td>Negative low impact to negligible</td></tr>
</table>

8.6 IMPACT ASSESSMENT – DECOMMISSIONING PHASE TRAFFIC

Table 8.5: Impact assessment – decommissioning phase traffic

CRITERIA	DESCRIPTION AND/OR RATING
Nature	<u>Increased traffic during decommissioning phase:</u> The traffic will increase slightly due to the employees and heavy vehicles on site during the decommissioning phase.
Geographical Extent	The decommissioning phase traffic will affect routes in surrounding towns. The impact is therefore classified as “Local”. *Rating – 2*
Probability	Increase in traffic during decommissioning phase may occur. The impact is therefore classified as “Possible”. *Rating – 3*
Duration	The duration of the decommissioning phase of the solar power plant is estimated to be six months. The impact is therefore classified as “Short term”. *Rating – 1*
Intensity/ Magnitude	The traffic expected on site during the decommissioning phase is barely perceptible. The impact is therefore classified as “Low”.

<table>
<tr><th>CRITERIA</th><th>DESCRIPTION AND/OR RATING</th></tr>
<tr><td></td><td>Rating – 1</td></tr>
<tr><td>Reversibility</td><td>The decommissioning phase traffic volumes will no longer be required once the phase is completed. The impact is therefore classified as “Completely reversible”.
Rating – 1</td></tr>
<tr><td>Irreplaceable Loss of Resources</td><td>No irreplaceable loss of resources will occur due to the decommissioning traffic. The impact is therefore classified as “No Loss”.
Rating – 1</td></tr>
<tr><td>Cumulative Effect</td><td>The impact is classified as “Negligible cumulative”.
Rating – 1</td></tr>
<tr><td>Significance
The calculation of the significance of an impact uses the following formula:
(Extent + probability + duration
+ reversibility
+ irreplaceability
+ cumulative effect)
x magnitude/intensity.</td><td>Therefore, the Impact Significance Rating = 9

<table><tr><th>Points</th><th>Impact significance rating</th><th>Description</th></tr><tr><td>6 to 28</td><td>Negative low impact</td><td>The anticipated impact will have negligible negative effects and will require little to no mitigation.</td></tr></table></td></tr>
<tr><td>Possible Mitigation Measures</td><td>The impact of the increased traffic during the decommissioning phase is negligible due to the expected number of employees and heavy vehicles on site. The magnitude of the increased traffic is relatively small and is not likely to require mitigation measures. The access road at the R36 may require maintenance at the end of the decommissioning phase.</td></tr>
<tr><td>Post-mitigation Rating</td><td>Negative low impact</td></tr>
</table>

8.7 SUMMARY

The above impact assessment is summarised as follows, according to the methodology provided. See *Appendix C* for assessment methodology and key.

Table 8.6: Traffic and transport related impact assessment summary

POTENTIAL IMPACT	SIGNIFICANCE AND MAGNITUDE OF POTENTIAL IMPACTS						
DESCRIPTION	MINOR	MAJOR	EXTENT	DURATION	PROBABI-LITY	REVERSIBI-LITY	IRREPLACE-ABLE LOSS
CONSTRUCTION PHASE							
Increased regional traffic	-		(I)	(S)	(D)	(CR)	(NL)
Increased local traffic	-		(L)	(S)	(Pr)	(CR)	(NL)
Site roads infrastructure	-		(L)	(S)	(Pr)	(PR)	(ML)
OPERATIONAL PHASE							
Increased traffic	-		(L)	(L)	(Pr)	(CR)	(NL)
DECOMMISSIONING PHASE							
Increased traffic	-		(L)	(S)	(Pr)	(CR)	(NL)

CHAPTER 9 SUMMARY AND CONCLUSION

9.1 SUMMARY

The proposed *Mafadi SPP* is located on a site approximately 30 km south of Louis Trichardt in the Limpopo Province. It will comprise several arrays of PV panels and associated infrastructure and will have a contracted capacity of up to 150 MW. The proposed *Mafadi SPP* will be located on Farm Langgedacht No. 1210 and is proposed to cover approximately 320 ha. The infrastructure will include the PV grid with inverters and transformers, BESS, operations and maintenance buildings, internal site roads and electrical grid connection infrastructure.

The site for this development is located off a two-lane surfaced road, Regional Road R36, which links to the N1, at the south-western corner of the site.

