

Appendix G.9

TRAFFIC ASSESSMENT





iWink Consulting

Traffic & Transport Engineering
Road Safety

**PROPOSED ABO UVEMVANE
WIND ENERGY FACILITY 1**

MPUMALANGA & GAUTENG PROVINCE

**Traffic Impact Assessment
for EIA Stage**

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Issue 02

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TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1 INTRODUCTION	2
1.1 Project Description	2
1.2 Scope, Purpose, and Objectives of Specialist Report	5
1.3 Details of Specialist	5
1.4 Terms of Reference	5
2 APPROACH AND METHODOLOGY	9
2.1 Information Sources	9
2.2 Assumptions, Knowledge Gaps and Limitations	10
2.3 Consultation Processes Undertaken	10
3 LEGISLATIVE AND PERMIT REQUIREMENTS	11
4 DESCRIPTION OF PROPOSED PROJECT	12
4.1 General Description	12
4.2 Accessibility	13
4.3 Alternatives	29
5 DESCRIPTION OF TRANSPORT ROUTES TO SITE	31
5.1 Port of Entry	31
5.2 Transportation Requirements	33
5.3 Abnormal Load Considerations	34
5.4 Further Guideline Documentation	34
5.5 Permitting – General Rules	35
5.6 Load Limitations	35
5.7 Dimensional Limitations	35
5.8 Transporting Wind Turbine Components	36
5.9 Transporting Cranes, Mobile Cranes, and other Components	37
5.10 Transporting Other Plant, Material and Equipment	39
5.11 Route for Components manufactured within South Africa	39
5.12 Surrounding Road Network	42
6 ISSUES, RISKS AND IMPACTS	44
6.1 Identification of Potential Impacts/Risks	44
7 IMPACT ASSESSMENT	48
7.1 Potential Impact during the Construction and Decommissioning Phases	48
7.2 Potential Impact (Operation Phase)	48
7.3 Cumulative Impacts	48
7.4 No-Go Alternative	48
8 INPUT INTO ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPR)	50

9 CONCLUSION AND RECOMMENDATIONS.....	52
10 REFERENCES.....	53

TABLES

Table 1-1: Project information	3
Table 1-2: List of Specialist studies content	7
Table 4-1: Overview of Roads and jurisdiction	14
Table 7-1: Impact Rating – Summary Table	49
Table 8-1: Overall Impact Rating.....	50
Table 8-2: Summary of mitigation measures for Input into EMPr.....	50

FIGURES

Figure 1-1: Aerial View of the Uvemvane WEF 1 project site	2
Figure 4-1: Aerial View of Uvemvane WEF 1 project area	12
Figure 4-2: Aerial view of assessed access routes.....	15
Figure 4-3: Recommended Stopping Sight Distances as per SANRAL Geometric Design Guideline	16
Figure 4-4: Shoulder Sight Distances as per TRH17 Guidelines	17
Figure 4-5: Aerial overview of Access route 1.....	18
Figure 4-6: Aerial View of intersection P243/1 and farm road.....	19
Figure 4-7: View from P243/1 to Farm road toward the project site.....	19
Figure 4-8: Aerial overview of Access route 1a.....	20
Figure 4-9: View of Lagerspoort Road from R23.....	21
Figure 4-10: View of assessed access point towards site from R23	21
Figure 4-11: Aerial View of Access route 2	22
Figure 4-12: Aerial view of intersections of D1422/D605 and D1422/D1220	23
Figure 4-13: Aerial View of Access route 2a.....	24
Figure 4-14: Aerial view of bridge locations on Access route 2a	25
Figure 4-15: Aerial View of Access route 3	26
Figure 4-16: View of existing access road (D1220) on P243/1.....	26
Figure 4-17: Aerial View of Access route 3a.....	27
Figure 4-18: Aerial View of Access routes 4 (light green) and 5 (dark green)	28
Figure 5-1: Possible Ports of Entry	31
Figure 5-2: Route from Port of Richards Bay to proposed project site	32
Figure 5-3: Route from Port of Durban to proposed project site	33
Figure 5-4: Blade transport (Froese, 2019)	36
Figure 5-5: Examples of Crawler Cranes used to assemble turbines.....	38
Figure 5-6: Cranes at Port of Entry (Authors picture)	38
Figure 5-7: Route from Cape Town area to project site	40

Figure 5-8: Route from Durban/Pinetown area to the project site	41
Figure 5-9: Route from Gqeberha area to project site	42
Figure 5-10: Road Network in vicinity of project site.....	43
Figure 6-1: Aerial View of cumulative projects within a 30kms radius of the project site	47

ANNEXURES

Annexure A: Specialist Expertise

Annexure B: Specialist Statement of Independence

Annexure C: Impact Assessment Methodology

LIST OF ACRONYMS

Acronym	Definition
BESS	Battery Energy Storage System
CBD	Central Business District
COTO	Committee of Transport Officials
CPD	Continued Professional Development
DFFE	Department of Forestry, Fisheries and the Environment
EAP	Environmental Assessment Practitioner
ECSA	Engineering Council of South Africa
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
GNR	Government Notice Regulation
ha	Hectare(s)
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
km	Kilometer
km/h	Kilometers per Hour
kV	Kilovolt
LDV	Light Differential Vehicle
Li-ion	Lithium Ion
LILO	Loop in Loop out
LPS	Lightning Protection System
LV	Low Voltage
m	Meters
MTS	Main Transmission Substation
MW	Megawatts
MV	Medium Voltage
MWh	Megawatts Hour
NaS	Sodium Sulphur
NLTA	National Land Transport Act
NMT	Non-Motorised Transportation
O&M	Operations and Maintenance
OHL	Overhead Line
PV	Photovoltaic
RAMS	Road Asset Management System
RISFSA	Road Infrastructure Strategic Framework for South Africa
SANRAL	South African National Road Agency
SANS	South African National Standards
SARTSM	South African Road Traffic Signs Manual
SIP	Strategic Integrated Project
SS	Substation
TMH	Technical Methods for Highways
TRH	Technical Recommendations for Highways
WEF	Wind Energy Facility

EXECUTIVE SUMMARY

This report serves as the Traffic Impact Assessment (TIA) aimed at determining the traffic impact of the proposed up to 170 MWac ABO Uvemvane Wind Energy Facility 1 ('Uvemvane WEF 1') and its associated grid infrastructure.

The Uvemvane WEF 1 will include associated infrastructure, i.e., grid and battery energy storage system (BESS) and be located across land parcels between the towns of Balfour in the Mpumalanga Province and Heidelberg in the Gauteng Province. It is planned to accommodate up to 20 wind turbines including the associated support structures and facilities to allow for the generation and evacuation of electricity.

Feasible accessibility of the site was investigated in line with required sight lines, access spacing and gradients. Where sight line issues have been noted, it is recommended that the sight lines be improved to improve road safety (i.e., allowing for a setback distance that will remain clear of vegetation and obstructions).

It is expected that non-motorised transportation (NMT) is an important mode of transportation in the environment of the site, together with private cars and minibus/taxis. Typically, the appointed contractor of a renewable energy project will provide shuttle buses or similar for workers to be picked up at pre-arranged pick up points during the construction phase.

The highest trip generator for the site is expected to be the construction phase. The exact construction stage peak hour trips are dependent on the construction period, construction programming, material availability, component delivery, abnormal load permitting etc. The decommissioning phase is expected to generate similar, if not slightly less, trips as the construction phase.

For the construction and decommissioning phases, the impacts expected to be generated by the vehicle trips are an increase in traffic and related possible delays and safety issues and the associated noise and dust pollution, as well as potential damage to road surfaces caused by construction vehicles. Based on the high-level screening of impacts and including mitigation measures, the site is expected to have a low impact during the construction and decommissioning stage.

The traffic impact during the operational phase is considered low.

1 INTRODUCTION

1.1 Project Description

ABO Uvemvane Wind Energy Facility 1 (Pty) Ltd proposes the development of the ABO Uvemvane Wind Energy Facility 1 (WEF 1), a commercial wind energy generation facility comprising up to 20 turbines and with a total generation capacity of up to 170 MWac in capacity, as well as associated infrastructure.

The project site is located approximately 9km west of the town of Balfour in the Mpumalanga Province in the Lesedi and Midvaal Local Municipalities within the Gert Sibande District Municipality and approximately 14km south-east of the town Heidelberg in the Gauteng Province in the Lesedi and Midvaal Local Municipalities within the Sedibeng District Municipality (see **Figure 1-1**).

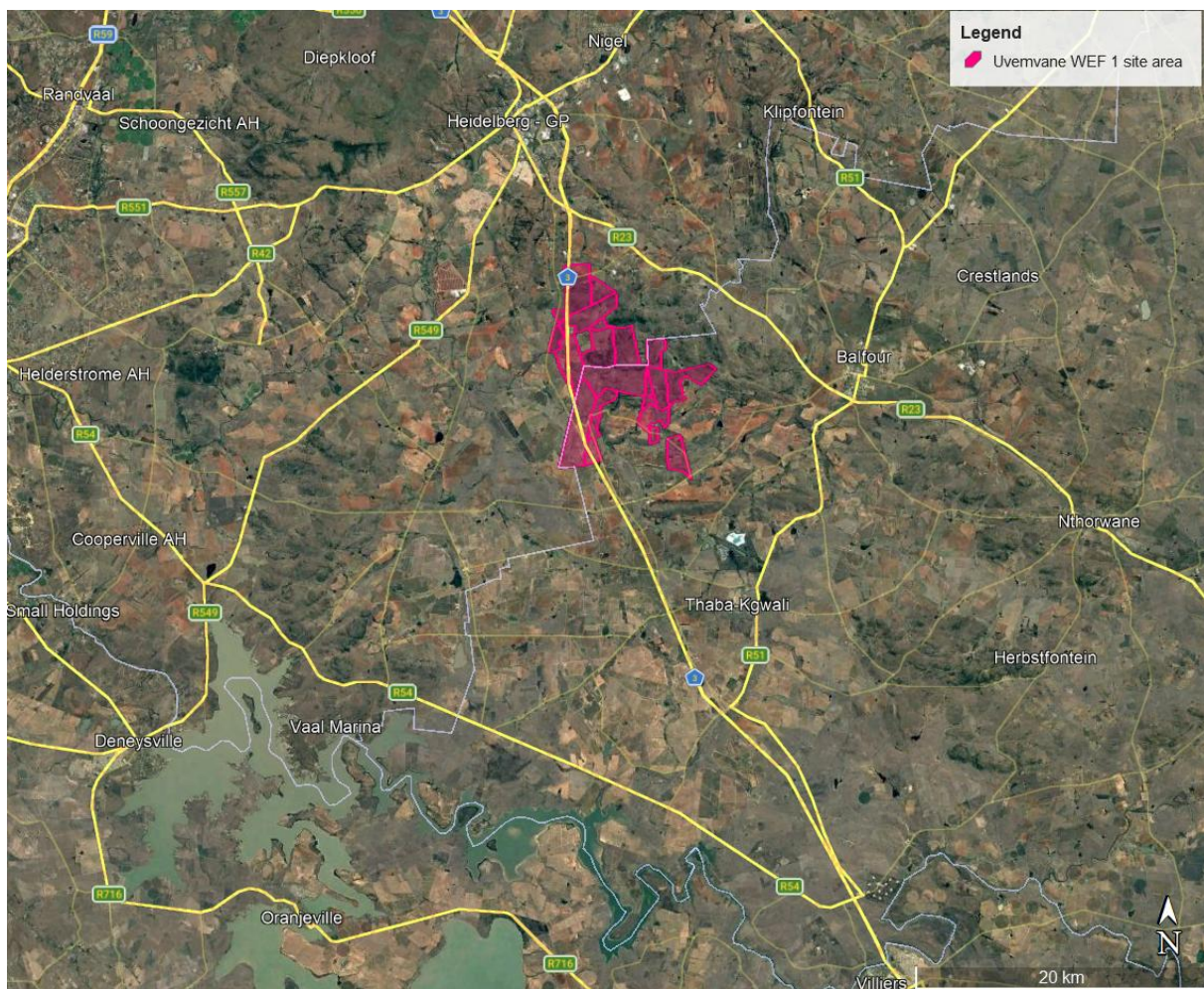


Figure 1-1: Aerial View of the Uvemvane WEF 1 project site

The project details for the Uvemvane WEF 1 and associated infrastructure are summarized in **Figure 1-1**.

Table 1-1: Project information

Facility Name:	ABO Uvemvane Wind Energy Facility 1 (Uvemvane WEF 1)
Applicant:	ABO Uvemvane Wind Energy Facility 1 (Pty) Ltd
Location:	Between Balfour and Heidelberg (Mpumalanga & Gauteng Province)
Affected Farms:	See above
Site Extent:	A preferred study area with a total combined extent of approximately 8,200 ha was identified as a technically suitable project site for the development of the WEF project, within this an affected area of approximately 6 000 ha has been assessed.
Development Footprint:	~67.2 ha
Total Capacity:	Up to 170 MW
Number of turbines:	Up to 20 turbines
Turbine hub height:	Up to 180 m
Rotor Diameter:	Up to 200 m
Turbine foundations:	Concrete turbine foundations with excavations extending below ground level, area ~1 ha.
Turbine hardstands:	Permanent hardstand areas: ~20 ha.
Construction camp / laydown:	Typically located within the temporary laydown area. Includes: Parking areas and construction offices. Sewage typically conservancy or septic tanks and portable toilets. No worker camps planned as workers will be sourced from nearby areas and transported to site.
Temporary laydown or staging area	Four (4) temporary laydown or staging areas with typical area approximately 150m x 20m per areas, totaling around 15 ha.
Operations and Maintenance (O&M) footprint:	Including operations buildings, workshop and stores building or designated area, refuse area for temporary storage of waste before collection and delivery to an appropriate facility and ablution facilities and supporting conservancy tank. O&M complex may include installation of a communications tower on site with a maximum height of 32m. Temporary concrete batching plant will be included in temporary laydown areas and is expected to comprise amongst others, a concrete storage area, batching plant, electrical infrastructure and substation, generators and fuel stores, gantries and loading facilities, offices, material stores (rebar, concrete, aggregate and associated materials), mess rooms, workshops, laydown and storage areas, sewage and toilet facilities, offices and boardrooms, labour mess and changerooms, mixers, water and settling tanks, pumps, silos and hoppers, a laboratory, parking areas, internal and access roads - Gravel and sand will be stored in separate heaps whilst the cement will be contained in a silo.

Other infrastructure:	<p>Fencing and lighting</p> <p>Lightning Protection System (LPS)</p> <p>Telecommunication infrastructure</p>
On-site Electrical Infrastructure Hub:	<p>On-site electrical infrastructure hub of up to 7 ha (note there are three locations options assessed. Only one will eventually be constructed) consisting of:</p> <ul style="list-style-type: none"> ▪ On-site substation and associated infrastructure, ▪ Additional step-up/ transformation/ collector/switchyard infrastructure, ▪ Auxiliary buildings (including, but not limited to, Operation and Maintenance (O&M) building/s, admin building/s, workshop/s, gatehouse/s, security building/s, control centre/s, office/s, visitor centre/s, warehouse/s, etc.), ▪ May include the installation of a communications tower and lighting mast on site with a maximum height of 32 m and 25m respectively, and/or ▪ The BESS.
Cables:	<p>Associated internal electrical reticulation/ cabling (i.e., low- and medium voltage powerlines), will be located underground as far as is feasible, and to run within the proposed road footprint/route as far as possible.</p> <p>33kV overhead/underground line to connect northern and southern parts of the facility:</p> <p>A 100 m assessment corridor should be assessed; the actual servitude width would only be 22m.</p> <p>The line is approximately 8km long and a conservative average span length of approximately 100 m can be assumed for assessment purposes, although actual spans may be longer (depending on final engineering design and terrain).</p> <p>Two route alternatives to assess.</p>
Grid connection:	The proposed grid connection will follow its own application.
Internal Roads:	<p>Primary/main access roads as well as internal road reticulation (note that existing roads/disturbed areas would be used as far as possible, and for the proposed roads, a corridor of up to 12 m wide may be temporarily impacted upon during construction and be rehabilitated to up to 10 m wide after construction), inclusive of stormwater infrastructure where relevant. Up to 31km (approx. 18km of which are existing roads to be widened).</p>
Accessibility:	Via N3, R23 and farm roads

Note that a separate application will be made for the grid connection options under consideration, however the impacts of the potential grid connection scenarios have been addressed in this process from a **cumulative perspective** (which also adopts a precautionary approach and considers all scenarios). There are several overhead lines (OHLs) in the vicinity. The grid connection for the

project could occur at these via a new loop-in-loop-out connection or via a direct connection to a nearby substation.

1.2 Scope, Purpose, and Objectives of Specialist Report

The Traffic Impact Assessment is aimed at determining the traffic impact of the proposed land development and whether such development can be accommodated by the external transportation system.

The report deals with the items listed below and focuses on the surrounding road network in the vicinity of the site:

- The proposed project,
- The existing road network,
- Trip generation for the proposed development during the construction, operation, and decommissioning phases of the facility,
- Traffic impact of the proposed project,
- Access requirements,
- Determine a preliminary main route for the transportation of components to the proposed site,
- Determine a preliminary transportation route for the transportation of materials, equipment, and people to site, and
- Road Safety Principles.

1.3 Details of Specialist

Iris Sigrid Wink of iWink Consulting (Pty) Ltd. is the Traffic & Transportation Engineering specialist appointed to provide a Traffic Impact Assessment for the proposed Uvemvane Wind Energy Project 1. Iris Wink is registered with the Engineering Council of South Africa (ECSA), with Registration Number 20110156. A curriculum vitae is included in Appendix A of this specialist assessment. In addition, a signed specialist statement of independence is included in Appendix B of this specialist assessment.

1.4 Terms of Reference

A specialist report prepared in terms of the Regulations (*published In Government Notice No. 320 Government Gazette 43110 20 March 2020, gazetted for implementation Site Sensitivity Verification requirements where a Specialist Assessment is required but no Specific Assessment Protocol has been prescribed*) must contain the following (see also **Table 1-2**):

- (a) details of-
 - (i) the specialist who prepared the report; and
 - (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;
- (b) a declaration that the specialist is independent in a form as may be specified by the competent authority;
- (c) an indication of the scope of, and the purpose for which, the report was prepared;
 - (cA) an indication of the quality and age of base data used for the specialist report
 - (cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;
- (d) the duration date and season of the site investigation and the relevance of the season to the outcome of the assessment;

- (e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;
- (f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;
- (g) an identification of any areas to be avoided, including buffers;
- (h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;
- (i) a description of any assumptions made and any uncertainties or gaps in knowledge;
- (j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;
- (k) any mitigation measures for inclusion in the EMPr;
- (l) any conditions for inclusion in the environmental authorisation;
- (m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;
- (n) a reasoned opinion-
 - (i) whether the proposed activity, activities or portions thereof should be authorised; and (considering impacts and expected cumulative impacts),
 - (iA) regarding the acceptability of the proposed activity or activities, and
 - (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;
- (o) a description of any consultation process that was undertaken during the course of preparing the specialist report;
- (p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and
- (q) any other information requested by the competent authority.

