Traffic Assessment Report for the proposed Mutsho Power Project near Makhado, Limpopo

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SUMMARY SHEET

Report Type:	Traffic Assessment Report
Title:	Traffic Screening Report for the proposed Mutsho Power Project near Makhado in Limpopo
Location:	Two potential sites at the intersection of D744 and D1021 are identified
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This Traffic Screening Report has been prepared in accordance with the requirements in the TMH 16 Vol 1 & 2 South African Traffic Impact and Site Traffic Assessment Manual, August 2012, compiled by the Committee of Transport Officials (COTO) by a suitably qualified and registered professional traffic engineering technologist. Details of any of the calculations on which the results in this report are based will be made available on request.

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1. PROJECT DESCRIPTION

Savannah (Pty) Ltd has been requested to prepare an Environmental Impact Assessment (EIA) proposal for a new coal-fired power station either near Makhado in the Limpopo Province.

The proposed project will have a generation capacity of up to 600MW and will occupy an area of land approximately 600ha in extent.

The project is proposed in response to the requirement for additional electricity generation capacity at a national level.

The construction phase is planned to take approximately 36 months and the Mutsho Power Project will have an operational period of 30 years.

2. PURPOSE OF THE REPORT

This report contains a description of the status quo transport environment and infrastructure, the transport/traffic impact for the construction and operation of the proposed power station. It considers the proposed Plant traffic impact, with reference to road transport routing and site access for the Mutsho Power Project and also assesses the Plant traffic related impacts on the environment. Where issues are identified the report makes recommendations to mitigate those impacts.

3. METHODOLOGY

This methodology followed in this report is as follows:

- The extent of the project was considered to ascertain the anticipated traffic during construction and operations;
- A site visit was undertaken on 26 & 27 June 2017 at the identified sites to view road transport access routes and access implications for the project, in relation to the background traffic and anticipated Plant traffic;
- Road conditions and road environment serving the project site was assessed and documented;
- Traffic counts were undertaken at identified intersections during the above site visits, for the AM and PM peak hours, and at the N1/D1021 intersection during the AM peak hour;
- Peak hour Plant trip generation, for the Construction and the Operations phases were determined based on the scale of the Plant and with reference to staffing requirements for a similar sized Plant;
- Assumptions were made for modal split, and vehicle numbers were determined based on anticipated staffing levels (Management/Specialist Staff and Construction Staff numbers), vehicle types and vehicle capacity;
- Trips were distributed in proportion to the observed staff origins to the north and south of the site, and were assigned to the road network accordingly;
- Where relevant, intersection capacity analysis was carried out with background traffic grown at 2% pa; and
- A Traffic Impact Assessment was carried out, for the project construction and the operations phases, to highlight the Plant transport related environmental impacts.

4. PLANT LOCATION

The two sites which comprise the project area, Farm Du Toit No. 563 and Farm Vrienden No. 589, are located in the Limpopo Province, at the intersection of D744 and D1021 roads.

The sites are approximately midway between Louis Trichardt and Musina and are some 12 km west of the N1 (see **Figure 4-1** and **Figure 4-2** below).

Figure 4-1: Locality Map 1

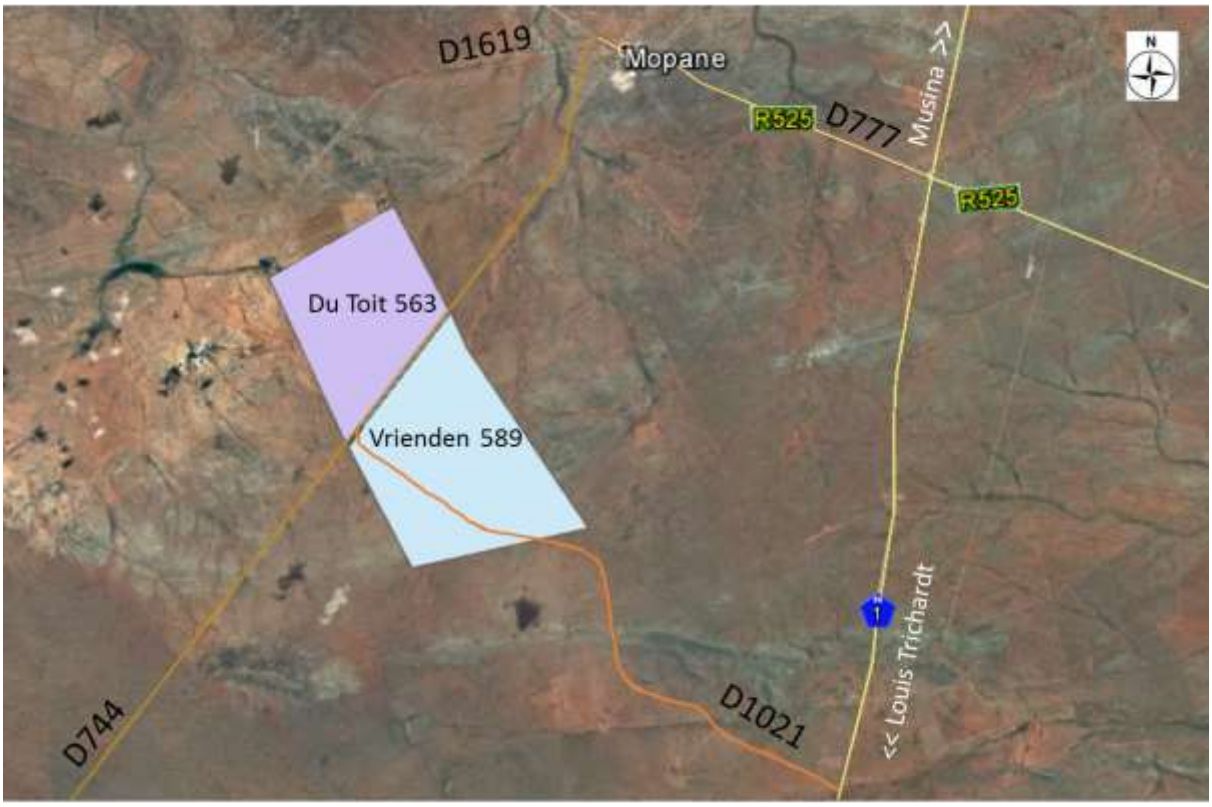

Figure 4-2: Locality Map 2

5. STATUS QUO

The following section summarises the present conditions impacting on traffic and transportation for the proposed Plant of the Mutsho Power Project.

