APPENDIX N: TRAFFIC STUDY

global environmental solutions

Commissiekraal Coal Mine Project

Traffic Impact Assessment

SLR Ref : 4AF.03471.00030

Report 01

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Thoile Logistics (Pty) Ltd

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CONTENTS

FIGURES

APPENDICES

DRAWINGS

1.0 INTRODUCTION

SLR Consulting (Pty) Ltd (SLR) has been appointed to provide a traffic impact assessment (TIA) to support a mining right application for a proposed mine located 28km to the north of Utrecht.

Thoile Logistics are seeking permission to mine coal from a 2000ha area. The coal will be transported by means of trucks to a regional rail access point. At this stage in project planning it is assumed that the coal will be transported to Paulpietersburg approximately 74km from the site. The planned life of mine is 20 years. The project site is predominantly made up of farm land with a small amount of naturally occurring forests evident in places.

This report has been prepared to assess the impacts associated with the transport aspects of the proposed development for the 20 year period of operation. The report includes a description of the existing situation, details of the proposed development and outlines the transport demands associated with the development operation. The potential impacts are identified and possible mitigation measures proposed.

2.0 ASSESSMENT APPROACH

2.1 Terms of Reference

The terms of reference is as per the final scoping report and discussions held with Alex Pheiffer (SLR-EIA Project Manager) during the course of the study.

- Identification of the existing road network in the vicinity of the project;
- Quantification of current road usage, capacity (service levels) and road conditions;
- Quantification of additional traffic associated with the proposed project;
- Assessment of impacts on road conditions, service levels and safety;
- Recommendation of alternatives to be considered (if any); and
- Recommendation of mitigation measures to be included in the management plan.

2.2 Potential Impacts

Impacts from the proposed development will arise as a result of increased traffic on the adjacent road network. Traffic will be generated predominantly during the operational phase with materials being hauled by road to a regional rail siding; some traffic will also be generated by the site during the construction and decommission phases at the mine.

Some roads within the study area are not surfaced and those which are surfaced are, in places, in poor condition. Based on this, the potential impacts associated with additional traffic will be:

- Impact on road link and intersection capacity;
- Impact on road structure and make-up; and
- Impacts caused by additional traffic on users of existing roads.

There are three phases related to the development of the mine. These consist of the construction phase, the operational phase and the decommissioning phase. The potential traffic impacts associated with each phase will be discussed in this report.

2.3 Study Area & Scope

The site is located in a remote area west of Paulpietersburg and is currently accessed via gravel roads. The location of the site in the context of the surrounding road network is shown on Drawing 001.

At this stage in project planning and for the purposes of this report, it is assumed that the coal will be transported to a rail siding at Paulpietersburg, approximately 74km from the project site. The proposed haulage route to this location is given below and shown on Drawing 001:

- Upgraded farm track to an intersection with the D699;
- D699 gravel road east and then south-east to P40;
- P40 surfaced road east to R33 south-west of Paulpietersburg;
- R33 regional road north-east to P221 immediately south of Paulpietersburg; and
- P221 surfaced road south to rail siding access.

Further to the haulage of coal product from the site, additional road trips will arise in respect of the movement of employees to and from site. These will likely be sourced from nearby towns, such as Paulpietersburg, Piet Retief, Wakkerstroom and Utrecht, therefore some of these trips to site will follow the same route as for coal haulage traffic whereas limited traffic is expected to leave the site travelling west. There will also be a small number of deliveries

and visitors to the site during a typical working day. Prior to the beginning of the operational phase, a six month construction phase will also see vehicle trips generated by the site. Deliveries of mechanised equipment will take place along with the site contractor facilities, site services and construction workers. All deliveries and worker trips will be made along the same route as will be used during the operation of the mine; similarly, the trips made to remove equipment during the decommission of the mine will also use the same route. The study area for the assessment is therefore defined by the coal haulage route detailed above as traffic during the site construction and decommission phases are anticipated to follow a similar route.

2.4 Information Sources

2.4.1 Site Investigation

A site investigation was undertaken on the 11th to 12th of June 2013. The following information was gathered during the investigation:

- A visual inspection of the site, site access track, haulage route and location of likely rail siding point;
- A general review of other roads near to the study area;
- Completion of traffic count surveys on the 12th June 2013 at the P40/R33 and R33/P221 intersections; and
- Confirmation of site details and surroundings were obtained from the current site landowner.

The locations of the traffic counts were decided during the site visit and were based on an understanding of the haul route from the application site to the rail siding. Observations of the existing traffic flows during the first day of the visit also informed the decision. Traffic flows were then measured through isolated period site observations during the second day of the visit. Traffic levels on the P40 further west and on the D699 were observed to be very low and not sufficient to provide an adequate sample of baseline data; for this reason traffic counts were not undertaken on the P40 and D699. It was deemed appropriate to focus the traffic surveys at the two locations identified above as these would provide both reliable and usable traffic flow data required for assessment purposes.

The traffic surveys were undertaken in 2013 and are still considered recent and relevant as they have been undertaken in the last three years. The rural and remote area surrounding the application site is not expected to see any significant increases in the baseline traffic flows and so the traffic data is deemed applicable.

2.4.2 Other Information

Details of road names and road hierarchy were obtained from the local IDP[1].

[1] eDumbe Local Municipality's 2012/2013 – 2016/2017 Draft IDP Review 2013/2014

3.0 BASELINE SITUATION

3.1 Location and Brief Description of the Site

The site of the proposed development is located within an area of existing farmland in a remote rural area approximately 30km west of Paulpietersburg. The location of the site in the context of the surrounding road network is shown on Drawing 001.

It is expected that a 2000ha area of the 2461ha site will be mined for coal. Direct access to the mine by means of a box cut will be located in the northern section of the site, near to the vehicle access.

3.2 Existing Road Network

The following sections provide a description of the current condition of the site access track and public roads within the study area.

Given the extent of the study area and limited defining features, points of interest were located using GPS and these are marked on Drawing 001 and referenced within the text below as point of interest (POI) 1, 2 etc.

3.2.1 Site Access Track

The site access track is a gravel track of varying width up to 4m wide, which follows the natural surrounding landform. The track provides access to the site farmland, together with other adjacent land. Speeds along this track are likely to be restricted by the nature of the road surface.

At POI1, the track crosses a stream by provision of a culvert crossing, as shown on Plate 1 below.

Plate 1
POI1 – Site Access Track Crossing of Stream

The track will need to be upgraded over its full length to serve as a suitable access to the proposed development, which is detailed in Section 4 below.

3.2.2 D699/Site Access Track Intersection

At POI2, the track meets with the D699 via a priority intersection, which is laid out for the purposes of agricultural vehicles and other associated traffic. Visibility at the intersection is good for vehicles wishing to emerge onto the D699 and the D699 offers good forward visibility. The existing condition of the intersection is shown in Plate 2 below.

Plate 2
POI2 – D699 / Site Access Track Intersection

At the location of the intersection, a roadside ditch runs alongside the D699 within its southern verge and a culvert is provided at the point of crossing of the site access track as shown in Plate 2. At this intersection the site access road is approximately 3-4m in width, with grass verges on either side. The surface type changes from the dirt track to the gravelled surface of the D699 which measures 6-7m wide.

Within the vicinity of the intersection, a school is located on the north side of the D699, with access directly onto the road and associated bus parking provision on the south side of the road. Pedestrian movements associated with this school, together with other schools within the vicinity of the study area, are detailed in Section 3.5 below.

If used, the intersection would require upgrading to accommodate vehicle trips to the proposed development, as detailed later within Section 5 of this report.

3.2.3 D699

The D699 is a gravel road which provides a link south towards the town of Utrecht. The road is of varying width but generally 6 - 7m wide, and follows the surrounding landform. The road is of a reasonable condition for its status, with some rutting and failure of the road

surface, presumably caused predominantly by storm water runoff as traffic usage of the road is very low. In line with the national speed limits for South Africa the speed limit along this road is 100kph, however given the condition of the road it is unlikely that these speeds would be reached safely.

Forward visibility on the road is considered generally good; however it reduces in places where the road alignment alters with horizontal bends and/or where there are changes in gradients. Drainage is accommodated by provision of roadside ditches and culverts and is of varying standard.

Photographs showing the general condition of the D699 are shown in Plate 3 and Plate 4 below. The surface of the D699 is reasonable, and the horizontal alignment of the road in relation to the adjacent land provides limited level change.

Plate 3
D699 – General Road Condition

Plate 4
D699 – General road condition

At POI3 the D699 crosses the Pandana watercourse via a concrete road bridge, which is shown in Plate 5 below. The structure is showing signs of failure in the support elements on the downstream side, potentially as a result of water flow in the wet season. The road width over the structure is approximately 7m.

Plate 5
POI3 – Crossing of D699 Over Pandana Watercourse.

In following the surrounding landform, the road passes through some steep gradients, in particular a point at POI4 where the road traverses the side of a valley, as shown in Plate 6 below.

Plate 6
POI4 – D699 Crossing of Valley

The D699 passes through a plantation, with access to a lumber yard provided on the northern side, and evidence of roadside collection of lumber material within verges on both sides of the road. From the lumber access east, the road is of a better maintained condition and is clearly used by timber traffic.

The D699 in general will require improvements to accommodate access to the proposed development, as summarised below:

- Re-grading and subsequent ongoing maintenance to the gravel road;
- Widening in places to ensure a minimum of 6m road width;
- Assessment of, and reinforcement if necessary, to the bridge structure at POI3; and
- Raising of road within valley crossing section and suitable culverting of watercourse beneath road at POI4.

These required works are given further consideration in Section 5 of this report.

3.2.4 D699 / P40 Intersection

The intersection of the D699 with the P40 is a priority intersection laid out to accommodate the movements of turning traffic, including heavy goods vehicle (HGV) traffic. The P40 represents the major arm of the intersection, approximately 6m wide, with the D699 being the minor arm, approximately 10m wide within the vicinity of the junction .

Visibility at the intersection is good in both directions. The P40 accommodates a roadside ditch on its northern side, which is culverted beneath the D699 side road. The layout of the intersection is shown on Plate 7 below.