Table 1-2: List of Specialist studies content

GNR 326, Appendix 6 Ref.:	Item	Report section
(1) (a)	Details of	
(1) (a) (i)	The specialist who prepared the report; and	1.3
(1) (a) (ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae;	Annexure A
(1) (b)	A declaration that the specialist is independent in a form as may be specified by the competent authority;	Annexure C
(1) (c)	An indication of the scope of, and the purpose for which, the report was prepared;	1.2
(1) (cA)	An indication of the quality and age of base data used for the specialist report;	Throughout report
(1) (cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	6 & 7
(1) (d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	n/a
(1) (e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	2
(1) (f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Throughout report
(1) (g)	An identification of any areas to be avoided, including buffers;	n/a
(1) (h)	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	n/a
(1) (i)	A description of any assumptions made and any uncertainties or gaps in knowledge;	6 & 7
(1) (j)	A description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	6 & 7
(1) (k)	Any mitigation measures for inclusion in the EMPr;	Table 9-2
(1) (l)	Any conditions for inclusion in the environmental authorisation;	Table 9-2
(1) (m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Table 9-2
(1) (n)	A reasoned opinion:	
(1) (n) (i)	Whether the proposed activity, activities or portions thereof should be authorised;	10
(1) (n) (iA)	Regarding the acceptability of the proposed activity or activities; and	10

GNR 326, Appendix 6 Ref.:	Item	Report section
(1) (n) (ii)	If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	10
(1) (o)	A description of any consultation process that was undertaken during the course of preparing the specialist report;	n/a
(1) (p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	n/a
(1) (q)	Any other information requested by the competent authority.	n/a
(2)	Where the government notice <i>gazetted</i> by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	n/a

2 APPROACH AND METHODOLOGY

The report deals with the traffic impact on the surrounding road network in the vicinity of the site during the:

- Construction phase;
- Operational phase; and
- Decommissioning phase.

This Traffic study includes the following tasks:

Project Assessment

- Communication with the project team to gain sound understanding of the project.
- Overview of available project background information including, but not limited to, location maps, site development plans, anticipated vehicles to the site (vehicle type and volume), components to be transported and any resulting abnormal loads.
- Research of all available documentation and information relevant to the proposed facility.

Access and Internal Roads Assessment

- Assessment of the proposed access points including:
 - Feasible location of access points
 - Motorised and non-motorised access requirements
 - Stacking distance requirements
 - Sight distances and required access spacing

Haulage Route Assessment

- Determination of possible haulage routes to site regarding:
 - National routes
 - Local routes
 - Site access points
 - Road limitations due to abnormal loads

Traffic Estimation and Impact

- Construction, operational, and decommissioning phase vehicle trips
 - Generated vehicles trips
 - Abnormal load trips
 - Access requirements
- Investigation of the impact of the development traffic generated during construction, operation, and decommissioning.

Report (Documentation)

- Reporting on all findings and preparation of the report.

2.1 Information Sources

The following guidelines have been used to determine the extent of the traffic study:

- Manual for Traffic Impact Studies, Department of Transport, 1995;
- TRH26 South African Road Classification and Access Management Manual, COTO;

- TMH 16 South African Traffic Impact and Site Traffic Assessment Manual (Vol 1), COTO, August 2012;
- TMH 16 South African Traffic Impact and Site Traffic Assessment Manual (Vol 2), COTO, February 2014;
- SANRAL Geometric Design Standards;
- Department of Forestry, Fisheries and the Environment (DFFE) Online Database;
- Google Earth Pro 2024;
- Transnet Port terminals website ; and
- Mpumalanga Road Asset Management System (RAMS).

2.2 Assumptions, Knowledge Gaps and Limitations

The following assumptions and limitations apply:

- This study is based on the project information provided by the client as available at commencement of the assessment.
- According to the Eskom Specifications for Power Transformers (Eskom Power Series, Volume 5: Theory, Design, Maintenance and Life Management of Power Transformers), the following dimensional limitations need to be kept when transporting the transformer – total maximum height 5 000 mm, total maximum width 4 300 mm and total maximum length 10 500 mm. It is envisaged that for this project, the inverter, transformer, and switchgear will be transported to site in containers on a low bed truck and trailer. Besides the turbine blades and tower sections as well as nacelle, a mobile crane and transformers will be transported to site with abnormal load vehicles. The crane will be utilised for offloading equipment, such as the transformers.
- Maximum vertical height clearances along the haulage route are 5.2 m for abnormal loads.
- If any elements are manufactured within South Africa but not on-site, these will be transported from their respective manufacturing centres.
- All haulage trips will occur on either surfaced national and provincial roads or existing gravel roads.
- Material for the construction of internal access roads will be sourced locally as far as possible.
- The maximum number of turbines to be constructed for Uvemvane WEF 1 was estimated to be up to 20.
- The final access points are to be determined during the detailed design stage. Only recommended access points at conceptual level can be given at this stage.
- Projects in the vicinity of the site to be considered as part of the EIA cumulative impacts.
- A maximum construction period of 24-months was assumed for the purpose of this study.

2.3 Consultation Processes Undertaken

The Traffic Impact Assessment is based on available project information and consultation with the appointed environmentalist and the project developer.

3 LEGISLATIVE AND PERMIT REQUIREMENTS

Key legal requirements pertaining to the transport requirements for the proposed development are:

- Abnormal load permits, (Section 81 of the National Road Traffic Act 93 of 1996 and National Road Traffic Regulations, 2000),
- Port permit (Guidelines for Agreements, Licenses and Permits in terms of the National Ports Act No. 12 of 2005), and
- Authorisation from Road Authorities to modify the road reserve to accommodate turning movements of abnormal loads at intersections.

4 DESCRIPTION OF PROPOSED PROJECT

4.1 General Description

The project site for the proposed Uvemvane WEF 1 is located approximately 9km west of the town of Balfour in the Mpumalanga Province in the Dipaleseng Local Municipality within the Gert Sibande District Municipality and approximately 14km south-east of the town Heidelberg in the Gauteng Province in the Lesedi and Midvaal Local Municipalities within the Sedibeng District Municipality (see **Figure 4-1**).

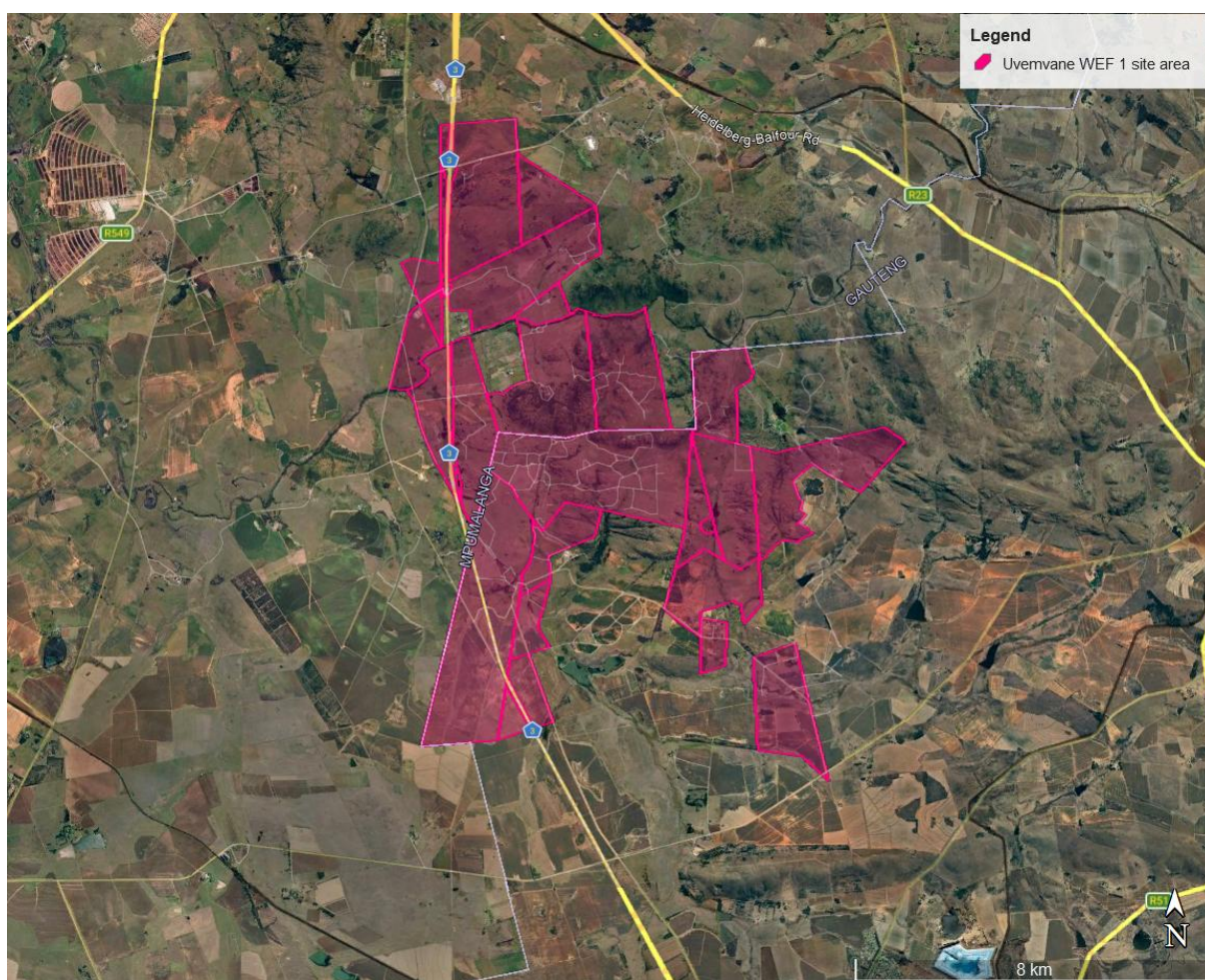


Figure 4-1: Aerial View of Uvemvane WEF 1 project area

4.2 Accessibility

4.2.1 General

The Uvemvane WEF 1 project sits can be accessed via a number of existing roads and have a network of internal farm roads and paths that are proposed to be used as far as possible. The accessibility from the external roads onto/towards the site has been assessed taking into account:

- Distance to site from external road;
- No direct access from high order roads (such as the N3);
- Geometry of the external road, from which access is taken;
- Sight lines on the external road when turning into such road;
- Limit impact on communities;
- Consider possible gradients for abnormal and large haulage vehicles (i.e. avoid mountainous terrain as far as possible);
- Utilising existing farm roads or gates; and
- Upgrading requirements
- Consider road safety principles.

Even though not all the assessed access roads may eventually be chosen, the feasible ones from a traffic engineering perspective have been included for the purpose of this study and shown in **Figure 4-2**:

1. Access route 1 (in light blue): from N3 onto D1290 east and then immediately left towards the site (north) – (~15km depending on site parcel to be accessed);
2. Access route 2 (in darker blue): from N3 onto D605 west, then onto D1422 and eventually D1220 towards the site (~19km distance from N3 to site);
3. Access route 3 (orange): from N3 just north of Villiers onto the R54 west, after approximately 28km right onto the D1490 north, then right onto R234/1 towards the site; alternatively, construction vehicles arriving via the R549 will turn into P243/1 towards the site (shown in light orange) – (~55 km from N3 to site);
4. Access route 4 (in light green): turning north of the site from the N3 onto the R23 west and after approximately 14km onto D1177 towards the site (~21 km from the N3 to site); and
5. Access route 5 (in dark green): from N3 onto R23 west and immediately left onto D1220 towards the site.

An overview of the jurisdiction in which the respective roads fall, is shown in **Table 4-1**.

Table 4-1: Overview of Roads and jurisdiction

Access Route	Roads Used	Classification	Road Authority
Route 1	N3	National Road	SANRAL
	D1290	District Road	Municipality
Route 2	N3	National Road	SANRAL
	D605	District Road	Municipality
	D1422	District Road	Municipality
	D1220	District Road	Municipality
Route 3	N3	National Road	SANRAL
	R54	Regional/Provincial Road	SANRAL
	D1490	District Road	Municipality
	R234/1	Regional/Provincial Road	Province
Alternative	R549	Regional/Provincial Road	SANRAL
	P243/1	Provincial Road	Province
Route 4	N3	National Road	SANRAL
	R23	Regional/Provincial Road	SANRAL
	D1177	District Road	Municipality
Route 5	N3	National Road	SANRAL
	R23	Regional/Provincial Road	SANRAL
	D1220	District Road	Municipality
Route 1a	N3	National Road	SANRAL
	R23	Regional/Provincial Road	SANRAL
Route 2a	N3	National Road	SANRAL
	R23	Regional/Provincial Road	SANRAL
	D1422	District Road	Municipality
Route 3a	N3	National Road	SANRAL
	D1290	District Road	Municipality

Access Route	Roads Used	Classification	Road Authority
	Farm road parallel to N3	Private/Farm Access	Private Owner
	R23	Regional/Provincial Road	SANRAL

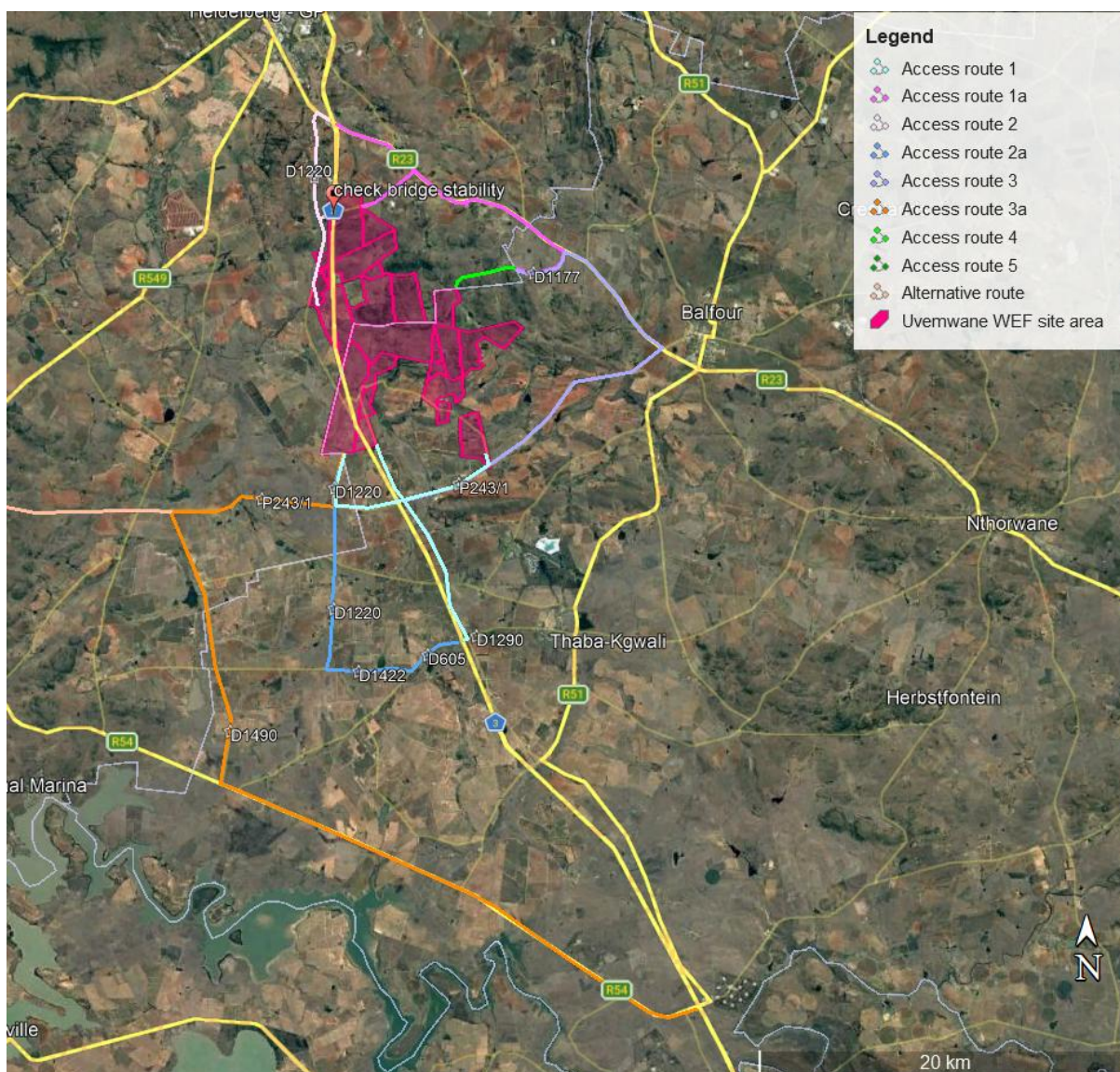


Figure 4-2: Aerial view of assessed access routes

4.2.2 Sight distances

As some of the roads will be under the jurisdiction of SANRAL (i.e., N3, R23), while other will be provincial and municipal roads (i.e., R243/1, R549), the *SANRAL Geometric Design Guidelines as well the TRH17 Guidelines for the Geometric Design of Rural Roads* were taken into consideration when establishing the required sight distances.

4.2.2.1 SANRAL Geometric Guideline

As per Section 3.5.1 of the SANRAL guideline, the Intersection Sight Distance allows a driver on a minor or access road to evaluate whether it is safe to enter the opposing traffic of the intersecting road. Table 3.6 in these guidelines shows a required sight distance of 200 m for a speed limit of 100km/h (see **Figure 4-3**).

Design Speed (km/h)	Stopping Sight Distance (m)		
	Calculated	Recommended for Design	Green Book 2000
30	32,5	35	35
40	48,6	50	50
50	67,2	70	65
60	88,4	90	85
70	112,3	110	105
80	138,7	140	130
90	167,8	170	160
100	199,4	200	185
110	233,6	230	220
120	270,5	270	250
130	309,9	310	285

Figure 4-3: Recommended Stopping Sight Distances as per SANRAL Geometric Design Guideline

However, in accordance with *Figure 2.5.5(a) of the TRH17 Guidelines for the Geometric Design of Rural Roads*, the Shoulder sight distance for a stop-controlled condition on a road with a speed limit of 100 km/h, needs to be a minimum of 420 m for the largest vehicle (from 5m set back at access in each direction of the road) (see **Figure 4-4**). For the purpose of this study, the 500m sight distance was used to determine if the sight lines at the access points are acceptable.

For a conservative approach, the 420m sight distance was used to determine whether the sight lines are sufficient along the assessed access routes.

