

TWEEFONTEIN ROAD REALIGNMENT PROJECT

PROPOSED CLOSURE & REALIGNMENT OF A SECTION OF ROAD D2770 (R547)

REVISED TRAFFIC IMPACT STUDY



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February 2014

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REVISED TRAFFIC IMPACT STUDY

1. INTRODUCTION

1.1 Purpose of this study

An expansion of mining operations is being planned on the Tweefontein Complex, situated between Ogies and Witbank in the Highveld District of Mpumalanga. AvzconS (Pty) Ltd were appointed to conduct a traffic impact study to assess the traffic implications of this proposed expansion of mining operations on the surrounding road network.

The expansion of the existing mining operations at the Tweefontein Complex form part of the proposed Tweefontein Optimisation Project Amendment (TOPA). The proposed mining operations associated with the TOPA necessitated the proposed road realignment which in turn forms part of the Tweefontein Road Realignment Project.

Figure TOP-TA-41 is a cadastral locality map and **Figure TOP-TA-42** is an aerial photo locality map, both of which show the Tweefontein Complex mining area in relation to the surrounding towns and the existing road network of the area, as well as the provincial route numbers of all the roads within the scope of the study area.

1.2 Study approach

In order to make recommendations to the relevant roads authority on the feasibility of the proposed expansion of the mining operations, all work is done in accordance with the “**Guidelines for Traffic Impact Studies**” of the Department of Transport and the study is structured as follows:

- Determine the scope/boundaries of the required survey field and study area.
- Identify all possible factors and elements which might influence the adjudication of the application.
- Discuss existing standards which are normally applied and which are to be satisfied, in relation to applicable norms experienced at similar developments.
- Compile a database of available information that might influence the decision of the relevant authorities.

- Discuss the expected traffic impact of the expansion proposals on the regional road network.

1.3 Proposed development

The proposed additional opencast mining operations will be within the mine boundary of the Tweefontein Complex. The purpose of this planned expansion of the project will be to extend the life of the current mining operations, which in turn is coupled to major regional benefits of which the most important are sustained employment opportunities and extended foreign revenue generation.

2. PRESENT SITUATION

Figures TOP-TA-41 and **42** indicate the location of the Tweefontein Complex mining area in relation to its surroundings. This area is situated to the east of Ogies and to the south-west of Witbank with Clewer directly to the north thereof.

All planned future operations will be conducted in accordance with the mining rights applicable to the properties within the mine boundary.

The following road sections fall within the mine boundary:

- National route N12 \pm 3,4km
- Provincial road R555 (P29-1) \pm 5,6km
- Provincial road R547 (D2770) \pm 12,1km
- Provincial road P141-1 \pm 6,9km
- Provincial road D2769 \pm 2,2km

The relative importance of the various elements of the road network, from a road user point of view, is represented on **Figure TOP-TA-43**, in a format representing the current average daily traffic volumes.

- The N12 is of national importance and the optimisation activities, planned for, will not impact on this route at all.
- Provincial Road R555 (P29-1) is of major importance to the regional road network due to the interchange at the intersection with Route N12 as well as the fact that it provides access to the "*Minnaar Station*" which is a vital factor from an operational point of view. No mining activities are planned to impact on the alignment of this route.
- Provincial Road R547 (D2770) does not have access via an interchange onto the N12 and only a short section within the mine boundary, south of Road D2769, will be impacted upon by the proposed expansion project and will require the closure and re-alignment of a short section thereof.

- Provincial Road P141-1, between the R555 and the R547, is of minimal importance to the regional road network, as the overwhelming majority of the existing daily trips on this road are actually internal mining traffic.
- Provincial Road D2769, between the R544 and the R547, experiences a relative high average daily traffic, but the only impact by the planned future mining operations will be a short extension to link onto the realigned Road P141-1/R547 with negligible additional traveling time.