Plate 7
D699 / P40 Intersection

Two primary schools are present within the vicinity of the intersection and as such there are associated pedestrian movements on the D699 and P40. Pedestrian movements associated with these schools are detailed in Section 3.5 below.

The intersection will require improvements to accommodate the turning movements of heavy loads, including repairs to the existing P40 carriageway and the surfacing of the D699 over a 50m length, together with associated drainage works. These required works are given further consideration in Section 5 below.

3.2.5 P40

The P40 is a tarmac surfaced road which provides a link east towards the regional road R33 and the town of Paulpietersburg. The road is of varying width but generally 7m wide, and follows the surrounding landform. At one section on the P40 the tarmac surface has completely failed and the section is predominantly gravelled.

In reference to the national speed limits for South Africa the speed limit along this road is 100kph, however given the condition of the road it is unlikely that these speeds would be reached safely. The road is of a reasonable condition for its status, with some failure of the road surface, presumably caused by storm water runoff and the infrequent HGV traffic volumes. The general condition of the road is shown in Plate 8 below.

Plate 8
P40 – General Condition

The P40 is considered generally acceptable for serving as part of the route for traffic to the proposed site, with a requirement for general road repairs and ongoing maintenance, together with the re-surfacing of the failed section of carriageway as discussed above. These required works are given further consideration in Section 5 below.

3.2.6 P40 / R33 Intersection

The intersection of the P40 with the R33 is a priority intersection accommodating ghost islanding for a central right turn lane from the R33 into the P40. The intersection is laid out to accommodate the movements of turning traffic, including HGV traffic, and the layout is shown in Plate 9 below.

Plate 9
P40 / R33 Intersection

The layout and construction make-up of the interchange is considered suitable for use by HGVs as part of the route to the proposed development with no need for improvement.

3.2.7 R33

The R33 is a tarmac surfaced road which operates as a strategic link road, locally linking Paulpietersburg with Vryheid to the south of the study area. The road is a minimum of 7m in width and is of a good standard. The road is subject to 100kph outside of urban areas and reduces to 60kph upon entering the town of Paulpietersburg.

3.2.8 R33 / P221 Intersection, Paulpietersburg

The intersection of the R33 with the P221 is a priority intersection laid out to accommodate the turning movements of all vehicles. At the intersection, the R33 continues north to Paulpietersburg, with the P221 providing a link south to Vryheid.

The interchange is set out so that entries from the R33 west and P221 south arms give way, with movements from the R33 north having priority. The intersection has been observed to operate satisfactorily under this arrangement. The road surface is in reasonable condition with some evidence of wear and tear and general weather damage. The layout of the intersection is shown in Plates 10 and 11 below.

Plate 10
R33 / P221 Intersection Viewed from South

Plate 11
R33 / P221 Intersection Viewed from West

3.3 Existing Traffic Flows

3.3.1 Traffic Count Data Collected

Sample traffic counts were undertaken at key intersections within the study area on 12th June 2013 to include the R33 intersection south of Paulpietersburg and the P40 / R33 intersection. As explained in Section 2.4.1 above, the traffic count locations were determined based on observations on the first day of the site visit where flows along the D699 and the P40 were identified as being too low to provide usable traffic data.

While the traffic data obtained and referenced below was collected in 2013, the limited growth likely in the area means it is still considered to be relevant. For assessment purposes later in the report the data has been growthed to account for a limited level of background growth.

The data measured are included at Appendix A and a summary is provided in Table 1 below.

Table 1 Measured Traffic Flows (vehicles per hour)

Road Link	One Way Flow			Two Way Flow	
	Direction	Total	% HGV	Total	% HGV
R33 Hogg Street	Northbound	115	24.3%	181	21.0
	Southbound	66	15.2%		
R33 West of Paulpietersburg	Westbound	41	9.8%	103	13.6
	Eastbound	62	16.1%		
P221 South of Paulpietersburg	Southbound	26	23.1%	80	30.0
	Northbound	54	33.3%		
R33 North of P40 Intersection	Northbound	76	21.1%	104	19.2
	Southbound	28	14.3%		
R33 South of P40 Intersection	Southbound	24	0.0%	96	16.7
	Northbound	72	22.2%		
P40	Westbound	4	100.0%	8	50.0
	Eastbound	4	0.0%		

3.4 Current Road Network Level of Service

Table 1 above provides a summary of the observed traffic flows at the two intersection locations and along the corresponding link roads. It can be seen that the more heavily trafficked roads are those of the R33 and the P221, with total two-way flows recorded between 96 and 181 on the R33 and 80 on the P221. The P221 was observed to have 30% HGVs making up the two-way flow of traffic, while the R33 was observed to have between 13% and 21% HGVs.

The observed flows at the intersection of the P40 and the R33 recorded a two-way flow of 8 vehicles on the P40, with all vehicles recorded as HGVs. This would imply that the traffic movements associated with the existing plantations accessed from the P40 make up most, in not all of the traffic observed.

The roads within the study area are clearly lightly trafficked in terms of their available capacity; however it has been shown that there is a significant difference between flows on the more rural roads (P40) in comparison to the main roads in the area (R33 and P221). The P221, Hogg Street and R33 were recorded to have considerably higher flows than the P40. This is likely to be as a result of their location to Paulpietersburg and as the R33 serves as a regional link to Vryheid.

The flows observed along the western end of the P40 and the D699 were minimal and therefore considered to be too low to provide accurate traffic data for the same time periods. For this reason the traffic data is not available to include a detailed discussion of these two routes closer to the application site; the on-site observations however confirm that the flows along these roads are negligible.

Using suitable UK guidance for comparison purposes[2], the estimated level of service of each road link in the existing situation is summarised in Table 2 below. TA 46/97 provides a methodology for calculating the theoretical capacity of a road link, above which congestion would be likely to be experienced. It is considered a suitable methodology in this instance, given that the road network is laid out similar to UK standards. It is understood that this methodology is similar to that used to define the LOS thresholds within the Highway Capacity Manual 2010[3].

Table 2 Calculation of Link Road Level of Service

Road Link	Calculated Congestion Reference Flow (CRF)	Estimated 24 Hour Flow	Level of Service
R33 Hogg Street	9,767	2,172	0.222
R33 West of Paulpietersburg	24,079	1,236	0.051
P221 South of Paulpietersburg	13,362	960	0.072
R33 North of P40 Intersection	9,271	1,248	0.134
R33 South of P40 Intersection	31,268	1,152	0.037
P40	5,211	96	0.018

Table 2 confirms that the roads within the study area accommodate only a small proportion of their available capacity. The figures show that the highest existing level of service is seen on the R33 Hogg Street, where a 0.222 level of service has been identified. This indicates that this road has over 75% available capacity. The other roads all show a lower level of existing service with available capacity in excess of 85%.

[2] TA 46/97 Traffic Flow Ranges for the Assessment of New Rural Roads

[3] TRB Publication – Highway Capacity Manual 2010

As discuss above, the D699 had not been included within Table 2 as the flows were considered too low to justify counts, therefore it can be assumed that the level of service on the D699 is not high, with suitable capacity available.

3.5 Vulnerable Road Users

Schools are located within the study area at the following locations:

- Luthilunye Primary School, adjacent to the site access intersection with the D699;
- Kwamagidela Secondary School, located west of the D699/P40 intersection;
- Protes Primary School, located east of the D699/P40 intersection; and
- Ndabambi Primary School, located north west of the R33 / P40 Intersection.

There are children pedestrian movements associated with trips to these schools, from residential areas which are remote and spread throughout the area: some of these walking trips to school will include pedestrian journeys of several kilometres.

There is no pedestrian provision on any of the roads within the study area, and pedestrians walk, generally, in the middle of the road.

Despite the very lightly trafficked roads, and the users being very young, it was noted that pedestrians are cautious when vehicles pass by and move to the side of the road in good time.

4.0 PROPOSED DEVELOPMENT

4.1 Proposed Site Usage

The proposed usage of the site is to mine coal from around 2000 hectares for a period of 20 years. A box cut in the north eastern area of the site will provide direct access into the mine. There will be no processing onsite, however other onsite facilities will include crushing and screening and temporary stockpiling of coal ore.

The approximate extraction rate from the site is 1,000,000 tonnes per annum. Minimal waste material is anticipated from the development of the boxcut. This will remain on site and be used to establish a platform at the box cut entrance and/or roads. Operations will occur at the site 24 hours a day, Monday to Saturday. Transport of materials from the site will be limited to daylight hours, between 06:00 and 18:00 during summer months and 07:00 and 18:00 during winter months.

The development is anticipated to commence in 2016 and will create around 160 jobs during the six month construction phase and up to 200 jobs when operating. Staff will likely be employed from Paulpietersburg, Piet Retief, Utrecht and Wakkerstroom and will get to work by means of a contractor bus or private car.

4.2 Proposed Haulage

The proposed development will generate around 94 HGV trips from the site per day. The vehicles used will be 34 tonne trucks which will likely be supplied from a company offsite. These HGVs will transport the raw material from the site to a regional rail siding. At this stage in project planning and for the purposes of this report, it is assumed that the material will be transported to a siding to the south of Paulpietersburg. The transport route to be used is discussed in Section 3.2 above and this is considered to be the most efficient route between the site and rail siding as the route utilises predominantly roads within the existing transport network.

Paulpietersburg was identified by the client as a suitable rail siding for the onward transportation of coal. The use of trains to transport material was a well-established practice before the increase in weight limit for road HGVs in 1980s. The rail route near Paulpietersburg used to serve a number of mines in the local area and the infrastructure still remains. . Transnet, the country's main rail freight company is currently developing a plan to encourage the use of the rail network to help reduce the congestion on the country's roads. This development seeks to utilise the country's existing transport infrastructure, without the need to create new roads or train lines.

4.3 Site Construction and Decommission

The construction period for proposed mine is expected to begin six months prior to the commencement of operations from the site. It has been confirmed that trips will not exceed 50 per day and will consist of equipment deliveries, construction material deliveries, waste removal and transportation for the construction staff. The period of site decommissioning is anticipated to take less than time than the construction period and will not require a higher amount of trips than the construction period.