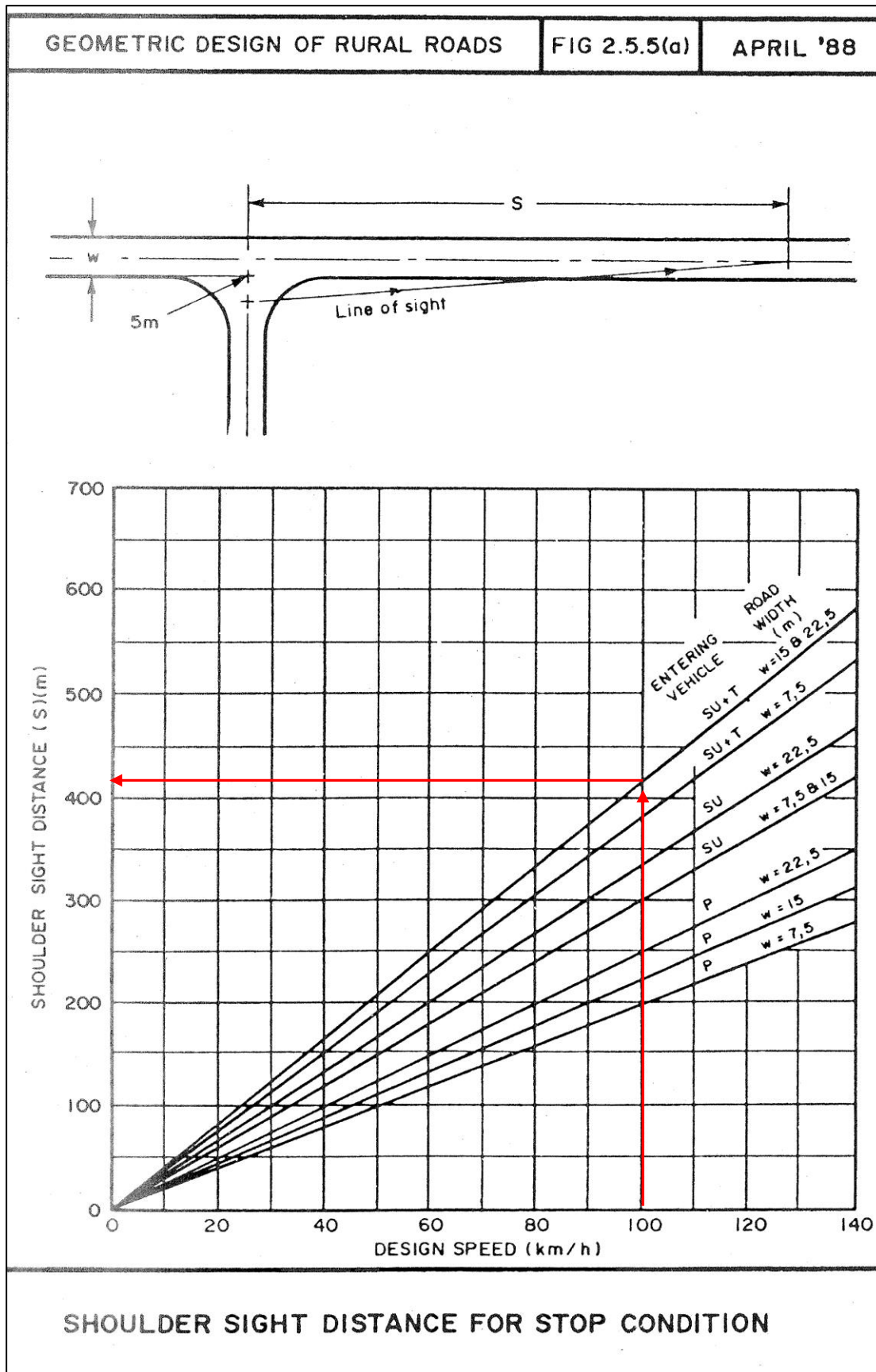


Figure 4-4: Shoulder Sight Distances as per TRH17 Guidelines

4.2.3 Access route 1

Access route 1 turns off of the N3 at its connection with the R243/1 (see **Figure 4-5**). This route follows an existing gravel road, which may be widened at some locations (see **Figure 4-6** and **Figure 4-7**). The required sight distances of 420 m are met in both directions for vehicle accessing the P243/1 (northern and southern direction) when turning from the Access into the P243/1.

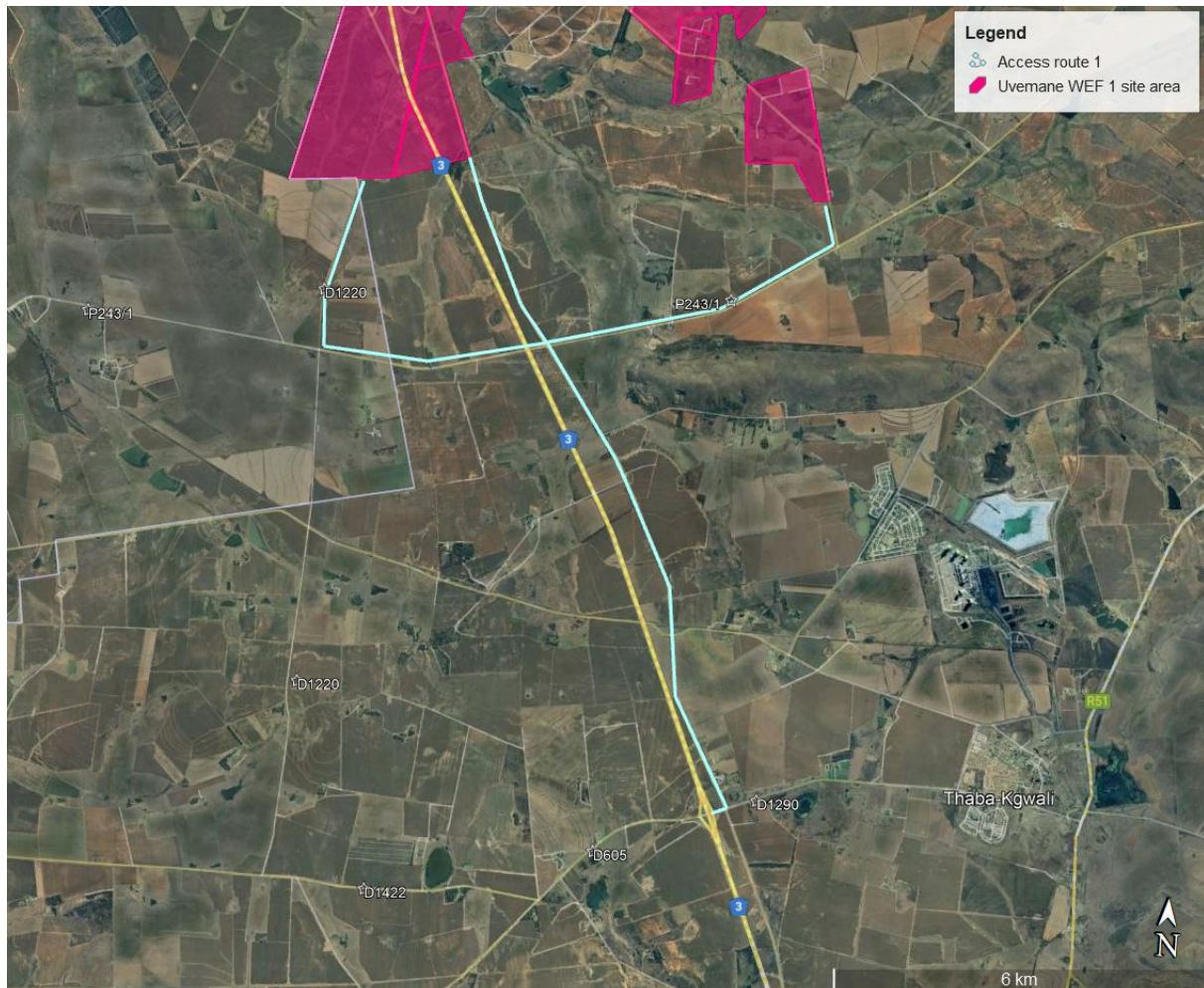


Figure 4-5: Aerial overview of Access route 1

This access route is supported from a traffic engineering perspective, provided that the turns along this route are wide enough for large haulage and construction vehicles to navigate. Any vegetation obstructing light lines for vehicles turning from one road into another will need to be cut back. This route will provide access to development parcels on both sides of the N3.



Figure 4-6: Aerial View of intersection P243/1 and farm road



Figure 4-7: View from P243/1 to Farm road toward the project site

4.2.4 Access route 1a

Following Access route 1a, construction vehicles would turn from N3 onto the R23 east. Four access points towards the site were assessed from a traffic engineering perspective, which will need to further be looked at if suitable from a landownership and detail design point of view (see **Figure 4-8** to **Figure 4-10**).

The required sight distances of 420 m are met in both directions for vehicle accessing the R23 when turning from one of the farm roads into the R23 again.

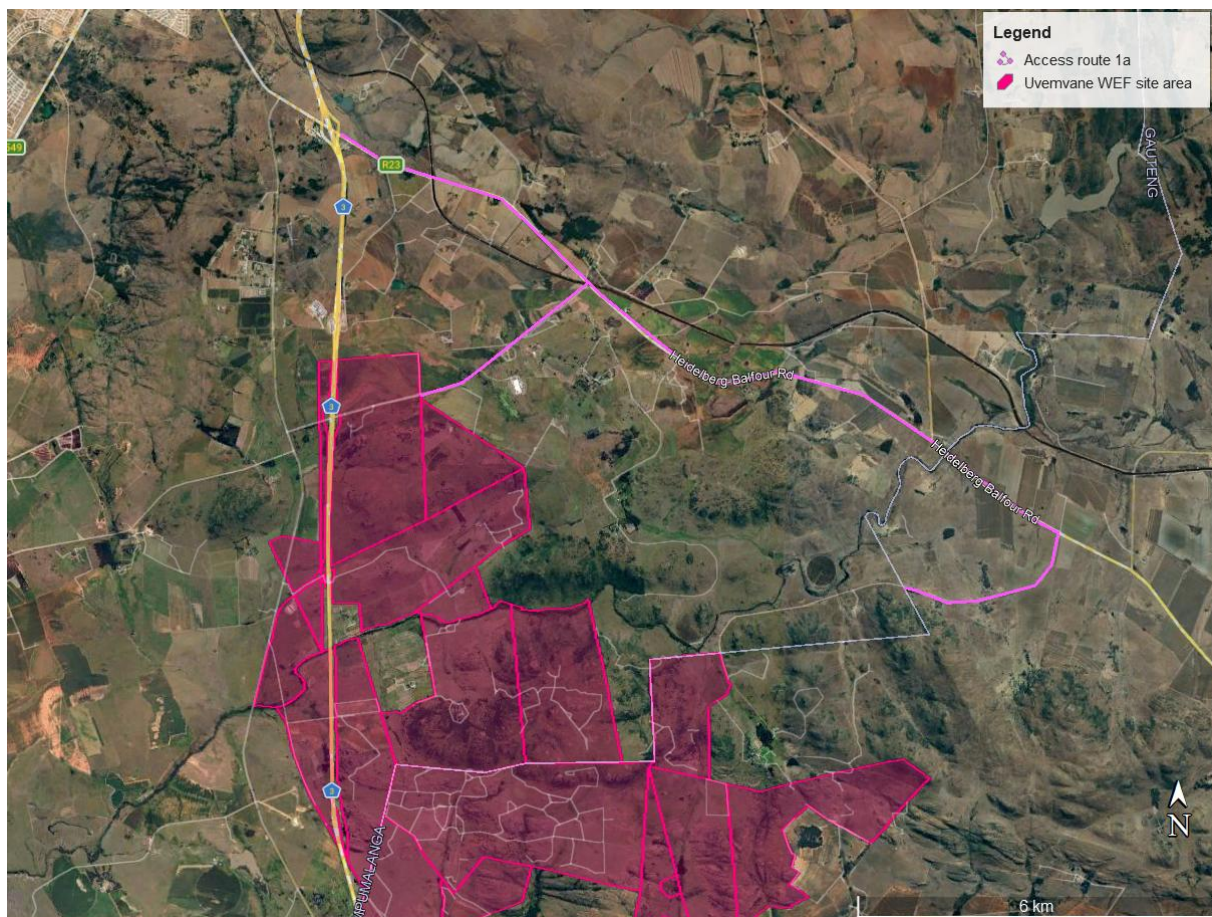


Figure 4-8: Aerial overview of Access route 1a



Figure 4-9: View of Lagerspoort Road from R23



Figure 4-10: View of assessed access point towards site from R23

The access route is supported from a traffic engineering perspective, provided that the eventually four assessed turn-offs from the external road towards the site are upgraded (where necessary) to be wide enough for large haulage and construction vehicles to navigate. Any vegetation obstructing light lines for vehicles turning from one road into another will need to be cut back.

4.2.5 Access route 2

An alternative access route to reach the portion of the project site being located on the western side of the N3 is Access route 2 (see **Figure 4-11**). This route exits the N3 at its connection with the D1422 and approaches the western parcel of the project site via the D1220.

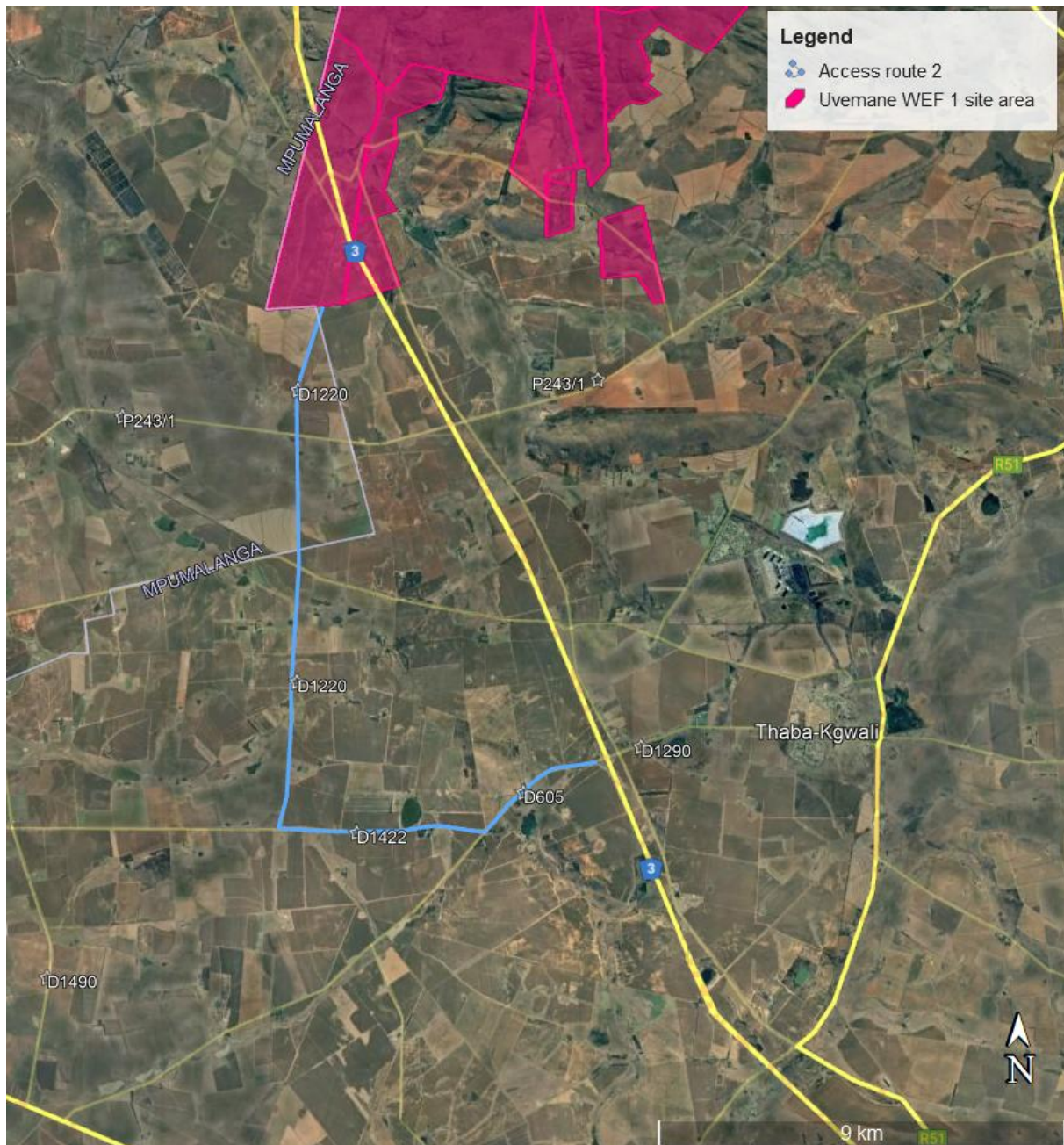


Figure 4-11: Aerial View of Access route 2

This route is gravel surfaced and may require some upgrading (i.e. widening, grading), specifically at the two turning points shown with red circles in **Figure 4-12**. Sight distances are met as both turns, and this route would provide an alternative to access route 1 for the western portion of the project site. Provided that the route has been upgraded to accommodate all construction vehicles safely, it is supported from a traffic engineering perspective.



Figure 4-12: Aerial view of intersections of D1422/D605 and D1422/D1220

4.2.6 Access route 2a

Access route 2a would cater for the north-western portion of the project. Construction vehicles would turn from the N3 onto the R23 and then onto D1422 (Lagerspoort Road) in a southern direction towards the site (~11km distance from N3 to site) (see **Figure 4-13**).