5.1. Provincial Roads and Traffic Volumes in the Surrounding Area

Peak hour classified traffic counts were undertaken in July 2017 at the following intersections:

- N1 / D1021 (AM)
- D744 Road / D1021 Road (AM and PM)
- D777 Road & D744 Road (AM and PM)

D744 and D1021 are secondary roads that carry very low traffic volumes (<10 vehicles per hour). D777 also carries low traffic volumes (less than 50 vph).

The major road in the vicinity of the study area is the N1, between Louis Trichardt and Musina. This section of the N1 carries low traffic volumes, but has a high percentage of heavy vehicles (Over 25% heavy vehicles counted but generally some 17% based on annual traffic count data). The heavy vehicles comprise mainly freight trucks and buses.

The AM traffic volume on the N1 is low, as shown in **Table 5.1** below.

Table 5.1: AM Traffic counts on N1 at N1/D1021 junction

1 Hr Vehicle Count on N1 at N1/D1021 Junction (27 June 2017)									
Time	SB - To Louis Trichardt				NB - To Mussina				Sum
	P Veh	HV	Taxi	Bus	P	HV	Taxi	Bus	
7:15 - 7:30	18	10	1		21	5	2	0	57
7:30 - 7:45	14	2	1		13	1	2	1	34
7:45 - 8:00	9	2	1		23	4		2	41
8:00 - 8:15	10	7		3	22	10			52
Vph	51	21	3	3	79	20	4	3	184
	78				106				
Directional Split (%)	42%				58%				100%
EVU ph	51	63	3	9	79	60	4	9	278
SUM	126				152				
Directional Split (%)	45%				55%				100%

In view of the low background traffic flow at the above intersection, and observations of traffic flow during the PM, the intersection was not counted for the PM.

5.2. Description of Road Infrastructure

The roads in the immediate vicinity of the site are shown in **Figure 4-1** and **Figure 4-2** and Appendix B – Pictures, are discussed below:

N1: Paved National Route with north south orientation located some 12km east of the site. It has one lane in each direction carrying low volumes of traffic during the critical peak hours but a high proportion of heavies throughout the day. The road is in a fair condition, but pavement deformation is evident in some areas. This section of the N1 is due to be upgraded.

D744: Gravel District road with north-south orientation. One lane in each direction and carries very low volumes of traffic during peak hours. The road condition is poor.

D777: Paved District road with east-west orientation. One lane in each direction and carries low volumes of traffic during peak hours. The road condition is good.

D1021: Gravel District road with east-west orientation. One lane in each direction and carries very low volumes of traffic during peak hours. The road bisects Farm Vrienden No. 589. The road condition is poor.

5.3. Location of Staff Residences

The major source of construction workers, and employees for the proposed power station are anticipated to be Makhado and nearby townships to the south and Musina to the north.

5.4. Other Transport Infrastructure

A railway line runs parallel to and east of D744. This could be used to transport and deliver sorbent, and other equipment and a new rail siding will be required. A gravel road will be required to provide access to the new rail siding. The rail line links Pretoria to Zimbabwe at Beit Bridge, via Musina.

6. SITE ACCESS

6.1. Site Access

Access to the two sites are as discussed below:

Farm Du Toit No. 563
Access to the subject property is from D744.

The site abuts D744 and is virtually opposite the D744/D1021 intersection (see **Figure 4-2**).

In view of the close proximity of the railway line to D744 (see **Photograph 6-1** below) access to this site should be located on D744 and to the north of D744/D1021 junction, to accommodate vehicle stacking, etc. (See Appendix B for further photos).

Photograph 6-1: D1021 viewed from D744. Note railway level crossing.

Farm Vrienden No. 589
Access to the subject property can be from D1021.

The site access would need to be positioned sufficiently far from the D744/D1021 junction and the railway level crossing for road safety and also requires careful placement in view of road geometry, in order to achieve adequate shoulder sight distance around bends.

7. SITE ACCESS ROUTING

7.1. Site Accessibility/Routing

Figure 7-1 below shows approximate travel distance along various road segments leading to the two identified sites.

Figure 7-1: Routes to Proposed Plant

7.1.1. To and from the north (Musina)

The preferred route is along the paved N1 and paved D777 and along gravel road D771.

This route has 3.5 km less gravel road and 5.5 km less paved road (total distance some 9 km shorter) as opposed to travelling via the N1 and D1021 from the north. This route also avoids the Baobab Toll Plaza on the N1 (see **Figure 7-1** above).

The N1 is a high speed, high capacity two-lane road, and has sufficient spare capacity to accommodate the Plant traffic.

The D777 is an underutilised paved roadway with sufficient spare capacity to accommodate the Plant traffic. It traverses a railway level crossing and passes through Mopane (a small town with few inhabitants). Mopane is characterised by lack of sidewalks, with people and some cattle walking in the streets. The boarding school located in Mopane caters for the scholars needs, including shopping, entertainment, etc., and children are not allowed to leave the premises to go to town.

D771 is a quiet two-lane gravel road and is shared by vehicles and a few pedestrians.

7.1.2. To and from the south (Makhado)

The preferred / shortest route to and from the south is along the paved N1 and gravel road D1021 (12.5 km).

D1021 is a quiet two-lane gravel road shared by vehicles and a few pedestrians. Animals were observed being herded across the road on occasion.

7.2. Routes selected to serve the Plant

Considering the above, and the intention to source construction workers and staff from townships to the south (Makhado and others nearby) as well as Musina to the north, both of the above-mentioned routes should be used to serve the Plant, regardless of which site is selected, particularly during the construction period. Consequently, both of these routes are assessed.

8. ASSUMPTIONS FOR TRAFFIC IMPACT ASSESSMENT

8.1. Workforce and Vehicle Trips

The number of employees and vehicles generated/attracted to the proposed 600 MW Mutsho Power Project is based on the staffing requirements for similar sized Plant. It is understood that the ash disposal site will be located in close proximity to the proposed Mutsho Power Project, within the same project site.

