BRANDVALLEY WIND ENERGY FACILITY
TRANSPORT IMPACT ASSESSMENT

November 2021
REVISION 2

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VERIFICATION PAGE

Qual-frm-026

Rev 14

TITLE: Brandvalley Wind Energy Facility-Transport Impact Assessment		
JGA REF. NO. 5610_01	**DATE:** 18/11/2021	**REPORT STATUS** Third issue

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SYNOPSIS

Preparation of the Transport Impact Assessment for the proposed Brandvalley Wind Energy Facility located on the border of the Western Cape and Northern Cape Provinces. The assessment pertains to all relevant traffic and transportation engineering aspects of the facility.

KEY WORDS:

Wind Energy Facility, Transport Impact Assessment

QUALITY VERIFICATION

This report has been prepared under the controls established by a quality management system that meets the requirements of ISO 9001: 2015 which has been independently certified by DEKRA Certification.

Verification	Capacity	Name	Signature	Date
By Author	Engineer	A Ramawa		18-11-2021
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Authorised by:	Director	H Tiganis		18-11-2021

Filename:	https://jgafrika.sharepoint.com/sites/Job5610-team-100-WIP-Internal-Eng/Shared Documents/100-WIP-Internal-Eng/104-Studies/Brandvalley wind energey facility TIA-18-11-2021.docx

Report template version: 2017-10-30

BRANDVALLEY WIND ENERGY FACILITY
TRANSPORT IMPACT ASSESSMENT

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1 INTRODUCTION & SCOPE OF WORK

1.1 Terms of reference

WSP appointed JG Afrika Pty (Ltd) to provide an updated Transport Impact Assessment (TIA) for the Brandvalley Wind Energy Facility (WEF) as part of the amendment and update of the Environmental Management Process (EMPr).

On the 23rd of November 2016, the Applicant (Brandvalley Wind Farm (Pty) Ltd) obtained authorisation from the Department of Environmental Affairs (DEA) to establish a 140 MW Wind Energy Facility within the Karoo Hoogland, Witzenberg and Laingsburg Local Municipalities in the Northern and Western Cape Provinces. It must be noted that the above authorisation does not include the approval of the site layout and environmental management process as these project aspects are expected to change over time until the site is ready for construction.

The following Transport Impact Assessment (TIA) forms part of the EMPr and aims to review the proposed traffic impacts and mitigations as assessed in the May 2016 Transport Impact Assessment conducted by Aurecon. This study will ensure that any traffic impacts associated with the final site layout are considered and mitigated accordingly.

The 140MW WEF is located approximately 25km north of Matjiesfontein, on the border of the Western Cape and Northern Cape provinces. The location of the proposed WEF is shown in **Figure 1.1** below.

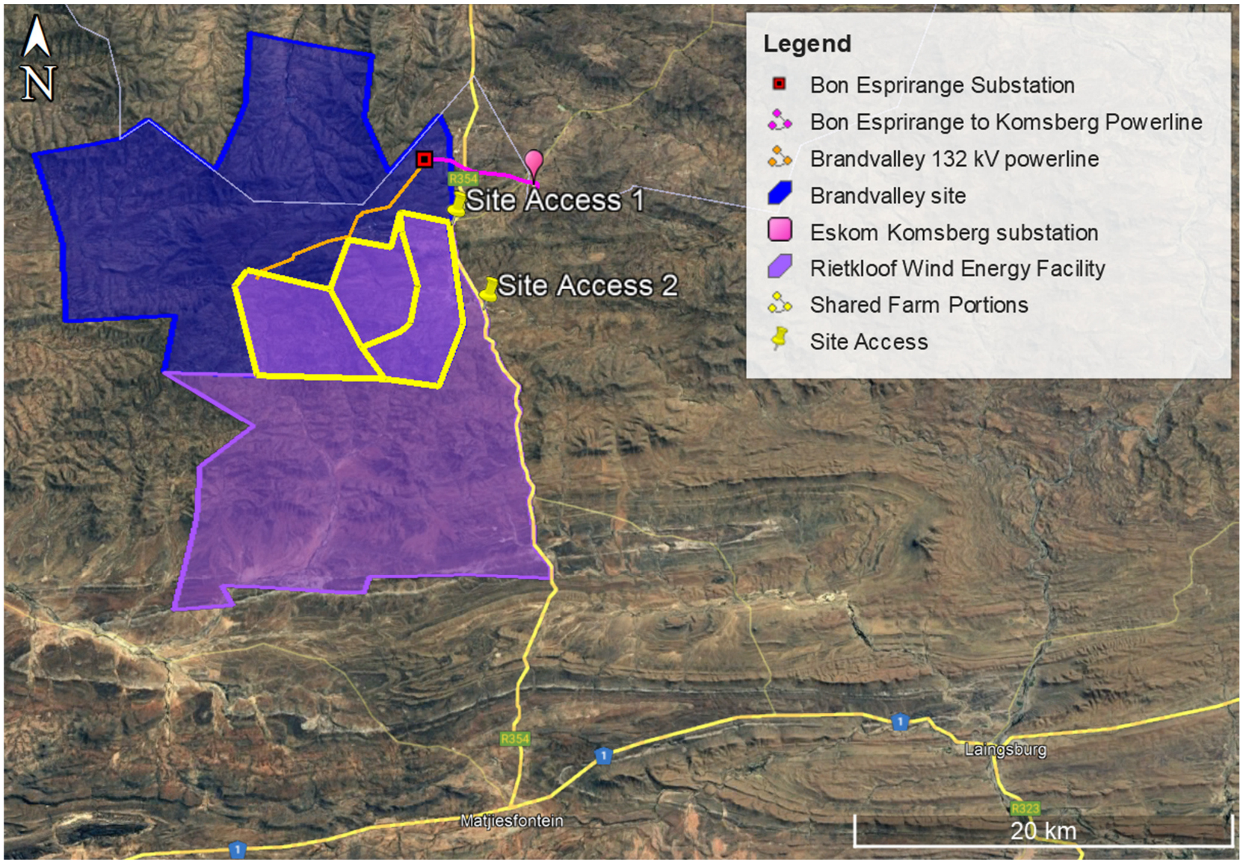

Figure 1-1: Locality Map

1.2 Scope of work

The aim of the TIA is to determine the transport impact of the development on the existing transport network during the construction, operation, and decommissioning phases of the development.

The report will deal with the items listed below and focuses on the surrounding road network that may be impacted by construction and maintenance of the site:

<u>Traffic and Route Assessment</u>

- Trip generation and potential traffic impact
- Possible haul routes between port of entry / manufacturing location and sites in regards of
- National route
- Local route
- Site access route (internal roads)
- Road limitations due to abnormal loads
- Construction and maintenance (operational) vehicle trips
- Generated vehicles trips
- Abnormal load trips
- Access requirements

- Investigation of the impact of the development traffic generated during construction and operation.