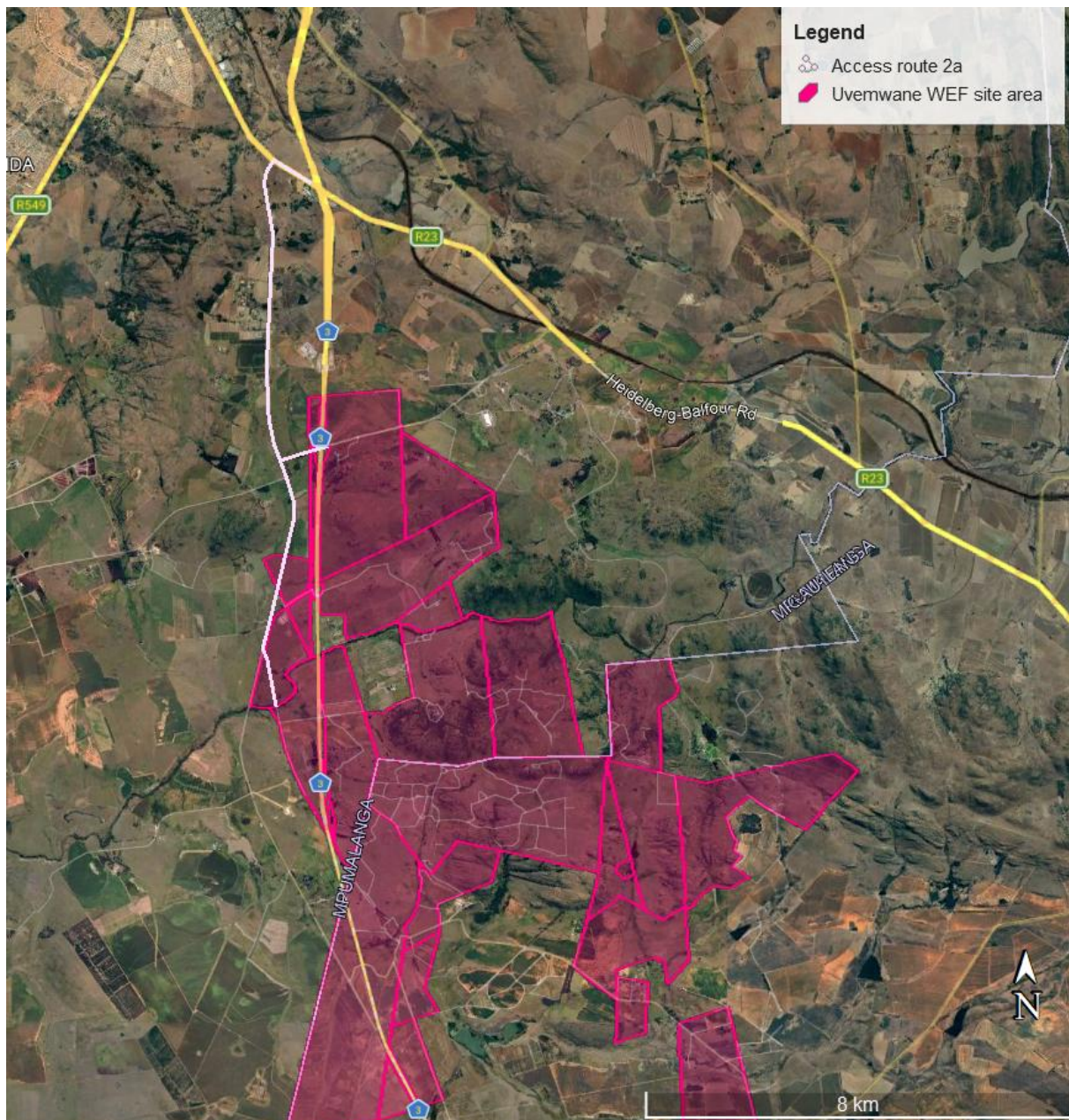


Figure 4-13: Aerial View of Access route 2a

This route is suitable from a traffic engineering perspective; however, it needs to be investigated if the two bridges along the route are stable enough to carry heavy construction vehicles (see **Figure 4-14**). Sight distances are met at turns along this route.

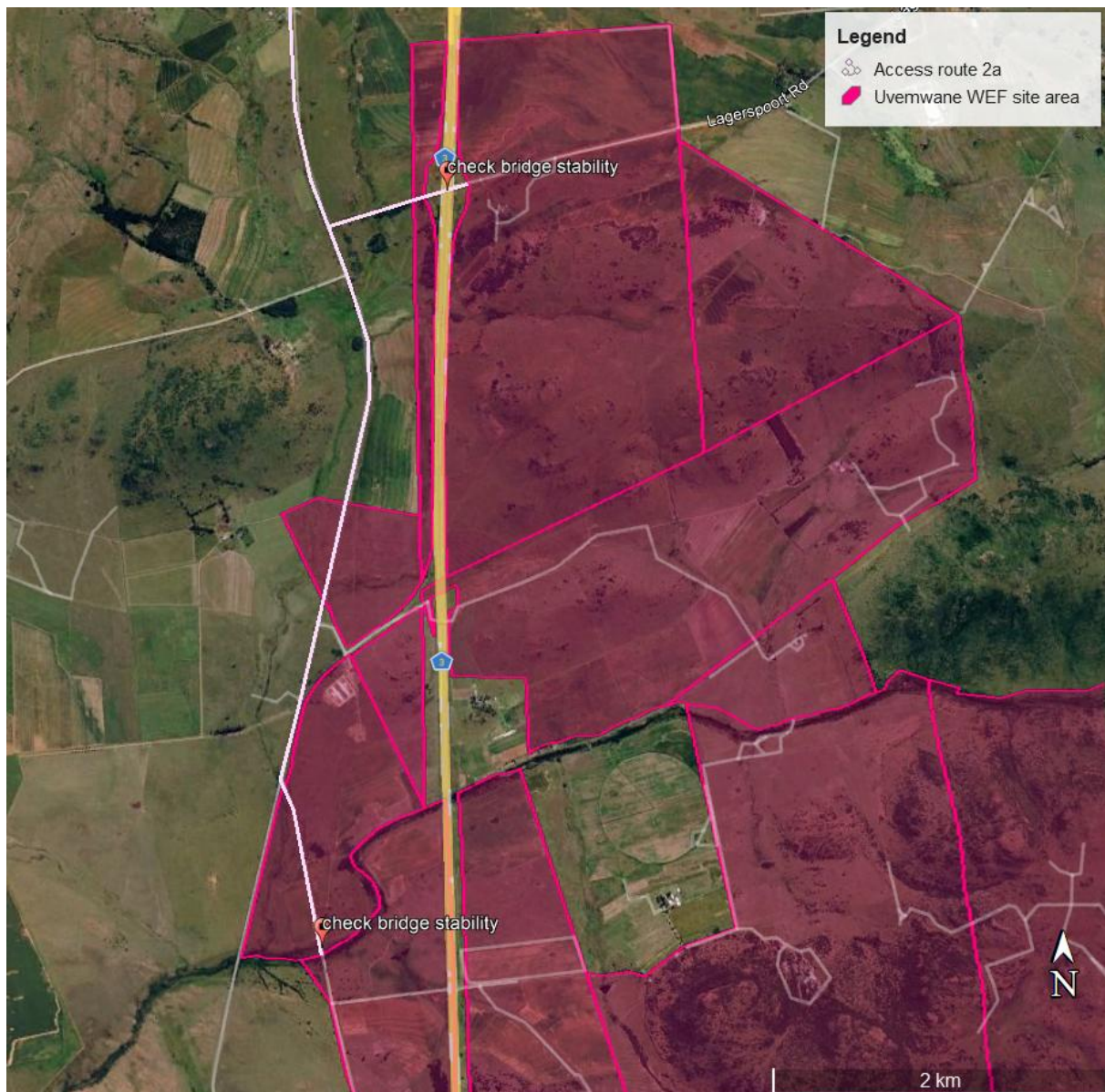


Figure 4-14: Aerial view of bridge locations on Access route 2a

4.2.7 Access point 3

This access route has been included into the study, should there be any limitations traveling on the N3 to site from a southern direction. This route follows the R54 south of the project site for approximately 28 km before turning right into the D1490, after around 15 km right again into the P243/1 and eventually left into the D1220 towards the site (see **Figure 4-15** and **Figure 4-16**).

Sight distances at the intersections, shown in the Figure with circles, are acceptable. Any sight limiting vegetation will need to be cut back.

Provided that this route has been upgraded, where required, to accommodate all construction vehicles safely, it is supported from a traffic engineering perspective.

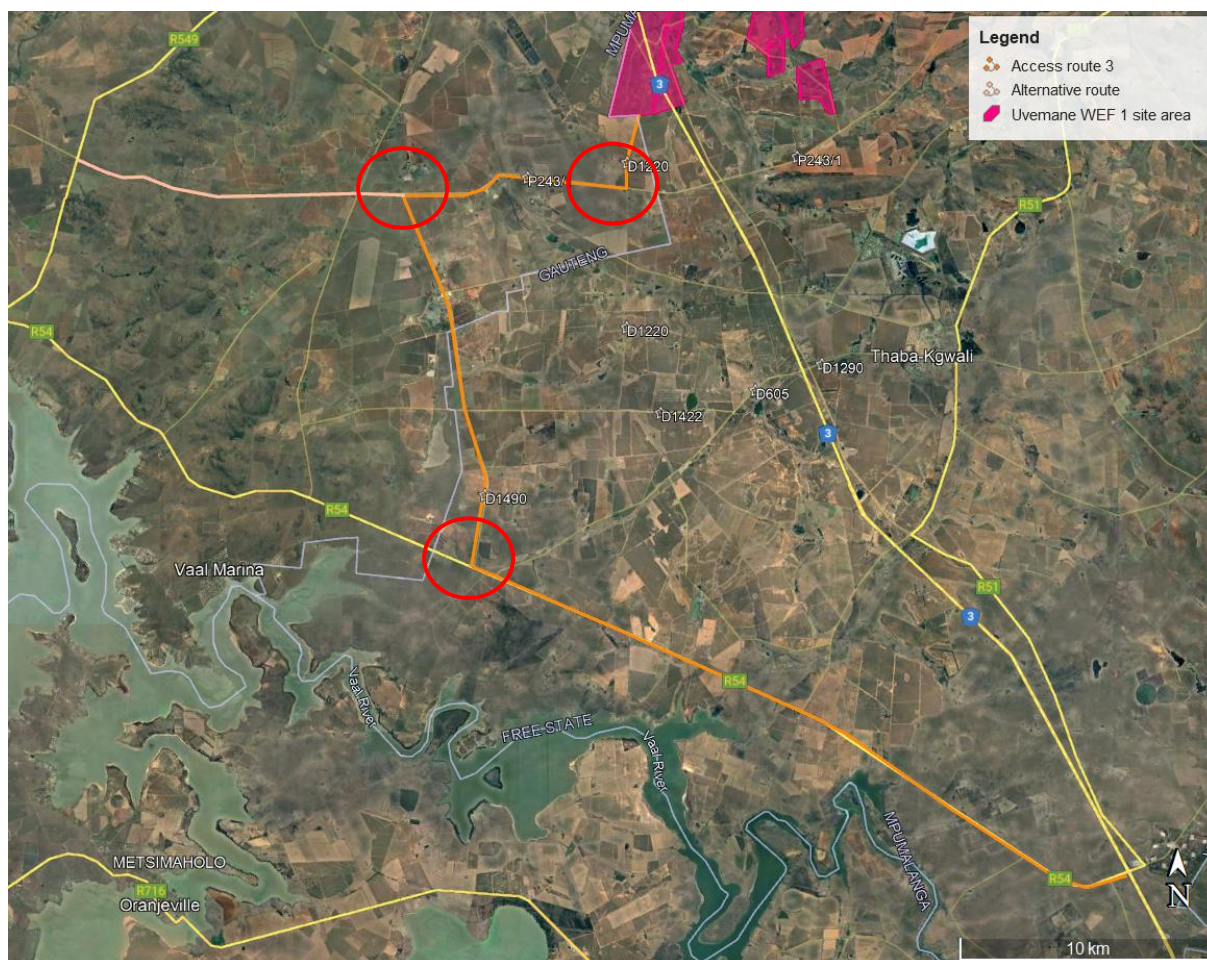


Figure 4-15: Aerial View of Access route 3



Figure 4-16: View of existing access road (D1220) on P243/1

4.2.8 Access route 3a

Access route 3a would lead construction vehicles from the N3 just north of Villiers onto the D1290 and at the first intersection left in a northern direction onto the farm road running parallel to the N3, before turning left into the R23 towards the site (~35 km from N3 to site) (see **Figure 4-17**).

Sight distances at the turns along the route are acceptable, however, any sight limiting vegetation will need to be cut back. Provided that this route has been upgraded, where required, to accommodate all construction vehicles safely, it is supported from a traffic engineering perspective.

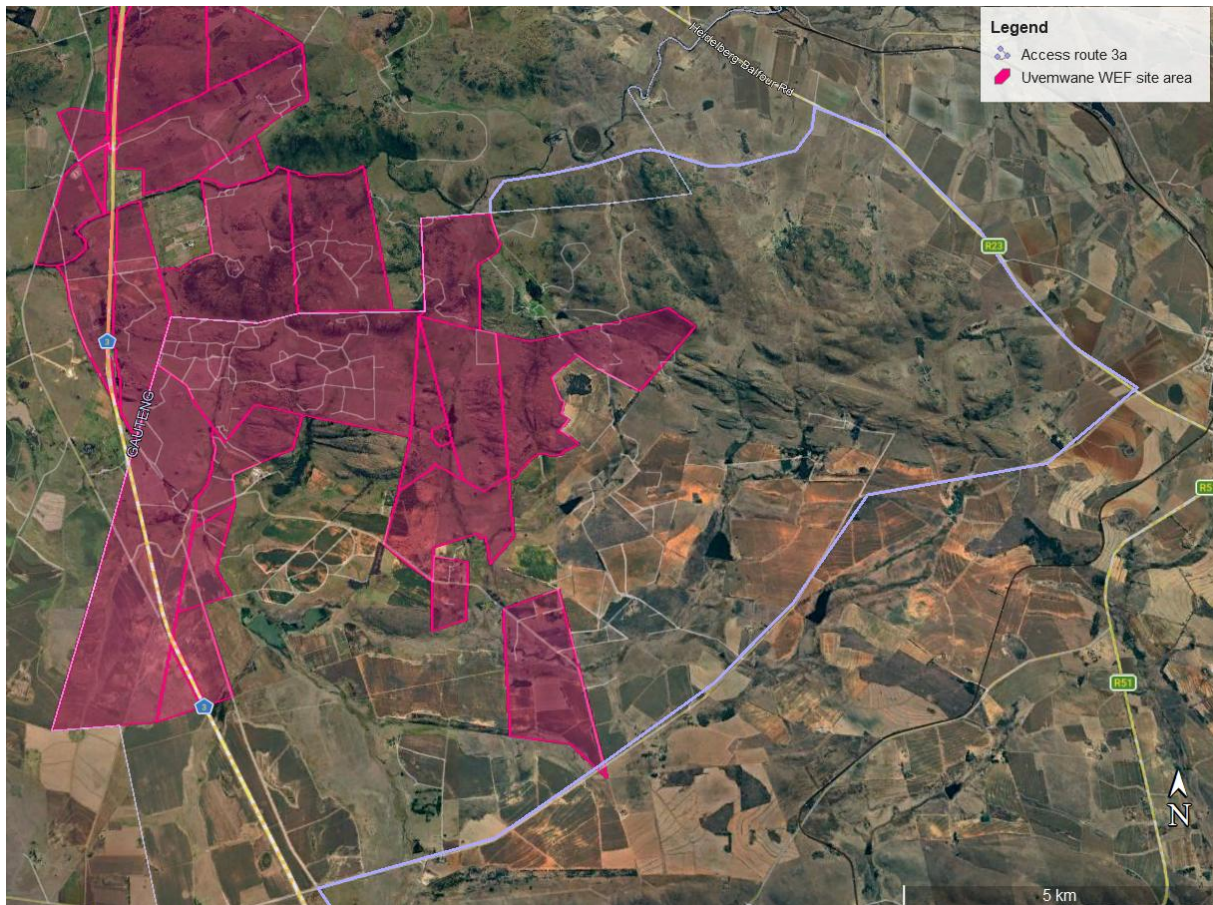


Figure 4-17: Aerial View of Access route 3a

4.2.9 Access route 4 and 5

Access route 4 and 5 would cater for construction vehicles arriving at the project site from a northern direction on the N3 (see **Figure 4-18**) with:

- Access route 4 providing access to the northern part of the project via the R23 and then D1177; and
- Access route 5 providing access to the small parcel located on the western side of the N3 via the R23 and D1220.

The required sight distances are met at the intersection along the routes. Both access routes are suitable from a traffic engineering perspective, provided that the necessary upgrades along the routes will be implemented to ensure that construction vehicles can safely navigate the roads.

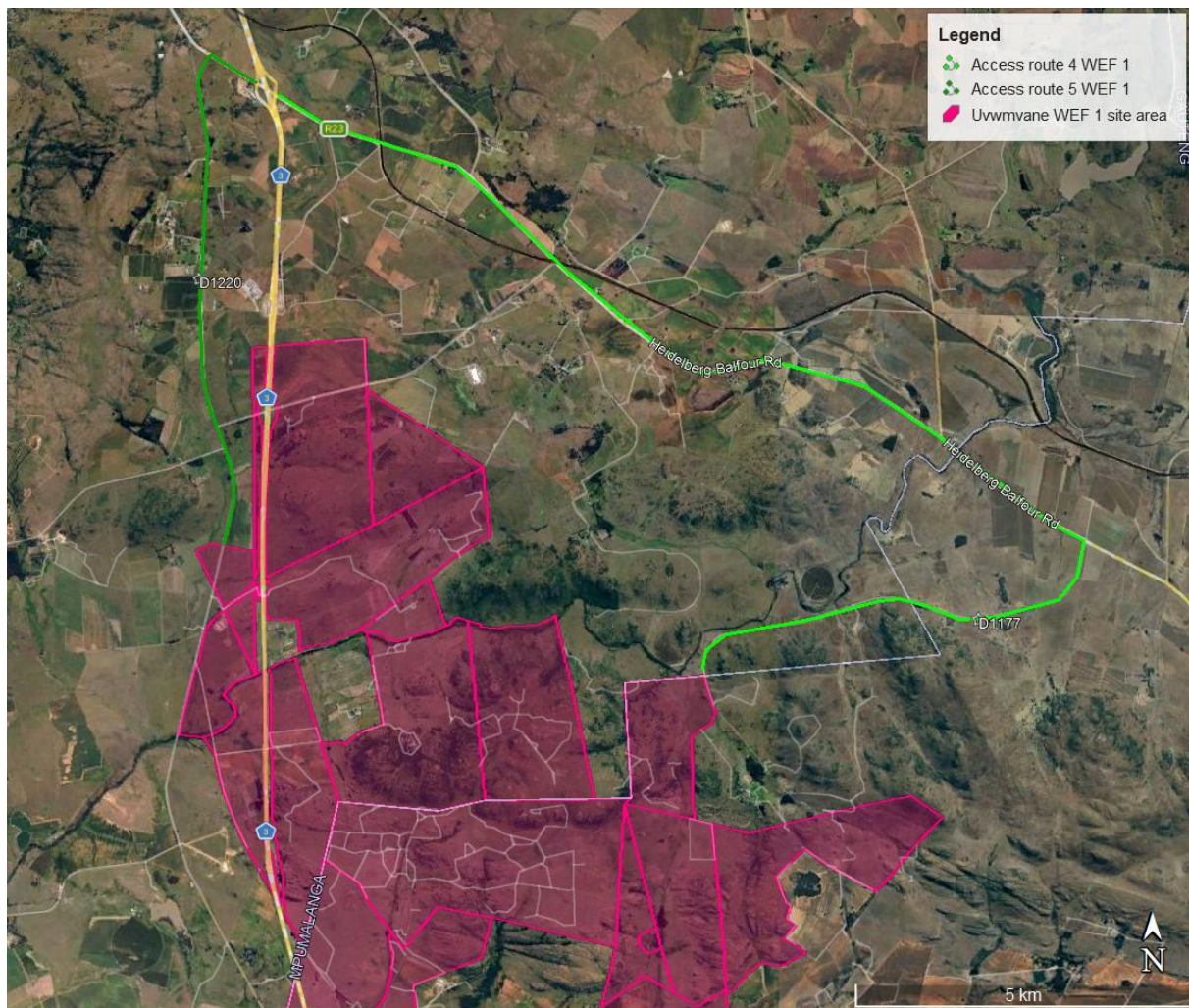


Figure 4-18: Aerial View of Access routes 4 (light green) and 5 (dark green)

4.2.10 General

The following general comments are made in regard to accessibility:

- All access routes assessed are suitable in principle. However, some will require more upgrading than others. The preferred number of accesses by the client is currently unknown. However, taking into account the dimension of the proposed project, it is recommended to provide several accesses during the construction period to avoid congestion.
- The exact upgrades necessary will be established at detail design stage.
- It needs to be ensured that no road signage or other road furniture obstruct turning movements and that the lifting of any existing overhead lines for the accommodation of large and abnormal vehicles need to be communicated to the respective service provider and reinstated after delivery.
- The direct site access points onto the site should be security controlled with security staff to be stationed on site and at the site access(es) during the construction phase.
- Temporary road markings and signage need to be erected on the external roads of the eventually chosen access routes to alert drivers of heavy construction vehicles turning in and out of side roads. The signage needs to be in accordance with the *South African Road Traffic Signs Manual (SARTSM)*.