3. TRAFFIC ASPECTS

3.1 Present traffic volumes

Traffic volumes as indicated on **Figure TOP-TA-43** were obtained from the database of the provincial roads authority and updated with surveys and manual traffic counts during February and March 2013.

These traffic counts obtained, were all converted to average daily trips and processed to reflect the current traffic movement on each section (link between each pair of intersections) of road. The values were then schematically recorded on **Figure TOP-TA-43**. This schematic reflection of the average daily traffic volumes in drawing format, provide a clear indication to the relative priority of the various road links within the area of interest.

The three southbound routes originating in the vicinity of Clewer/Witbank, passing through the mine area, and the only road completely within the mine boundary, have the following relation with regard to the present traffic volumes making use of them (for each trip/day on road P141-1, there are 4.95 trips/day on road D2769):

D2769	:	R555	:	R547	:	P141-1
4.95	:	3.47	:	2.20	:	1.0

Of the five road sections passing through the area inside the mine boundary, as recorded in paragraph 2 above, it is clear that although R547 (D2770) will be impacted upon by the proposed optimisation activities, this road section carries the second lowest number of trips on an average daily base.

3.2 Expected future trip generation

As can be expected, additional mining activities due to the proposed Tweefontein Optimisation Project Amendment will generate additional vehicle trips. However, when considering these expected additional trips, the following aspects are of high importance:

Important notes:

- (i) The expected additional trips will predominantly be operational trips that will not make use of the road network but are only involved with actual mining activities.
- (ii) Some of the extended mining activities are planned across a short section of Road D2770 between Road D2769 and the southern mine boundary. This section is therefore proposed to be closed and a new alignment is planned with an additional route length of merely 0,9km which will only have limited impact to the average individual road user.
- (iii) The material to be produced by the proposed expanded mining activities will not be transported by road to the applicable end-user destination. From the various stockpiles within the mining area, it will be transported by way of a dedicated conveyer rail towards the “*Minnaar Station*” and thereafter by rail.
- (iv) The Tweefontein Complex is an existing operational mining development with the necessary infrastructure to support the operations currently in process. Any new construction work that will be required in support of the proposed additional mining activities will generate mostly on-site trips with only a few new trips on the surrounding road network in the form of delivery vehicles for the relative short term construction periods.

3.3 Accommodation of future activities

The proposed future mining activities that will result from the planned Tweefontein Optimisation Project Amendment will take place within the mine boundary indicated on the drawings. The specific target area which will impact on the current alignment of public roads is located south of National Route N12 and east of Provincial Road R555 (P29-1). The specific road section that will be impacted upon is:

- Road D2770 (R547) between Road D2769 and a point 3,8km to the south thereof, in the vicinity of the southern mine boundary.

In order to accommodate the future activities of the Tweefontein Optimisation Project, the following available information were taken into account:

- The financial sustainability of the Tweefontein Complex.
- Regional benefits for the community by extending the life of the mine.
- The Final Design Report for the realignment of provincial roads D2770, P141-1 and 0154 by Jeffares & Green (Pty) Ltd.
- Geographical conditions and undermining in the area of interest.
- Road safety aspects related to an area with active mining operations.
- Existing alternative routes and their current conditions.

In combination these aspects justify a formal application for the closure and re-alignment of a section of R547 (D2770) as indicated on **Figure TOP-TA-44**.

3.4 Trip distribution and assignment

The road section proposed to be closed and realigned will not result in revised routes for the current trips on any routes. The expected future situation regarding the proposed amended route is indicated on the following drawing:

- **Fig. TFN-TA-45:** Expected revised routes from Witbank & Clewer towards Bethal. *The relevant current and expected future travelling lengths of the proposed revised route are also indicated on this drawing.*

Taking into account transportation related aspects such as current traffic patterns, route preferences of the current road users and the combination of origins and destinations applicable, the traffic currently making use of the road section that are proposed to be closed and re-aligned was applied to the proposed revised route.