Access and Internal Roads Assessment

- Assessment of proposed access points including:
- Feasible location of access points
- Motorised and non-motorised access requirements
- Queuing analysis and stacking requirements if required
- Access geometry
- Sight distances and required access spacing
- High-level input into the proposed internal roads on site
- High-level input into the internal circulation of trucks and proposed roads layout

1.3 Approach and Methodology

The report deals with the traffic impact on the surrounding road network in the vicinity of the site during the construction of the access roads, construction and installation of the turbines and during maintenance.

This transport study includes the following tasks:

<u>Project Assessment</u>

- Overview of project background information including the previous TIA, location maps, component specs and any resulting abnormal loads to be transported
- Research of all available documentation and information relevant to the proposed windfarm and substations

<u>Traffic and Route Assessment</u>

- Trip generation and potential traffic impact
- Possible haul routes between port of entry / manufacturing location and sites in regards of
  - National route
  - Local route
  - Site access route (internal roads)
  - Road limitations due to abnormal loads
- Estimation of construction and maintenance (operational) vehicle trips
  - Generated vehicles trips
  - Abnormal load trips
  - Access requirements
- Investigation of the impact of the development traffic generated during construction and operation.

<u>Access and Internal Roads Assessment</u>

- Assessment of the proposed access points including:
  - Feasible location of access points
  - Motorised and non-motorised access requirements
  - Queuing analysis and stacking requirements if required
  - Access geometry
  - Sight distances and required access spacing
  - Comments on internal circulation requirements and observations

<u>Report (Documentation and Figures)</u>

- Reporting on all findings and preparation of the report.

1.4 General assumptions

The following assumptions were made:

- According to the Eskom Specifications for Power Transformers, the following dimensional limitations need to be kept when transporting the transformer – total maximum height 5 000mm, total maximum width 4 300mm and total maximum length 10 500mm.
- Maximum vertical height clearances along the haulage route is 5.2 m for abnormal loads.
- The imported elements will be transported from the most feasible port of entry, which is deemed to be Port of Saldanha.
- 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 decommissioning phase will have similar transport impact as the construction phase.

1.5 Source of information

Information used in a transport study includes:

- Project information provided by the Client
- Google Earth. kmz provided by the Client
- Google Earth Satellite Imagery
- Chief surveyor general website
- TRH11, Dimensional and mass limitations and other requirements for abnormal loads, August 2009
- 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", 2000
- National Road Traffic Act, Act 93 of 1996
- National Department of Transport (NDoT), Manual for Traffic Impact Studies, October 2005
- Department of Transport (DoT), Geometric Design of Rural Roads, 1988
- SANS 10280/NRS 041-1:2008 Overhead Power Lines for Conditions Prevailing in South Africa
- 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

2 SITE DESCRIPTION

2.1 General

It is proposed to develop the Brandvalley 140 MW WEF approximately 25km north of Matjiesfontein on the border of the Western Cape and Northern Cape provinces. The site is aimed to accommodate the following infrastructure:

- A maximum of 34 wind turbines with an individual energy generation capacity of up to 7 MW each. The wind turbine rotor diameter is proposed to be 180m with a hub height of 125m.
- Concrete foundations,
- transformers,
- Laydown areas,
- Construction camp and onsite batching plant of 1ha,
- Internal road network up to 9m in width,
- Buildings,
- Overhead powerlines and underground cabling,
- Low voltage yard onsite substation,
- Lighting system,
- Fencing of the site construction camp; and
- 4 x 125m tall wind measuring lattice masts strategically placed within the wind farm development footprint to collect data on wind conditions during the operational phase.

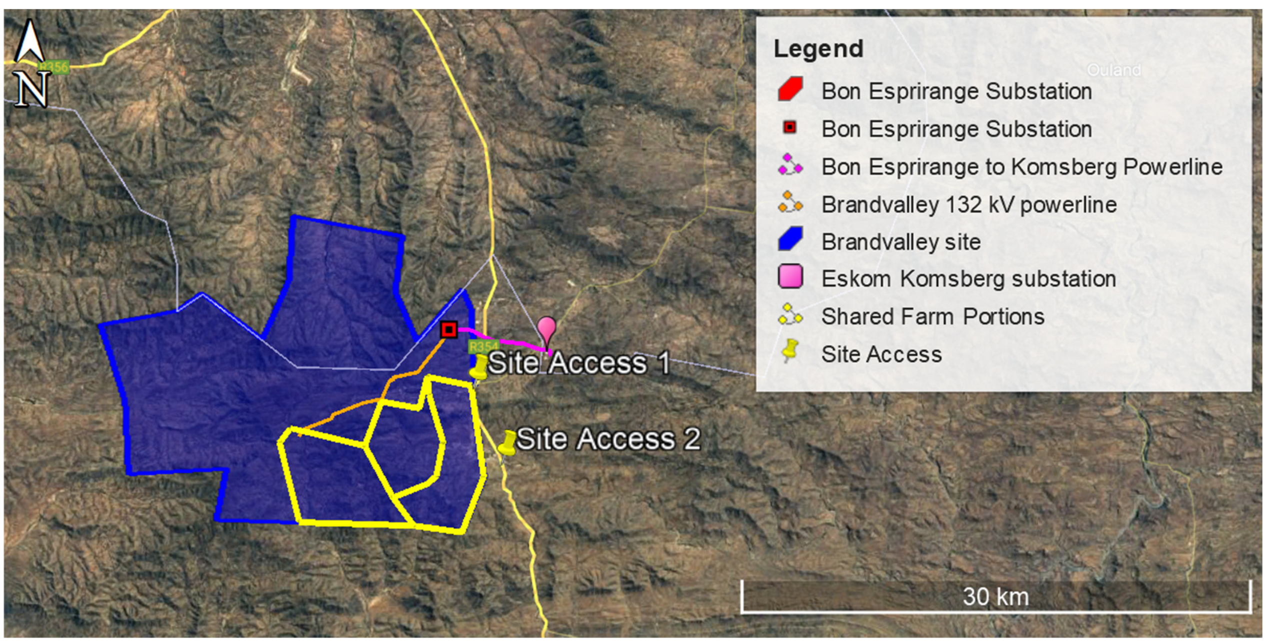

Figure 2-1:The site

2.2 Powerline connection

A 132kV overhead powerline will be constructed to connect the Brandvalley WEF to the national grid via the existing Eskom Komsberg substation. The powerline will be an overhead powerline which will link to a proposed Bon Espirange substation (BE substation) on Remainder Bon Espirange 73. A Bon Espirange to Komsberg powerline route will be constructed to connect from the BE substation to the existing Eskom Komsberg substation.