For the traffic assessment, regional and local transport routes were investigated:

- For regional routes, haulage routes from various ports of entry (Durban Harbour and Saldanha Bay Harbour) were investigated. The regional routes were mainly national routes, with the N3, N5 and N1 considered from Durban Harbour and N7, R27 and N14 considered from Saldanha Bay Harbour. A regional route from Johannesburg has also been assessed and presented for the haulage of major electrical components.
- For the assessment of local routes, National Route N1 close to the site was assessed for impact of local trips on the local network.
- The existing traffic volumes on the transportation routes were sourced and used to calculate the current background traffic, the expected background traffic during construction and, thereby, the expected Level of Service. The number of trips generated from the construction period were estimated and the impact of these additional trips on the regional and local transport routes were also investigated.

As part of the cumulative impact assessment, similar solar farm projects within a radius of 30 km were also assessed and the impact assessment reported in terms of the assessment methodology required.

9.2 CONCLUSIONS

The following conclusions were drawn from the study:

- The major traffic impact occurs during the construction phase of the project. The impact of the construction trip generation, on the predicted 2026 (estimated time of construction) traffic volumes on the local and the regional transportation routes are expected to be low. No mitigation measures for these routes will be necessary.
- The photovoltaic (PV) components will be delivered to site from two possible ports, either from Durban Harbour over a distance of 960 km or from Saldanha Bay Harbour over a distance of 1 970 km. The regional routes indicated in the analysis would need to be confirmed by freight carriers as suitable for the sensitive normal loads. The final decision

on the selected route would be based on a combination of cost, distance and road condition at the time of transport.

- Transformer and substation components will be transported via abnormal loads. An abnormal load will necessitate an application to the *Department of Transport and Public Works* for a permit. A permit is required for each province that the transportation route traverses. Only 1-2 abnormal load trips is expected for *Mafadi SPP*. Abnormal load transportation is therefore considered to be isolated and would have a negligible impact on traffic over the construction phase of the project.
- In terms of impact on roads infrastructure:
  - A main access road has been presented for site access roads from the R36, along the eastern boundary of the site. This is a suitable location, due to its proximity to the N1 and it is at an existing access.
  - Access to a water source on the site is proposed to form part of an internal access road.
  - It is proposed that the access roads in close proximity to the site be investigated for rehabilitation prior to construction and be maintained during construction in order to mitigate against the possibility of damaged goods due to poor road infrastructure.
  - The formalisation of the site access point will likely be a requirement as part of the wayleave approval of the local and provincial roads authorities.
  - Adequate traffic accommodation signage must be erected and maintained on either side of the access throughout the construction period of the project.
  - The construction and provision of internal roads that cross the Eskom servitude need to be according to Eskom wayleave requirements.
- In terms of impact on traffic:
  - The regional construction trips will be insignificant when compared to the existing Average Daily Traffic (ADT) and projected ADT without the development. It has been noted that the N1 in the region of the site is already at a low level of service, without the addition of the proposed development. Mitigation measures, such as staggered trips and reduced peak time travel are proposed if needed.
- In terms of cumulative impact:
  - The concurrent construction of an additional solar farm in a 30 km radius of the site has also been considered and is deemed to have a low impact. Mitigation measures that may be considered, should concurrent construction occur, include the staggering of trips at the site and the implementation of a roads maintenance programme.

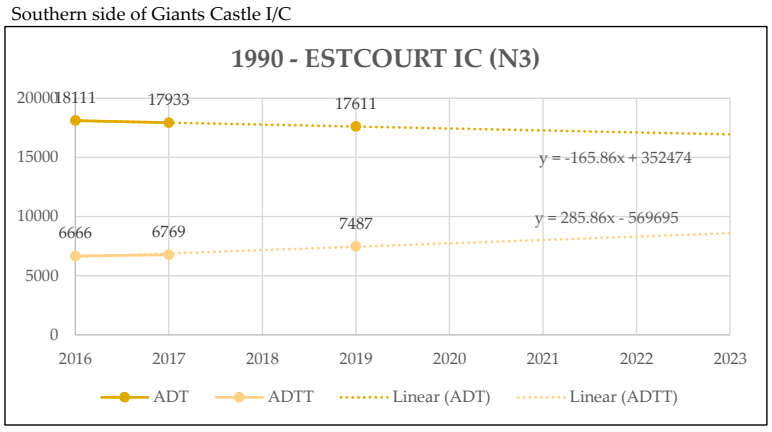
The development of the *Mafadi SPP* on Farm Langgedacht No. 1210 near Louis Trichardt in the Limpopo Province can therefore be supported from a traffic engineering perspective.