4.2.11 Internal Roads

The geometric design and layout for the internal roads from the site access need to be established at detailed design stage. Existing structures and services, such as drainage structures, signage, street lighting and pipelines will need to be evaluated if impacting on the roads. It needs to be ensured that gravel sections remain in good condition and will need to be maintained during the additional loading of the construction phase and then reinstated after construction is completed.

Preferably, the internal roads need to be designed with smooth, relatively flat gradients (recommended to be no more than 8%) to allow a larger transport load vehicle to ascend to the respective laydown areas.

4.2.12 Transportation of Materials, Plant and People to the proposed site

It is assumed that the materials, plant, and workers will be sourced from the surrounding towns as far as possible.

4.2.13 Public Transport and Non-Motorised Transport

In terms of the National Land Transport Act (NLTA) (Act No.5 of 2009), the assessment of available public transport services is included in this report. The following comments are relevant in respect to the public transport availability for the proposed development.

It is expected that Non-Motorised Transportation (NMT) is an important mode of transportation, together with private cars and minibus/taxis. Currently, there are no known future planned public transport facilities in the vicinity of the site. However, it is expected that the appointed contractor of a large-scale project, such as many renewable energy projects, will provide shuttle buses or similar to pick up and drop off workers at predetermined locations during the construction phase.

4.3 Alternatives

Layout

Several potential locations for the electrical infrastructure hub have been assessed. A 33 kV overhead/underground line is also proposed to connect the northern and southern parts of the facility.

For this connection, a 100 m assessment corridor has been considered, although the actual servitude width is expected to be approximately 22 m. The line is approximately 8 km in length. For assessment purposes, a conservative average span length of approximately 100 m has been assumed; however, actual span lengths may be longer depending on the final engineering design and terrain. Two route alternatives have been assessed.

BESS Technology

With regard to the proposed BESS, the technology thereof is dynamic and so the specific type/technology to be developed would be selected based on market demands and technology availability at the time of construction. Therefore, both Lithium-ion and redox-flow are assessed as technology alternatives, with Lithium-ion being the current preferred technology.

No-go alternative

This alternative considers the option of 'do nothing' and maintaining the status quo. Should the proposed activity not proceed, the site will remain unchanged and will continue to be used for agricultural purposes. The potential opportunity costs in terms of alternative land use income through rental for energy facility and the supporting social and economic development in the area would be lost if the status quo persists.

It needs to be highlighted, that the actual WEF design would have a nominal impact on the findings of the TIA report, unless significantly altered. Current electrical infrastructure hub and BESS technology alternatives are considered the same from a transport perspective, with neither having more significant or different implications than the other.

5 DESCRIPTION OF TRANSPORT ROUTES TO SITE

5.1 Port of Entry

As the proposed Uvumvane WEF 1 would be located in fairly similar distances to the Port of Durban and the Port of Richards Bay (see **Figure 5-1**), both have been taken into consideration. Should both ports not be available, then the Port of Ngqura can handle the project components as well.



Figure 5-1: Possible Ports of Entry

5.1.1 Port of Richards Bay

The Port of Richards Bay is situated on the coast of KwaZulu-Natal and is a deep-sea water port boasting 13 berths. The terminal handles dry bulk ores, minerals and break-bulk consignments with a draft that easily accommodates Cape size and Panamax vessels. The Port is operated by Transnet National Ports Authority.

One possible route to the site is via the N2 and N3 with a travel distance of approximately 600 km (see **Figure 5-2**).

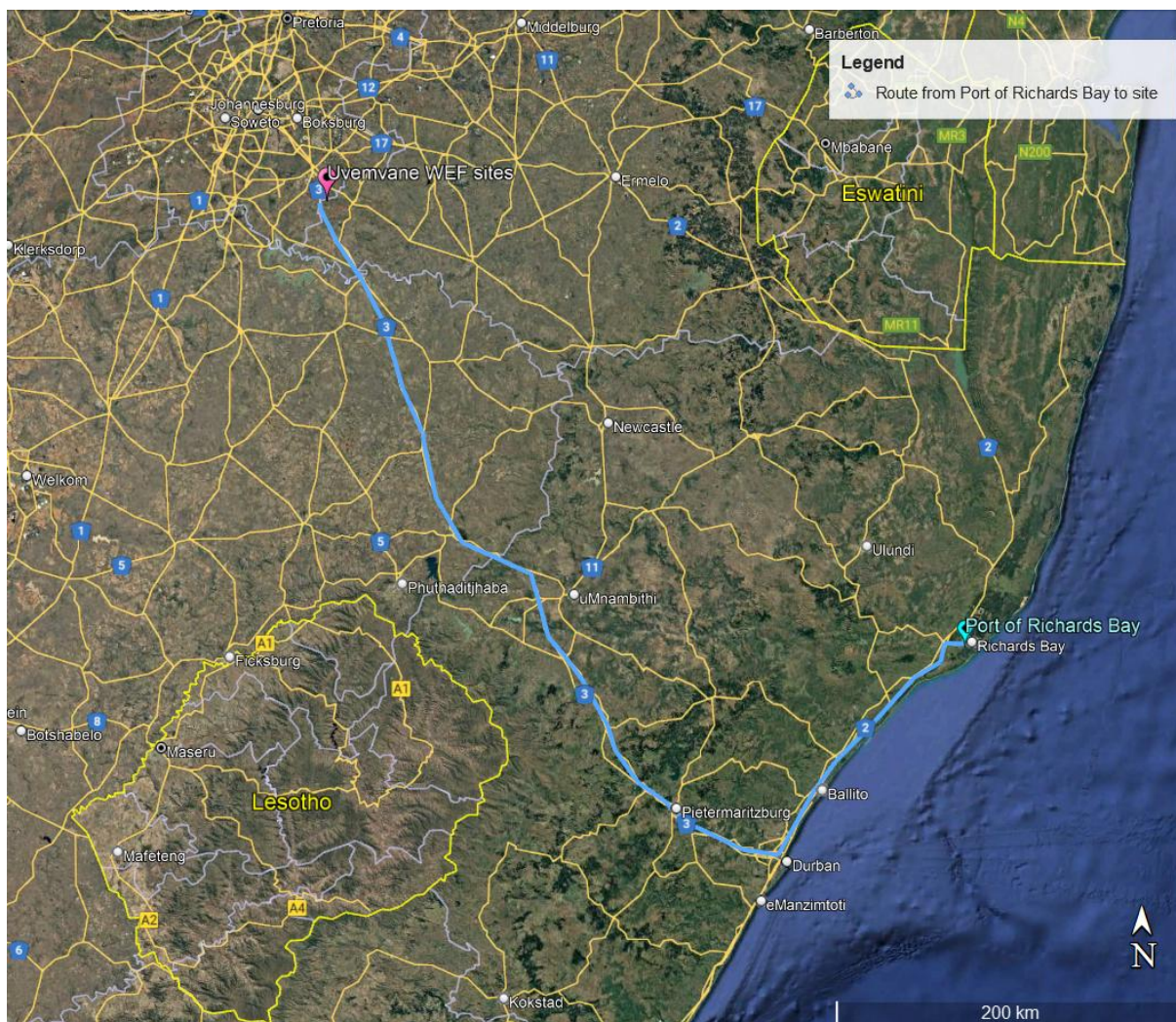


Figure 5-2: Route from Port of Richards Bay to proposed project site

5.1.2 The Port of Durban

The Durban container terminal is one of the largest container terminals in the African continent and operates as two terminals - Pier 1 and Pier 2. It is ideally located to serve as a hub for containerized cargo from the Indian Ocean Islands, Middle East, Far East and Australia. Various capacity creation projects are currently underway, including deepening of berths and operational optimization. The terminal currently handles 65% of South Africa's container volumes. (Transnet Port Terminals, n.d).

The project site is located approximately 450 km from the Port of Durban if travelling via the N3 (Figure 5-3).

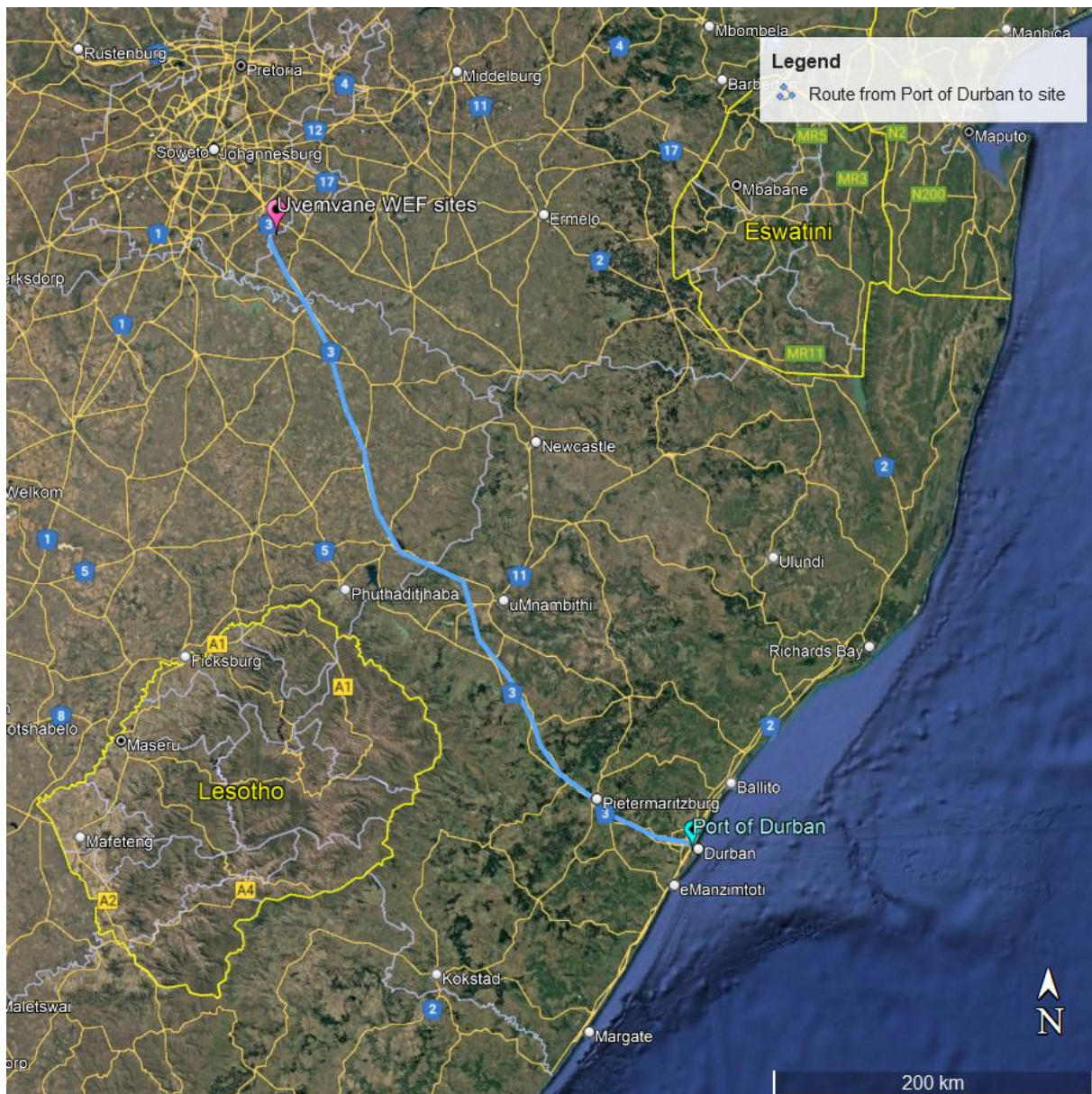


Figure 5-3: Route from Port of Durban to proposed project site

5.2 Transportation Requirements

It is anticipated that the following vehicles will access the site during construction:

- Conventional trucks within the freight limitations to transport building material to the site,
- Light vehicles and buses transporting workers from surrounding areas to site,
- Drilling machines and other required construction machinery being transported by conventional trucks or via self-drive to site,
- Nacelle transported by abnormal load,
- Turbine blades transported by abnormal load,
- Steel/hybrid tower sections to be transported to site / concrete tower sections manufactured on site – tbc,
- Turbine hub and rotary units by abnormal load,
- Abnormal mobile crane for assembly on site,

- The transformers transported in an abnormal loads vehicles, and
- Grid connection components are mostly transported in haulage vehicles within freight limitations.

5.3 Abnormal Load Considerations

Abnormal permits are required for vehicles exceeding the following permissible maximum dimensions on road freight transport in terms of the Road Traffic Act (Act No. 93 of 1996) and the National Road Traffic Regulations, 2000:

- Length: 22 m for an interlink, 18.5 m for truck and trailer and 13.5 m for a single unit truck.
- Width: 2.6 m Height: 4.3 m measured from the ground. Possible height of load – 2.7 m.
- Weight: Gross vehicle mass of 56 t resulting in a payload of approximately 30 t.
- Axle unit limitations: 18 t for dual and 24 t for triple-axle units.
- Axle load limitation: 7.7 t on the front axle and 9t on the single or rear axles.

Any dimension / mass outside the above will be classified as an Abnormal Load and will necessitate an application to the Department of Transport and Public Works for a permit that will give authorisation for the conveyance of said load. A permit is required for each Province that the haulage route traverses.

In addition to the above, the preferred routes for abnormal load travel should be surveyed prior to construction to identify any problem areas, e.g., intersections with limited turning radii and sections of the road with sharp horizontal curves or steep gradients, which may require modification. It needs to be ensured that gravel sections (if any) of the haulage routes remain in good condition and will need to be maintained during the additional loading of the construction phase and reinstated after construction is completed.

There are bridges and culverts along the National and Provincial routes, which need to be confirmed for load bearing capacity and height clearances. However, there are alternative routes which can be investigated if the selected route or sections of the route should not be feasible.

Any low hanging overhead lines (lower than 5.1 m), e.g., Eskom and Telkom lines, along the proposed routes will have to be moved to accommodate the abnormal load vehicles.

The expected abnormal load trip generators are for the transport of the transformer, nacelles, turbine blades, tower sections, and turbine hub and rotary units, as well as the abnormal mobile crane needed for assembly on site.

5.4 Further Guideline Documentation

The Technical Recommendations for Highways (TRH) 11: “Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads” outlines the rules and conditions that apply to the transport of abnormal loads and vehicles on public roads and the detailed procedures to be followed in applying for exemption permits are described and discussed. Legal axle load limits and the restrictions imposed on abnormally heavy loads are discussed in relation to the damaging effect on road pavements, bridges, and culverts.

The general conditions, limitations and escort requirements for abnormally dimensioned loads and vehicles are also discussed, and reference is made to speed restrictions, power / mass ratio, mass distribution and general operating conditions for abnormal loads and vehicles. Provision is also made

for the granting of permits for all other exemptions from the requirements of the Road Traffic Act and the relevant regulations.

5.5 Permitting – General Rules

In general, the limits recommended in TRH 11 are intended to serve as a guide to the Permit Issuing Authorities. It must be noted that each Administration has the right to refuse a permit application or to modify the conditions under which a permit is granted. It is understood that:

- a) A permit is issued at the sole discretion of the Issuing Authority. The permit may be refused because of the condition of the road, the culverts and bridges, the nature of other traffic on the road, abnormally heavy traffic during certain periods or for any other reason.
- b) A permit can be withdrawn if the vehicle upon inspection is found in any way not fit to be operated.
- c) During certain periods, such as school holidays or long weekends an embargo may be placed on the issuing of permits. Embargo lists are compiled annually and are obtainable from the Issuing Authorities.

5.6 Load Limitations

The maximum load that a road vehicle or combination of vehicles will be allowed to carry legally under permit on a public road is limited by:

- the capacity of the vehicles as rated by the manufacturer,
- the load which may be carried by the tyres,
- the damaging effect on pavements,
- the structural capacity of bridges and culverts,
- the power of the prime mover(s),
- the load imposed by the driving axles, and
- the load imposed by the steering axles.

5.7 Dimensional Limitations

A load of abnormal dimensions may cause an obstruction and danger to other traffic. For this reason, all loads must, as far as possible, conform to the legal dimensions. Permits will only be considered for indivisible loads, i.e., loads that cannot, without disproportionate effort, expense, or risk of damage, be divided into two or more loads for the purpose of transport on public roads. For each of the characteristics below there is a legally permissible limit and what is allowed under permit:

- Width,
- Height,
- Length,
- Front Overhang,
- Rear Overhang,
- Front Load Projection,
- Rear Load Projection,
- Wheelbase,
- Turning Radius, and
- Stability of Loaded Vehicles.

5.8 Transporting Wind Turbine Components

Wind turbine components can be transported in several ways with different truck/trailer combinations and configurations. The travel arrangements and logistics will be investigated when the transporting contractor and the plant hire companies apply for the necessary permits from the Permit Issuing Authorities.

5.8.1 Nacelle

The heaviest component of a wind turbine is the nacelle with the weight varying depending on the type of wind turbine. (i.e., for a 5MW turbine the weight of the nacelle can be about 300 tons). Based on the weight limitations, route clearances and permits will be required for transporting the nacelle by road-based transport. The unit will require a minimum height clearance of 5.1 metres.

5.8.2 Blades

Wind turbine blades are the longest and most vulnerable components and must be protected during shipment. Manufacturers are actively improving on blade designs with blade lengths that go beyond 100 m. Blades need to be transported on an extendible blade transport trailer or in a rigid container with rear steerable dollies (see an example in **Figure 5-4**). Blades can be transported individually, in pairs, or threes, although different manufacturers have different packaging methods for transporting the blades. The transport vehicle typically exceeds the dimensional limitation (length) of 22 metres and will only be allowed under permit, provided the trailer is fitted with steerable rear axles or dollies.