8.2. Coal Supply

Coal required for the project will be sourced from the Makhado Colliery to be developed approximately 20km south-west of the project site. Coal will be transported to site either via a new 22km railway loop proposed for development between the Makhado Colliery and existing Huntleigh railway siding, or via road transport.

8.3. Sorbent

Limestone will be transported to site either via rail or road transport.

8.4. Ash Handling

The transport of ash from the power station to the ash dump will be via ground level conveyor systems. The dry ash will be conditioned by the addition of water at the power station to ensure dust generation is minimised.

8.5. Access Design

Access to the power station and the ash stack area will be from D771 and / or D1021 (to be decided during further design planning). The access intersection configuration will need to be designed accordingly.

Alternate access for construction access and delivery of equipment and material will also be determined and designed accordingly.

It is assumed that on any normal day all coal, sorbent and ash will be moved within the project site via the conveyor system. Consequently, the only road based impact would be staff movement to and from the power station and the ash stack.

9. TRAFFIC IMPACT ASSESSMENT

9.1. Traffic Impact

The **Construction Phase Traffic** and **Operation Phase Traffic impact** is determined based on the Plant build and operations staffing and transport needs. Trip generation and modal split are determined and Plant trips distributed and assigned to the road network with reference to the staff origins/places of residence. Critical road elements/intersections are identified for capacity analysis.

9.2. Construction Traffic

This traffic relates directly to the traffic expected during the construction of the Makhado Power station and the ash stack facility which is expected to take place over a period of 36 months including testing and commissioning of the units. It is expected that Plant will begin operations 36 months from the start of site preparation. With construction completed the Plant trips will be substantially reduced.

It is estimated that a peak number of construction staff will be 2500 persons per month. The worst-case scenario would be when the same number of staff arrives on site each day. As a conservative approach, it was therefore assumed that all 2500 workers will be on site each day. The majority of the workforce is expected to be local from Makhado and nearby towns and a small portion from Musina.

10% of the construction personnel are expected to use private cars while the remainder is expected to make use of a bus shuttle service provided for by the contractor.

A total of 250 people is expected to use private vehicles and the remaining 2250 will use buses from local residential areas.

Assuming a vehicle occupancy of 1.2 per vehicle, 208 light vehicle trips are expected to be generated by mostly management, specialists, engineers, etc.

20 seater, 40 seater, and 60 seater buses will be used to shuttle the construction staff from various township in close proximity to the site. For staff transport to site, 20% are assumed to use 20 seater buses; 30% to use 40 seaters and the remaining 40% to use 60 seater buses. These trips are expected to arrive in the morning and leave in the afternoon. The contractor is expected to provide a secure holding area for the buses.

The peak construction period is expected to generate about 40 trucks per day with 50% expected to arrive during the morning (AM) peak hour and depart during afternoon (PM) peak hour.

The total peak hour trips expected to be generated by the construction phase is shown in **Table 9.1** below. For the AM peak hour an 80/20% in/out split for all vehicles is assumed (and visa-versa in the PM).

The impact of heavy vehicle traffic in terms of capacity is expected to be minimal.

Construction related trips are shown in **Table 9.1** below:

Table 9.1: Construction Traffic

Vehicle Trips (AM and PM Peak Hr)						
Description	**% or #**	**Peak Hr Trips**				
Vehicle Classification		Light Veh	Heavy Vehicles			
Vehicle Type		Passenger	Buses			Trucks
Vehicle Occupancy		1,2	20	40	60	
% by Mode	100%	10%	20%	30%	40%	
# Staff	2500	250	500	750	1000	
# Vehicles	269	208	25	19	17	20
SUM		**208**	**80**			
To and From South	85%	177	68			
To and From North	15%	31	12			

It is difficult to accurately determine the heavy vehicle traffic to the site, in the absence of a project program and transport logistics. The sources of construction materials, supply of material components and the construction programme all influence the nature and frequency of road-based vehicle transport to and from the site. The main source of construction material is assumed to be from Gauteng. The raw materials for the plant will be transported either by road or rail transport.

9.3. Transport of Abnormal Load Components during Construction

The estimated dimensions and gross weights of heavy and oversize equipment and components to be delivered to the Plant site are a function of the project build planning, which details are not yet disclosed. These items typically comprise Cranes, Deaerators and Deaerator Tanks, Transformers, Generators, Turbines, Boiler Drums, etc. Abnormal load transport permits are required for the transport of abnormal loads.

Abnormal loads would need to be transported to the site from Durban harbour or possibly Richards Bay.

The most likely route from Durban harbour follows National Route N3 and turns off at the N11, travelling through Ladysmith and Newcastle and then turning onto the N1 near Mokopane. On the N1 it travels north through Polokwane and through Louis Trichardt, eventually turning off at the D1021 to access the proposed power station site some 12.5 km to the west.

Although the tonnage is expected to be significant the low frequency of the trips means that the traffic loading impact is negligible.

Turning radii of 15m are required for the large super-link loads and the access gate should be set back sufficiently to accommodate vehicles standing off the public road.

9.4. Operational Traffic

The facility will operate 24 hours a day. An estimated total number of Operation and Maintenance staff is 200 working on three shifts rotations. It is assumed that 50 staff at the end of a shift will not leave the site until the next 50 shift workers have assumed duty. It is assumed that operations staff will be transported via a taxi shuttle service.

A 10% / 90% modal split between private cars and shuttle taxis respectively was assumed.

A taxi shuttle service will be provided for the operations phase. The modal split will see approximately 8 light vehicles and 4 taxis during the operations phase.

Should the new rail loop between the Makhado Colliery and existing Huntleigh railway siding not be built, coal will need to be transported by road. It is estimated that 45 x 20 Tonne trucks per hour will be required, to supply the required coal, over an 8-hour day. Transport of Limestone could require a further 10 trucks per hour for an eight-hour day.

This equates to 55 trips in and 55 trips out during an hour.

The trip generation during this phase is lower than during the Construction Phase.

9.5. Critical Peak Hours

The critical peak hour from a road capacity point of view, occurs when the traffic generated by the Plant is at a maximum or when the highest combination of existing road traffic and traffic generated by the Plant occurs.

The critical Plant peak hours are:

- Weekday AM peak hour; and
- Weekday PM peak hour.