5.0 TRIP GENERATION & ASSIGNMENT

5.1 Current Trip Generation & Assignment

As the site currently comprises of farmland and small scale plantations it is assumed that whilst there may be trip generation from the site these will be at very low levels. This has been confirmed by observations during the site visit. Therefore a trip rate of zero will be used for the assessment below. Applying this assumption ensures that a robust assessment of the traffic impact from the proposed development is presented.

5.2 Trip Generation

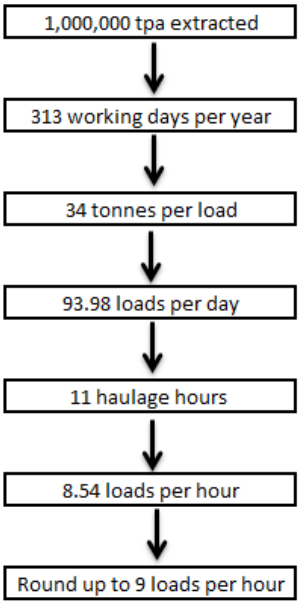
The proposed development would generate the majority of its associated road trips during the operational phase. During the construction and decommission phases at the mine when compared to the operation phase there would be negligible trips generated, with less than 50 two-way trips anticipated. The construction and decommissioning phases of the development have been scoped out of the assessment and, therefore, this section of the report provides detailed calculations and timing of trips arising through the operational phase.

The trips anticipated to be generated by the site during the operational phase have been derived from information provided by Thoile Logistics. The following sections contain an overview of the information provided, assumptions derived from this and a summary of the proposed trip generation throughout key periods of a typical week.

The operational hours of the site will be Monday-Saturday, 24 hours a day. The site would not operate on a Sunday; this would translate to 313 working days a year, excluding public holidays. Material from the site is to be transported by heavy goods vehicles with a 34 tonne capacity. Haulage of the material will take place over the day during daylight hours between 06:00 and 18:00 in summer months and 07:00 and 18:00 in winter months. To ensure a robust assessment of the impact of the development the shorter operating hours during the winter months will be assessed as the development traffic will be more concentrated in the shorter haulage hours. No processing will be carried out on site meaning all material exported will be in raw form and there will be no weight difference between extracted material and transported material.

The material is to be extracted at a rate of 1,000,000 tonnes per annum (tpa) which translates to 94 loads per day or 9 loads per hour. Figure 1 below shows how the trips to the site have been calculated using first principles.

Figure 1
First principles used to calculate trips (one-way)



It is anticipated that staff will not live on site; therefore staff will commute to the site at the beginning and end of each shift. Two ten-hour shifts will run each day with an hour overlap meaning shifts will run from 06:00 till 16:00 and 15:00 till 01:00. Two buses each shift will provide a means of transport for many staff to and from the site and it is anticipated that 20 individual cars will access the site at the beginning and end of each shift.

It is expected that there will be one large truck delivering equipment or material (diesel, stone dust, cement, roof bolts, general spares and mining equipment) to the site per day. Up to four visitors are also expected over the course of the day and will travel by means of a car or light good vehicle (LGV).

5.3 Trip Distribution

All HGV movements associated with the transport of material from the site will use the route as stated below:

- Mine access road and intersection;
- D699 gravel road east and then south-east to P40;
- P40 surfaced road east to R33 south-west of Paulpietersburg;
- R33 regional road north-east to P221 immediately south of Paulpietersburg; and
- P221 surfaced road south to rail siding access.

It is anticipated that staff will travel to the site from Paulpietersburg, Piet Retief, Utrecht Wakkerstroom and the local area. Therefore a 50:50 divide of private cars for staff heading east and west from site access will be applied to the generation. For assessment purposes the two contractor buses for staff will have a 50:50 divide applied in an east and west direction from the intersection of the private site access road with the D699.

5.3.1 Summary

Trip generation for the site has been calculated taking into account the above information. The following assumptions have been made:

- The 94 daily trips generated by the site will be evenly spread throughout the haulage hours of the site (11 hours), equating to nine trips an hour each way or 18 trips an hour two way;
- All HGVs transporting coal to the rail siding will use the route outlined above;
- 20 private cars and two buses will provide staff transport to and from the site at the beginning and end of each shift. These will be split in a 50:50 divide east: west from the site access;
- Staff heading east towards Paulpietersburg will utilise the same route as the HGVs;
- The single HGV delivery each day will arrive in the morning from the direction of Paulpietersburg, therefore entering the site from the east; and
- The four visitors will arrive evenly throughout the day from the direction of Paulpietersburg, therefore entering the site from the east.

The above assumptions have been used to approximate the trip profile of the proposed development.

6.0 IMPACT ASSESSMENT

The proposed development is anticipated to result in an increase in the level of vehicular traffic generated by the site which could have a material impact on the surrounding transport network. This section therefore considers the impact of the proposed development on the operation of the local highway network.

The most critical time period will be on a weekday between 14:00-15:00, when baseline traffic flows and the proposed development trip generation will be greatest at 40 movements (two-way movements of 18 HGVs, 21 car movements and one bus). In addition one of the main concerns highlighted by local residents was the presence of vulnerable road users such as school children; the period from 14:00 - 15:00 coincides with the end of the school day ensuring that this potential impact is considered. This assessment therefore considers the operation of the local highway network during this hour, as determined through the trip generation process undertaken for the proposed development, discussed in further detail above. This will help ensure that a robust assessment of the impact of the site is achieved.

6.1 Assessment Year and Forecasting

The impact of the proposed development is assessed over the baseline traffic demand expected in the anticipated opening year of 2016 and a robust future year of 2021. The traffic numbers from the Commisiekraal Mine have been included within the future year assessment (2021), as described below.

Baseline traffic demand is expected to change over such time scales, with a general trend of growth over time. The scale of changes in traffic demand will vary across the country and between types of road. These changes in baseline traffic demand are the result of a combination of new development and economic and social changes across the country.

The Manual for Traffic Impact Studies (Department of Transport, 1995) suggested a standard range of 2.5 – 3.5% growth per annum; therefore a growth factor of 3% per annum was applied.

6.2 Area of Analysis

The following intersections and roads were identified in order to assess the impact and operational acceptability of the proposal:

- P40;
- R33;
- Intersection of P40 and R33;
- Intersection of Hogg Street and R33 to the south of Paulpietersburg; and
- P221.

At these locations traffic counts were carried out to determine flows or movements along each road or at the intersection.

6.3 Traffic Flows

A summary of the traffic flows for the three roads within the study area are summarised in Table 3. This section provides a summary of the traffic flows.

Table 3
Existing and Proposed Traffic Flows along Route

Flow	Site Peak (14:00-15:00)											
	2016 Base		2016 Base + Devt				2021 Base		2021 Base + Devt			
	Total	HGV	Total	HGV	% Increase from 2016		Total	HGV	Total	HGV	% Increase from 2021	
					Total	HGV					Total	HGV
P40												
East	4	0	14	9	250%	--	5	0	15	9	198%	--
West	4	4	24	14	500%	250%	5	5	25	15	398%	198%
Two Way	8	4	38	23	375%	475%	10	5	40	24	298%	378%
R33												
North	74	14	84	24	14%	71%	85	16	95	35	12%	119%
South	37	4	57	23	54%	475%	42	5	52	15	23%	205%
Two Way	110	18	140	37	27%	106%	127	21	158	40	24%	91%
P221												
North	57	19	66	28	16%	47%	66	22	75	31	13%	40%
South	28	6	37	15	32%	150%	32	7	41	16	28%	117%
Two Way	85	25	103	43	21%	72%	98	30	116	40	18%	36%

A quantitative assessment of the D699 route would not accurately demonstrate the impact of the development as the existing flows are negligible, as discussed above in Section 3.4; therefore the D699 has been excluded from Table 3. The percentage impact anticipated along the D699 as a result of the additional development generated traffic will be significant due to the very low baseline; any increase will look significant as there is currently very little along this road.

Table 3 above shows that, during the assessment hour, the existing traffic flows along the P40 in 2016 give a two-way flow of 8 total vehicles with 4 HGVs per hour. In 2016 with the additional traffic from the proposed development the total two way flows will increase to 38 vehicles, with an additional 23 HGVs, resulting in a percentage increase in two-way traffic of 375%.

The existing two-way traffic flows along the R33 show the current two way flow of total traffic to be 110 vehicles, with HGVs making up 18 of these. With the addition of development traffic this will see an increase to 140 two way total vehicle traffic, and an increase to 37 HGVs. In 2021 the two way flow in total traffic increases from 127 to 158 vehicles, with HGVs increasing from 21 to 40.

Two-way vehicle flows along the P221 are anticipated to increase from 85 to 103 in 2016 with the traffic flows associated with the proposed development. Northbound flows will increase from 57 to 66 vehicles and southbound flows will increase from 28 to 37 vehicles. With the development in 2021 these flows are anticipated to increase to 116, 75 and 41, two-way, northbound and south bound respectively.

The percentage increase for flows along the P40 is significantly high, from 250% to 500% in 2016 with development traffic. This is because there are currently very low flows of traffic along these roads meaning that any change would lead to a vast increase of percentage. This is true for HGV percentage increases for all the roads within the study area as HGV flows are currently low.

Flows along the R33 increase by 14%, 54% and 27% northbound, southbound and two-way, respectively, with the associated development traffic. For 2021 traffic flows with the development it is suggested that there will be a 12%, 23% and 24% increase in flows from the growthed baseline of 2021 traffic flows. The P221 would see a percentage increase of 16%, 32% and 21% in 2015 with the development and 13%, 28% and 18% in 2021 with development traffic northbound, southbound and two-way, respectively.

6.4 Capacity Modelling

Capacity assessments of the following intersections have been carried out:

- The P40 and R33; and
- The R33 with Hogg Street and P221 South.

A quantitative assessment of the D699/P40 intersection would not accurately demonstrate the impact of the development as the existing flows are negligible; therefore the D699 has been excluded from the capacity assessment.