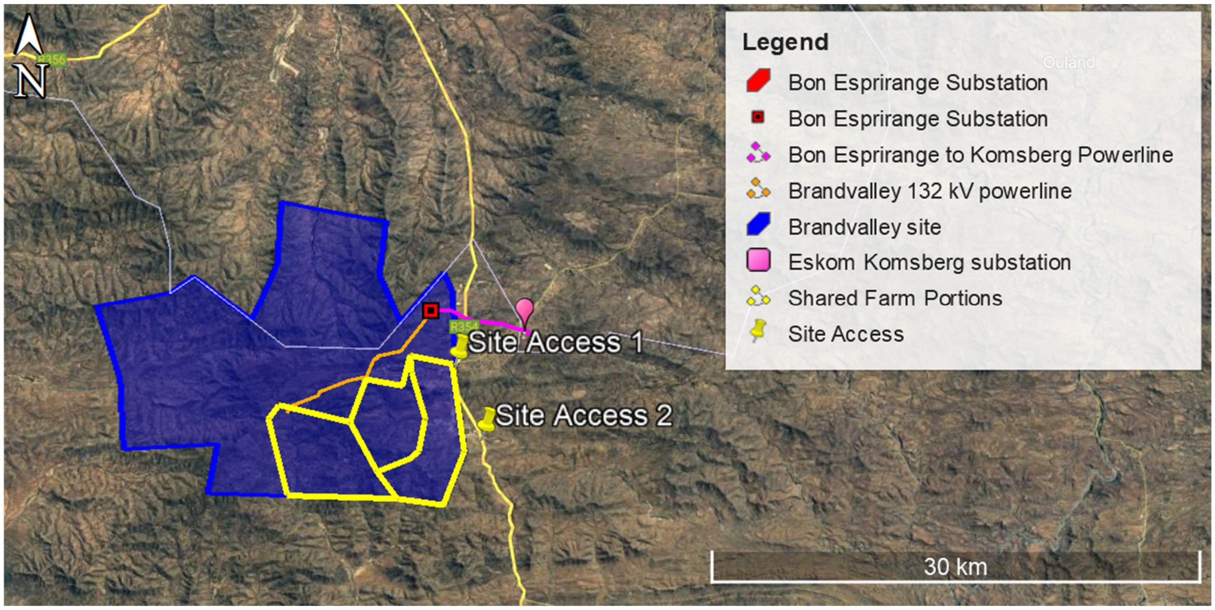

Figure 2-2: 132 KV Powerline

3 TRANSPORTATION ROUTES

3.1 Site access points

The proposed site layout considers two site access points connecting to the R354 located at the eastern end of the site. The site is accessed via existing minor provincial roads, namely OP08042 and OP08044. One of the access roads (access 2) allows access to the Rietkloof site.

As the site is being accessed via existing access points, access spacing restrictions are not envisaged. It should, however, be noted that road upgrades may be required along the existing access roads to accommodate abnormal vehicles expected to deliver components to the site.

The R354 is a Class 2 minor arterial route running in a south-north direction from Matjiesfontein to the R356 in the Northern Cape. The road is a surfaced single carriage way with one lane per direction.

3.2 Port of entry

It is assumed that the blades and nacelle components will be imported to South Africa via the Port of Saldanha. The Port of Saldanha is South Africa's largest natural anchorage and port with the deepest water. It is located 60 nautical miles northwest of Cape Town (Longitude 170 58' E and Latitude 330 02' S) and is operated by Transnet National Ports Authority.

Depending on the type of turbine and tower, the tower sections can either be imported, or alternatively be manufactured locally. There are several types of towers available on the market, i.e., concrete, steel or hybrid concrete-steel towers. Within South Africa, steel towers can be sourced from Atlantis or Port Elizabeth, and concrete towers can be manufactured on site or sourced from the Cape Town area.

3.2.1 Main route for the transportation of the wind turbine components

Based on experience with similar projects as well as input from the previous transport investigation, the possible ports of entry include Port of Saldanha (approximately 364 km from the site), Port of Cape Town (approximately 267km from the site) or the Port of Ngqura (approximately 614km from the site).

The following aspects were considered about the above routes:

1. Port of Saldanha (approximately 364 km from the site):
   This is the second shortest route. The route comprises of high order routes surrounded by rural developments and farm properties and passes through Ceres and Moorreesburg. The density of these two towns is lower than the Cape Town area of route option 2.

2. Port of Cape Town (approximately 267km from the site):
   This route provides the shortest distance to the site and comprises entirely of high order routes from the port of entry to the site. However, sections of the route passes through highly developed areas (e.g., Cape Town, Paarl, Worcester etc). Due to this aspect, disruption of traffic due to the abnormal load traffic is expected along these built-up areas.