The only intersection that will be impacted upon by the proposed closure and re-alignment is:

Intersection C: The intersection of Road D2769 with the R547 (D2770)

To be able to analyse this intersection, the daily peak hour traffic was determined for both the current road network with the current traffic movements as well as the proposed future road network with the re-configured traffic movements. Both these sets of the daily peak hour traffic volumes are indicated on **Figure TOP-TA-46**, for the intersection included in the detail analysis.

4. TRAFFIC IMPACT ANALYSIS

4.1 Level of service (LOS)

The surrounding roads should cater for the revised traffic demand determined in the previous section, and road improvements for the account of the Tweefontein Expansion Project will have to be done to enable the existing road infrastructure to function effectively, given the revised traffic movements caused by the amended network due to the proposed road closure. This normally means that no approach to any intersection should in total have a level of service less than C (see **Paragraph 4.2**) and if the current situation is less than a C the situation must not be worsened, which is aimed at in the analysis.

Making use of the SIDRA computer simulation programme, a complete level of service analysis was done for intersection **C** as indicated on **Figure TOP-TA-46**, for the weekday peak hour.

The results of the computer analysis are summarised in **Table 1**, and the SIDRA - results are included in **Annexure A**.

4.2 Assessment (refer also to Tables 1)

The level of service (LOS) of a traffic movement is a scale on which the operational capability of a movement or collection of movements is judged, mainly according to delay times.

A	:	Very good
B	:	Good
C	:	Acceptable
D	:	Poor
E	:	Very poor
F	:	Unacceptable

(i) Intersection C: (Road D2769 with Road R547)

- This existing T-intersection, with stop control on the eastern approach, is able to carry the current traffic, at a very good level of service (LOS A). The worst approach (east) is at an acceptable level of service (LOS C).
- With the re-configuration, this intersection will still operate at a very good level of service (LOS A). The worst approach (north) is at an acceptable level of service (LOS C) with the other two approaches still at a LOS A. The total intersection is even operating at a lesser delay time.
- In view of the current growth rate, a 5 year future scenario was analysed with the road works as detailed on **Figure TOP-TA-47**. Even this future scenario has a slightly better level of service than the current intersection in terms of delay time.

4.3 Road improvements

The minimum required road improvements at the amended intersection C, due to the proposed road closure and re-alignment to accommodate the future activities of the Tweefontein Expansion Project, are shown and described on **Figure TOP-TA-47**, as well as on the applicable **Table 1**.

4.4 Economic evaluation

The proposed alternative configuration of Intersections C, to accommodate the re-aligned route due to the proposed road closure as depicted on **Figures TOP-TA-44** and **45** will result in longer routes for the diverted trips, as follows:

- a) An additional 0,9km for the $\pm 1,400$ daily trips between Clewer and Bethal currently using Road D2770.
- b) An additional 0,9km for the $\pm 1,200$ daily trips between Witbank and Bethal currently using Road D2770.

Such diverted trips with a longer route will generate additional cost to the road user in the format of:

- Time cost at an average rate of R0.95/km
- Variable operating cost at an average rate of R3.80/km

The combined effect of these two cost factors on the 2,626 trips that will on average be diverted on a daily basis will cost the road users R11,230/day. However this cost is expected to be overshadowed completely by the positive impact of extending the life span of the mine which will create benefits such as:

- New and/or extended job opportunities for an expected additional 20 years.
- Temporary employment for ± 24 months during new construction activities.
- Earning of foreign revenue for an extended period of time.
- Power stations will be supplied with coal for an extended period of time.
- Rehabilitation and maintenance work on existing road infrastructure committed to as part of the proposal by the mine (see **Paragraph 6. Impacts & mitigation measures**)

5. CONCLUSIONS AND RECOMMENDATION

It is concluded that the proposed future revised road network, surrounding the Tweefontein Complex, will be able to handle the traffic with the calculated and identified road improvements (see **Paragraph 4.2 and 6**), with no detrimental impact on the traffic on any of the relevant roads.