The hours of 14:00 – 15:00 were assessed so that the report provides a robust assessment of the entire route for the same peak hour from the site, which also coincides with the end of a school day when vulnerable road users may be using the same roads.

These intersections were assessed in the UK industry standard software PICADY 5, which uses empirical formulas based upon intersection geometry and traffic demand characteristics to model the operation of priority intersection. The key outputs of the model are the ratio of flow to capacity (RFC), queue lengths and average delay per arriving vehicle.

The RFC is calculated for each opposed turning manoeuvre at the intersection, providing a comparison of the demand for each manoeuvre and the calculated capacity of the manoeuvre. The largest RFC calculated over all manoeuvres throughout the modelled time period is used to represent the level of operation expected at the intersection. RFC values between zero and one indicate that the demand can be accommodated within the available capacity, a value of one indicates that the demand is equal to capacity, and values greater than one indicate that the demand is greater than the available capacity. Due to site-to-site variations it is generally accepted that RFC values below 0.85 indicate that an intersection will operate without congestion or delay in the vast majority of cases.

PICADY is unable to model the two stop lines that occur at the intersection of the R33 with Hogg Street and P221 South, and so this intersection was modelled as a simple priority T intersection with the R33 and Hogg Street as the major road. Using this method gave a more accurate representation of how the traffic has to give way at the intersection. This means that:

- Traffic arriving at the intersection from the Hogg Street has priority over all traffic and is not delayed when heading onto the P221 South;
- Traffic arriving at the intersection from R33 has priority heading north but has to give way to traffic arriving from Hogg Street when turning onto the P221 South; and
- Traffic arriving at the intersection from the P221 South has to give priority to all other movements.

While not a standard approach, use of this method ensures that the majority of HGV traffic from the site will be modelled as having to give way, as would occur at the intersection. The model therefore provides a more accurate representation of what currently happens as well as what is likely to occur at this intersection with the proposed development.

This section provides a summary of the PICADY model outputs. The full PICADY model outputs are included at Appendix B.

A summary of the model output for the intersection of the P40 with the R33 is shown in Table 44 below.

Table 4
PICADY Output values for the intersection of the P40 with R33

Manoeuvre	P40 and R33 Intersection											
	2015 Base			2015 Base + Devt			2021 Base			2021 Base + Devt		
	RFC	Max Q (veh)	Avg Delay (min)	RFC	Max Q (veh)	Avg Delay (min)	RFC	Max Q (veh)	Avg Delay (min)	RFC	Max Q (veh)	Avg Delay (min)
Left turn out of P40 to R33 north	0.005	0.00	0.07	0.017	0.02	0.07	0.006	0.01	0.07	0.018	0.02	0.07
Right turn out of P40 to R33 south	0.000	0.00	0.00	0.000	0.00	0.00	0.000	0.00	0.00	0.000	0.00	0.00
Right turn into P40	0.035	0.04	0.09	0.077	0.08	0.11	0.042	0.04	0.10	0.084	0.09	0.11

The model output results above show that the intersection currently operates at a maximum RFC of 3.5%. There is minimal queuing of vehicles and this will be accommodated by the right hand turn lane of the intersection. With the addition of the development in 2016 the maximum RFC increases by 0.032, indicating that 7.7% of total junction capacity will be utilised during the peak hour assessed.

During 2021 the addition of development traffic will increase the maximum RFC at the intersection to 0.084, a 0.042 increase over the expected maximum RFC during the 2021 baseline scenario. Queuing on the minor arms is not expected to extend beyond one vehicle at any point during the study period. Queuing in the ghost island right hand turn lane is also expected to be minimal at all times.

All of these outputs are significantly below the 0.85 RFC value that is considered the maximum value under which an intersection is likely to operate without congestion or delay.

A summary of the model output for the intersection of the R33 with the P221 is shown in Table 5 below.

Table 5
PICADY Output values for the intersection of the R33 with Hogg Street/P221

Manoeuvre	R33 and Hogg Street/P221 Intersection											
	2015 Base			2015 Base + Devt			2021 Base			2021 Base + Devt		
	RFC	Max Q (veh)	Avg Delay (min)	RFC	Max Q (veh)	Avg Delay (min)	RFC	Max Q (veh)	Avg Delay (min)	RFC	Max Q (veh)	Avg Delay (min)
Left/right turn out of P221 to R33 south/Hogg Street	0.151	0.18	0.14	0.177	0.21	0.15	0.175	0.21	0.15	0.202	0.25	0.16
Right turn into P221	0.000	0.00	0.00	0.037	0.05	0.17	0.000	0.00	0.00	0.37	0.25	0.17

The model output results above show that the intersection currently operates at a maximum of 15.1% capacity. There is minimal queuing of vehicles. During 2016 the proposed development will increase the maximum RFC of the intersection by 0.026, indicating that the proposed traffic demand will utilise approximately 17.7% of available capacity. During 2021 the addition of development traffic will increase the maximum RFC at the intersection to 0.202, a 0.027 increase over the expected maximum RFC during the 2021 baseline scenario. Queuing on the minor arms is not expected to extend beyond one vehicle at any point during the study period with a very minimal increase seen between 2015 values and 2021 with the inclusion of development traffic demand.

All of these outputs are significantly below the 0.85 RFC value that is considered the maximum value under which an intersection is likely to operate without congestion or delay.

6.4.1 Summary of Potential Impacts

The results of the above assessment show that there will be an increase of traffic along all roads associated with the proposed development at Commisiekraal. The discussion below identifies the potential impacts and specific areas of concern.

D699 and P40

As discussed above, traffic data along the D699 and P40 were not obtained for each road specifically and it has not been possible to undertake a quantitative assessment for these two routes in a similar manner to the R33 and P221 assessments. The figures provided by the P40/R33 intersection survey suggest that these rural routes have minimal traffic flows and as such the increase in flows as a result of the proposed development will be significant.

The D699 has a reasonable width and for the majority of its length from the site access, also a reasonable gravelled surface. It has not been possible to determine the existing level of service on the D699 however it is reasonable to state that the existing capacity is sufficient to accommodate the proposed vehicle numbers. The P40 is a formally tarmac surfaced road with a width of 7m; by its nature this route will be able to accommodate the additional vehicles as current flows are currently very low. The development traffic will see the two-way demand increase by approximately 30 movements in any hour, equivalent to one movement every two minutes. The D699 and P40 will be able to accommodate these flows.

While there are no capacity issues anticipated with the D699 and P40, due to the nature of the proposed development and the long term and constant use of the roads, it is considered important and relevant to undertake improvement works at the more vulnerable locations where the infrastructure has been identified as sub-standard. This is to ensure that the

existing level of service is maintained. Such improvements and maintenance of the infrastructure within the immediate area around the application site will benefit the local community and other smaller businesses. These are discussed in more detail below.

It is also important to give consideration to the use of the roads by vulnerable road users and improvements which may be introduced to avoid potential conflict with haulage vehicles. Due to the lack of pedestrian facilities around the site access and the location of the Luthilunye Primary School it may be recommended that the development funds a school bus for students at this school to reduce the risk of accidents with increased vehicle movement in this area. This is discussed in more detail below.

R33 and P221

The R33 is a provincial main route and key road which links Paulpietersburg with Vryheid to the south and Piet Retief to the north. The R33 is designed to accommodate larger numbers of vehicles as these major regional routes are the second category of road in the South African route-numbering scheme. The additional traffic resulting from the proposed development will see an increase of 27% in the two-way traffic on the R33. While this is not a small increase, it has been demonstrated in Table 2 that the existing level of service is well below the maximum. The P221, while not of the same classification, is a major road of similar construction and width to the R33. This route will see an increase of 21% to the two-way traffic; however the impact will be small due to the free flow level of service which currently exists.

The assessments of the flows and intersections of the P40/R33 and R33/P221, the two main routes within the study area, suggest that the local transport network and relevant intersections would operate at a maximum of 0.15 capacity (RFC) in 2016 and a predicted capacity of 0.17 in 2021. Even with the development this will see an RFC increase to 0.17 in 2016 and 0.2 in 2021 when factoring in annual growth factors. There are no delays to vehicles expected at any of the intersections within the study area with the addition of the development traffic flows.

In summary, traffic flows along all of the roads within the study area are expected to increase, with large percentage increases predicted on many of the roads and two-way traffic flows expected to be 30 movements in any hour. This level of increase is equivalent to one movement every two minutes, which would be a noticeable increase above the levels currently recorded. A portion of the development traffic will disperse across multiple routes farther from the application site, lowering the increase on any one road link.

It is envisaged that the proposed development at Commisiekraal will have an impact on the surrounding road network simply due to the scale of the increase, but that the additional vehicle numbers will be accommodated within the existing infrastructure. Moreover the use of the rail siding to transport material further afield seeks to reduce the impact of the development traffic on the transport network and make use of the country's exiting transport infrastructure where possible.

There is some evidence of over running due to restricted radii and so minor improvements may be needed in locations along the R33 or P221.

6.5 Proposed mitigation measures

In order to accommodate the use of the roads within the study area for coal haulage, the following improvements are to be considered for inclusion within the development and for implementation in consultation with the Roads Authority:

- Upgrading of access track over its length to suitable width and structure;
- Widening and improvements to the Site Access Track / D699 Intersection to accommodate vehicles turning into and out of the intersection;
- Possible realignment of the site access/D699 junction to provide a junction located to the east of the school;
- Improvements to the D699, including:
  - Re-grading and subsequent ongoing maintenance to the gravel road;
  - Widening in places to ensure a minimum of 6m road width;
  - Assessment of, and reinforcement if necessary, to the bridge structure at POI3; and
  - Raising of road within valley crossing section and suitable culverting of watercourse beneath road at POI4;
- Minor improvements to the D699/P40 Intersection to accommodate turning HGV traffic;
- Minor improvements to the R33 Intersection south of Paulpietersburg to accommodate turning movements of HGVs; and
- Minor improvements to the P221 / Railhead access intersection to accommodate turning HGVs.
- A monitoring programme to review the infrastructure and safety record on a regular basis. This will include regular twelve monthly reviews of the physical structure of the road, consideration of reported incidents and regular communication with the HGV drivers.