APPENDIX A

BACKGROUND TRAFFIC VOLUMES

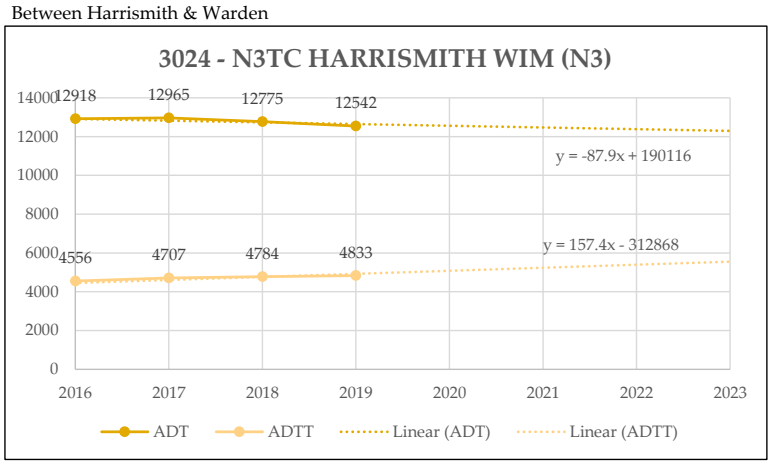
1990 - ESTCOURT IC (N3)						
YEAR	AVERAGE DAILY TRAFFIC (ADT)			AVERAGE DAILY TRUCK TRAFFIC (ADTT)		
	TO SPRINGBOK	TO CAPE TOWN	TOTAL	TO SPRINGBOK	TO CAPE TOWN	TOTAL
2015						
2016	8933	9178	18111	3351	3315	6666
2017	9022	8911	17933	3375	3394	6769
2018						
2019	8847	8764	17611	3590	3897	7487
2020	8544	8893	17437	3794	3949	7742
2021	8463	8808	17271	3934	4094	8028
2022	**8381**	**8724**	**17105**	**4074**	**4240**	**8314**
2023	8300	8639	16939	4214	4386	8600
2024	8219	8554	16773	4354	4532	8886
2025	8138	8470	16608	4494	4677	9172
2026	**8056**	**8385**	**16442**	**4634**	**4823**	**9457**

Southern side of Giants Castle I/C



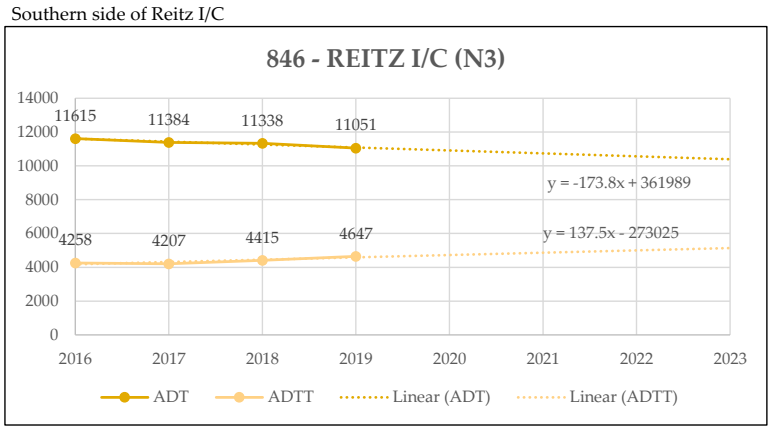
3024 - N3TC HARRISMITH WIM (N3)						
YEAR	AVERAGE DAILY TRAFFIC (ADT)			AVERAGE DAILY TRUCK TRAFFIC (ADTT)		
	TO WARDEN	TO HARRISMITH	TOTAL	TO WARDEN	TO HARRISMITH	TOTAL
2015	6557	6353	12910	2166	1994	4160
2016	6560	6358	12918	2389	2167	4556
2017	6556	6409	12965	2433	2274	4707
2018	6480	6295	12775	2481	2303	4784
2019	6330	6212	12542	2480	2353	4833
2020	6364	6194	12558	2636	2444	5080
2021	6320	6150	12470	2717	2520	5237
2022	**6275**	**6107**	**12382**	**2799**	**2596**	**5395**
2023	6231	6064	12294	2880	2672	5552
2024	6186	6020	12206	2962	2747	5710
2025	6142	5977	12119	3044	2823	5867
2026	**6097**	**5933**	**12031**	**3125**	**2899**	**6024**