It is therefore recommended that the proposed Tweefontein Road Realignment Project be approved from a traffic point of view, by the Mpumalanga Department of Roads and Transport, on condition that:

- Formal application be made for the deproclamation of the relevant road section and the proclamation of the re-alignment as identified on **Figure TOP-TA-44** of this report, and the required process thereof implemented.
- The proposed work on provincial roads as identified in **Paragraph 6** be quantified, designs thereof submitted for final approval and the execution of such work implemented.
- The required minimum road improvements to be provided by this project according to **Figure TOP-TA-47**, be designed, approved and the execution of such work implemented.
- All costs related to the above items to be for the account of the Tweefontein Expansion Project.

6. IMPACTS AND MITIGATION MEASURES

The closure of a section of Road R547 (D2770) will cause a number of existing trips on the road network to be diverted to the new alignment thereof. In addition to the required improvements to accommodate the re-configured turning movements at Intersection C, as shown and described on **Figure TOP-TA-47**, the following road works are also considered as conditional requirements for the proposed road closure and re-alignment as recorded in this report:

- ❖ Design and construction of the re-alignment as proposed for Route R547 to the design standard as required by the Provincial Roads Authority.

TABLES

SIDRA LEVEL OF SERVICE (LOS)

INTERSECTION C: Road D2769 with Road D2770 (R547)

REQUIRED IMPROVEMENTS:
For detail see Figure TOP-TA-47

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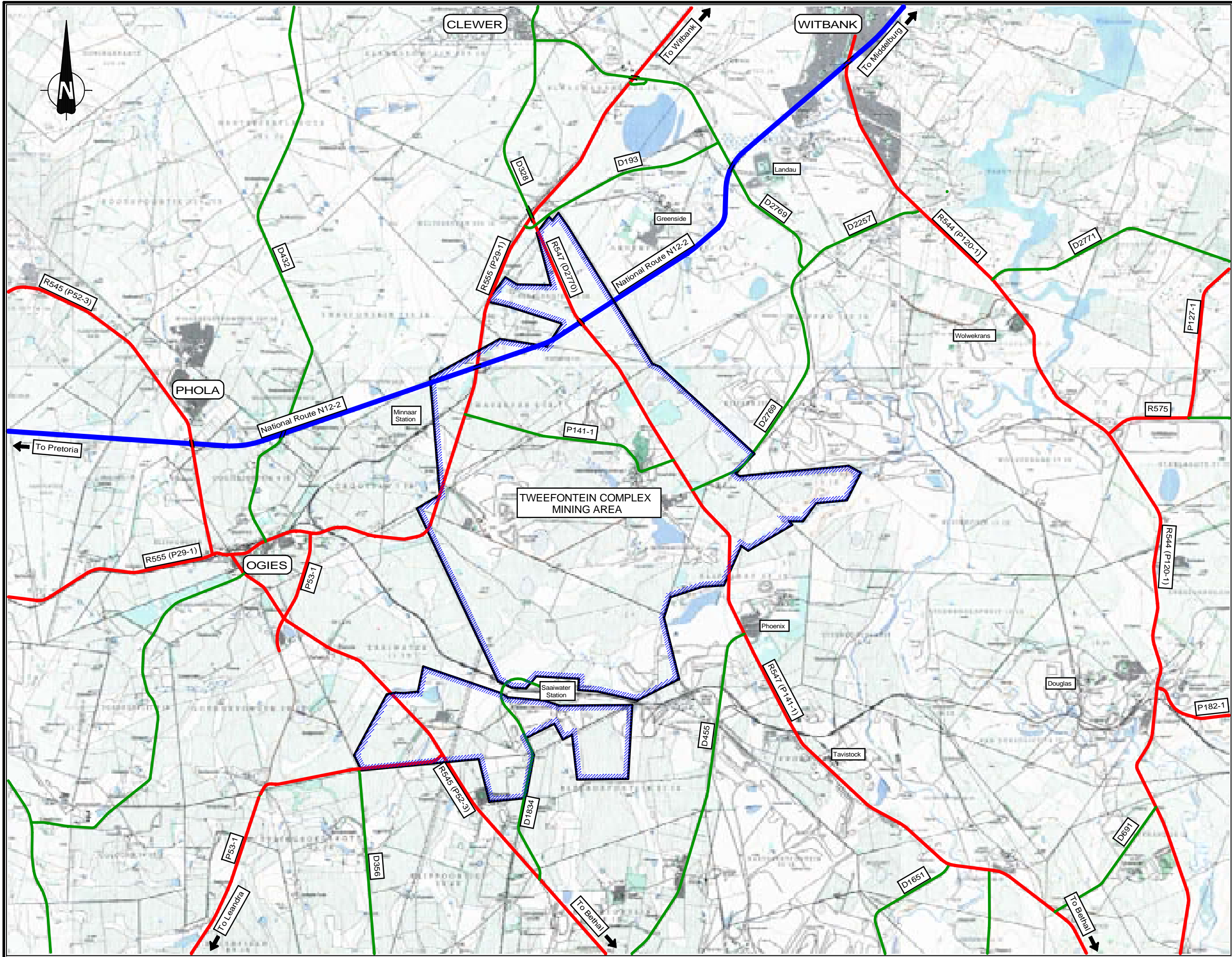
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ORIGIN of APPROACH		WEEKDAY PEAK HOUR			
		Current Traffic with existing layout	Future Traffic with required revisions	5 Year scenario with required revisions	
SOUTH Roads D2770 (To be closed)	Left				
	Through	A			
	Right	B			
	TOTAL APPROACH	A (6.5 sec)			
EAST Rd D2769	Left	C			
	Through		A	A	
	Right	C	B	B	
	TOTAL APPROACH	C (20.9 sec)	A (1.6 sec)	A (1.7 sec)	
NORTH Road D2770	Left	A	C	C	
	Through	A			
	Right		C	D	
	TOTAL APPROACH	A (2.3 sec)	C (20.1 sec)	C (24.5 sec)	
WEST Proposed re-alignment	Left		A	A	
	Through		A	A	
	Right				
	TOTAL APPROACH		A (3.3 sec)	A (3.3 sec)	
TOTAL INTERSECTION		A (9.4 sec)	A (6.9 sec)	A (7.9 sec)	