The majority of the route infrastructure is of a suitable condition to accommodate the traffic associated with the proposed development; this includes the route along the P221, Hogg Street, R33, P40 and much of the D699. However some locations along the site access road and D699 will need improvements to accommodate the development traffic. The site access road will need to be widened in some locations to accommodate two HGVs, with suitable passing bays provided. Much of the site access road will need to be widened and resurfaced due to the restricted existing width of 4m. There is a culvert crossing along this section of the route that will require upgrading to accommodate increased heavy vehicle movements to the site. A culvert at the existing site access point will need to be suitably reinforced and covered to ensure protection from damage by HGVs turning; this may not be needed if the site access junction onto the D699 is relocated to the east.

The D699 is currently a gravel track measuring up to 6-7m wide. The road surface, although currently in reasonable condition will need improving in some locations to facilitate increased traffic usage. It is recommended that the road will need to be widened to provide a consistent width of at least 6m to accommodate HGVs along the whole length.

Although the P40 is mostly tarmacked it will be necessary to carry out repairs to the current road surface in places, particularly along the length where the road surface has failed due to storm water runoff.

When considering the changes required to the road infrastructure it will be necessary to follow the guidelines suggested in the South African Pavement Engineering Manual and other relevant documents. It is advised that when building roads for the haulage of material across rural land, special consideration should be given to the meandering, incline and surface of the road.

The three final sections of the route, the R33, P221 and Hogg Street, have suitable infrastructure that will support the proposed development traffic. These are well established, wide, tarmacked roads with painted road layouts that have higher traffic flows. The intersections of these roads can accommodate HGV manoeuvres safely.

The layout of the intersection into the site access needs to be able to accommodate the turning movements of HGVs safely. If it is considered suitable to provide a new junction for the site access onto the D699 it will still be relevant to ensure the junction is designed to accommodate HGVs. As HGVs make regular trips to the site consistently throughout the haulage day this is essential to not only improve safety at the intersection but to increase efficiency. Suitable improvements to the intersection of the D699 and P40 would be required to accommodate HGVs safely and improve the road surface.

Due to the nature of the climate in this region and the impacts of the storm water runoff on the road surface it would be suitable to make improvements to the current drainage infrastructure in suitable locations along the D699. Consequently it would be advised to maintain these facilities along these roads to help prevent failure to the road structure as evidence suggests this has occurred previously. During the operational time frame of the site it would be necessary to monitor the condition of all these roads along the haulage road, especially the more rural roads as these would see the highest increase of traffic. Moreover it may be necessary to carry out continued maintenance and when vehicle movements from the site has ceased to ensure road provisions are left at a suitable condition for future usage.

7.0 SAFETY CONSIDERATIONS

7.1 Safety Considerations

During the site visit it was identified that vulnerable road users currently use the route proposed for HGV trips, especially at the beginning and end of the school day when school students are arriving and leaving the school site. The development proposals are to include an upgrade to the existing access road to the site in discussion with the Roads Authority, as outlined above. The suggested upgrades to the local transport network would help to improve the current safety standards of these roads for all users as it would widen the roads and improve the road surface.

However as there is the potential for safety issues related to the presence of pedestrians along the D699 it is recommended that additional measures be considered to reduce the likelihood of any conflict:

- A slip lane type entrance to provide access into the site from a location further east along the D699. This will ensure that all site traffic avoids the school site;
- Consideration of changing shift times to avoid the start and finish of the school day; and
- Monitoring of the D699 route and other sensitive areas to ensure that any issues are picked up and solutions identified.

As the pedestrians have been identified as school age children travelling to the Luthilunye Primary School and it is likely that pupils travel for some distance along the local roads to access the school. A further solution could include a bus service provided to collect the school pupils from close to their home locations will help to ensure the safety risk is mitigated. However it is important that the service is arranged and supervised, with a fully accredited contractor who will operate a transparent and accountable service at all times. It is vital that the safety of the learners is secure while being transported to school and the following precautions are advised:

- The service provider should be required to transport learners in line with a service level agreement;
- Bus stop locations should be sited where learners will not be put at risk;
- The operator should be required to provide transport on all school days;
- The vehicles used should be registered and certificated to comply with current legislation for public transportation;
- Suitable liability insurance must be in place;
- All vehicles should have validated road worthiness certificates; and
- Regular safety checks of the vehicles should be undertaken.

It may also be suitable to consider bus service transport for the two schools at the intersection of the D699 and P40, Kwamagidela Secondary School and Protes Primary School as pedestrians travelling to these schools may also see an impact from the additional HGVs along these routes.

8.0 CONCLUSIONS

This traffic impact study has been produced to determine the significance of any traffic impacts associated with the proposal to operate a mine at the Commisiekraal Farm site to the west of Paulpietersburg, Kwazulu-Natal.

The mine will be worked for coal over a period of twenty years (commencing in 2016). The extracted material will be taken to a rail siding located 1.2km to the south of Paulpietersburg by means of HGVs carrying 34 tonnes per load then transported by rail. Extraction will occur at a maximum rate of 1,000,000tpa equating to 94 HGV trips from the site per day. In an average haulage day this will create 18 HGV movements per hour associated with the site. Staff will work over two ten-hour shifts and will arrive at the site by means of 20 private cars and two buses per shift. A small number of visitors and an HGV delivery are expected at the site daily.

The assessment suggests that there will be an increase to traffic flows along the roads of the proposed haulage route and a reduction in residual link capacity. Percentages suggest high impacts will be experienced but the low existing flows will mean any change to traffic will lead to a high percentage increase. During the assessed hour a maximum two way flow of 30 vehicles is anticipated along one road. This equates to one vehicle movement every two minutes. The capacity assessments carried out along these roads and intersections suggest that there will be minor reductions to residual capacity; however the roads will continue to operate significantly below maximum capacity.

Suggestions have been made as to improvements to transport infrastructure. These include the widening of roads to accommodate passing HGVs and turning HGVs as well as the upgrade of road surfaces and reinforcement to road infrastructure such as bridges and culverts. It has also been suggested that the drainage systems around these roads should be maintained to ensure that the improvements to these roads will last throughout the wet season. Finally to reduce the impact of the proposed development on vulnerable road users, a great concern to locals within the area, it has been suggested that the site access junction be relocated to a position east of the existing location and the school. In addition the regular monitoring of the safety situation will identify if further action is required, which may include the provision of a school bus for students of Luthilunye Primary School so that school students using the road around the site access would be reduced.

In conclusion the proposed development of the coal mine at the Commisiekraal site will result in negligible to minor adverse impact on the local highway network. By implementing the proposed mitigation works discussed throughout this report it is considered that the proposed development will have no significant adverse impact on the local highway network. Indeed, transport infrastructure improvement works will provide a benefit to the local community and other small businesses for many years into the future.

9.0 CLOSURE

This report has been prepared by SLR Consulting Limited with all reasonable skill, care and diligence, and taking account of the manpower and resources devoted to it by agreement with the client. Information reported herein is based on the interpretation of data collected and has been accepted in good faith as being accurate and valid.

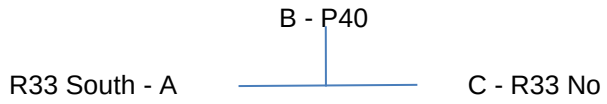
This report is for the exclusive use of Thoile Logistics; no warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR.

SLR disclaims any responsibility to the client and others in respect of any matters outside the agreed scope of the work.

Appendices

Appendix A

Project	***Commisiekrall***
Location	***R33 / P40 Junction***
Date	***12-06-13***



	CARS / VANS / LGVs									
	Segment Start Time								With Development	
Movement		10:15	10:30	10:45	11:00		TOTAL	Peak Hour	Addition	TOTAL
A-B		0	0	0	0		0	0		0
A-C		14	14	14	14		56	56		56
B-A		0	0	0	0		0	0		0
B-C		1	1	1	1		4	4		4
C-A		6	6	6	6		24	24		24
C-B		0	0	0	0		0	0		0

	HGVs									
	Segment Start Time								With Development	
Movement		10:15	10:30	10:45	11:00		TOTAL	Peak Hour	Addition	TOTAL
A-B		0	0	0	0		0	0		0
A-C		4	4	4	4		16	16		16
B-A		0	0	0	0		0	0		0
B-C		0	0	0	0		0	0		0
C-A		0	0	0	0		0	0		0
C-B		1	1	1	1		4	4		4

	TOTALS									
	Segment Start Time								With Development	
Movement	07:45	08:00	08:15	08:30	08:45	09:00	TOTAL	Peak Hour	Addition	TOTAL
A-B	0	0	0	0	0	0	0	0	0	0
A-C	0	18	18	18	18	0	72	72	0	72
B-A	0	0	0	0	0	0	0	0	0	0
B-C	0	1	1	1	1	0	4	4	0	4
C-A	0	6	6	6	6	0	24	24	0	24
C-B	0	1	1	1	1	0	4	4	0	4

	%age HGVs									
	Segment Start Time								With Development	
Movement	07:45	08:00	08:15	08:30	08:45	09:00	TOTAL	Peak Hour	Addition	TOTAL
A-B	0%	0%	0%	0%	0%	0%	0%	0%		0%
A-C	0%	22%	22%	22%	22%	0%	22%	22%		22%
B-A	0%	0%	0%	0%	0%	0%	0%	0%		0%
B-C	0%	0%	0%	0%	0%	0%	0%	0%		0%
C-A	0%	0%	0%	0%	0%	0%	0%	0%		0%
C-B	0%	100%	100%	100%	100%	0%	100%	100%		100%

ODTAB
AM peak

EXISTING
TRAFFIC

To	A	B	C
From			
A	0	0	72
B	0	0	4
C	24	4	0

HGVs

To	A	B	C
From			
A	0%	0%	22%
B	0%	0%	0%
C	0%	100%	0%

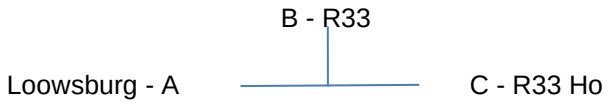
WITH DEVELOPMENT
TRAFFIC

To	A	B	C
From			
A	0	0	72
B	0	0	4
C	24	4	0

HGVs

To	A	B	C
From			
A	0%	0%	22%
B	0%	0%	0%
C	0%	100%	0%

Project	***Commisiekrall***
Location	***R33 Junction, Paulpietersburg***
Date	***12-06-13***