Between Harrismith & Warden



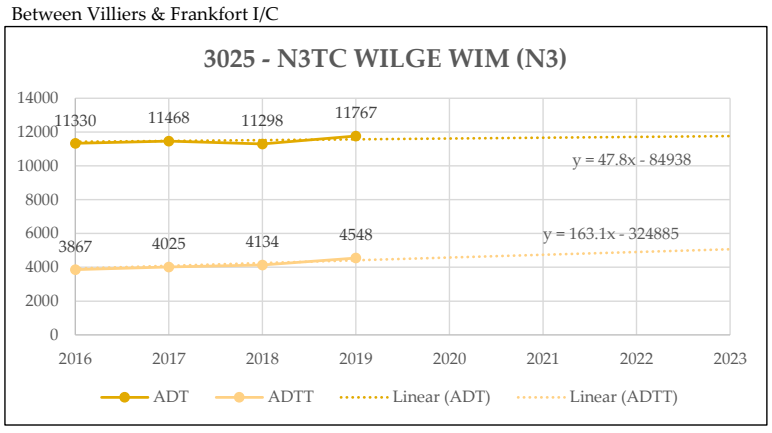
846 - REITZ I/C (N3)						
YEAR	AVERAGE DAILY TRAFFIC (ADT)			AVERAGE DAILY TRUCK TRAFFIC (ADTT)		
			TOTAL			TOTAL
2015						
2016			11615			4258
2017			11384			4207
2018			11338			4415
2019			11051			4647
2020			10913			4725
2021			10739			4863
2022			**10565**			**5000**
2023			10392			5138
2024			10218			5275
2025			10044			5413
2026			**9870**			**5550**

Southern side of Reitz I/C



3025 - N3TC WILGE WIM (N3)						
YEAR	AVERAGE DAILY TRAFFIC (ADT)			AVERAGE DAILY TRUCK TRAFFIC (ADTT)		
	TO VILLIERS	TO WARDEN	TOTAL	TO VILLIERS	TO WARDEN	TOTAL
2015	5849	5663	11512	2040	1826	3866
2016	5744	5586	11330	2034	1833	3867
2017	5796	5672	11468	2093	1932	4025
2018	5839	5459	11298	2155	1979	4134
2019	5788	5979	11767	2336	2212	4548
2020	5876	5742	11618	2388	2189	4577
2021	5901	5765	11666	2473	2267	4740
2022	**5925**	**5789**	**11714**	**2558**	**2345**	**4903**
2023	5949	5812	11761	2644	2423	5066
2024	5973	5836	11809	2729	2501	5229
2025	5997	5860	11857	2814	2579	5393
2026	**6021**	**5883**	**11905**	**2899**	**2657**	**5556**

Between Villiers & Frankfort I/C

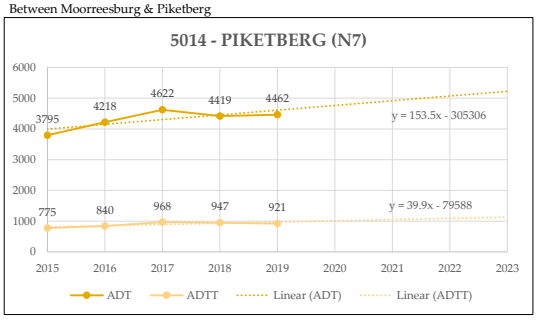


672 - CONSTANTIA (N1)						
YEAR	AVERAGE DAILY TRAFFIC (ADT)			AVERAGE DAILY TRUCK TRAFFIC (ADTT)		
			TOTAL			TOTAL
2015			16199			3446
2016			18342			3761
2017			17413			3524
2018			17602			3648
2019			17522			3621
2020			17987			3671
2021			18178			3695
2022			**18368**			**3718**
2023			18559			3742
2024			18749			3766
2025			18940			3790
2026			**19131**			**3813**

Southern side of Naboomspruit I/C

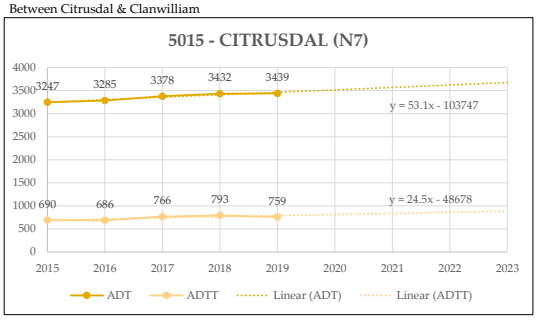
5014 - PIKETBERG (N7)						
YEAR	AVERAGE DAILY TRAFFIC (ADT)			AVERAGE DAILY TRUCK TRAFFIC (ADTT)		
	TO SPRINGBOK	TO CAPE TOWN	TOTAL	TO SPRINGBOK	TO CAPE TOWN	TOTAL
2015	1912	1883	3795	388	387	775
2016	2123	2095	4218	414	426	840
2017	2311	2311	4622	476	492	968
2018	2197	2222	4419	474	473	947
2019	2210	2252	4462	455	466	921
2020	2381	2383	4764	501	508	1009
2021	2458	2460	4918	520	528	1049
2022	**2535**	**2537**	**5071**	**540**	**548**	**1088**
2023	2611	2613	5225	560	568	1128
2024	2688	2690	5378	579	588	1168
2025	2765	2767	5532	599	608	1208
2026	**2842**	**2844**	**5686**	**619**	**628**	**1247**