* C (0.2 sec): Level of service & delay in seconds

TABLE 1

FIGURES



No. 1000 1000

LEGEND:

- National Road
- Prov. Primary Road
- Secondary Road
- Mine Boundary

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Tek. Titel **LOCALITY MAP WITH EXISTING ROAD NETWORK** Drw. Titel

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 DATE:



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Tek. Nr. **FIG. TOP-TA-41** Drw. Nr.



No tes No tes

LEGEND:

- National Road
- Prov. Primary Road
- Secondary Road
- Mine Boundary

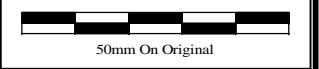
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Project Project
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 TRANSPORTATION
 ASPECTS**

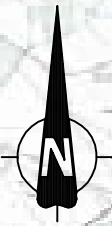
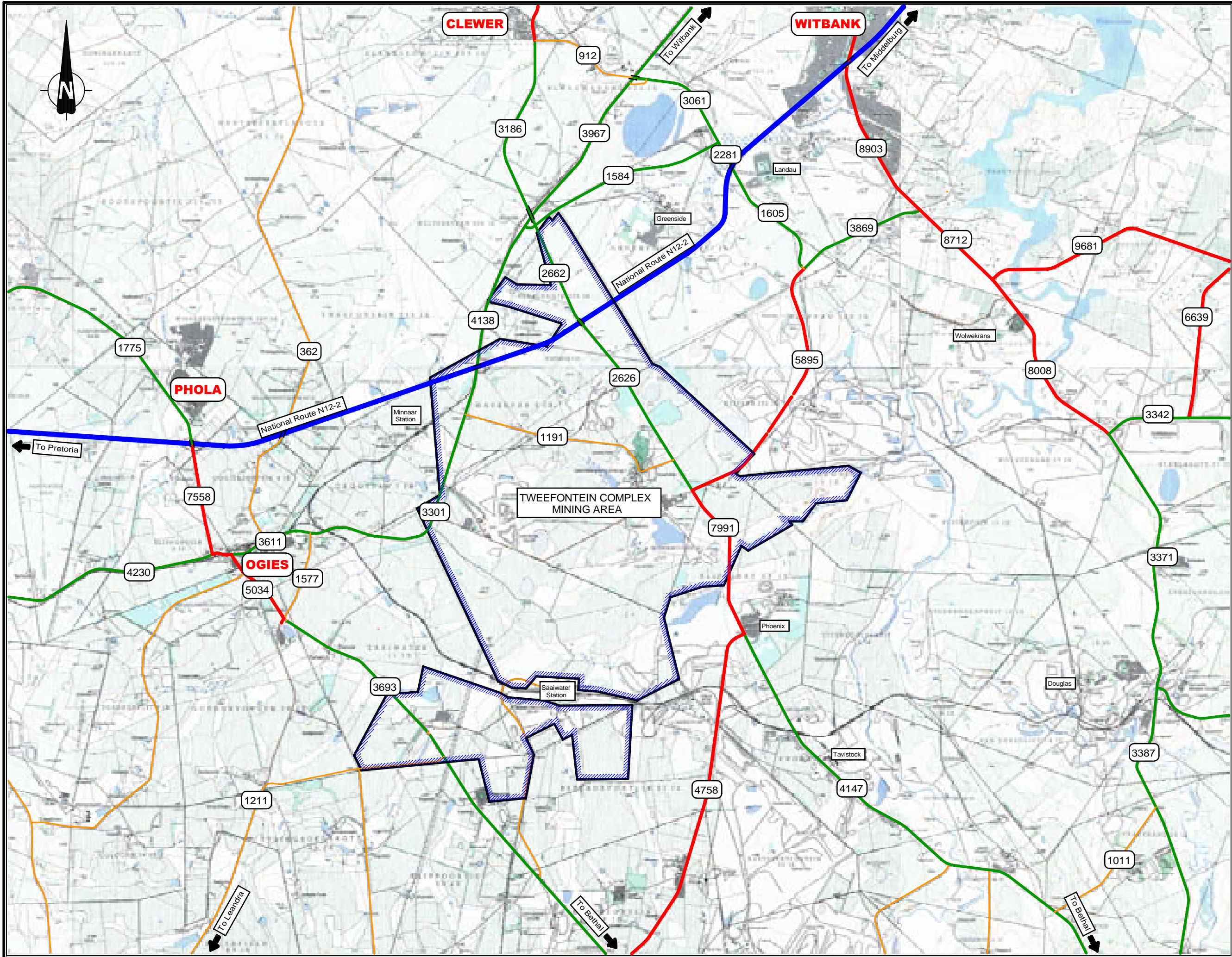
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**AERIAL PHOTO
 WITH EXISTING
 ROAD NETWORK**

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FIG. TOP-TA-42



No. 1000 1000

LEGEND:

Average Daily Trips:

- █ More than 13,500
- █ 4,000 - 13,500
- █ 1,500 - 4,500
- █ Less than 1,500
- 8,143 24h Trip number
- Mine Boundary