9.6. Trip Distribution and Trip Assignment

The new trips that are expected to be generated by the proposed Plant were distributed and assigned to the adjacent road network based on the road layout and likely routing and with reference to the observed size of townships to the south and north of the site that will supply staff for the Plant build and operations.

For the Construction Phase:

- The following trip distribution was assumed for the Plant:
- 85% to / from the south; and
- 15% to / from the north.

The expected trip distribution is shown in Table 9.2 below.

Table 9.2: Peak Hour Trip Distribution

Peak Hour Trip Distribution							
To and From South				To and From North			
Light Vehicles		Heavy Vehicles		Light Vehicles		Heavy Vehicles	
AM in / PM Out	AM Out/PM IN	AM in / PM Out	AM Out/PM IN	AM in / PM Out	AM Out/PM IN	AM in / PM Out	AM Out/PM IN
85%	15%	85%	15%	85%	15%	85%	15%
151	27	58	10	27	5	10	2
177		68		31		12	

Tips for the Construction Phase are assigned to the critical N1/D1021 intersection as shown in **Error! Reference source not found.** and **Error! Reference source not found.** below

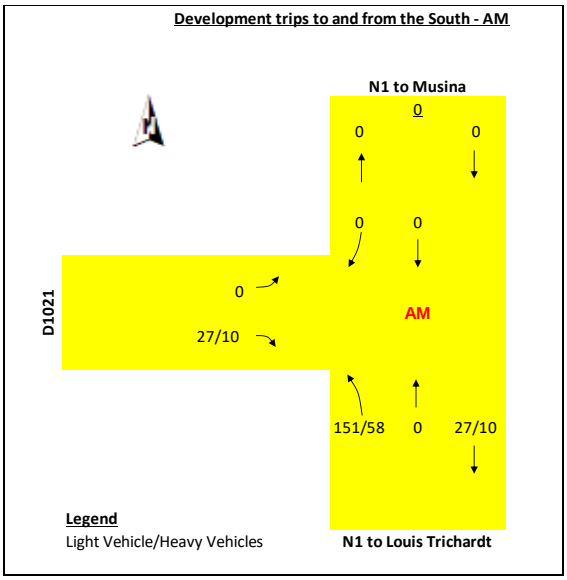

Figure 9-1: Trip Assignment at N1/D1021 Intersection - AM

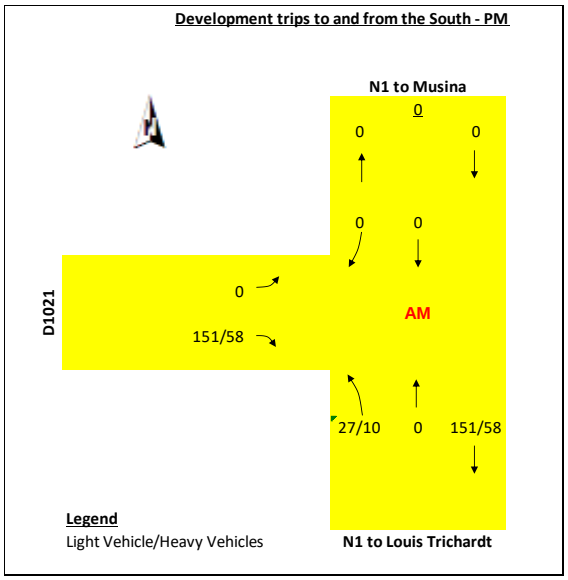

Figure 9-2: Trip Assignment at N1/D1021 Intersection – PM

For the Operations Phase all trips are assumed to be to and from the south, for analysis purposes. It is possible that a few trips might be to and from the north. Tips for the Construction Phase are assigned to the critical N1/D1021 intersection as shown in **Figure 9-3** and **Figure 9-4** below

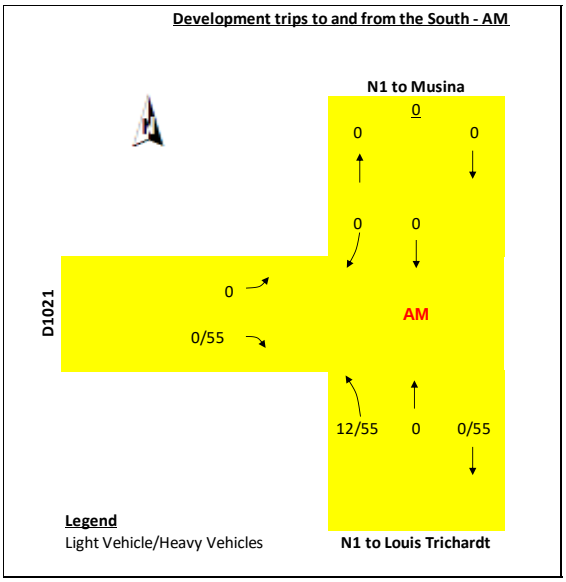

Figure 9-3: Trip Assignment at N1/D1021 Intersection - AM

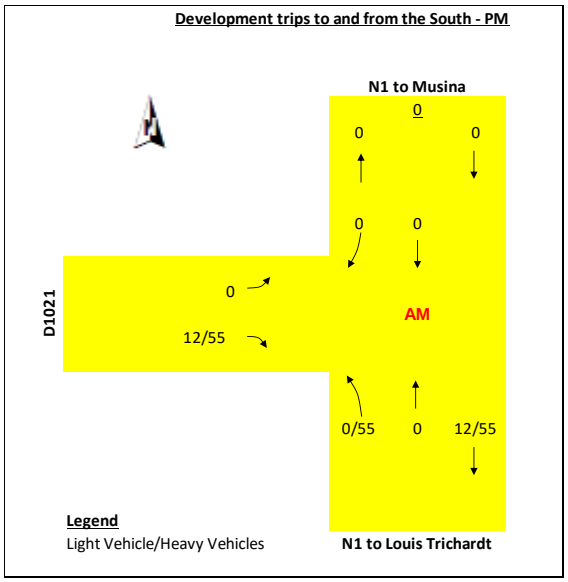

Figure 9-4: Trip Assignment at N1/D1021 Intersection – PM

9.7. Latent Traffic Demand and Traffic Growth

No Plants are anticipated in the immediate area and a conservative growth rate of 2% per annum was assumed for the N1.