Between Moorreesburg & Piketberg



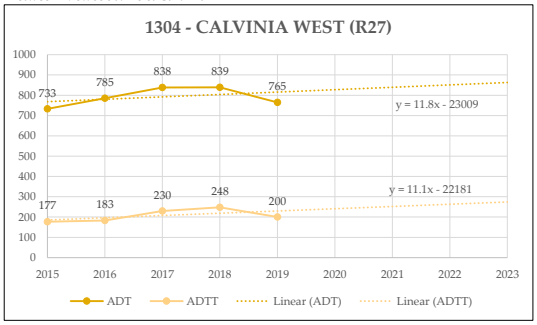
5015 - CITRUSDAL (N7)						
YEAR	AVERAGE DAILY TRAFFIC (ADT)			AVERAGE DAILY TRUCK TRAFFIC (ADTT)		
	TO CLANWILLIAM	TO CITRUSDAL	TOTAL	TO CLANWILLIAM	TO CITRUSDAL	TOTAL
2015	1633	1614	3247	350	340	690
2016	1641	1644	3285	342	344	686
2017	1691	1687	3378	383	383	766
2018	1718	1714	3432	400	393	793
2019	1712	1727	3439	377	382	759
2020	1758	1757	3515	407	405	812
2021	1785	1783	3568	419	417	837
2022	**1811**	**1810**	**3621**	**432**	**429**	**861**
2023	1838	1836	3674	444	442	886
2024	1864	1863	3727	456	454	910
2025	1891	1889	3781	469	466	935
2026	**1918**	**1916**	**3834**	**481**	**478**	**959**

Between Citrusdal & Clanwilliam



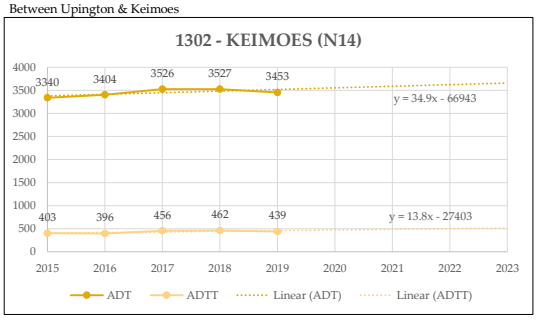
1304 - CALVINIA WEST (R27)						
YEAR	AVERAGE DAILY TRAFFIC (ADT)			AVERAGE DAILY TRUCK TRAFFIC (ADTT)		
	TO CALVINIA	TO NIEUWOUDTVILLE	TOTAL	TO CALVINIA	TO NIEUWOUDTVILLE	TOTAL
2015	373	360	733	93	84	177
2016	397	388	785	96	87	183
2017	425	413	838	120	110	230
2018	428	411	839	131	117	248
2019	390	375	765	106	94	200
2020	420	407	827	127	114	241
2021	426	412	839	133	119	252
2022	**432**	**418**	**851**	**138**	**125**	**263**
2023	438	424	862	144	130	274
2024	444	430	874	150	135	285
2025	450	436	886	156	141	297
2026	**456**	**441**	**898**	**162**	**146**	**308**

Between Niewoudtville & Calvinia



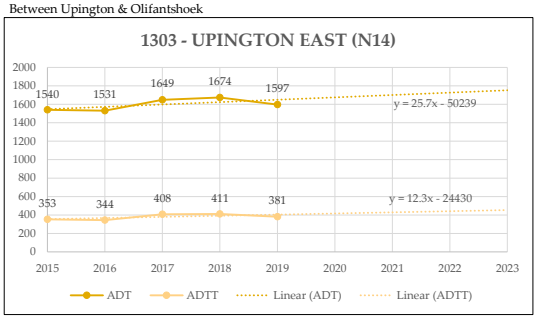
1302 - KEIMOES (N14)						
YEAR	AVERAGE DAILY TRAFFIC (ADT)			AVERAGE DAILY TRUCK TRAFFIC (ADTT)		
	TO UPINGTON	TO KEIMOES	TOTAL	TO UPINGTON	TO KEIMOES	TOTAL
2015	1662	1678	3340	202	201	403
2016	1692	1712	3404	198	198	396
2017	1761	1765	3526	228	228	456
2018	1763	1764	3527	233	229	462
2019	1726	1727	3453	219	220	439
2020	1773	1782	3555	237	236	473
2021	1791	1799	3590	244	243	487
2022	**1808**	**1817**	**3625**	**251**	**250**	**501**
2023	1825	1834	3660	258	257	514
2024	1843	1852	3695	265	264	528
2025	1860	1869	3730	271	271	542
2026	**1878**	**1887**	**3764**	**278**	**277**	**556**