	CARS / VANS / LGVs									
	Segment Start Time								With Development	
Movement	07:45	08:00	08:15	08:30	08:45	09:00	TOTAL	Peak Hour	Addition	TOTAL
A-B	0	0	1	0			1	1		1
A-C	8	19	10	6			43	35		35
B-A	0	0	0	0			0	0		0
B-C	14	14	26	12			66	52		52
C-A	12	7	8	5			32	20		20
C-B	13	16	10	10			49	36		36

	HGVs									
	Segment Start Time								With Development	
Movement	07:45	08:00	08:15	08:30	08:45	09:00	TOTAL	Peak Hour	Addition	TOTAL
A-B	0	0	0	0			0	0		0
A-C	2	9	6	3			20	18		18
B-A	0	0	0	0			0	0		0
B-C	2	2	7	1			12	10		10
C-A	0	2	4	0			6	6		6
C-B	1	0	3	1			5	4		4

	TOTALS									
	Segment Start Time								With Development	
Movement	07:45	08:00	08:15	08:30	08:45	09:00	TOTAL	Peak Hour	Addition	TOTAL
A-B	0	0	1	0	0	0	1	1	0	1
A-C	10	28	16	9	0	0	63	53	0	53
B-A	0	0	0	0	0	0	0	0	0	0
B-C	16	16	33	13	0	0	78	62	0	62
C-A	12	9	12	5	0	0	38	26	0	26
C-B	14	16	13	11	0	0	54	40	0	40

	%age HGVs									
	Segment Start Time								With Development	
Movement	07:45	08:00	08:15	08:30	08:45	09:00	TOTAL	Peak Hour	Addition	TOTAL
A-B	0%	0%	0%	0%	0%	0%	0%	0%		0%
A-C	20%	32%	38%	33%	0%	0%	32%	34%		34%
B-A	0%	0%	0%	0%	0%	0%	0%	0%		0%
B-C	13%	13%	21%	8%	0%	0%	15%	16%		16%
C-A	0%	22%	33%	0%	0%	0%	16%	23%		23%
C-B	7%	0%	23%	9%	0%	0%	9%	10%		10%

ODTAB
AM peak

EXISTING
TRAFFIC

To	A	B	C
From			
A	0	1	53
B	0	0	62
C	26	40	0

HGVs

To	A	B	C
From			
A	0%	0%	34%
B	0%	0%	16%
C	23%	10%	0%

WITH DEVELOPMENT
TRAFFIC

To	A	B	C
From			
A	0	1	53
B	0	0	62
C	26	40	0

HGVs

To	A	B	C
From			
A	0%	0%	34%
B	0%	0%	16%
C	23%	10%	0%

Appendix B

TRL LIMITED

CAPACITIES, QUEUES, AND DELAYS AT 3 OR 4-ARM MAJOR/MINOR PRIORITY JUNCTIONS

PICADY 5.1 ANALYSIS PROGRAM
RELEASE 4.0 (SEPT 2008)

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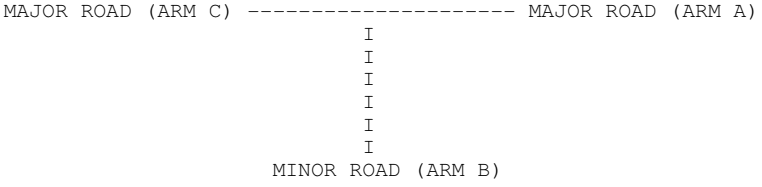
"T:\Projects\4AF\03471 - SLR (Africa) Pty\00030 - Commissiekrall Developments South Africa\Tech\H&T\Wking\
PICADY\150527_4AF_03471_00030_P40R33.vpi"
(drive-on-the-left) at 14:47:38 on Thursday, 28 May 2015

RUN INFORMATION

RUN TITLE	: Comm - P40/R33
LOCATION	: Paulpietersburg, SA
DATE	: 27/05/15
CLIENT	: Thoile Logistics
ENUMERATOR	: jgarlick [BRA3709L]
JOB NUMBER	:
STATUS	:
DESCRIPTION	:

MAJOR/MINOR JUNCTION CAPACITY AND DELAY

INPUT DATA



ARM A IS R33 South
ARM B IS P40
ARM C IS R33 North

STREAM LABELLING CONVENTION

STREAM A-B CONTAINS TRAFFIC GOING FROM ARM A TO ARM B
STREAM B-AC CONTAINS TRAFFIC GOING FROM ARM B TO ARM A AND TO ARM C
ETC.

GEOMETRIC DATA

DATA ITEM	MINOR ROAD B
TOTAL MAJOR ROAD CARRIAGEWAY WIDTH	(W) 7.42 M.
CENTRAL RESERVE WIDTH	(WCR) 0.00 M.
MAJOR ROAD RIGHT TURN - WIDTH	(WC-B) 3.50 M.
- VISIBILITY	(VC-B)250.00 M.
- BLOCKS TRAFFIC	YES
MINOR ROAD - VISIBILITY TO LEFT	(VB-C) 227.0 M.
- VISIBILITY TO RIGHT	(VB-A) 250.0 M.
- LANE 1 WIDTH	(WB-C) -
- LANE 2 WIDTH	(WB-A) -
WIDTH AT 0 M FROM JUNCTION	10.00 M.
WIDTH AT 5 M FROM JUNCTION	10.00 M.
WIDTH AT 10 M FROM JUNCTION	10.00 M.
WIDTH AT 15 M FROM JUNCTION	6.34 M.
WIDTH AT 20 M FROM JUNCTION	4.90 M.
- LENGTH OF FLARED SECTION	DERIVED: 3 PCU

.SLOPES AND INTERCEPT

(NB:Streams may be combined, in which case capacity will be adjusted)

Intercept For STREAM B-C	Slope For Opposing STREAM A-C	Slope For Opposing STREAM A-B
0.00	0.00	0.00

* Due to the presence of a flare, data is not available

Intercept For STREAM B-A	Slope For Opposing STREAM A-C	Slope For Opposing STREAM A-B	Slope For Opposing STREAM C-A	Slope For Opposing STREAM C-B
0.00	0.00	0.00	0.00	0.00

* Due to the presence of a flare, data is not available

Intercept For STREAM C-B	Slope For Opposing STREAM A-C	Slope For Opposing STREAM A-B
820.43	0.30	0.30

(NB These values do not allow for any site specific corrections)

TRAFFIC DEMAND DATA

ARM	FLOW SCALE(%)
A	100
B	100
C	100

Demand set: 2015 Base

TIME PERIOD BEGINS 13.45 AND ENDS 15.15

LENGTH OF TIME PERIOD - 90 MIN.
LENGTH OF TIME SEGMENT - 15 MIN.

DEMAND FLOW PROFILES ARE SYNTHESISED FROM TURNING COUNT DATA

ARM	NUMBER OF MINUTES FROM START WHEN FLOW STARTS TO RISE	NUMBER OF MINUTES FROM START WHEN TOP OF PEAK IS REACHED	NUMBER OF MINUTES FROM START WHEN FLOW STOPS FALLING	RATE OF FLOW (VEH/MIN) BEFORE PEAK	RATE OF FLOW (VEH/MIN) AT TOP OF PEAK	RATE OF FLOW (VEH/MIN) AFTER PEAK
ARM A	15.00	45.00	75.00	0.95	1.42	0.95
ARM B	15.00	45.00	75.00	0.05	0.08	0.05
ARM C	15.00	45.00	75.00	0.57	0.86	0.57

Demand set: 2015 Base

TIME	FROM/TO	ARM A	ARM B	ARM C
13.45 - 14.00	ARM A	0.000	0.000	1.000
		0.0	0.0	76.0
		(0.0)%	(0.0)%	(22.0)%
	ARM B	0.000	0.000	1.000
		0.0	0.0	4.0
		(0.0)%	(0.0)%	(0.0)%
	ARM C	0.543	0.457	0.000
		25.0	21.0	0.0
		(0.0)%	(20.0)%	(0.0)%

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA
THE PERCENTAGE OF HEAVY VEHICLES VARIES OVER TURNING MOVEMENTS

QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT
FOR DEMAND SET 2015 Base
AND FOR TIME PERIOD 1

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
13.45-14.00									
B-C	0.05	15.21	0.003		0.00	0.00	0.0		0.07
B-A	0.00	10.20	0.000		0.00	0.00	0.0		0.00
C-AB	0.26	11.11	0.024		0.00	0.02	0.4		0.09
A-B	0.00								
A-C	0.95								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
14.00-14.15									
B-C	0.06	15.13	0.004		0.00	0.00	0.1		0.07
B-A	0.00	10.10	0.000		0.00	0.00	0.0		0.00
C-AB	0.31	11.05	0.028		0.02	0.03	0.4		0.09
A-B	0.00								
A-C	1.14								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
14.15-14.30									
B-C	0.07	15.02	0.005		0.00	0.00	0.1		0.07
B-A	0.00	9.97	0.000		0.00	0.00	0.0		0.00
C-AB	0.39	10.97	0.035		0.03	0.04	0.5		0.09
A-B	0.00								
A-C	1.39								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
14.30-14.45									
B-C	0.07	15.02	0.005		0.00	0.00	0.1		0.07
B-A	0.00	9.97	0.000		0.00	0.00	0.0		0.00
C-AB	0.39	10.97	0.035		0.04	0.04	0.5		0.09
A-B	0.00								
A-C	1.39								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
14.45-15.00									
B-C	0.06	15.13	0.004		0.00	0.00	0.1		0.07
B-A	0.00	10.10	0.000		0.00	0.00	0.0		0.00
C-AB	0.31	11.05	0.028		0.04	0.03	0.4		0.09
A-B	0.00								
A-C	1.14								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
15.00-15.15									
B-C	0.05	15.21	0.003		0.00	0.00	0.1		0.07
B-A	0.00	10.20	0.000		0.00	0.00	0.0		0.00
C-AB	0.26	11.11	0.024		0.03	0.02	0.4		0.09
A-B	0.00								
A-C	0.95								