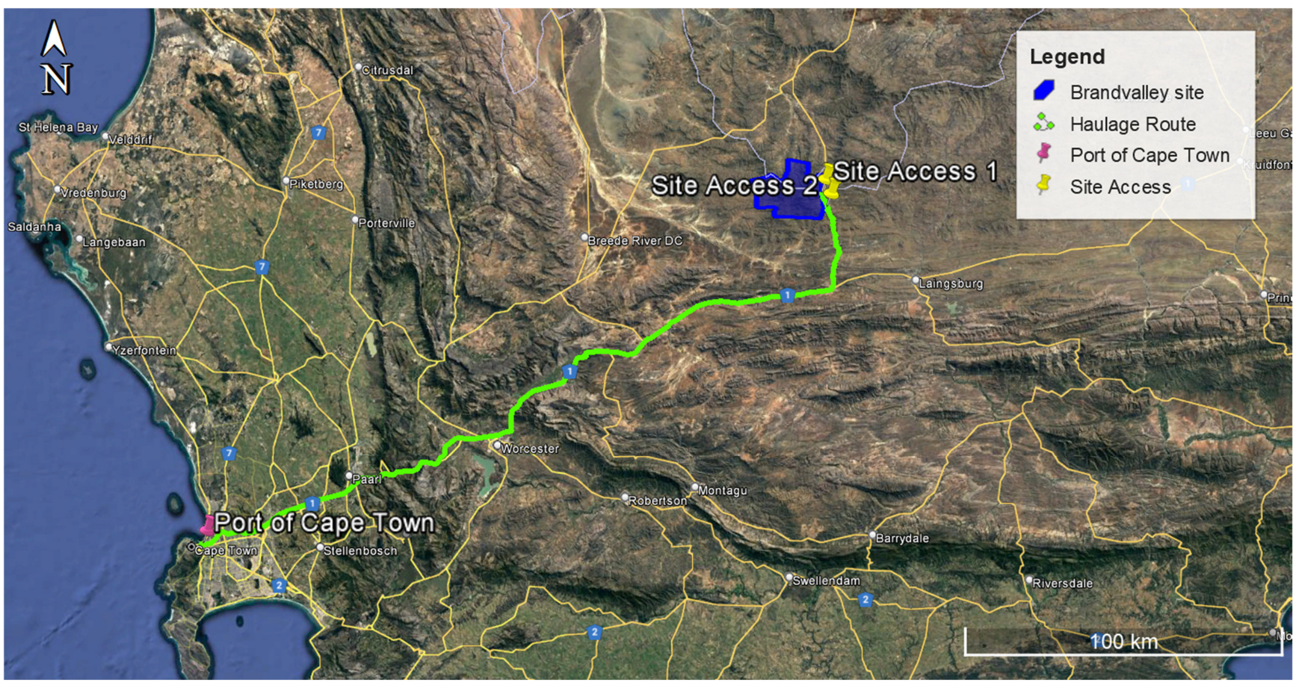

Figure 3-1: Route from the port of Cape Town to the Site

3. Port of Ngqura (approximately 614km from the site):
   This route has the longest distance to the site. It comprises of majority high order routes. It passes through some small towns with low densities. Not much congestion is expected.

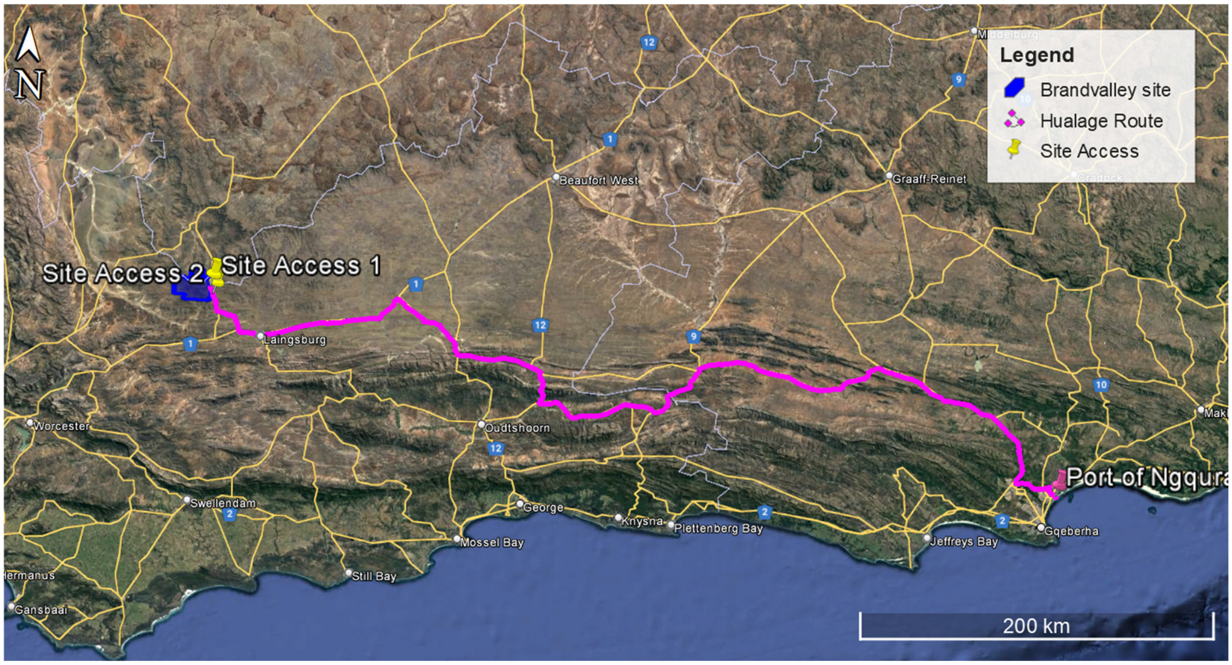

Figure 3-2:Route from the Port of Ngqura to the site

3.2.2 Preferred port of entry

The preferred port of entry to the site is the Port of Saldanha. This route maximises the use of higher order routes, which are designed to handle / accommodate larger vehicles and minimise travelling through towns as far as possible. This was deemed important to minimise congestion and avoid disruptions to communities in these towns.

The delivery company is advised to conduct a dry-run of the route to determine the practical suitability of the route for abnormal load travel.

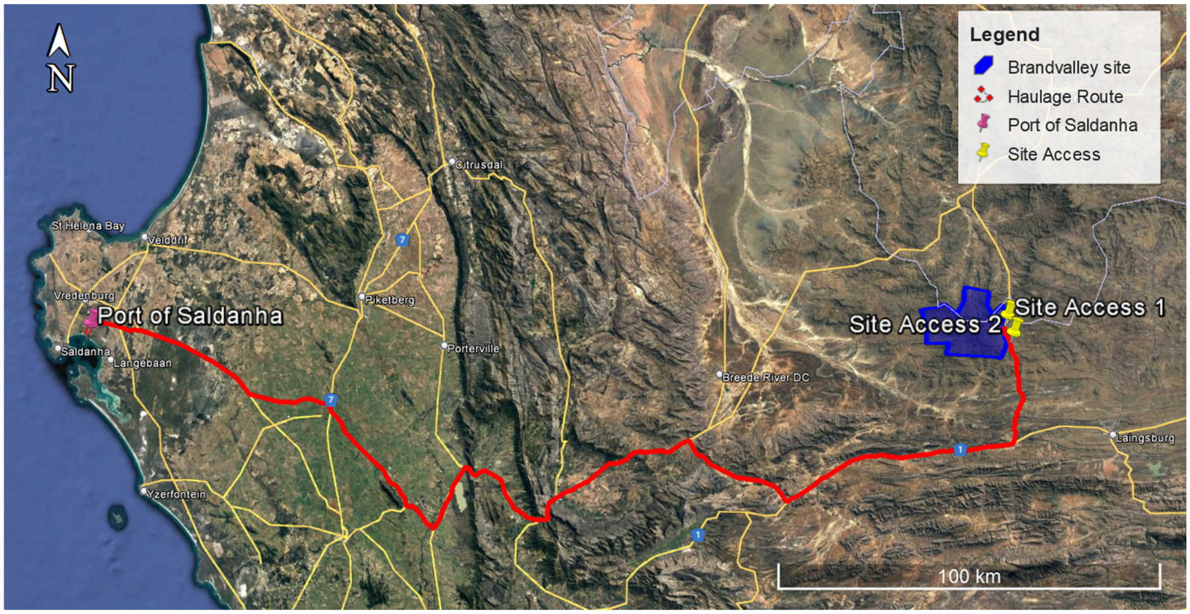

Figure 3-3:Preferred Route from the Port of Saldanha to the site

4 DESCRIPTION OF PROJECT ASPECTS RELEVANT TO THE TRANSPORT STUDY

4.1 Selected Candidate Turbine

The possible range of wind turbines varies largely with various wind turbine manufacturers operating worldwide. The exact wind turbines to be used on-site have not been finalised yet. For this study, a turbine with a maximum hub height of 125m and a blade length of up to 90m is assumed for the assessment.