Between Upington & Keimoes



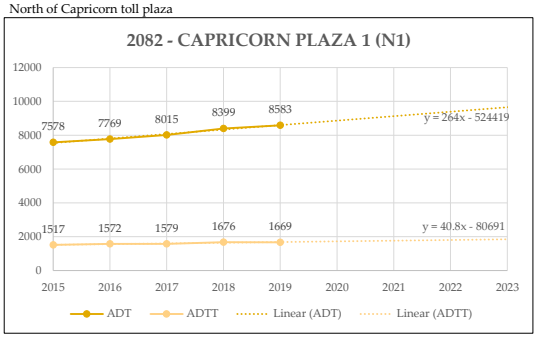
1303 - UPINGTON EAST (N14)						
YEAR	AVERAGE DAILY TRAFFIC (ADT)			AVERAGE DAILY TRUCK TRAFFIC (ADTT)		
	TO OLIFANTSHOEK	TO UPINGTON	TOTAL	TO OLIFANTSHOEK	TO UPINGTON	TOTAL
2015	775	765	1540	178	175	353
2016	770	761	1531	175	169	344
2017	827	822	1649	206	202	408
2018	842	832	1674	209	202	411
2019	804	793	1597	191	190	381
2020	842	833	1675	210	206	416
2021	855	846	1701	217	212	428
2022	**868**	**858**	**1726**	**223**	**218**	**441**
2023	881	871	1752	229	224	453
2024	894	884	1778	235	230	465
2025	907	897	1804	241	236	478
2026	**920**	**909**	**1829**	**248**	**242**	**490**

Between Upington & Olifantshoek



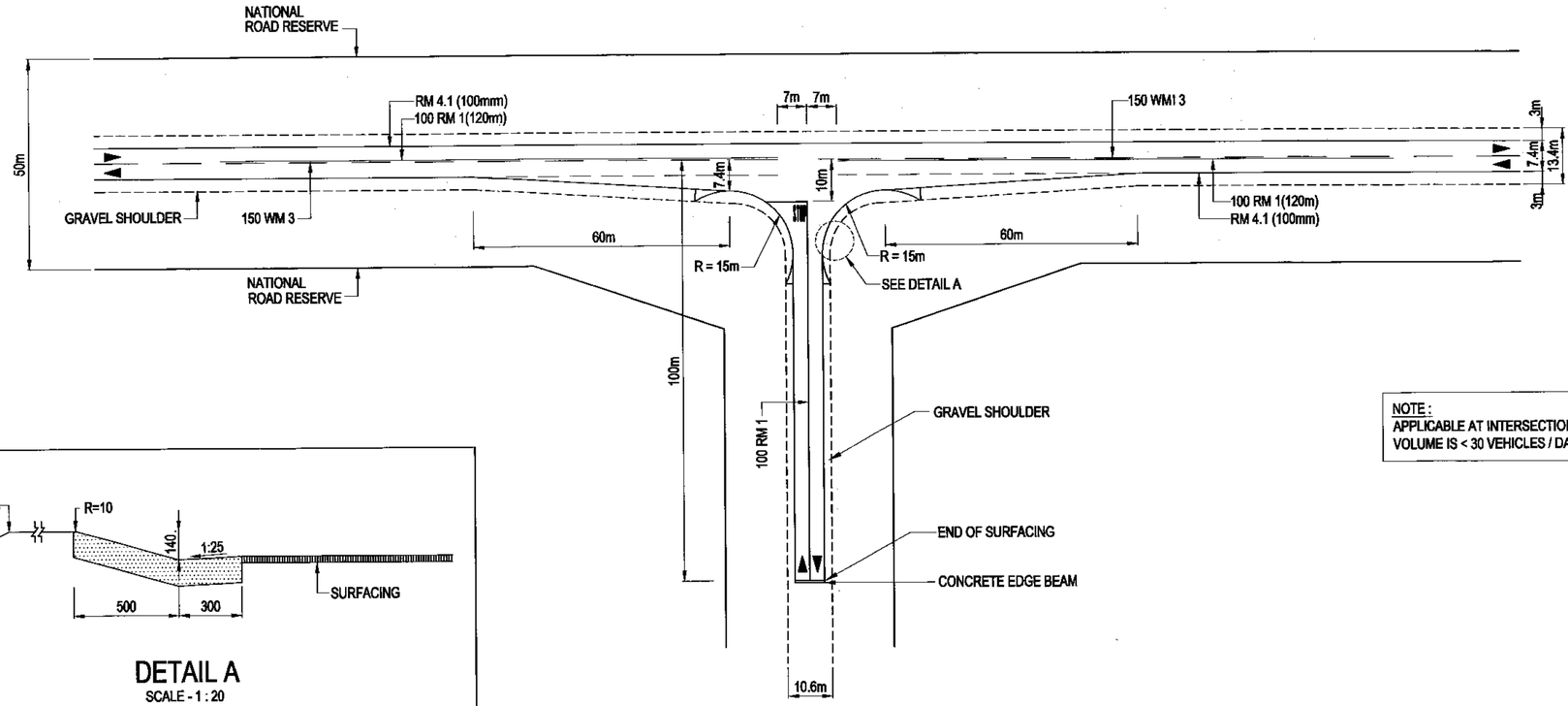
2082 - CAPRICORN PLAZA 1 (N1)						
YEAR	AVERAGE DAILY TRAFFIC (ADT)			AVERAGE DAILY TRUCK TRAFFIC (ADTT)		
	TO BEIT BRIDGE	TO POLOKWANE	TOTAL	TO BEIT BRIDGE	TO POLOKWANE	TOTAL
2015	3839	3739	7578	779	738	1517
2016	3929	3840	7769	803	769	1572
2017	4060	3955	8015	805	774	1579
2018	4245	4154	8399	850	826	1676
2019	4342	4241	8583	865	804	1669
2020	4485	4376	8861	883	842	1725
2021	4619	4506	9125	904	862	1766
2022	**4753**	**4636**	**9389**	**925**	**882**	**1807**
2023	4886	4767	9653	945	902	1847
2024	5020	4897	9917	966	922	1888
2025	5154	5027	10181	987	942	1929
2026	**5287**	**5158**	**10445**	**1008**	**962**	**1970**