9.8. Assessment Years

The assessment year(s) and different scenarios considered for the Plant are discussed below:

- **Year 2017**: Background traffic volumes are low and Level of Service (LOS) A was observed on the critical N1/D1021 intersection approaches. This scenario does not warrant Analysis.
- **Scenario 1: Horizon Year 2021:** The expected 2021 traffic conditions are based on the 2017 background traffic adjusted for growth (2% per annum for 4 years). This is the year with the highest background and Plant (construction) traffic and is therefore analysed. The background AM peak flow was mirrored for the PM analysis.
- **Scenario 2: Horizon Year 2031:** Background traffic volumes are low and the traffic is lower than the Construction Phase.

9.9. Assessment Scenarios

Three scenarios were considered for analysis and are discussed below:

- **Scenario 1 - 2017: The current scenario** is not analysed in view of low background traffic flow and negligible traffic on the lower order/gravel roads.
- **Scenario 2 – 2021: The Construction Phase** has higher trip generation than the Operations Phase. It is assumed that the Construction Phase will commence in year 2018 and will reach completion 3 years later. The year 2021 represents the scenario with the highest traffic impact. With the bulk of traffic expected to route along D1021 and the N1 towards the south, this intersection is therefore analysed, for both critical peak periods, for the chosen horizon year (Year 2021).
- **Scenario 3 – 2031: The Operations Phase** will generates less trips than the Construction Phase, during the peak hour. It will however generate a regular hourly truck trips, if the rail loop is not constructed. It is analysed for 10 years into the Operations Phase. These trips will be considerably reduced if the rail loop is built.

9.10. Intersection Capacity Evaluation

Intersection Capacity Analysis was not carried out on the intersections along D777 in view of the low background traffic volumes and low development trips assigned to the areas north of the site.

Intersection Capacity Analysis of the critical N1/D1021 intersection was undertaken using the Signalised and Unsignalised Intersection Design Research Aid (SIDRA) analysis software program, Version 6.1 Plus, for the horizon years (year 2021 and 2031) with traffic growth and with construction traffic). SIDRA default settings were used in the analysis.

Level of Service (LOS) definitions are shown in Table 9.3 below:

LOS	Signalised Intersection and Traffic Roundabouts	Unsignalised Intersections
A	≤ 10 sec	≤ 10 sec
B	10-20 sec	10-15 sec
C	20-35 sec	15-25 sec
D	35-55 sec	25-35 sec
E	55-80 sec	35-50 sec
F	≥80 sec	≥50 sec

Table 9.3: Level of Service Criteria (HCM)

9.10.1. SCENARIO 1 - 2017 Traffic Conditions

The following conclusions can be drawn from observation on-site and from capacity analysis results:

Intersection N1/D1021:
The D1021 approach to the N1 operates at an acceptable LOS A in both the AM and PM Peaks in Year 2017, with LOS A on the N1 intersection approaches, as observed on site.

9.10.2. SCENARIO 2 - 2021 Background Traffic Demand with Construction Traffic

Intersection N1/D1021:
The D1021 approach to the N1 is expected to operate at an acceptable LOS B in the AM Peak and LOS C in the PM Peak, with LOS A on the N1 intersection approaches for both peak hours.

9.10.3. SCENARIO 3 - 2031 Background Traffic Demand with Operations Traffic

Intersection N1/D1021:
The D1021 approach to the N1 is expected to operate at an acceptable LOS C, with LOS A on the N1 intersection approaches for both peak hours.

10. IMPACT ASSESSMENT METHODOLOGY

10.1. Impact Assessment Methodology

The Impact Assessment Methodology assists in evaluating the overall effect of a proposed activity on the environment. The environmental impact is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts is undertaken through an assessment of the significance of the impacts.

10.2. Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence, as shown in Table 1.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact. Significance is calculated using the Impact Ratings System as described below.

10.3. Impact Rating System

Impact assessment takes account of the nature, scale and duration of the effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages:

- Planning (*Not applicable in this instance – no traffic impact*)
- Construction
- Operation
- Decommissioning (*Not evaluated during site selection, will cope with short-term traffic of less intensity than compared to constructing traffic*)

Where necessary, the proposal for mitigation or optimisation of an impact is detailed. A brief discussion of the impact and the rationale behind the assessment of its significance is included.

A rating system is used to classify the impacts. The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue, the following criteria (including an allocated point system) is used:

Direct, indirect and cumulative impacts of the issues identified through the scoping study, as well as all other issues identified in the EIA phase must be assessed in terms of the following criteria:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.

- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of Plant) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):

- The **duration**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - medium-term (5–15 years) – assigned a score of 3;
  - long term (> 15 years) - assigned a score of 4; or
  - permanent - assigned a score of 5;

- The **consequences (magnitude)**, quantified on a scale from 0-10, where
  - 0 - is small and will have no effect on the environment,
  - 2 - is minor and will not result in an impact on processes,
  - 4 - is low and will cause a slight impact on processes, is moderate and will result in processes continuing but in a modified way,
  - 8 - is high (processes are altered to the extent that they temporarily cease), and
  - 10 - is very high and results in complete destruction of patterns and permanent cessation of processes.

- The **probability** of occurrence, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where
  - 1 - is very improbable (probably will not happen),
  - 2 - is improbable (some possibility, but low likelihood),
  - 3 - is probable (distinct possibility),
  - 4 - is highly probable (most likely) and
  - 5 - is definite (impact will occur regardless of any prevention measures).

- the **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
- the **status**, which will be described as either positive, negative or neutral.
- the *degree* to which the impact can be *reversed*.
- the degree to which the impact may cause irreplaceable loss of resources.
- the *degree* to which the impact can be *mitigated*.

The **significance** is calculated by combining the criteria in the following formula:
S=(E+D+M)P

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:
- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

Assessment of impacts are summarised in table format. The rating values as per the above criteria are included. The table and associated ratings are completed for **each** impact identified during the assessment.

10.4. Impact Assessment

The impact assessment is shown in Table 10.1 to

Table 10.4 below, in accordance with the above methodology.