In general, each turbine unit consists of a tower, a nacelle (final weight dependent on the supplier and whether the nacelle has gears or not), and rotor blades. It is assumed that all turbine parts will be imported and shipped via the Port of Sadhana.

4.2 Transportation requirements

4.2.1 Abnormal Load Considerations

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

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

Any dimension/mass exceeding 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.

4.2.2 Further Guideline Documentation

The Technical Recommendations for Highways (TRH 11): "Draft Guidelines for Granting of Exemption Permits for the Conveyance of Abnormal Loads and 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 concerning 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.

4.3 Permitting – General Rules

The limits recommended in TRH 11 serve as a guide to the Permit Issuing Authorities. Each Administration has the right to refuse a permit application or modify the conditions to grant a permit. It is understood that:

a. A permit is issued at the sole discretion of the Issuing Authority. The Issuing Authority may refuse a permit because of the condition of the road, the culverts, and bridges, the nature of road traffic, excessive heavy traffic during specific periods, or for any other reason.

b. A permit can be withdrawn if the vehicle is inspected and found unfit for operation.

c. During specific 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.

4.3.1 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 vehicle capacity as rated by the manufacturer,
- the load which may be carried by the tyres,
- the damaging effect on pavements,
- the structural capacity on 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.

4.3.2 Dimensional Limitations

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

- Width
- Height
- Length
- Front Overhang
- Rear Overhang
- Front Load Projection
- Rear Load Projection

- Wheelbase
- Turning Radius
- Stability of Loaded Vehicles

4.4 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.

4.4.1 Nacelle

The heaviest component of a wind turbine is the nacelle (i.e., approximately 100 tons depending on the manufacturer and design of the unit). Combined with road-based transport, a total vehicle mass of approximately 145 000kg for a 100-ton unit can be expected. Based on the weight limitations, route clearances and permits will be required for transporting the nacelle by road-based transport (see an example of road-based transportation below). The unit will require a minimum height clearance of 5.1 metres.

Figure 4-1:Transporting the Nacelle (Dvorak, 2010)

4.4.2 Blades

A wind turbine's 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 100m. Blades need to be transported on an extendible blade transport trailer or in a rigid container with rear steerable dollies. 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 4-2: Blade transport (Froese, 2019)

For this study, turbine blades of a maximum length of 90 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.

4.4.3 Tower Sections

Tower sections generally 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 125 metres, a maximum of 7 tower sections is required. 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.

Figure 4-3:Transporting the Tower Sections (Montiea, 2014)

4.4.4 Turbine Hub and Rotary Units

Turbine Hub need to be transported separately, due to their significant weights. A hub unit weighs around 45 tons.

Figure 4-4:Transporting the rotor hub (Richardstransport, n.d.)

4.5 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.

4.5.1 Examples of Cranes for Assembly and Erection on Site

Option 1: Crawler Crane and Assembly Crane

The main lift crane capable of performing the required lifts (i.e., lifting the tower sections into position, lifting the nacelle to the hub height and lifting the rotor and blades into place) needs to be similar to the Liebherr Crawler Crane LR1750 with an SL8HS (Main Boom and Auxiliary Jib) configuration. A smaller 200-ton Liebherr Mobile Crane LTM 1200-5.1 is also required to lift the components and assist in the assembly of the crawler crane at each turbine location.

- **Crawler Crane LR1750 with the SL8HS boom system (Main Lifting Crane):**

The Crawler Crane will be transported to the site in components and the heaviest load will be the superstructure and crawler centre section (83 tons). The gross combination mass (truck, trailer, and load) will be approximately 133 000 kg. The boom sections, counterweights and other equipment will 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 Crane before it can be mobilised to perform the heavy lifts.

Figure 4-5: Crawler Crane used to assemble turbine (Liebherr, 2017)

- **Mobile Crane LTM 1200-5.1 (Assembly Crane):**

The Liebherr LTM 1200-5.1 crane is a 5-axle vehicle with rubber tyres, which will travel to site on its own. However, the counterweights will be transported on conventional tri-axle trailers and then assembled on site. The assembly crane is required to assemble the main lift crane as well as assist in the installation of the wind turbine components.

Option 2: GTK 1100 Crane & Assembly Crane

For the single wind turbine at Coega, the GTK 1100 hydraulic crane was used (see example in Figure 3 6). The GTK 1100 was designed to lift ultra-heavy loads to extreme heights and its potential lies in being deployed on facilities such as wind farms.

Figure 4-6: Cranes at work

- **Hydraulic GTK 1100 Crane**

A key benefit of the GTK 1100 is its quick set-up due to the vertical rigging of the self-erecting tower and it can be operational in four to six hours. The crane has a small footprint of 18x18m (including the boom set-up) for a restricted job site area and its self-levelling function results in minimal ground preparation. In addition, the crane can operate at these heights with very heavy loads of up to 100 tons without a counterweight. The GTK 1100 can be transported on four truckloads including two abnormal trailers (for the Boom and Crane).

- **Mobile Crane LTM 1200-5.1 (Assembly Crane):**

As above - a smaller 200-ton Liebherr Mobile Crane LTM 1200-5.1 is also required to lift the components and assist in the assembly of the hydraulic crane at each turbine location.

4.5.2 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.

Figure 4-7: Cranes at Port of Entry

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.

4.6 Transporting Other Material and Equipment

In addition to transporting the specialised lifting equipment, the normal Civil Engineering construction materials and equipment will need to be brought to the site (e.g., sand, stone, cement, gravel for road building purposes, excavators, trucks, graders, compaction equipment, cement mixers, transformers in the substation, cabling, transmission pylons etc.). Other components, such as electrical cables, pylons, and substation transformers, will also be transported to site during construction. The transport of these items will generally be conducted with normal heavy loads vehicles.

5 IDENTIFICATION OF TRAFFIC IMPACT

5.1 Activities with potential traffic impact

The traffic expected to be generated by the proposed WEF can be divided into three phases outlined as follows.

5.1.1 Construction phase

The construction phase includes the transportation of people, construction materials and equipment to the site. This phase also includes the construction of roads, excavation of turbine footings, trenching for electrical cables and other ancillary construction works that will temporarily generate the largest amount of traffic.