WARNING NO MARGINAL ANALYSIS OF CAPACITIES AS MAJOR ROAD BLOCKING MAY OCCUR

QUEUE FOR STREAM B-C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
14.00	0.0
14.15	0.0
14.30	0.0
14.45	0.0
15.00	0.0
15.15	0.0

QUEUE FOR STREAM B-A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
14.00	0.0
14.15	0.0
14.30	0.0
14.45	0.0
15.00	0.0
15.15	0.0

QUEUE FOR STREAM C-AB

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
14.00	0.0
14.15	0.0
14.30	0.0
14.45	0.0
15.00	0.0
15.15	0.0

Demand set: 2015 w/ Devt

TIME	FROM/TO	TURNING PROPORTIONS / TURNING COUNTS (PERCENTAGE OF H.V.S) ARM A	ARM B	ARM C
13.45 - 14.00	ARM A	0.000	0.000	1.000
		0.0	0.0	76.0
		(0.0)	(0.0)	(22.0)
	ARM B	0.000	0.000	1.000
		0.0	0.0	14.0
		(0.0)	(0.0)	(0.0)
	ARM C	0.379	0.621	0.000
		25.0	41.0	0.0
		(0.0)	(35.0)	(0.0)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA
THE PERCENTAGE OF HEAVY VEHICLES VARIES OVER TURNING MOVEMENTS

QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

FOR DEMAND SET 2015 w/ Devt
AND FOR TIME PERIOD 1

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
13.45-14.00									
B-C	0.18	15.21	0.012		0.00	0.01	0.2		0.07
B-A	0.00	10.05	0.000		0.00	0.00	0.0		0.00
C-AB	0.51	9.87	0.052		0.00	0.05	0.8		0.11
A-B	0.00								
A-C	0.95								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
14.00-14.15									
B-C	0.21	15.13	0.014		0.01	0.01	0.2		0.07
B-A	0.00	9.92	0.000		0.00	0.00	0.0		0.00
C-AB	0.61	9.82	0.063		0.05	0.07	1.0		0.11
A-B	0.00								
A-C	1.14								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
14.15-14.30									
B-C	0.26	15.02	0.017		0.01	0.02	0.3		0.07
B-A	0.00	9.75	0.000		0.00	0.00	0.0		0.00
C-AB	0.75	9.75	0.077		0.07	0.08	1.2		0.11
A-B	0.00								
A-C	1.39								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
14.30-14.45									
B-C	0.26	15.02	0.017		0.02	0.02	0.3		0.07
B-A	0.00	9.75	0.000		0.00	0.00	0.0		0.00
C-AB	0.75	9.75	0.077		0.08	0.08	1.3		0.11
A-B	0.00								
A-C	1.39								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
14.45-15.00									
B-C	0.21	15.13	0.014		0.02	0.01	0.2		0.07
B-A	0.00	9.92	0.000		0.00	0.00	0.0		0.00
C-AB	0.61	9.82	0.063		0.08	0.07	1.0		0.11
A-B	0.00								
A-C	1.14								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
15.00-15.15									
B-C	0.18	15.21	0.012		0.01	0.01	0.2		0.07
B-A	0.00	10.05	0.000		0.00	0.00	0.0		0.00
C-AB	0.51	9.87	0.052		0.07	0.06	0.8		0.11
A-B	0.00								
A-C	0.95								

WARNING NO MARGINAL ANALYSIS OF CAPACITIES AS MAJOR ROAD BLOCKING MAY OCCUR

QUEUE FOR STREAM B-C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
14.00	0.0
14.15	0.0
14.30	0.0
14.45	0.0
15.00	0.0
15.15	0.0

QUEUE FOR STREAM B-A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
14.00	0.0
14.15	0.0
14.30	0.0
14.45	0.0
15.00	0.0
15.15	0.0

QUEUE FOR STREAM C-AB

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
14.00	0.1
14.15	0.1
14.30	0.1
14.45	0.1
15.00	0.1
15.15	0.1

QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

STREAM	TOTAL DEMAND		* QUEUEING * DELAY *		* INCLUSIVE QUEUEING * DELAY *	
	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
B-C	19.3	12.8	1.3	0.07	1.3	0.07
B-A	0.0	0.0	0.0	0.00	0.0	0.00
C-AB	56.4	37.6	6.1	0.11	6.1	0.11
A-B	0.0	0.0				
A-C	104.6	69.7				
ALL	214.7	143.1	7.4	0.03	7.4	0.03

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES
WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS
A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

*******END OF RUN*******

.SLOPES AND INTERCEPT

(NB:Streams may be combined, in which case capacity will be adjusted)

Intercept For STREAM B-C	Slope For Opposing STREAM A-C	Slope For Opposing STREAM A-B
0.00	0.00	0.00

* Due to the presence of a flare, data is not available

Intercept For STREAM B-A	Slope For Opposing STREAM A-C	Slope For Opposing STREAM A-B	Slope For Opposing STREAM C-A	Slope For Opposing STREAM C-B
0.00	0.00	0.00	0.00	0.00

* Due to the presence of a flare, data is not available

Intercept For STREAM C-B	Slope For Opposing STREAM A-C	Slope For Opposing STREAM A-B
820.43	0.30	0.30

(NB These values do not allow for any site specific corrections)

TRAFFIC DEMAND DATA

ARM	FLOW SCALE(%)
A	100
B	100
C	100

Demand set: 2021 Base

TIME PERIOD BEGINS 13.45 AND ENDS 15.15

LENGTH OF TIME PERIOD - 90 MIN.
LENGTH OF TIME SEGMENT - 15 MIN.

DEMAND FLOW PROFILES ARE SYNTHESISED FROM TURNING COUNT DATA

ARM	NUMBER OF MINUTES FROM START WHEN FLOW STARTS TO RISE	TOP OF PEAK IS REACHED	FLOW STOPS FALLING	RATE OF FLOW (VEH/MIN) BEFORE PEAK	AT TOP OF PEAK	AFTER PEAK
ARM A	15.00	45.00	75.00	1.11	1.67	1.11
ARM B	15.00	45.00	75.00	0.06	0.09	0.06
ARM C	15.00	45.00	75.00	0.69	1.03	0.69

Demand set: 2021 Base

TIME	FROM/TO	ARM A	ARM B	ARM C
13.45 - 14.00				
	ARM A	0.000	0.000	1.000
		0.0	0.0	89.0
		(0.0)	(0.0)	(22.0)
	ARM B	0.000	0.000	1.000
		0.0	0.0	5.0
		(0.0)	(0.0)	(0.0)
	ARM C	0.545	0.455	0.000
		30.0	25.0	0.0
		(0.0)	(20.0)	(0.0)

TURNING PROPORTIONS
TURNING COUNTS
(PERCENTAGE OF H.V.S)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA
THE PERCENTAGE OF HEAVY VEHICLES VARIES OVER TURNING MOVEMENTS

QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

FOR DEMAND SET 2021 Base
AND FOR TIME PERIOD 1

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
13.45-14.00									
B-C	0.06	15.14	0.004		0.00	0.00	0.1		0.07
B-A	0.00	10.11	0.000		0.00	0.00	0.0		0.00
C-AB	0.31	11.06	0.028		0.00	0.03	0.4		0.09
A-B	0.00								
A-C	1.12								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
14.00-14.15									
B-C	0.07	15.05	0.005		0.00	0.00	0.1		0.07
B-A	0.00	9.99	0.000		0.00	0.00	0.0		0.00
C-AB	0.37	10.99	0.034		0.03	0.03	0.5		0.09
A-B	0.00								
A-C	1.33								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
14.15-14.30									
B-C	0.09	14.93	0.006		0.00	0.01	0.1		0.07
B-A	0.00	9.84	0.000		0.00	0.00	0.0		0.00
C-AB	0.46	10.90	0.042		0.03	0.04	0.7		0.10
A-B	0.00								
A-C	1.63								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
14.30-14.45									
B-C	0.09	14.93	0.006		0.01	0.01	0.1		0.07
B-A	0.00	9.83	0.000		0.00	0.00	0.0		0.00
C-AB	0.46	10.90	0.042		0.04	0.04	0.7		0.10
A-B	0.00								
A-C	1.63								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
14.45-15.00									
B-C	0.07	15.05	0.005		0.01	0.01	0.1		0.07
B-A	0.00	9.99	0.000		0.00	0.00	0.0		0.00
C-AB	0.37	10.99	0.034		0.04	0.04	0.5		0.09
A-B	0.00								
A-C	1.33								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
15.00-15.15									
B-C	0.06	15.14	0.004		0.01	0.00	0.1		0.07
B-A	0.00	10.11	0.000		0.00	0.00	0.0		0.00
C-AB	0.31	11.06	0.028		0.04	0.03	0.4		0.09
A-B	0.00								
A-C	1.12								

WARNING NO MARGINAL ANALYSIS OF CAPACITIES AS MAJOR ROAD BLOCKING MAY OCCUR

QUEUE FOR STREAM B-C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
14.00	0.0
14.15	0.0
14.30	0.0
14.45	0.0
15.00	0.0
15.15	0.0

QUEUE FOR STREAM B-A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
14.00	0.0
14.15	0.0
14.30	0.0
14.45	0.0
15.00	0.0
15.15	0.0

QUEUE FOR STREAM C-AB

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
14.00	0.0
14.15	0.0
14.30	0.0
14.45	0.0
15.00	0.0
15.15	0.0

QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

STREAM	TOTAL DEMAND		* QUEUEING * DELAY *		* INCLUSIVE QUEUEING * DELAY *	
	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
B-C	6.9	4.6	0.5	0.07	0.5	0.07
B-A	0.0	0.0	0.0	0.00	0.0	0.00
C-AB	34.4	22.9	3.2	0.09	3.2	0.09
A-B	0.0	0.0				
A-C	122.5	81.7				
ALL	205.1	136.7	3.7	0.02	3.7	0.02

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES
WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS
A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

*******END OF RUN*******

.SLOPES AND INTERCEPT

(NB:Streams may be combined, in which case capacity will be adjusted)

Intercept For STREAM B-C	Slope For Opposing STREAM A-C	Slope For Opposing STREAM A-B
0.00	0.00	0.00

* Due to the presence of a flare, data is not available

Intercept For STREAM B-A	Slope For Opposing STREAM A-C	Slope For Opposing STREAM A-B	Slope For Opposing STREAM C-A	Slope For Opposing STREAM C-B
0.00	0.00	0.00	0.00	0.00

* Due to the presence of a flare, data is not available

Intercept For STREAM C-B	Slope For Opposing STREAM A-C	Slope For Opposing STREAM A-B
820.43	0.30	0.30

(NB These values do not allow for any site specific corrections)

TRAFFIC DEMAND DATA

ARM	FLOW SCALE(%)
A	100
B	100
C	100

Demand set: 2021 w/ Devt

TIME PERIOD BEGINS 13.45 AND ENDS 15.15

LENGTH OF TIME PERIOD - 90 MIN.
LENGTH OF TIME SEGMENT - 15 MIN.