North of Capricorn toll plaza



APPENDIX B

TYPICAL ACCESS GEOMETRY



ROAD MARKING LEGEND

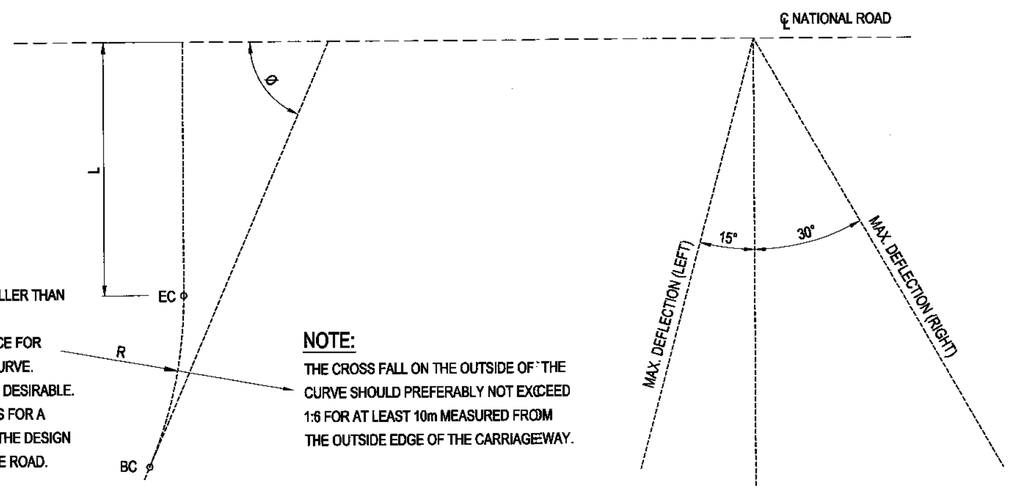
RM 1 = NO OVERTAKING LINE
RM 4.1 = LEFT EDGE LINE
WM 3 = DIVIDING LINE

NOTE :
APPLICABLE AT INTERSECTIONS WHERE THE RIGHT TURNING VOLUME IS < 30 VEHICLES / DAY.

DETAIL A
SCALE - 1 : 20

TABLE 1
SHOULDER SIGHT DISTANCE FOR STOP CONDITIONS

DESIGN SPEED (THROUGH ROAD) (km/h)	SIGHT DISTANCE (D) (m)
50	150
60	180
70	210
80	240
90	270
100	300
110	330
120	360



NOTE

1. Ø = DEFLECTION ANGLE SMALLER THAN SAFE ANGLE.
2. L = STOPPING SIGHT DISTANCE FOR DESIGN SPEED FOR LAST CURVE. MINIMUM LENGTH OF 155m IS DESIRABLE.
3. R = CORRESPONDING RADIUS FOR A SPEED 15km/h LOWER THAN THE DESIGN SPEED FOR THE REST OF THE ROAD.