The exact traffic to be generated during the construction phase cannot be determined until project planning and haulage logistics has been determined. However, for the proposes of assessing traffic impact, the major traffic contributors can be estimated to help advise on mitigation measures.

The following activities with trip generation estimates is assumed for the study:

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 (reinforced concrete materials): 60 trips per turbine (i.e., 2 040 trips for 34 turbines)
   - Heavy vehicle (road layer works): 90 trips per turbine (i.e.,3 060 trips for 34 turbines)

   The above would result in a total of 5 100 heavy vehicle trips for the full site construction.

   Based on a 18-24 month estimated construction period, with ± 235 annual average working days (five-day work week), an estimated maximum of 16 daily trips can be assumed for material delivery. This results in 4 peak hour estimated trips (a 4-hr delivery window/day is assumed).

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 can be used to reduce material delivery during peak hours.

2. **Wind turbine component delivery:** This includes delivery of wind turbine components (i.e., blades, nacelle, turbine hub, and tower sections).

   The blades, nacelle and turbine hub are expected to be transported by abnormal loads. These are expected to be shipped for the nearest port of entry (i.e., Port of Saldanha Bay). As the worst-case scenario, it will be assumed that the turbine blades will each be delivered separately.

   The wind turbine towers can be manufactured locally. Steel towers can be sourced from Atlantis or Port Elizabeth, and concrete towers can be manufactured on site or sourced from Cape town. As the worst-case scenario, it will be assumed that the towers will be sourced from a manufacturer and delivered on site.

   - Abnormal loads (turbine components): 12 trips per turbine (i.e., 408 total trips for 34 turbines)

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

3. **Construction machinery:** 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.

4. **Traffic during the Construction of Grids/Powerlines**
   The grid/ powerline expected for the site is a 132kV steel single or double structure with kingbird conductor (between 15 and 20m in height – above ground level). The powerline will typically have main components such as support masts, cables, connectors, transformers, etc.
   These components are expected to be transported by normal load vehicles.

   A standard overhead line construction methodology will be employed – drill holes (typically 2 – 3m in depth), plant poles, string conductor. It is not envisaged that any large excavations and stabilized backfill will be required, however, this will only be verified on site once the geotechnical study has been undertaken at each pole position (part of construction works).

   The traffic generated for the construction of the grid/powerline is expected to be negligible.

5. **Site personnel and workers:** Based on previous experience, the personnel during construction are envisaged to be between 150 to 200 persons. It is further assumed that 15% of the staff will comprise of skilled personnel (i.e., engineers, land surveyors, project managers etc.). The personnel will most likely reside in Sutherland, Matjiesfontein or Laingsburg as the closest communities.

Based on traffic station data sourced from the Western Cape Government Road Network Information System, there are no taxis or Busses running along the R354 running east of the site. It is recommended that the majority of construction personnel be transported to and from site by means of busses.

Busses have an average 60 passenger capacity and assuming the skilled personnel will travel by means of passenger vehicles the following trips are assumed:

- with a maximum of 170 persons expected to travel by bus, approximately 3 (three) bus trips are assumed.
- for the skilled personnel a maximum of 30 trips are expected. It is further assumed that 50% of the trips will occur during the peak hour.

Depending on the construction schedule an estimated of 18 peak hour site personnel trips is assumed for the purposes of this assessment.

6. **Total estimated peak hour trips (construction phase)**

Based on the above 22 peak hour trips can be assumed for the site excluding abnormal load vehicle trips. Due to permitting restrictions it can be assumed that less than 50 peak hour trips will be generated by the site. According to the Traffic Impact Assessment Manual TMH 16 Vol 1, traffic impact assessments are warranted if vehicle trips exceed 50 peak hour vehicles. It can therefore be assumed that trips less than this are deemed to have a negligible impact on the traffic capacity of the surrounding road infrastructure.

5.1.2 Operation and maintenance phase

The operation and maintenance phase include the operation and maintenance of the WEF. The envisaged site traffic would be limited to a few light vehicles, transporting approximately 20 employees per day.

The maintenance or replacement of wind turbine components would require a crane and abnormal vehicles. Although abnormal load vehicles would be required, the maintenance or replacement of components can be staggered, and the transportation of the components would therefore take place over a short period of time, presumably delivered in one day. Furthermore, traffic disruptions can be minimised by transporting the components during off-peak hours. This phase is therefore expected to generate minimal traffic.

5.1.3 Decommissioning phase

The decommissioning phase includes, but is not limited to, the dismantling of wind turbine components (blades, nacelle and tower), removal of electrical systems and substation, dismantling and removal of the operations and maintenance buildings, removal of wind turbine pads and removal of access/ service roads.

The decommissioning phase will generate construction related traffic including transportation of people, construction materials, water and equipment (abnormal trucks transporting turbine components). It is therefore expected that the decommissioning phase will generate the same impact as that of the construction phase.

5.1.4 Cumulative impacts

According to the Traffic Impact Assessment Manual TMH 16 Vol 1, road network capacity related impacts are considered only if a site generates more than 50 peak hour trips. It is also acknowledged that developments have an impact on the wider road network however, due to the limitations of the Traffic Impact Assessment Methodology, the assessment of wider impacts is addressed by means of master planning. Since the site is not envisaged to generate more than 50 peak hour trips the cumulative impacts considered in this study are discussed below only to help inform the master planning processes conducted by the relevant transport regulating authority.

To assess the cumulative impact, it will be assumed that all wind farms within 50km currently proposed and/or approved, would be constructed at the same time. It must be noted that this is a conservative approach.

5.1.4.1 During Construction

The total estimated construction peak hour trips are summarised in **Table 5-1.** It must however be noted that this is a conservative estimate, and the likelihood of occurrence is considered low due to the following:

- these projects would be subject to a highly competitive bidding process. Only a handful of projects would be selected to enter into a power purchase agreement with Eskom.
- even if all wind farms are constructed and decommissioned on 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.

Table 5-1:Estimated Cumulative construction trips

Developments with access routes along R354 within 50km from site	Megawatt	Estimated peak hour construction traffic (excluding abnormal loads)
Gunstfontein WEF	200	32
Hidden Valley WEF (Karusa, Soetwater)	140 each	44
Roggeveld WEF	140	22
Komsberg West Wind Energy Facility.	275	44
Esizayo WEF	140	22
Brandvalley WEF	140	22
Rietkloof WEF	183	29
Maralla East and West WEF	140 each	44
Total peak hour trips		259

5.1.4.2 During Operation

The total estimated operational peak hour trips are summarised in **Table 5-2**. It must, however, be noted that these trips will not necessarily occur during the peak hour and the access roads connect to a higher order road (i.e., R354) which is designed to accommodate high traffic volumes.