Figure 5-4: Blade transport (Froese, 2019)

For this study, turbine blades of a maximum length of 100 metres have been assessed. Due to this abnormal length, special attention needs to be given to route planning, especially to suitable turning radii and adequate sweep clearance. Therefore, vegetation or road signage may have to be removed before transport. Once transported to the site, the blades need to be carefully stored in their respective laydown areas before being installed onto the rotary hub.

5.8.3 Tower Sections

Tower sections typically consist of sections of around 20 metres in length. The number of tower sections required depends on the selected hub height and type of tower section (i.e., tubular steel, hybrid steel/concrete tower, etc.). For a hub height of 180 metres, a maximum of up to 9 tower sections is anticipated. Each tower section is transported separately on a low-bed trailer. Depending on the trailer configuration and height when loaded, some of these components may not meet the dimensional limitations (height and width) but will be permitted under certain permit conditions.

5.8.4 Turbine Hub and Rotary Units

The turbine hub needs to be transported separately due to its significant weight. A hub unit weighs from around 45 tons.

5.9 Transporting Cranes, Mobile Cranes, and other Components

Crane technology has developed rapidly, and several different heavy lifting options are available on the market. Costs involved to hire cranes tend to vary and should be compared beforehand. For this assessment, some possible crane options are outlined as follows.

5.9.1 Examples of Cranes for Assembly and Erection on Site

A range of cranes are available in South Africa or alternatively can be sourced and brought to South Africa from overseas, depending on the type of wind turbine components to be lifted. These cranes need to be capable of performing the required lifts (i.e., lifting the tower sections into position, lifting the nacelle to the hub height, lifting the rotor and blades into place). Smaller cranes are then used to lift the components and assist in the assembly of the crawler crane at each turbine location.

Lattice Boom Crawler Cranes (see two examples in **Figure 5-5**) will be transported to the site in components and the heaviest load will be the superstructure and crawler centre section. The boom sections, counterweights and other equipment can be transported on conventional tri-axle trailers and then assembled on site. It will require several truckloads of components to be delivered for assembly of the Crawler Cranes before it can be mobilised to perform the heavy lifts.



**Source: Liebherr, 2017*



**Source: Walter Payton Power Equipment*

Figure 5-5: Examples of Crawler Cranes used to assemble turbines

5.9.2 Cranes at the Port of Entry

Most shipping vessels importing the turbine components will be equipped with on-board cranes to do all the safe off-loading of the wind turbine components to the abnormal transport vehicles, parked adjacent to the shipping vessels (see **Figure 5-6**).



Figure 5-6: Cranes at Port of Entry (Authors picture)

The imported turbine components may be transported from the Port of Entry to the nearby turbine laydown area. Mobile cranes will be required at these turbine laydown areas to position the respective components at their temporary storage location.

5.10 Transporting Other Plant, 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.). Other components, such as electrical cables, battery energy storage compartments, pylons, transformers, and switchgear, will also be transported to site during construction. The transport of these items will be conducted with normal heavy load vehicles.

5.11 Route for Components manufactured within South Africa

In South Africa, the majority of the manufacturing industry's national workforce resides in the metros of Johannesburg, Cape Town, Gqeberha and eThekweni. It is therefore anticipated that elements that can be manufactured within South Africa will be transported to the site from those areas. Components will be transported to site using appropriate National and Provincial routes. It is expected that the components will generally be transported to site with normal heavy load vehicles.

5.11.1 Route from Cape Town Area to Site – Locally sourced materials and equipment

Cape Town has a large manufacturing sector located throughout the metro. The proposed industrial hubs being considered to source the required materials and components is currently unknown. With quite an extensive and widespread industrial market, a specific route to the site cannot be considered at this point in time, however, should materials and equipment be transported from the Cape Town area, a majority of the route length will follow the N1 with a travel distance of around 1 400 km. No road limitations envisaged along the route for normal load freight (see **Figure 5-7**).

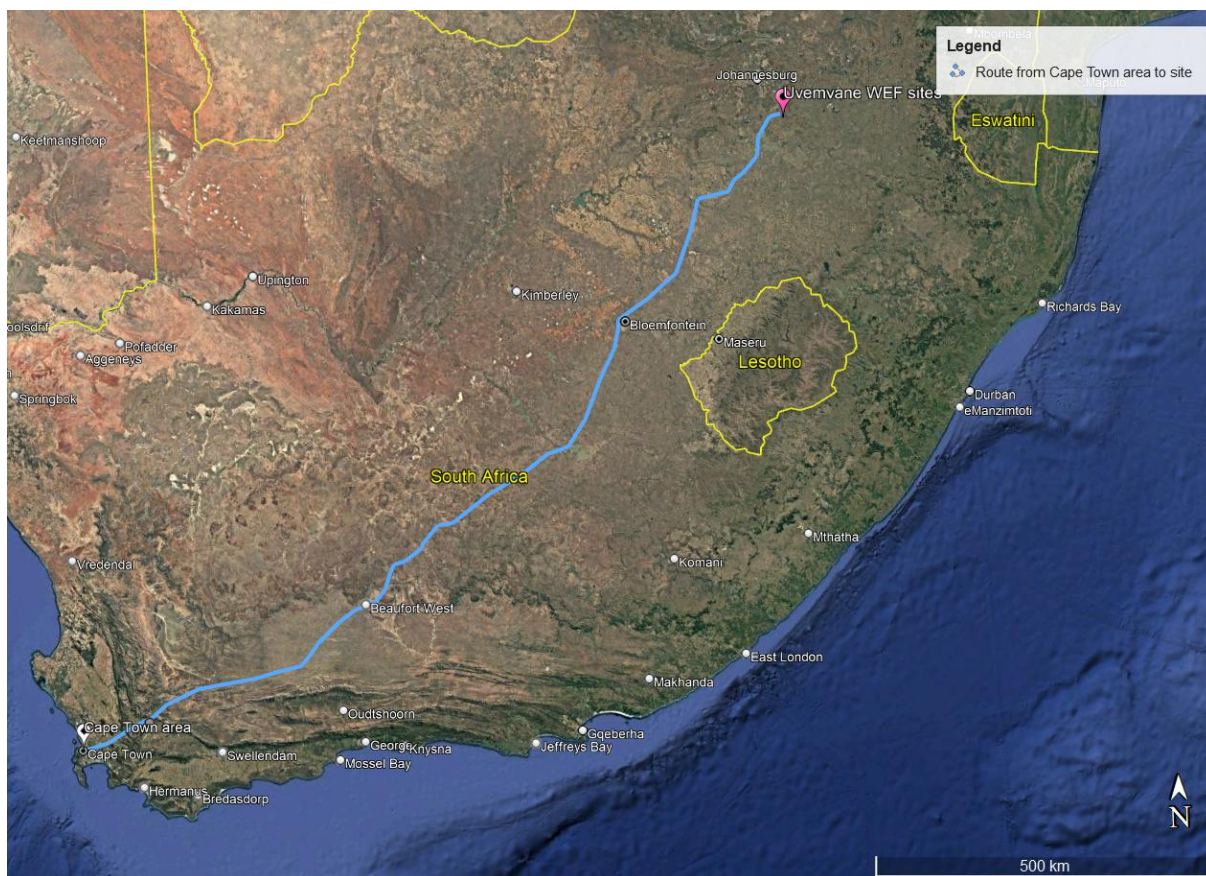


Figure 5-7: Route from Cape Town area to project site

5.11.2 Route from Johannesburg Area to Site – Locally sourced materials and equipment

If delivery from Johannesburg is considered, normal loads from Johannesburg to the site can be transported on numerous routes, due to the project's location being near Johannesburg. No road limitations are envisaged along the route for normal load freight.

5.11.3 Route from eThekweni area (i.e. Pinetown / Durban areas) to Site - Locally sourced materials and equipment

Normal loads can transport elements via several routes from the Durban and Pinetown areas to the site, of which one will follow the same route as from Port of Durban to site (see **Figure 5-8**). No road limitations are envisaged along the route for normal load freight.

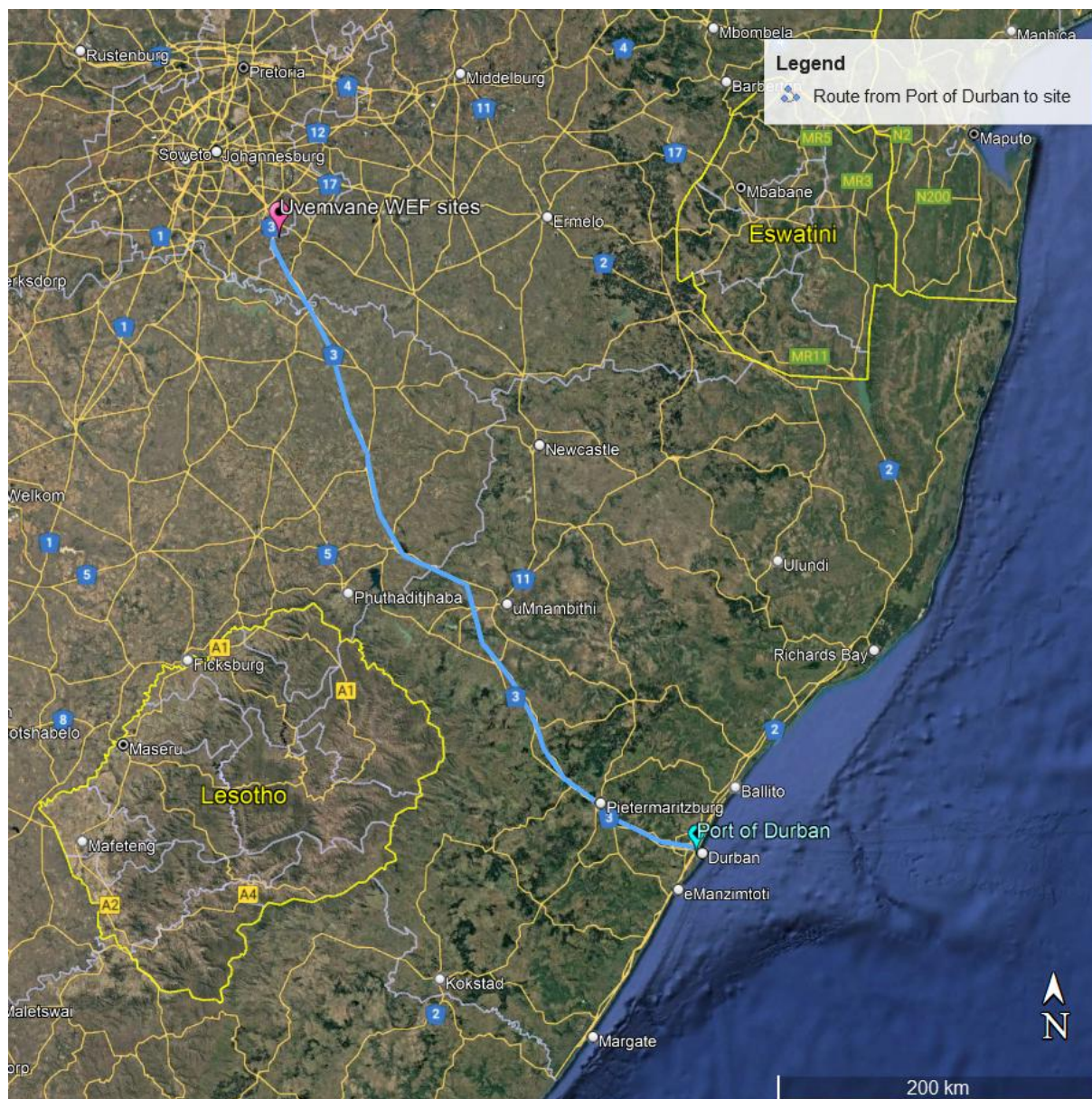


Figure 5-8: Route from Durban/Pinetown area to the project site

5.11.4 Route from Gqeberha area to site

If loads are transported from the Gqeberha area to site, several routes to site are available. One possible route is shown in **Figure 5-9** via the R75 and N1 with a travel distance of approximately 850 km.

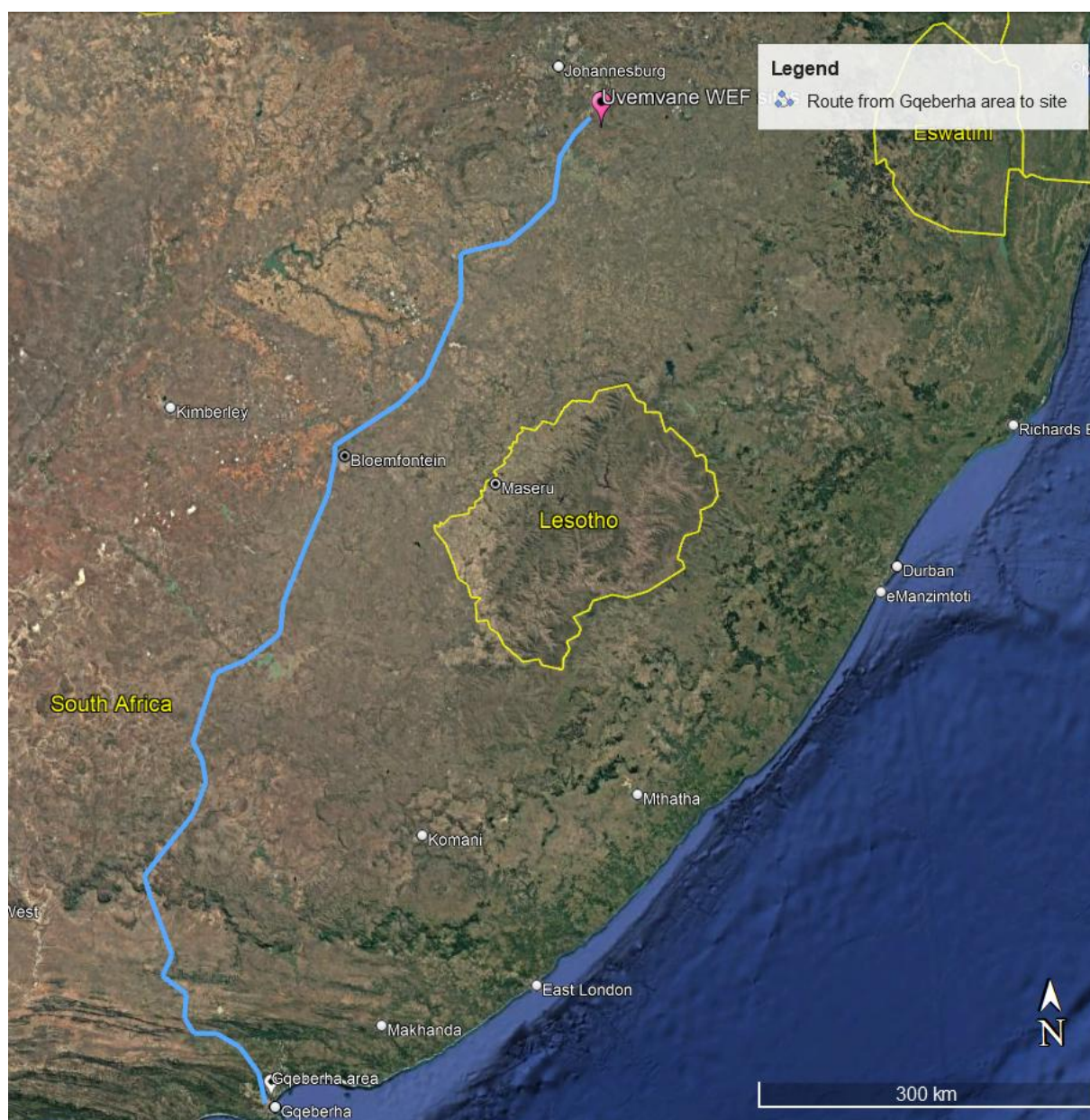


Figure 5-9: Route from Gqeberha area to project site

5.12 Surrounding Road Network

National route N3 crosses the proposed Uvemvane WEF 1 site on its western side. The regional routes R51 and R23 are located to the North and respectively East of the project (see **Figure 5-10**).

The N3 is a national route which connects Johannesburg and Durban passing through a number of towns, with a total length of approximately 579 km. This route can be classified as a Rural Class 1 principal arterial, which carries countrywide traffic between:

- Metropolitan areas and large cities (population typically greater than about 500 000);
- Large border posts;
- Other Class 1 Arterials; and
- Smaller centres than the above when travel distances are very long.

The R23 is a provincial route that links Benoni with Volksrust via Brakpan, Heidelberg and Standerton with a total length of approximately 243 km. The R51 is a provincial route that connects Bapsfontein with the N3 north of Villiers, via Springs, Nigel and Balfour with a total length of approximately 133 km. Both, the R23 and R51, can be classified as Class R2 rural major arterials carrying inter-regional traffic between:

- Smaller cities and medium to large towns (population typically greater than about 25 000);
- Smaller border posts;
- Class 1 and other Class 2 routes;
- Important regions, transport nodes and commercial areas that generate large volumes of freight and other traffic such as seaports and international airports; and
- Smaller centres than the above when travel distances are relatively long.