Table 10.1: Ratings of impacts (Gravel road integrity and dust) – Construction Phase

IMPACT TABLE – CONSTRUCTION PHASE		
Environmental Parameter	Road network.	
Issue/Impact/Environmental Effect/Nature	Increase in traffic volumes (heavy and light vehicles) on low volume gravel roads (D771 and D1021) resulting in deterioration of the road and increased dust.	
Extent	The extent of the road network affected is small, with construction workers and staff living in relatively close proximity to the Plant.	
Probability	There is a 100% probability that the Plant will result in increased traffic volumes during construction should the Plant proceed.	
Reversibility	Construction traffic will only occur during the 3 years construction phase.	
Irreplaceable loss of resources	The Plant will result in increased vehicle trips burning fossil fuels.	
Duration	3 years	
Cumulative effect	The Plant will result in increased vehicle trips causing more dust over abutting land and the road reducing driving visibility road and causing rapid deterioration of the gravel roads (D771 and D1021).	
Intensity/magnitude	The Plant traffic impact will substantially impact on the gravel roads (D771 and D1021)	
Significance Rating	The anticipated impact has a medium negative impact rating and will require some mitigation.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	(Low) 2	(Low) 2
Duration	(Short-term) 2	(Short-term) 2
Intensity/magnitude	(Low) 4	(Low) 2
Probability	(High) 4	(High) 4
Significance rating	(Medium) 32	(Low) 24
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Yes	Yes
Can the impacts be mitigated	Yes	No
Mitigation measures	Gravel roads (D771 and D1021) up to the Plant should be hard surfaced to accommodate increased vehicle traffic and to cut down on dust.	

Table 10.2: Ratings of impacts (Road and Pedestrian safety) – Construction Phase

IMPACT TABLE – CONSTRUCTION PHASE		
Environmental Parameter	Road network.	
Issue/Impact/Environmental Effect/Nature	Increase in traffic volumes (heavy and light vehicles) impacts on road safety, particularly in Mopane and along gravel roads D771 and D1021 with no clear space for pedestrians. Presence of cattle / animals in the travelled way also compromises road safety.	
Extent	The extent of the road network affected is small, with construction workers and staff living in relatively close proximity to the Plant.	
Probability	There is a 100% probability that the Plant will result in increased traffic volumes during construction should the Plant proceed.	
Reversibility	Construction traffic will only occur during the 3 years construction phase.	
Irreplaceable loss of resources	The Plant will result in increased vehicle trips burning fossil fuels.	
Duration	3 years	
Cumulative effect	The Plant will result in increased vehicle trips.	
Intensity/magnitude	The Plant traffic impact will temporarily add a significant traffic volume to the N1 and local road network	
Significance Rating	The anticipated impact has a medium negative impact rating and will require some mitigation.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	(Low) 2	(Low) 2
Duration	(Short-term) 2	(Short-term) 2
Intensity/magnitude	(Low) 4	(Low) 3
Probability	(High) 4	(High) 4
Significance rating	(Medium) 32	(Low) 28
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Yes	Yes
Can the impacts be mitigated	Yes	No
Mitigation measures	Sidewalks should be provided along D777 in Mopane to separate pedestrians from Plant / through traffic. Gravel roads (D771 and D1021) up to the Plant should be hard surfaced to accommodate increased vehicle traffic and hard shoulders should also be provided to accommodate pedestrians along at least one side of the roadway. Signage alerting motorists to pedestrians and possible animals should also be erected along these routes.	

Table 10.3: Ratings of impacts (Gravel road integrity and dust) – Operations Phase

IMPACT TABLE – OPERATIONS PHASE		
Environmental Parameter	Road network.	
Issue/Impact/Environmental Effect/Nature	Increase in traffic volumes (heavy and light vehicles) on low volume gravel roads results in severe deterioration of the low order gravel roads (D771 and D1021) and causes increased dust (nuisance and road safety issue).	
Extent	The extent of the road network affected is small, with construction workers and staff living in relatively close proximity to the Plant.	
Probability	There is a high probability that the Plant will result in increased traffic volumes during construction.	
Reversibility	Operations traffic will occur during the 30 years operations phase.	
Irreplaceable loss of resources	The Plant will result in increased vehicle trips burning fossil fuels.	
Duration	30 years	
Cumulative effect	The Plant will result in increased vehicle trips.	
Intensity/magnitude	The Plant traffic impact will temporarily add traffic to the N1 and local road network	
Significance Rating	The anticipated impact has a medium negative impact rating and will require some mitigation.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	(Low) 2	(Low) 2
Duration	(Long-term) 4	(Long-term) 4
Intensity/magnitude	(Low) 4	(Low) 2
Probability	(High) 4	(High) 4
Significance rating	(Medium) 40	(Medium) 32
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Yes	Yes
Can the impacts be mitigated	Yes	No
Mitigation measures	Gravel roads (D771 and D1021) up to the Plant should be hard surfaced to accommodate increased vehicle traffic and to cut down on dust.	

Table 10.4: Ratings of impacts (Road and Pedestrian Safety) – Operations Phase

IMPACT TABLE – OPERATIONS PHASE		
Environmental Parameter	Road network.	
Issue/Impact/Environmental Effect/Nature	Increase in traffic volumes (heavy and light vehicles) impacts on road safety, particularly in Mopane and along gravel roads with no clear space for pedestrians. Presence of cattle/animals in the travelled way also compromises road safety.	
Extent	The extent of the road network affected is small, with construction workers and staff living in relatively close proximity to the Plant.	
Probability	There is a 100% probability that the Plant will result in increased traffic volumes during construction should the Plant proceed.	
Reversibility	Operations traffic will occur during the 30 years operations phase.	
Irreplaceable loss of resources	The Plant will result in increased vehicle trips burning fossil fuels.	
Duration	30 years	
Cumulative effect	The Plant will result in increased vehicle trips.	
Intensity/magnitude	The Plant traffic impact will temporarily add traffic to the N1 and local road network	
Significance Rating	The anticipated impact has a medium negative impact rating and will require some mitigation.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	(Low) 2	(Low) 2
Duration	(Long-term) 4	(Long-term) 4
Intensity/magnitude	(Low) 4	(Low) 3
Probability	(High) 4	(High) 4
Significance rating	(Medium) 40	(Medium) 36
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Yes	Yes
Can the impacts be mitigated	Yes	No
Mitigation measures	Sidewalks should be provided along D777 in Mopane to separate pedestrians from Plant / through traffic. Gravel roads (D771 and D1021) up to the Plant should be hard surfaced to accommodate increased vehicle traffic and to cut down on dust. Hard shoulders should also be provided to accommodate pedestrians along at least one side of the roadway. Signage alerting motorists to pedestrians and possible animals should also be erected along these routes.	