Table 5-2:Estimated Cumulative operational phase trips

Developments with access routes along R354 within 50km from site	Megawatt	Estimated daily operational traffic
Gunstfontein WEF	200	29
Hidden Valley WEF (Karusa, Soetwater)	140 each	40
Roggeveld WEF	140	20
Komsberg West Wind Energy Facility.	275	40
Esizayo WEF	140	20
Brandvalley WEF	140	20
Rietkloof WEF	183	20
Maralla East and West WEF	140 each	40
Total daily trips		229

5.1.4.3 Decommissioning Stage

It is expected that the decommissioning phase will generate the same impact as that of the construction phase.

6 ASSESSMENT OF TRAFFIC RELATED ENVIRONMENTAL IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

6.1 Potential Impact (Construction Phase or Decommissioning Phase)

The decommissioning phase will generate construction related traffic including transportation of people, construction materials, water and equipment (abnormal trucks transporting turbine components). It is therefore expected that the decommissioning phase will generate the same impact as that of the construction phase.

Nature of the impact

- Noise and dust pollution associated potential traffic congestion

Table 6-1: Impact Assessment Table (Construction Phase)

Impact number	Aspect	Description	Stage	Character		Pre-Mitigation							Post-Mitigation						
						(M+	E+	R+	D)x	P=	S	Rating	(M+	E+	R+	D)x	P=	S	Rating
Impact 1:	Traffic	Dust and noise pollution due to traffic	Construction/ Decommissioning	Negative	Moderate	3	1	3	2	5	**45**	**N3**	2	1	3	2	3	**24**	**N2**
Significance						**N3 - Moderate**							**N2 - Low**						

Proposed mitigation measures

1. The delivery of components to the site can be staggered and trips can be scheduled to occur outside of peak traffic periods.
2. Dust suppression of gravel roads during the construction phase, as required.
3. Regular maintenance of gravel roads is required by the Contractor during the construction phase and by the Owner/Facility Manager during the operational phase.
4. The use of mobile batch plants and quarries near the site would decrease traffic on the surrounding road network.
5. Staff and general trips should occur outside of peak traffic periods as far as possible.

6.2 Potential Impact (Operation Phase)

Nature of the impact

- Noise and dust pollution associated potential traffic congestion

Table 6-2:Potential Impact (Operation Phase)

Impact number	Receptor	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 1:	Traffic	Dust and noise pollution due to traffic	Operational	Negative	Very High	2	1	3	4	3	**30**	**N2**	1	1	3	4	2	**18**	**N2**
Significance						**N2 - Low**							**N2 - Low**						

Proposed mitigation measures

1. Consider scheduling shift changes to occur during off peak hours.
2. Regular maintenance of gravel roads is required by the Contractor during the construction phase and by the Owner/Facility Manager during the operational phase.

6.3 Potential cumulative Impact (Construction Phase or Decommissioning Phase)

The cumulative impact assumes that all wind farms within 50km currently proposed and/or approved, would be constructed at the same time. It must be noted that this is a conservative approach.

Nature of the impact

- Noise and dust pollution associated potential traffic

Table 6-3:Potential cumulative Impact (Construction Phase or Decommissioning Phase)

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 1:	Traffic	Dust and noise pollution due to traffic	Cumulative	Negative	Moderate	5	3	3	2	5	**65**	**N4**	3	2	3	2	4	**40**	**N3**
Significance						**N4 - High**							**N3 - Moderate**						

Proposed mitigation measures

1. The delivery of components to the site can be staggered and trips can be scheduled to occur outside of peak traffic periods.
2. Dust suppression of gravel roads during the construction phase, as required.
3. Regular maintenance of gravel roads is required by the Contractor during the construction phase and by the Owner/Facility Manager during the operational phase.
4. The use of mobile batch plants and quarries near the site would decrease traffic on the surrounding road network.
5. Staff and general trips should occur outside of peak traffic periods as far as possible.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Access and internal circulation

- For the access points, it is recommended that the road near the access point be kept clear of tall vegetation to allow for good sight lines.
- It needs to be noted that all access and internal roads should be investigated for their topographical suitability, i.e., feasibility for haulage trucks and especially abnormal loads to navigate and have sufficient height clearance for any Eskom lines, Telkom lines or similar.
- All bellmouths along the chosen site accesses to the wind turbine locations need to be in line with the required geometric standards to accommodate abnormal haulage vehicles. The exact location and upgrades of the internal access roads will need to be established at detailed design stage.
- The chosen access and circulation roads will have to be upgraded to suit abnormal load vehicle requirements. It needs to be ensured that if the access and circulation roads to the site are to remain as gravel roads, the routes need to be maintained during the additional loading experienced during the construction phase and be reinstated once construction is complete.

7.2 Haulage routes for wind turbine components

- The proposed haulage route is outlined in Section 3.2. The Port of Saldanha route was chosen as the preferred route because it provides the shortest route to the wind farm site, utilises higher order routes as far as possible and minimises travelling through towns.

- It is recommended that the respective haulage company conducts a dry-run to determine the restrictions relevant to the haulage vehicle to be utilised. With some route's road signs may need to be moved, overhead cables may need to be raised and bellmouths may need temporary widening to accommodate abnormal loads. A dry-run will help establish relevant changes specific to the abnormal load truck used to deliver the components and materials.

7.3 Traffic impact

- No capacity improvements are considered necessary based on the following:
  - The site gains access of the R354, which is a Class 2 road designed to accommodate large traffic volumes.
  - The only notable generated traffic would occur during the construction and decommissioning phases. The trips generated during these phases will only occur for short periods of time and the following mitigation measures are recommended for consideration:
    1. The delivery of wind turbine components to the site can be staggered and trips can be scheduled to occur outside of peak traffic periods,

ii. The use of mobile batching plants and any material sources in close proximity to the site would decrease the impact on the surrounding road network,
iii. Staff and general trips should can outside of peak traffic periods,
iv. Staff can be shuttled on scheduled busses to minimise the number of trips; and
v. Stagger the removal of turbines, foundations, crane pads etc during the decommissioning phase.

7.4 Assessment of traffic related environmental Impacts and Identification of Management Actions

i. This phase includes the construction of the Facility, including construction of the roads, excavations, trenching and ancillary construction works. This phase will temporarily generate the most development traffic.

The nature of environmental impact expected with construction traffic is noise and dust pollution. It is estimated that the construction traffic will have a moderate significance rating pre mitigation and a low significance rating post mitigation.