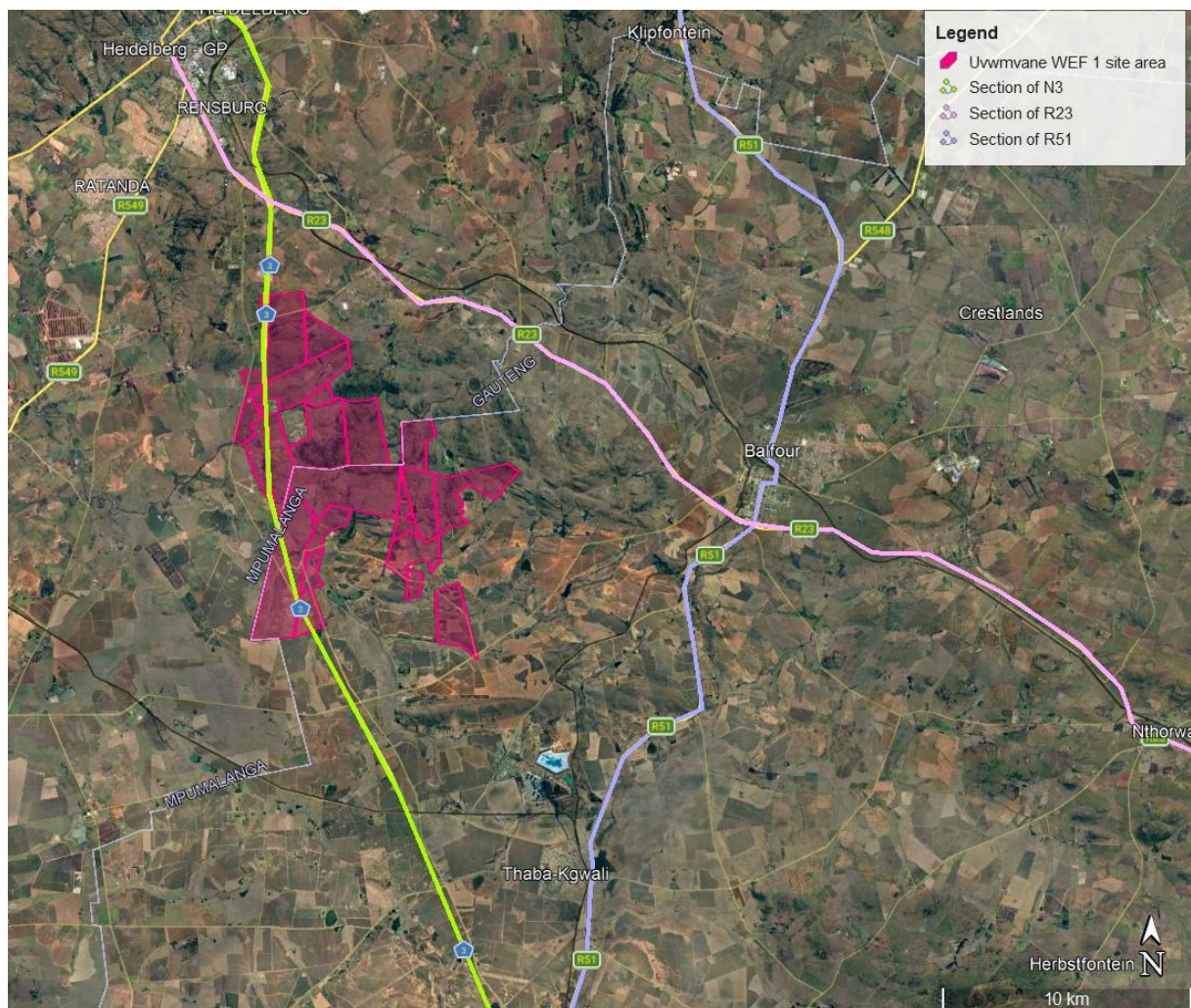


Figure 5-10: Road Network in vicinity of project site

6 ISSUES, RISKS AND IMPACTS

6.1 Identification of Potential Impacts/Risks

The potential impacts to the surrounding environment expected to be generated from the development traffic will derive from an increase in traffic and associated noise and dust pollution. It must be noted that significance of the impact is expected to be higher during the construction and decommissioning phase because these phases generate the highest development traffic.

6.1.1 Construction phase

This phase includes the transportation of people, construction materials and equipment to the site. This phase also includes the construction of the WEF, including construction of footings, roads, excavations, trenching, and ancillary construction works and will temporarily generate the most development traffic.

Nature of impact:

The nature of the impact expected to be generated at this stage is:

- Possible delays due to a temporary increase of traffic on the surrounding road network,
- Road safety issues for other traffic members (i.e., other vehicles, pedestrians, cyclists);
- Construction vehicle associated noise and dust pollution in the vicinity of the site and access routes;
- Possible damage to road surfaces caused by construction vehicles.

Estimated peak hour traffic generated by the Uvemvane WEF 1:

- **Material delivery:** This includes heavy vehicles for the transport of building materials such as reinforced concrete materials for foundations, gravel material for roadworks, brickwork material for buildings, fencing material, etc. The major trip generation activities are assumed to result from the construction of turbine foundations and road material delivery.
- **Heavy vehicles (turbine foundations):** Based on similar studies, around 150 trips per foundation are estimated, which results in a total of 3 000 trips. Estimating a construction period of 24 months and ~20 work days per month, 7 daily trips are estimated for the foundation material delivery.
- **Heavy vehicles (road layer works):** Assuming a typical 0.2 m gravel wearing course and a 10 m road width, 2 m² of gravel wearing course is assumed for the purpose of the trip estimate.

Typically, 1 trip/6 m³ can be assumed for material delivery. The total length of internal roads will be around 31 km, of which 18 km will follow existing roads to be widened. For the delivery of roads material for the 13 km of new internal roads, approximately 4 333 trips will be generated, which results in around 18 daily trips (based on 12-months construction period and 20 workdays per month).

- **Heavy vehicles (laydown area material):** 1 trip/6 m³ is assumed. With an envisaged 25 ha for temporary laydown, staging areas and cement batching plant, as well as a 0.2 m gravel wearing course, a total of ~8 330 trips and a resulting 35 daily trips for laydown area material delivery is estimated (based on 12-months construction period).

It must be noted that vehicle trips from material delivery vary depending on the construction task/program, fuel supply arrangements, as well as distance from the material source to the site. Project planning by the logistics manager can be used to reduce material delivery during peak hours.

- **Construction machinery:** This includes cranes for turbine assembly, heavy vehicles required for earthworks and roadworks. These vehicles are expected to have negligible traffic impact as they will arrive on site in preparation for construction. Once on site, these vehicles will produce internal site traffic with minimal effect on the external road network.

- **Component delivery trips:**

The blades: For this project a maximum rotor diameter of 200 m is assumed (i.e., 100 m blades). As a worst-case scenario, it is assumed that the blades will be transported separately (i.e., *three (3) trips per turbine or 40 trips for 20 wind turbines*).

The nacelle: one (1) abnormal load trip per turbine (i.e., *20 trips for 20 turbines*).

The turbine hub and rotor unit: one (1) abnormal load trip per turbine (i.e., *20 trips for 20 turbines*).

Tower sections:

Should concrete towers be manufactured on site, this will reduce the trips of haulage vehicles having to transport tower sections to site. However, for the purpose of this study, should tower sections be imported and transported to site, it is estimated that for a maximum hub height of 180 metres, nine (9) tower sections are required. Each tower section is transported separately on a low-bed trailer (i.e., *9 abnormal load trips per turbine or 180 trips for 20 turbines*).

In addition to the turbine component delivery trips, one (1) abnormal load can be estimated for each transformer, resulting in a total of up to 20 transformers if one transformer will be installed at each turbine.

The abnormal load trips are highly dependent on project planning and abnormal load permitting. These trips are not necessarily concentrated to the peak hours. Therefore, the exact number of peak hour vehicle trips generated by abnormal load vehicles is unknown at this stage.

- **Construction worker trips:**

According to available information received, the following breakdown of construction staff is expected during the construction phase:

- ♦ ~35 - 50 skilled,
- ♦ ~75-105 semi-skilled, and
- ♦ ~140 -195 unskilled.

Typically, contractors arrange transportation for site workers. The low-skilled and semi-skilled workers will commute by shuttle bus with a 60-passenger capacity, and consequently

a maximum of five (5) buses will be required. The skilled labourers are conservatively assumed to travel by passenger car (34 trips – 1.5 pax per vehicle).

6.1.2 Operational Phase

This phase includes the operation and maintenance of the WEF throughout its life span.

Nature of impact:

The nature of the impact expected to be generated at this stage would be caused by additional vehicle trips on the surrounding road network, which are deemed low.

Estimated peak hour traffic generated by the site:

▪ **Trips generated by staff traveling to the site:**

The number of permanent staff expected for the operational phase is still unknown. Based on similar studies it can be estimated that approximately 50 full-time employees will be stationed on site. Assuming 30% of trips occur during the peak hour, approximately 15 peak hour trips are estimated for the operational phase.

The operational peak hour trips generated by staff are expected to be low and will have a negligible impact on the external road network.

6.1.3 Decommissioning phase

This phase will have similar impacts and generated trips as the Construction Phase.

6.1.4 Cumulative Impacts

To assess a cumulative impact, it is generally assumed that all currently approved and authorized renewable energy projects within a 30 km radius would be constructed at the same time.

This is a precautionary approach as in reality, these projects would be subject to a highly competitive public bidding process or a similarly competitive private market, and not all the projects may be selected to enter into a Power Purchase Agreement. Even if all the facilities are constructed and/or decommissioned at the same time, the roads authority will consider all applications for abnormal loads and work with all project companies to ensure that loads on the public roads are staggered and staged to ensure that the impact will be acceptable.

The construction and decommissioning phases of a renewable energy project are the only significant traffic generators. The duration of these phases is short term, i.e., the potential impact of the traffic generated during the construction and decommissioning phases on the surrounding road network is temporary and wind energy projects, when operational, do not add any significant traffic to the road network.

At the time of preparing this report, one approved renewable energy project was known within a 30km radius as shown in **Figure 6-1**.

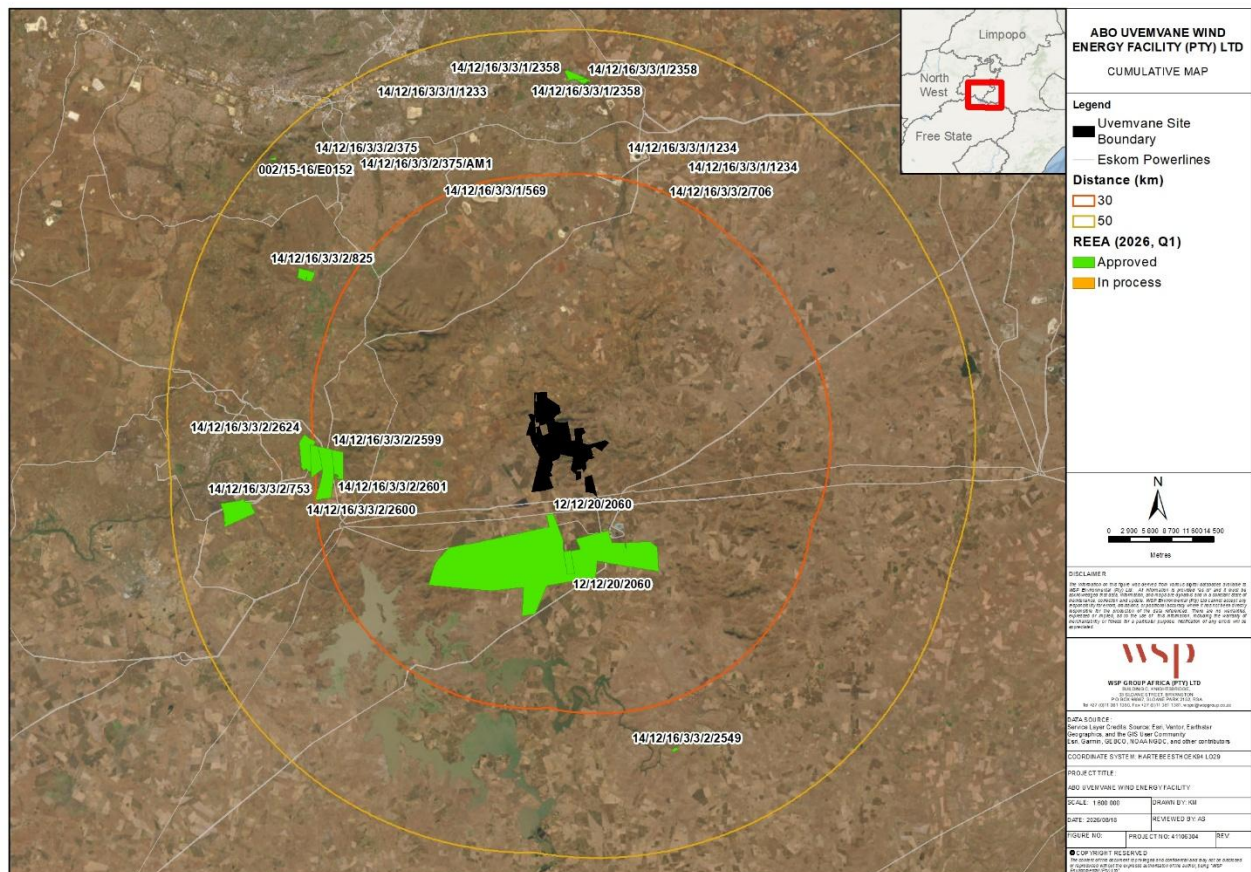


Figure 6-1: Aerial View of cumulative projects within a 30kms radius of the project site

It is noted that it is unlikely that the projects shown in the Figure above will be constructed at the same time. However, for the event that these developments have similar construction periods, it is recommended to agree on a delivery schedule, if possible, to reduce development trips and consequently the impact on the external road network.

The cumulative impact is assessed in Chapter 7.

7 IMPACT ASSESSMENT

7.1 Potential Impact during the Construction and Decommissioning Phases

The construction and decommissioning phases will generate additional traffic including transportation of people, construction materials, water, and equipment (abnormal trucks transporting turbine components). The exact number of trips generated will be determined by the appointed haulage company.

Nature of the impact:

- Delays to road users,
- Increased likelihood of road traffic accidents,
- Noise and dust pollution associated with potential traffic,
- Potential damage to road surfaces caused by construction vehicles.

7.2 Potential Impact (Operation Phase)

Nature of the impact

- Increase in traffic due to permanent staff traveling to site and irregular maintenance trips.

The traffic generated during this phase is expected to have a nominal impact on the surrounding road network. The following items need to be clarified:

- The number of permanent employees

7.3 Cumulative Impacts

At the time of preparing this report, the projects shown in **Figure 6-1** were considered in the cumulative impact assessment.

Nature of the impact

- Delays to road users,
- Increased likelihood of road traffic accidents,
- Noise and dust pollution associated with potential traffic,
- Potential damage to road surfaces caused by construction vehicles,
- Additional temporary increase in traffic due to other RE projects being developed at the same time.

7.4 No-Go Alternative

The no-go alternative implies that the proposed development of the Uvemvane WEF 1 does not proceed. This would mean that none of the impacts or benefits associated with the project would be realised.

Table 7-1 shows a summary of the impact rating for the construction/decommissioning, operational and cumulative stages.



Table 7-1: Impact Rating – Summary Table

CONSTRUCTION/DECOMMISSIONING																			
Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S	Rating	(M+	E+	R+	D)x	P=	S	Rating
Impact	Traffic Impact	Increase in development trips for the duration of the construction/decommissioning phase.	Construction/Decommissioning	Negative	yes	3	3	3	2	4	44	N3	2	3	2	2	3	27	N2
Impact	Noise & Dust pollution	Construction associated noise and dust pollution.	Construction/Decommissioning	Negative	yes	3	4	3	2	4	48	N3	2	4	2	2	3	30	N2
Impact	Damage to road surfaces	Possible damage to road surfaces caused by construction vehicles	Construction/Decommissioning	Negative	yes	3	4	3	2	3	36	N3	2	4	2	2	3	30	N2
Significance						N3 - Moderate							N2 - Low						
				Mitigation measures:		Stagger component delivery to site * Stagger the construction phase * Use of licensed quarries in close proximity to the site to decrease the impact on the surrounding road network if possible * Staff and general trips to occur outside of peak traffic periods as much as possible * Monitoring and maintenance of haulage routes * Maintenance of internal roads* Provide several access points to the site to split construction vehicle trips and reduce the risk of congestion at a single access. * Maintenance and repairs of any road sections of the district roads being used by construction vehicles. * Any road surface damage needs to be closely monitored to decide on the responsible party to repair it.													
OPERATIONAL																			
Impact number	Receptor	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S		(M+	E+	R+	D)x	P=	S	
Impact	Traffic Impact	Slight increase in trips due to permanent staff traveling to and from site; irregular periodical maintenance trips.	Operational	Negative	yes	1	2	1	4	2	16	N2	1	2	1	4	2	16	N2
Significance						N2 - Low							N2 - Low						
				Mitigation measures:		not required													
CUMULATIVE																			
Impact number	Receptor	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S		(M+	E+	R+	D)x	P=	S	
Impact	Additional Traffic Impact	Further increase in development trips and consequently delays on external roads during the construction phase should several RE projects construction periods overlap.	Cumulative	Negative	yes	4	3	3	2	4	48	N3	3	3	2	2	3	30	N2
Significance						N3 - Moderate							N2 - Low						
				Mitigation measures:		Same as for the Construction phase. However, it is noted that it is unlikely that the approved RE projects will be constructed at the same time.													

8 INPUT INTO ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPR)

The overall impact significance findings are summarized in **Table 8-1**.

Table 8-1: Overall Impact Rating

Phase		Overall Significance	Rating	Status
Construction/ Decommissioning	Without mitigation	45	N3	Neg
	With mitigation	29	N2	Neg
Operational	Without mitigation	16	N2	Neg
	With mitigation	16	N2	Neg
Cumulative	Without mitigation	48	N3	Neg
	With mitigation	30	N2	Neg

The applicable mitigation measures identified for each development phase are summarised in **Table 8-2**.

Table 8-2: Summary of mitigation measures for Input into EMPr

Impact/Aspect	Mitigation/Management Actions/ Methodology	Responsibility	Mitigation/ Management Objectives and Outcomes	Frequency
Construction / Decommissioning Phase				
Impact on external roads due to increase in vehicle trips (i.e., delays, safety issues)	<p>Component delivery to/ removal from the site can be staggered and trips can be scheduled to occur outside of peak traffic periods as far as possible.</p> <p>The use of mobile batching plants and existing licensed quarries near the site would decrease the impact on the surrounding road network.</p> <p>Staff and general trips to occur outside of peak traffic periods as far as possible.</p>	Haulage company, contractor.	Stagger and reduce development trips to and from site as far as feasible to limit development impact on surrounding road network.	Throughout construction/ decommissioning phases.

Impact/Aspect	Mitigation/Management Actions/ Methodology	Responsibility	Mitigation/ Management Objectives and Outcomes	Frequency
Dust Pollution on gravel roads in the vicinity of the site.	Dust suppression of access and internal site gravel roads.	Contractor.	Water spraying on gravel road surfaces to reduce dust.	Weekly.
Damage to road surfaces in the vicinity of the project site caused by construction vehicles.	Monitoring and maintenance of the access routes to site.	Contractor, haulage company.	Monitor and, if required, repair any damage to road surfaces caused by construction vehicles.	Throughout construction/ decommissioning phases.
Operational Phase				
Increase in traffic due to permanent staff traveling to site.	The impact on the roads is deemed negligible. However, the impact can be minimised if maintenance and staff trips occur outside peak traffic times as far as possible.	Owner	Maintenance and staff trips to occur outside peak traffic times as far as possible.	As it happens.

9 CONCLUSION AND RECOMMENDATIONS

The potential traffic and transport related impacts for the construction, operation and decommissioning phases of the proposed Uvemvane WEF 1 project were identified and assessed.

- The main impact on the external road network will be during the construction and decommissioning phases. This phase is temporary in comparison to the operational phase. The number of abnormal load vehicles was estimated and found to be accommodated by the road network including the recommended mitigation measures.
- The traffic generated during the construction phase, although significant, will be temporary and impacts are considered to be of medium negative impact. However, *after mitigation* a rating of **low negative** significance was given.
- During operation, it is expected that maintenance and security staff will periodically visit the facility. The generated trips can be accommodated by the external road network, and the impacts were rated **low negative**.
- The traffic generated during the decommissioning phase will be similar to or even less than the construction phase traffic and the impact on the surrounding road network was considered to be of **low negative** significance *with mitigation*.
- The other projects within a 30 km radius from the project site as indicated in this report were taken into consideration for the cumulative impact. *Mitigation measures would be important and can reduce the impact*. The cumulative impact can then be rated as **low negative with the mitigation measures**.