Table 10.5: Ratings of impacts (Traffic Safety) – Operations Phase

IMPACT TABLE – OPERATIONS PHASE		
Environmental Parameter	Road network.	
Issue/Impact/Environmental Effect/Nature	Increase in traffic volumes (heavy vehicles) along the N1 and route to Mopane Collieries throughout the day impacts on road safety.	
Extent	The extent of the road network affected is small, with the Mopane Collieries in relatively close proximity to the Plant.	
Probability	There is a strong probability that the Plant will result in increased traffic volumes during Operations.	
Reversibility	Operations traffic will occur during the 30 years operations phase.	
Irreplaceable loss of resources	The Plant will result in increased vehicle trips burning fossil fuels.	
Duration	30 years	
Cumulative effect	The Plant will result in increased vehicle trips.	
Intensity/magnitude	The Plant traffic impact will temporarily add traffic to the N1 and local road network.	
Significance Rating	The anticipated impact has a medium negative impact rating and will require some mitigation.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	(Low) 2	(Low) 2
Duration	(Long-term) 4	(Long-term) 4
Intensity/magnitude	(Low) 4	(Low) 2
Probability	(High) 4	(High) 2
Significance rating	(Medium) 40	(Low) 16
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Yes	Yes
Can the impacts be mitigated	Yes	No
Mitigation measures	Construct new rail loop between the Makhado Colliery and existing Huntleigh railway.	

11. CONCLUSIONS AND RECOMMENDATIONS

It is concluded that;

1. The proposed Mutsho Power Project trip generation will peak during the 3 year construction phase;
2. Abnormal Load vehicles will be required to transport various components to the site during the construction phase;
3. A rail siding and loading platfrom will be required to deliver sorbent to the site and other equipment,
4. Overland conveyor system will transport coal and conditioned ash on-site;
5. Gravel service roads (on-site) wil be used for maintenance purposes and will also serve as back up should conveyors fail on occasion;
6. Staff transport, and deliveries to site will load traffic onto the road network, mostly during the construction phase;
7. During Operations Phase coal and Limestone will be transported from Mokhado Colleries to the plant by road, unless the rail loop between Makhado Colleries and Huntleigh Railline is contructed,
8. The N1, D777 and D744 will provide access to the site from the north (Musina);
9. The N1 and D1021 will provide access from the south to the site (Makhado and surrounidng towns);
10. The bulk of Plant traffic will route along the D1021 and along the N1 towards Makhado in the south;
11. The critical N1/D1021 intersection approaches will yield acceptable Levels of Service in the Construction Phase Horizon Year (2021) and the Operations Phase Horizon Year (2031);
12. The gravel roads (D744 and D1021) will need to be hard surfaced to prevent dust (environmental, road safety and pedestrian safety issues) and to provide an acceptable road surface for the Plant traffic (road maintenance, vehicle accessibility, road safety issues);
13. A hardened shoulder, on at least one side of the D1021 and D777, should be provided for pedestrian safety,
14. Signage should be erected along the D1021 and D744 warning motorists of possible pedestrians and cattle/animals along the road.

It is recommended that:

1. The rail loop btween Makhado Colleries and Huntleigh be constructed to enable coal and limestone transport by rail rather than road, with associated traffic danger and pavement loading;
2. Site access design be submitted for approval when the development planning is undertaken;
3. The gravel roads (D744 and D1021) be hard surfaced to prevent dust and to provide an acceptable road surface for the Mutsho Power Plant traffic;
4. A hardened shoulder be provided on at least one side of the D1021 and D777, for pedestrian safety,
5. Signage be erected along the D1021 and D744 warning motorists of possible pedestrians and cattle/animals along the roads.

12. REFERENCES

1. TMH 16 Vol 1 & 2 South African Traffic Impact and Site Traffic Assessment Manual, August 2012, compiled by the Committee of Transport Officials (COTO).

2. South African Trip Generation Rates, Second Edition, Department of Transport – June 1995

3. Institute of Transport Engineers Trip Generation Manual 8th Edition

4. http://www.mmegi.bw/index.php?sid=4&aid=322&dir=2010/February/Monday22

APPENDIX A: SITE DRAWING

NOT AVAILABLE AT TIME OF THIS REPORT

APPENDIX B: PICTURES

D744 NEAR D1021	
 D744 view south towards D1021	 D744 view south towards D1021
 D744 view south towards D1021 intersection	 Signage on D744
 D744 - Exposed culvert	 D744 – Drift (low water course crossing)

D744 soft sand

D744 Vertical alignment restricting sight distance viewed towards D102

D744 – soft sand towards Mopane

Horizontal Curve viewing towards south (towards D1021 ahead on left)

Inside horizontal curve viewing to north

(i.e. access to site along D744 will need to be carefully considered in design stage)

D777 IN AND NEAR MOPANE	
 Cattle on D777 in Mopane	
 D777/ local street (to station and hostel) intersection	 Station entrance on local street in Mopane
 D777 in Mopane (lack of sidewalks for pedestrians)	 D777/access to Mopane School Hostel
 D777 westbound approach to Mopane (note pedestrians and commuter waiting for taxi/bus)	

N1/D777 INTERSECTION	
 N1/D777 Intersection (view towards N1 along D777)	 N1/D777 Intersection (view from N1 along D777)
 N1/D777 Intersection (view north along N1)	 N1/D777 Intersection (view south along N1, towards the Boabab Toll Plaza)

D777 IN AND NEAR MOPANE	
 D777 looking east towards rail level crossing	 D777 looking west towards Mopane from rail level crossing
 Level crossing on D777 in Mopane viewing north	 Level crossing on D777 in Mopane viewing south
 D777 exiting Mopane viewing towards bend before railway level crossing	 D777 (approach from N1) viewing towards Mopane
 D777 viewing towards school hostel access	

D744 NEAR MOPANE	
 D744 towards Mopane (soft sand on gravel road)	 D744 towards Mopane (soft sand on gravel road)
 DR744 towards Mopane (soft sand on gravel)	 DR744 towards Mopane (last 3 km better graded)
 D744/D777 intersection	 D744/D777 Mopanie ahead
 D744 viewed from D777	 D744 viewed from D777