NOTE:
THE CROSS FALL ON THE OUTSIDE OF THE CURVE SHOULD PREFERABLY NOT EXCEED 1:6 FOR AT LEAST 10m MEASURED FROM THE OUTSIDE EDGE OF THE CARRIAGEWAY.

SAFE ANGLES AND STOPPING SIGHT DISTANCE AT T-JUNCTIONS

SCALE - N.T.S

NOTE:

1. GRADIENT ON BOTH ROADS SHOULD NOT EXCEED 3%, ESPECIALLY ON THE JUNCTION LEG.
2. TABLE 1 CAN BE USED AS A BASIC GUIDELINE ON CONDITION THAT THE GRADIENTS ON BOTH THE JUNCTION AND PRIMARY ROADS DO NOT EXCEED 2%. THE SIGHT DISTANCE MUST BE MEASURED FROM AN EYE LEVEL OF 1,05m FROM A POINT 2m BEFORE THE STOP LINE ON THE JUNCTION ROAD TO AN OBJECT HEIGHT ON THE CENTRE LINE OF THE NATIONAL ROAD OF 1,30m.
3. THE DESIRABLE MINIMUM SIGHT DISTANCE IS 300m.
4. FOR DETAIL OF ROAD MARKINGS REFER TO THE SADC ROAD TRAFFIC SIGNS MANUAL.
5. THIS PLAN SERVES AS A GUIDE LINE AND WELL MOTIVATED DEVIATIONS MAY BE CONSIDERED.
6. WHERE APPLICABLE CROSS-SECTION DIMENSIONS MUST BE ADJUSTED ACCORDING TO THE APPROVED TYPICAL CROSS-SECTION BEING USED.

FOR LATEST VERSION CHECK www.nra.co.za

No.	DATE	VERSION / REVISION	APPROVED
V1	SEPT 2014	ORIGINAL VERSION	

THE SOUTH AFRICAN NATIONAL ROADS AGENCY SOC LTD
Reg. No. 1998/009584/30

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APPROVED
DATE: 2015/06/26

TYPICAL DRAWINGS - ROADWORKS

T - JUNCTIONS & INTERSECTIONS
T - JUNCTION WITH GRAVEL
CLASS 2 ROADS

SANRAL DOC. No. (PDF) 1693224
SANRAL DOC. No. (DWG) 1797268
SANRAL DRAWING No. TD-R-JI-1100-V1

APPENDIX C

ASSESSMENT METHODOLOGY

Impact Rating System

Impact assessment must take account of the nature, scale and duration of impacts on the environment whether such impacts are positive or negative. Each impact is also assessed according to the project phases:

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance should also be included. The rating system is applied to the potential impacts on the receiving environment and includes an objective evaluation of the mitigation of the impact. In assessing the significance of each impact, the following criteria is used:

The rating system

NATURE		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be experienced.		
1	Site	The impact will only affect the site.
2	Local/district	Will affect the local area or district.
3	Province/region	Will affect the entire province or region.
4	International and National	Will affect the entire country.
PROBABILITY		
This describes the chance of occurrence of an impact.		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
DURATION		
This describes the duration of the impacts. Duration indicates the lifetime of the impact as a result of the proposed activity.		

1	Short term	The impact will either disappear with mitigation or will be mitigated through natural processes in a span shorter than the construction phase (0 – 1 years), or the impact will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 30 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered indefinite.
INTENSITY/ MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/ component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired. Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

REVERSIBILITY		
This describes the degree to which an impact can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures.
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts. A cumulative impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects.
2	Low cumulative impact	The impact would result in insignificant cumulative effects.
3	Medium cumulative impact	The impact would result in minor cumulative effects.
4	High cumulative impact	The impact would result in significant cumulative effects

SIGNIFICANCE		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The calculation of the significance of an impact uses the following formula: (Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity. The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	Impact significance rating	Description
6 to 28	Negative low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative high impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive high impact	The anticipated impact will have significant positive effects.
74 to 96	Negative very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive very high impact	The anticipated impact will have highly significant positive effects.

Nature of the	(N/A) No	(+) Positive	(-) Negative		
Geographical	(S) Site;	(L)	(P)	(I) International	
Probability:	(U) Unlikely;	(Po) Possible;	(Pr) Probable;	(D) Definite	
Duration:	(S) Short	(M) Medium	(L) Long Term;	(P) Permanent	
Intensity /	(L) Low;	(M) Medium;	(H) High;	(VH) Very High	
Reversibility:	(CR)	(PR) Partly	(BR) Barely	-	
Irreplaceable loss	(IR)	(NL) No Loss;	(ML) Marginal	(SL) Significant	(CL)
Level of residual	(L) Low;	(M) Medium;	(H) High;	(VH) Very High	-