DEMAND FLOW PROFILES ARE SYNTHESISED FROM TURNING COUNT DATA

ARM	NUMBER OF MINUTES FROM START WHEN FLOW STARTS TO RISE	TOP OF PEAK IS REACHED	FLOW STOPS FALLING	RATE OF FLOW (VEH/MIN) BEFORE PEAK	AT TOP OF PEAK	AFTER PEAK
ARM A	15.00	45.00	75.00	1.11	1.67	1.11
ARM B	15.00	45.00	75.00	0.19	0.28	0.19
ARM C	15.00	45.00	75.00	0.94	1.41	0.94

Demand set: 2021 w/ Devt

TIME	FROM/TO	TURNING PROPORTIONS / TURNING COUNTS (PERCENTAGE OF H.V.S) ARM A	ARM B	ARM C
13.45 - 14.00	ARM A	0.000	0.000	1.000
		0.0	0.0	89.0
		(0.0)	(0.0)	(22.0)
	ARM B	0.000	0.000	1.000
		0.0	0.0	15.0
		(0.0)	(0.0)	(0.0)
	ARM C	0.400	0.600	0.000
		30.0	45.0	0.0
		(0.0)	(33.0)	(0.0)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA
THE PERCENTAGE OF HEAVY VEHICLES VARIES OVER TURNING MOVEMENTS

QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

FOR DEMAND SET 2021 w/ Devt
AND FOR TIME PERIOD 1

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
13.45-14.00									
B-C	0.19	15.14	0.012		0.00	0.01	0.2		0.07
B-A	0.00	9.96	0.000		0.00	0.00	0.0		0.00
C-AB	0.56	9.98	0.057		0.00	0.06	0.9		0.11
A-B	0.00								
A-C	1.12								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
14.00-14.15									
B-C	0.22	15.05	0.015		0.01	0.02	0.2		0.07
B-A	0.00	9.82	0.000		0.00	0.00	0.0		0.00
C-AB	0.67	9.92	0.068		0.06	0.07	1.1		0.11
A-B	0.00								
A-C	1.33								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
14.15-14.30									
B-C	0.28	14.93	0.018		0.02	0.02	0.3		0.07
B-A	0.00	9.62	0.000		0.00	0.00	0.0		0.00
C-AB	0.83	9.83	0.084		0.07	0.09	1.4		0.11
A-B	0.00								
A-C	1.63								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
14.30-14.45									
B-C	0.28	14.93	0.018		0.02	0.02	0.3		0.07
B-A	0.00	9.62	0.000		0.00	0.00	0.0		0.00
C-AB	0.83	9.83	0.084		0.09	0.09	1.4		0.11
A-B	0.00								
A-C	1.63								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
14.45-15.00									
B-C	0.22	15.05	0.015		0.02	0.02	0.2		0.07
B-A	0.00	9.81	0.000		0.00	0.00	0.0		0.00
C-AB	0.67	9.92	0.068		0.09	0.07	1.1		0.11
A-B	0.00								
A-C	1.33								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
15.00-15.15									
B-C	0.19	15.14	0.012		0.02	0.01	0.2		0.07
B-A	0.00	9.96	0.000		0.00	0.00	0.0		0.00
C-AB	0.56	9.98	0.057		0.07	0.06	0.9		0.11
A-B	0.00								
A-C	1.12								

WARNING NO MARGINAL ANALYSIS OF CAPACITIES AS MAJOR ROAD BLOCKING MAY OCCUR

QUEUE FOR STREAM B-C

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
14.00	0.0
14.15	0.0
14.30	0.0
14.45	0.0
15.00	0.0
15.15	0.0

QUEUE FOR STREAM B-A

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
14.00	0.0
14.15	0.0
14.30	0.0
14.45	0.0
15.00	0.0
15.15	0.0

QUEUE FOR STREAM C-AB

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
14.00	0.1
14.15	0.1
14.30	0.1
14.45	0.1
15.00	0.1
15.15	0.1

QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

STREAM	TOTAL DEMAND		* QUEUEING * DELAY *		* INCLUSIVE QUEUEING * DELAY *	
	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
B-C	20.6	13.8	1.4	0.07	1.4	0.07
B-A	0.0	0.0	0.0	0.00	0.0	0.00
C-AB	61.9	41.3	6.7	0.11	6.7	0.11
A-B	0.0	0.0				
A-C	122.5	81.7				
ALL	246.4	164.3	8.1	0.03	8.1	0.03

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* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES
WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS
A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

*******END OF RUN*******

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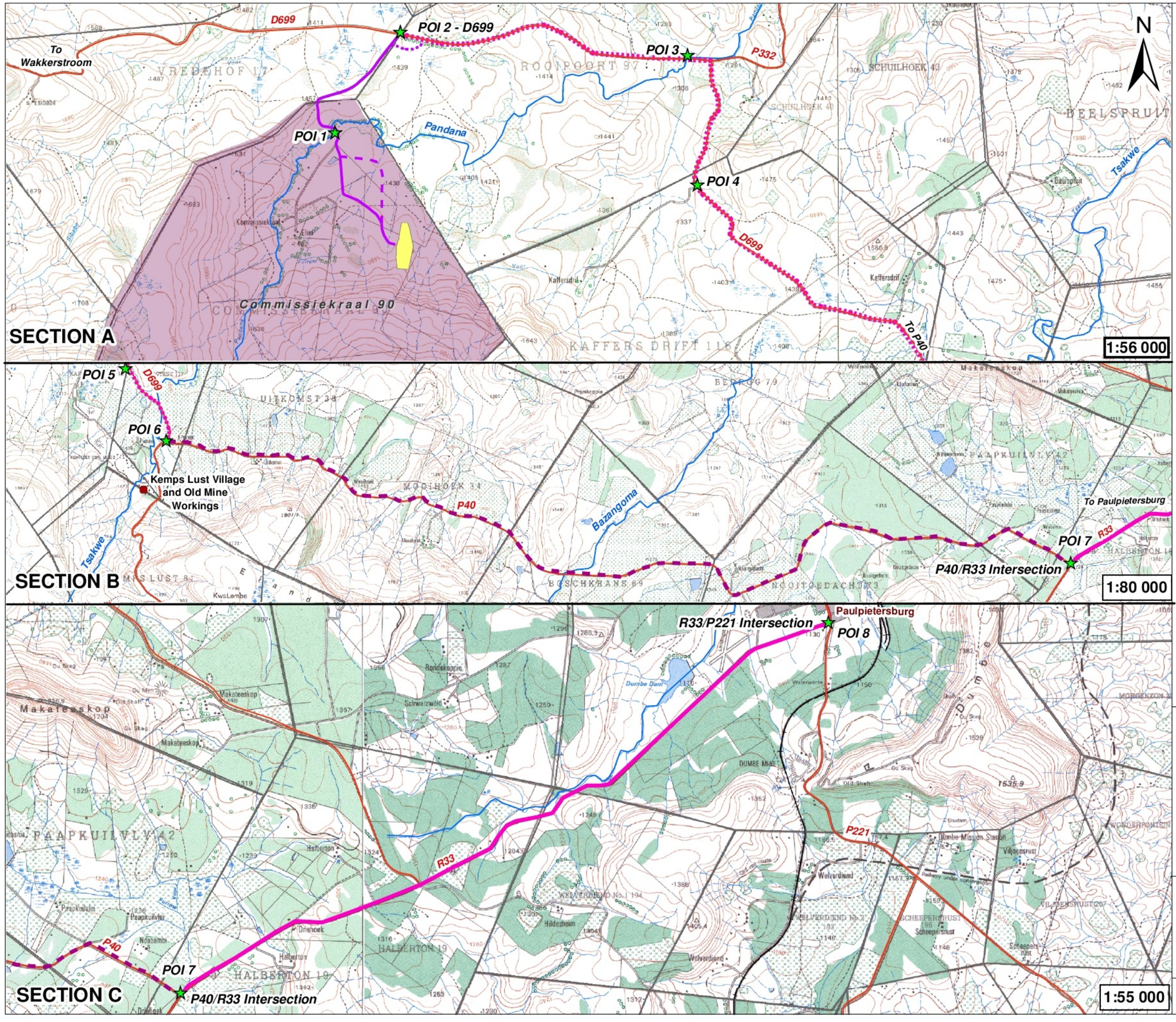

Legend

- Proposed Access Road
- Possible Mitigation to Avoid Homesteads
- Possible Mitigation to Avoid School
- Surface Infrastructure Site
- Project Area
- Gravel District Section
- Regional Tarred Section
- Regional Tarred Section
- Public Gravel Roads
- Railway
- Rivers - Perennial
- Farm Boundaries

1 : 150 000 @ A3

Projection: Transverse Mercator
Datum: Hartebeeshoek, LO31
Sourced from Traffic Specialist Study

THOLIE LOGISTICS
Commissiekraal Coal Project

Drawing 001

Existing Road Network

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