D777 looking west from D744 intersection

N1/D1021 INTERSECTION	
 N1/D1021 intersection (looking east towards N1)	 N1/D1021 intersection (looking west along D102)
 N1/D1021 intersection (looking north along N1)	 N1/D1021 intersection (looking south along N1)
 N1/D1021 intersection (looking north along N1)	 N1/D1021 intersection (looking south along N1)
	

N1/D1021 intersection (bleeding road surface bleeding on N1  N1/D1021 intersection (pavement distress on N1)	N1/D1021 intersection (looking north along N1

D1021	
 D1021 viewed west (near possible site access location)	 D1021 viewed east (near possible site access location)
 Livestock herded/crossing D1021	
 D1021 looking west towards Huntleigh	
 D1021 - railway line level crossing	 D1021 - railway line level crossing warning signage

D1021 - Sight line to north at rail level crossing limited by narrow cutting and rail line geometry

D1021 - Sight line at rail level crossing ok to south

D102/D744 intersection (looking west towards D744)

D102/D744 intersection (view from D744 looking east towards level crossing on D1021)

D744/D1021 intersection - view along D744 towards Mopane

APPENDIX C: INTERSECTION ANALYSIS RESULTS

MOVEMENT SUMMARY

Site: AM 2021 with dev

Mutsho Power
Stop (Two-Way)
Design Life Analysis (Final Year): Results for 4 years

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: N1											
1	L2	284	39.4	0.196	6.0	LOS A	0.0	0.0	0.00	0.57	52.0
2	T1	97	31.8	0.060	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		381	37.4	0.196	4.5	NA	0.0	0.0	0.00	0.42	53.8
North: N1											
8	T1	144	59.5	0.102	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
9	R2	1	0.0	0.001	7.3	LOS A	0.0	0.0	0.45	0.57	51.7
Approach		145	59.1	0.102	0.1	NA	0.0	0.0	0.00	0.00	59.9
West: D1021											
10	L2	1	0.0	0.102	8.5	LOS A	0.4	3.2	0.55	0.98	48.5
12	R2	42	27.0	0.102	15.1	LOS C	0.4	3.2	0.55	0.98	47.3
Approach		43	26.3	0.102	14.9	LOS B	0.4	3.2	0.55	0.98	47.3
All Vehicles		569	42.1	0.196	4.2	NA	0.4	3.2	0.04	0.36	54.6

MOVEMENT SUMMARY

Site: PM 2021 - with dev

Mutsho Power
Stop (Two-Way)
Design Life Analysis (Final Year): Results for 4 years

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: N1											
1	L2	42	27.0	0.027	5.9	LOS A	0.0	0.0	0.00	0.57	52.5
2	T1	144	59.5	0.102	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
Approach		186	52.1	0.102	1.3	NA	0.0	0.0	0.00	0.13	58.1
North: N1											
8	T1	121	25.5	0.072	0.0	LOS A	0.0	0.0	0.00	0.00	60.0
9	R2	1	0.0	0.001	6.3	LOS A	0.0	0.0	0.32	0.54	52.3
Approach		122	25.2	0.072	0.1	NA	0.0	0.0	0.00	0.01	59.9
West: D1021											
10	L2	1	0.0	0.469	11.0	LOS B	3.0	26.3	0.64	1.12	47.7
12	R2	238	27.8	0.469	16.4	LOS C	3.0	26.3	0.64	1.12	46.6
Approach		239	27.6	0.469	16.4	LOS C	3.0	26.3	0.64	1.12	46.6
All Vehicles		547	35.4	0.469	7.6	NA	3.0	26.3	0.28	0.53	52.7

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Minor Road Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: AM 2031 - With Dev

Mutsho Power
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: N1											
1	L2	71	82,1	0,060	6,5	LOS A	0,0	0,0	0,00	0,56	50,3
2	T1	147	25,7	0,088	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
Approach		218	44,0	0,088	2,1	NA	0,0	0,0	0,00	0,18	56,5
North: N1											
8	T1	175	59,6	0,124	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
9	R2	1	0,0	0,001	6,4	LOS A	0,0	0,0	0,34	0,54	52,2
Approach		176	59,3	0,124	0,1	NA	0,0	0,0	0,00	0,00	59,9
West: D1021											
10	L2	1	0,0	0,227	9,2	LOS A	0,9	11,3	0,66	0,94	44,9
12	R2	59	98,2	0,227	24,3	LOS C	0,9	11,3	0,66	0,94	41,9
Approach		60	96,5	0,227	24,0	LOS C	0,9	11,3	0,66	0,94	41,9
All Vehicles		454	56,8	0,227	4,2	NA	0,9	11,3	0,09	0,21	55,1

MOVEMENT SUMMARY

Site: PM 2031 - With Dev

Mutsho Power
Stop (Two-Way)

Movement Performance - Vehicles

Mov ID	ODMov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: N1											
1	L2	1	0,0	0,001	5,5	LOS A	0,0	0,0	0,00	0,58	53,6
2	T1	233	69,7	0,173	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
Approach		234	69,4	0,173	0,0	NA	0,0	0,0	0,00	0,00	59,9
North: N1											
8	T1	147	25,7	0,088	0,0	LOS A	0,0	0,0	0,00	0,00	60,0
9	R2	1	0,0	0,001	6,7	LOS A	0,0	0,0	0,38	0,55	52,1
Approach		148	25,5	0,088	0,1	NA	0,0	0,0	0,00	0,00	59,9
West: D1021											
10	L2	1	0,0	0,271	10,9	LOS B	1,1	13,2	0,70	1,06	44,3
12	R2	71	82,1	0,271	24,8	LOS C	1,1	13,2	0,70	1,06	41,8
Approach		72	80,9	0,271	24,6	LOS C	1,1	13,2	0,70	1,06	41,8
All Vehicles		454	56,8	0,271	3,9	NA	1,1	13,2	0,11	0,17	56,1

Level of Service (LOS) Method: Delay & v/c (HCM 2010).
Vehicle movement LOS values are based on average delay and v/c ratio (degree of saturation) per movement
LOS F will result if v/c > 1 irrespective of movement delay value (does not apply for approaches and intersection).
Minor Road Approach LOS values are based on average delay for all movements (v/c not used as specified in HCM 2010).
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.