<u>Proposed mitigation measures</u>

- 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 during the construction phase, as required.
- Regular maintenance of gravel roads is required by the Contractor during the construction phase and by the Owner/Facility Manager during the operational phase.
- The use of mobile batch plants and quarries near the site would decrease traffic on the surrounding road network.
- Staff and general trips should occur outside of peak traffic periods as far as possible.

ii. The operation and maintenance phase include the operation and maintenance of the WEF

The nature of environmental impact expected with operational traffic is noise and dust pollution. It is estimated that the operational traffic will have a low significance rating pre mitigation and post mitigation.

<u>Proposed mitigation measures</u>

- Consider scheduling shift changes to occur during off peak hours.
- Regular maintenance of gravel roads is required by the Contractor during the construction phase and by the Owner/Facility Manager during the operational phase.

iii. The decommissioning phase will generate construction related traffic including transportation of people, construction materials, water and equipment (abnormal trucks transporting turbine components). It is therefore expected that the decommissioning phase will generate the same impact as that of the construction phase.

iv. The cumulative impact assumes that all wind farms within 50km currently proposed and/or approved, would be constructed at the same time. It must be noted that this is a conservative approach.

The nature of environmental impact expected is noise and dust pollution. It is estimated that the construction traffic will have a high significance rating pre mitigation and a moderate significance rating post mitigation.

The mitigation measures proposed for the construction phase are proposed for the cumulative impacts during the construction stage.

8 SUMMARY

The aim of this study was to investigate all traffic and transportation related matters pertaining to the proposed Brandvalley 140 MW WEF approximately 25km north of Matjiesfontein on the border of the Western Cape and Northern Cape provinces.

The development of this wind energy facility is supported from a traffic engineering point of view, provided that the recommendations in this report are adhered to and are read in conjunction with the road design and environmental reports completed for this site.

9 WORKS CITED

1. Dvorak, P., 2010. *Transporter simplifies shipping nacelles.* [Online] Available at: https://www.windpowerengineering.com/transporter-simplifies-shipping-nacelles/
[Accessed 02 08 2021].
2. Froese, M., 2019. *New research brings aerospace blade protection to the wind industry.* [Online]
Available at: https://www.windpowerengineering.com/new-research-brings-aerospace-blade-protection-to-the-wind-industry/
[Accessed 02 08 2021].
3. Liebherr, 2017. *Liebherr.* [Online]
Available at: https://www.liebherr.com/en/int/latest-news/news-press-releases/detail/gulf-haulage-heavy-lift-company-erects-the-first-wind-turbine-in-saudi-arabia-using-a-liebherr-lr-1750-crawler-crane.html
[Accessed 02 08 2021].
4. Montiea, B., 2014. *Company completes transportation and erection of wind turbines.* [Online]
Available at: https://www.engineeringnews.co.za/article/company-completes-transportation-and-erection-of-wind-turbines-2014-11-28
[Accessed 02 08 2021].
5. Richardstransport, n.d. *Richardstransport.* [Online]
Available at: http://www.richardstransport.com/services/wind-turbines
[Accessed 02 08 2021].

Annexure A - IMPACT ASSESSMENT METHODOLOGY

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 direct[1], indirect[2], secondary[3] as well as cumulative[4] 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 criteria[5] presented in **Table 10_1**.

Table 10_1: 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

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
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:	$[S = (E + D + R + M) \times P]$ $Significance = (Extent + Duration + Reversibility + Magnitude) \times Probability$				
IMPACT SIGNIFICANCE RATING					
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 10_1** below.

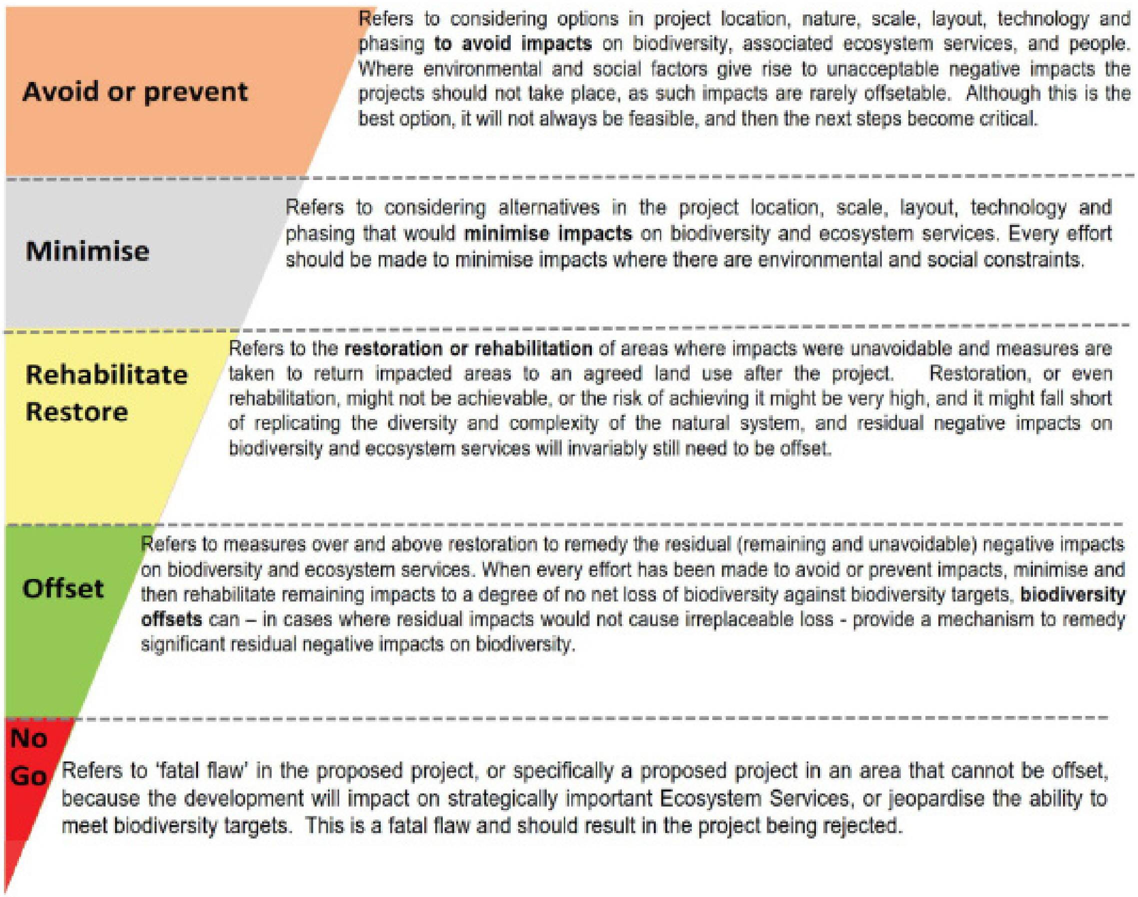

Figure 10_1: Mitigation Sequence/Hierarchy