The overall mitigation measures mentioned in the construction and decommissioning phases are:

- The delivery of components to the site can be staggered and trips can be scheduled to occur outside of peak traffic periods.
- Dust suppression of gravel roads located within the site boundary, including the main access road to the site and the site access roads, during the construction phase, if required.
- Regular maintenance of gravel roads located within the site boundary, including the access roads to the site, by the Contractor during the construction phase and by the Owner/Facility Manager during the operational phase.
- The use of existing licensed quarries near the site would decrease the traffic impact on the surrounding road network, if available and feasible.
- Staff and general trips should occur outside of peak traffic periods as far as possible.
- Vehicular movements within the site boundary are the responsibility of the respective Contractor and the Contractor must ensure that all construction road traffic signs and road markings (where applicable) are in place.
- If required, low hanging overhead lines (lower than 5.1m) e.g., Eskom and Telkom lines, along the proposed routes, will have to be moved (to be arranged by the haulage company and communicated beforehand with the service provider of the OHL) to accommodate the abnormal load vehicles. The Contractor and the Developer are to ensure that the haulage company is aware of this requirement.
- The haulage company is to provide evidence to the Contractor and the Developer that any affected overhead lines have been moved or raised.
- The preferred route should be surveyed by the haulage company to identify problem areas (e.g., intersections with limited turning radii and sections of the road with sharp horizontal curves or steep gradients, which may require modification). After the road modifications have been

implemented, it is recommended to undertake a “dry-run” with the largest abnormal load vehicle, prior to the transportation of any components, to ensure that delivery will occur without disruptions. This process is to be undertaken by the haulage company transporting the components and the contractor, who will modify the road and intersections to accommodate abnormal vehicles. The “dry-run” should be undertaken within the same month that components are expected to arrive. The haulage company is to provide evidence that the route has been surveyed and deemed acceptable for the transportation of the abnormal load.

- The Contractor needs to ensure that any gravel sections of the haulage routes (i.e., the site access road and the main access road to the site) remain in good condition and will need to be maintained during the additional loading of the construction phase and reinstated after construction is completed.
- Design and maintenance of internal roads. The internal gravel roads will require grading with a grader to obtain a camber of between 3% and 4% (to facilitate drainage), and regular maintenance blading will also be required. The geometric design of these gravel roads needs to be confirmed at detailed design stage. This process is to be undertaken by a civil engineering consultant or a geometric design professional.
- For upgraded or newly constructed site and access roads, it needs to be ensured that all bellmouths and radii of bends can accommodate the largest construction vehicle. The dimensions will be communicated as part of the detail design stage as per Geometric Design Standard guideline.

The construction and decommissioning phases of a wind energy facility are the only significant traffic generators. The duration of these phases is of a temporary nature, i.e., the impact of the WEF on the external traffic on the surrounding road network is temporary and operational WEFs not add significant traffic to the road network.

The proposed development of the Uvemvane WEF 1 and associated infrastructure is supported from a traffic engineering perspective, provided that the recommendations and mitigation included in this report are adhered to.

10 REFERENCES

- Gouws. S: “Concrete Towers – a business case for sustained local investment”, Concrete growth, www.slideshare.net/SantieGouws/concrete-towers-a-business-case-for-sustained-investmentrev-5
- National Road Traffic Act, 1996 (Act No. 93 of 1996)
- National Road Traffic Regulations, 2000
- SANS 10280/NRS 041-1:2008 - Overhead Power Lines for Conditions Prevailing in South Africa
- Transnetportterminals.net. n.d. *Transnet Port Terminals*. [online] Available at: <<https://www.transnetportterminals.net/Ports/Pages/default.aspx>>
- The Technical Recommendations for Highways (TRH 11): “Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and for other Events on Public Roads
- DFFE Online Data base 2025
- Google Earth Pro (2026)

Annexure A: Specialist Expertise

SUMMARY OF EXPERIENCE

Iris is a Professional Engineer registered with ECSA (20110156) and obtained her Master of Science degree in Civil Engineering in Germany in 2003. She has more than 22 years of experience in a wide field of traffic and transport engineering projects.

Iris left Germany in 2003 and has gained work experience as a traffic and transport engineer in South Africa and Germany. She has technical and professional skills in traffic impact studies, public transport planning, non- motorised transport planning and design, design and development of transport systems, project planning and implementation for residential, commercial, and industrial projects.

Her passions are the renewable energies and road safety, and she is highly experienced in providing traffic and transport engineering advice.

Iris is registered with the International Road Federation as a Global Road Safety Audit Team Leader and is a regular speaker at conferences, seminars and similar.

PROFESSIONAL REGISTRATIONS & INSTITUTE MEMBERSHIPS

PrEng	Registered with the Engineering Council of South Africa No. 20110156 Registered Mentor with ECSA
MSAICE	Member of the South African Institution of Civil Engineers
ITSSA	Member of ITS SA (Intelligent Transport Systems South Africa)
SAWEA	Member of the South African Wind Energy Association
SARF	South African Road Federation: Committee Member of Council
SARF WR	South African Road Federation Western Region – Chair
SARF RSC	South African Road Federation National Road Safety Committee
IRF	Registered as International Road Safety Audit Team Leader

EDUCATION

1996 – Matric (Abitur)	Carl Friedrich Gauss Schule, Hemmingen, Germany
1998 - Diploma (Draughtsperson)	Lower Saxonian State Office for Road Engineering
2002 – BSc Eng (Civil)	Leibniz Technical University of Hannover, Germany
2003 - MSc Eng (Civil & Transpt)	Leibniz Technical University of Hanover, Germany

***Master Thesis on the Investigation of the allocation of access rights** to the European rail network infrastructure - Research of the feasibility of the different bidding processes to allocate access rights of railway operators in the European railway market. Client: Technical University of Berlin and German Railway Company.*

SUMMARY OF EXPERIENCE

iWink Consulting (Pty) Ltd – Independent Consultant

2022 – present

Position: Independent Consultant – working as an independent Specialist in the field of Traffic & Transport Engineering, Renewable Energies and Road Safety.

JG Afrika (Pty) Ltd (Previously Jeffares & Green (Pty) Ltd)

2016 – 2022

Position: Associate / Division Head: Traffic & Transport Engineering

Jeffares & Green (Pty) Ltd

2012 – 2016

Position: Senior Traffic & Transport Engineer

Arup (Pty) Ltd

2010 - 2012

Position – Senior Traffic & Transport Engineer

Arup (Pty) Ltd

2004 - 2010

Position – Traffic & Transport Engineer

Schmidt Ingenieurbüro, Hannover, Germany

2000

Position – Engineering Assistant

Leibniz University of Hannover, Germany

2000 - 2003

Position – Engineering Researcher - Institute for Road & Railway Engineering

SELECTION OF PROJECTS

Please note: The below lists show only a *selection* of projects that Iris has been involved in over the last 20 years. More information and a complete Schedule of Experience can be made available on request.

RENEWABLE ENERGY PROJECTS

Transport Impact Assessments /Traffic Management Plans for:

- Aberdeen Windfarms, Eastern and Western Cape
- Thungela Isibonelo Waste to Energy
- Rhenosterkop Solar Farms, Western Cape
- Selebi Phikwe Solar PV Project, Botswana
- Cradock – Kaladokhwe WEFs
- Britstown WEFs
- Highveld Solar Cluster
- Dealsville & Bloemfontein Solar PV
- Great Karroo Wind and Solar Cluster
- Ummbila Emoyeni Solar Project
- Poortjie Wind&Solar
- Hydra B Solar Cluster
- Choje Windfarm, Eastern Cape
- Richards Bay Gas to Power Project
- Oya Black Mountain Solar Project
- De Aar Solar Project
- Euronotus Wind & Solar Cluster
- Pienaarspoort Wind Energy Project
- Karreebosch Wind Energy Project
- Dyasonsklip Solar Project
- Kuruman Windfarm
- Bloemsmond Solar Farms
- Hendrina Wind Energy Project
- Orkney Solar Project
- Bulskop Solar Project
- Hyperion Solar & Thermal Project
- Gromis & Komas Wind Energy Projects
- Kudusberg & Rondekop Wind Energy Projects
- Bayview Windfarm
- Coega West Windfarm
- Suikerbekkie Solar Project
- Poortjie Solar Project
- Northam Solar Project

- Sibanye Solar Project
- Du Plessis Dam Solar Project
- Mercury Solar Project
- Aberdeen Wind Energy Project
- Saldanha Wind and Solar Projects
- Ummbila Emoyeni Wind Energy Project
- Springhaas Solar Project

Clients:

- G7 Energies
- ABO Wind Renewable Energies
- Atlantic Renewable Energy Partners
- Mulilo
- Acciona
- Enel
- Engie
- DNV GL
- Enertrag
- Scatec Solar
- Red Rocket Energies
- Windlab
- Mainstream
- Africoast
- Genesis

FURTHER PROJECTS**Traffic Impact Studies & Site Development Plan Input:**

- Nooiensfontein Housing Development, City of Cape Town
- Belhar Housing Development, City of Cape Town
- Baredale Phase 7, City of Cape Town
- Beau Constantia Wine Farm
- Constantia Glen Wine Farm
- Eagles Nest Wine Farm
- Groenvallei Parking Audit, City of Cape Town
- Kosovo Housing Development, Western Cape Government
- Enkanini Housing Development, Stellenbosch
- Delft Housing Development, City of Cape Town
- Secunda Sasol, Free State
- Marula Platinum Mine
- InnerCity Transport Plan, City of Cape Town
- Stellenbosch Road Master Plan
- Nyanga Public Transport Interchange
- Crawford Campus Cape Town

- Durban RoRo Car Terminal, Transnet
- Durban Farewell Container Site
- Msunduzi Waterfront Housing Development
- Transnet Park Site – Traffic Management and Evacuation Plans
- UWC Bellville Medical Campus
- Bloekombos District Hospital
- Malabar Extension 3, Port Elizabeth

Traffic Engineering for Roads Projects:

- Namibia Noordoewer to Rosh Pina, Road Agency Namibia
- N2 Section 19 Mthatha – NMT Studies
- R63 Alice to Fort Beaufort – NMT, Road Link and Intersection Studies
- N2 Kangela to Pongola Upgrade
- Cofimvaba Eastern Cape – NMT, Road and Intersection Upgrades
- Stellenbosch R44 Traffic Signals
- Secunda Traffic Signals
- Fezile Dabi District Gravel Roads Upgrade, Free State Province
- Zambia RD Rehabilitation Project
- R61 Eastern Cape – NMT Studies, SANRAL

CONTINUED PROFESSIONAL DEVELOPMENT (CPD)

Last five years*full CPD list available

2023 – International Traffic Safety Conference, Doha – Speaker

2022 – 7th Regional Conference for Africa & PIARC International Seminar on Rural Roads and Road Safety - Speaker

2022 – Non-motorised Transport Seminar (SARF) – Co-Organizer / Speaker

2021 – SARF KZN Road Safety Considerations (SARF) – Guest Speaker

2021 – Road Safety Audit Course (IRF) – Guest Speaker

2021 – Legal Obligations / Road Safety Act (SARF) – Presenter

2020 – Understanding Road Accidents (SARF)

2020 – Road Safety Auditor Course (SARF) – Co-Lecturer

2018 – African Road Conference (IRF/SARF/PIARC)

2018 – Road Safety in Engineering (SARF) – Presenter

2016 - SATC Road Safety Audit Workshop Pretoria (SARF)

2015 - Non-motorised Transport Planning (SARF)

Annexure B: Specialist Statement of Independence

I, Iris Sigrid Wink, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations, and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan, or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist: *Iris Wink*

Name of Company: iWink Consulting (Pty) Ltd

Date: 12/08/2026

Annexure C: Impact Assessment Methodology

ASSESSMENT OF IMPACTS AND MITIGATION

The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation.

The key objectives of the risk assessment methodology are to identify any additional potential environmental issues and associated impacts likely to arise from the proposed project, and to propose a significance ranking. Issues / aspects will be reviewed and ranked against a series of significance criteria to identify and record interactions between activities and aspects, and resources and receptors to provide a detailed discussion of impacts. The assessment considers direct¹, indirect², secondary³ as well as cumulative⁴ impacts.

A standard risk assessment methodology is used for the ranking of the identified environmental impacts pre-and post-mitigation (i.e. residual impact). The significance of environmental aspects is determined and ranked by considering the criteria⁵ presented in **Table A**.

Table A: Impact Assessment Criteria and Scoring System

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries
Impact Reversibility (R) The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change	Reversible: Recovery without rehabilitation		Recoverable: Recovery with rehabilitation		Irreversible: Not possible despite action
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probability	Definite
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (E + D + R + M) \times P]$ <i>Significance = (Extent + Duration + Reversibility + Magnitude) × Probability</i>				
IMPACT SIGNIFICANCE RATING					

¹ Impacts that arise directly from activities that form an integral part of the Project.

² Impacts that arise indirectly from activities not explicitly forming part of the Project.

³ Secondary or induced impacts caused by a change in the Project environment.

⁴ Impacts are those impacts arising from the combination of multiple impacts from existing projects, the Project and/or future projects.

⁵ The definitions given are for guidance only, and not all the definitions will apply to all the environmental receptors and resources being assessed. Impact significance was assessed with and without mitigation measures in place.

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Total Score	4 to 15	16 to 30	31 to 60	61 to 80	81 to 100
Environmental Significance Rating (Negative (-))	Very low	Low	Moderate	High	Very High
Environmental Significance Rating (Positive (+))	Very low	Low	Moderate	High	Very High

IMPACT MITIGATION

The impact significance without mitigation measures will be assessed with the design controls in place. Impacts without mitigation measures in place are not representative of the proposed development's actual extent of impact and are included to facilitate understanding of how and why mitigation measures were identified. The residual impact is what remains following the application of mitigation and management measures and is thus the final level of impact associated with the development. Residual impacts also serve as the focus of management and monitoring activities during Project implementation to verify that actual impacts are the same as those predicted in this report.

The mitigation measures chosen are based on the mitigation sequence/hierarchy which allows for consideration of five (5) different levels, which include avoid/prevent, minimise, rehabilitate/restore, offset and no-go in that order. The idea is that when project impacts are considered, the first option should be to avoid or prevent the impacts from occurring in the first place if possible, however, this is not always feasible. If this is not attainable, the impacts can be allowed, however they must be minimised as far as possible by considering reducing the footprint of the development for example so that little damage is encountered. If impacts are unavoidable, the next goal is to rehabilitate or restore the areas impacted back to their original form after project completion. Offsets are then considered if all the other measures described above fail to remedy high/significant residual negative impacts. If no offsets can be achieved on a potential impact, which results in full destruction of any ecosystem for example, the no-go option is considered so that another activity or location is considered in place of the original plan.

The mitigation sequence/hierarchy is shown in **Figure A** below.

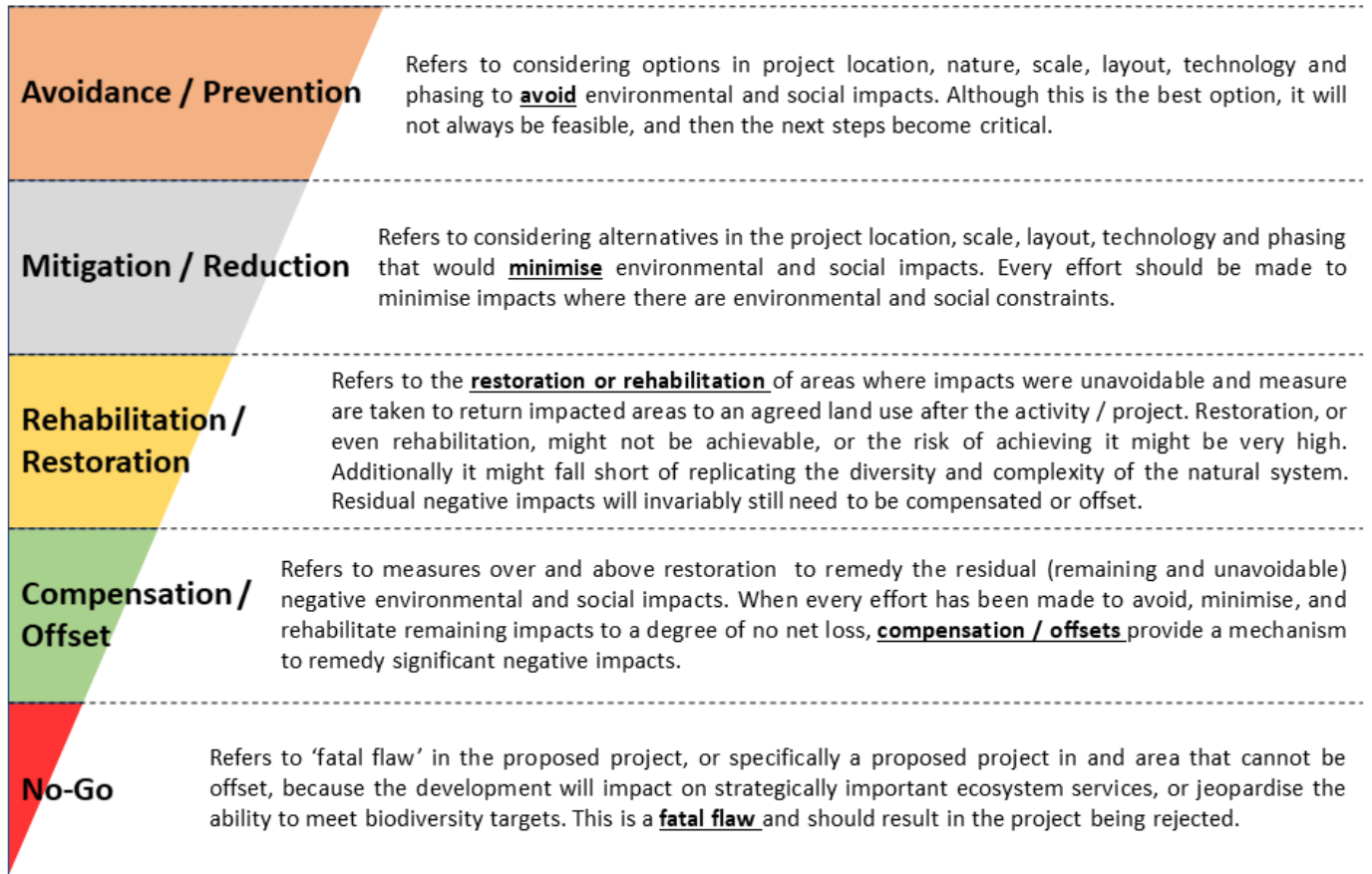


Figure A: Mitigation Sequence/Hierarchy