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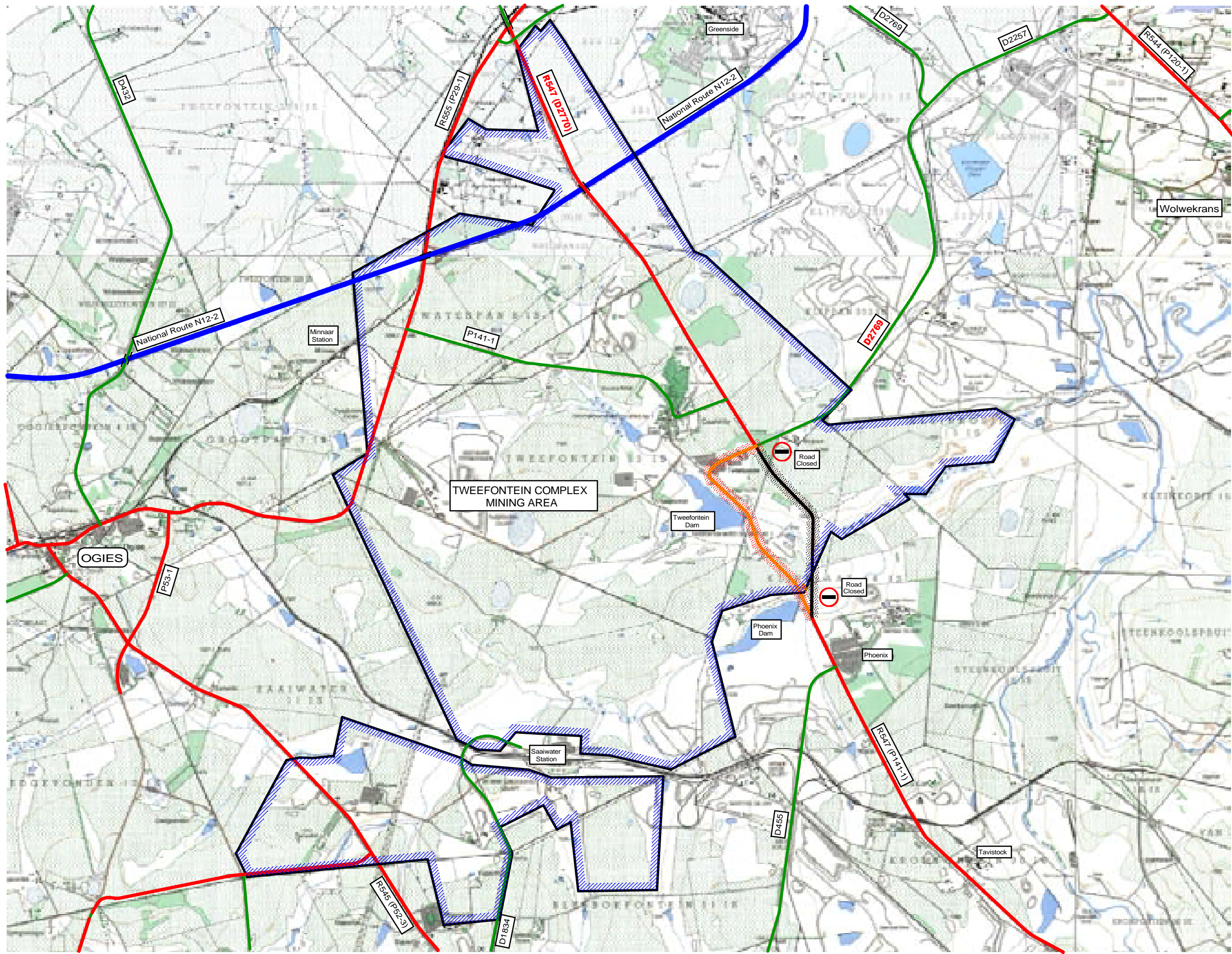
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Tek. Nr. **FIG. TFN-TA-43** Drw. Nr.



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LEGEND:

- National Road
- Prov. Primary Road
- Secondary Road
- Mine Boundary

ALIGNMENT PROPOSALS:

- New Alignment
- Roads to be closed

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Civil Engineering Consultant
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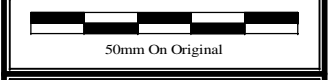
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**PROPOSED
ROAD NETWORK
RE-ALIGNMENTS**

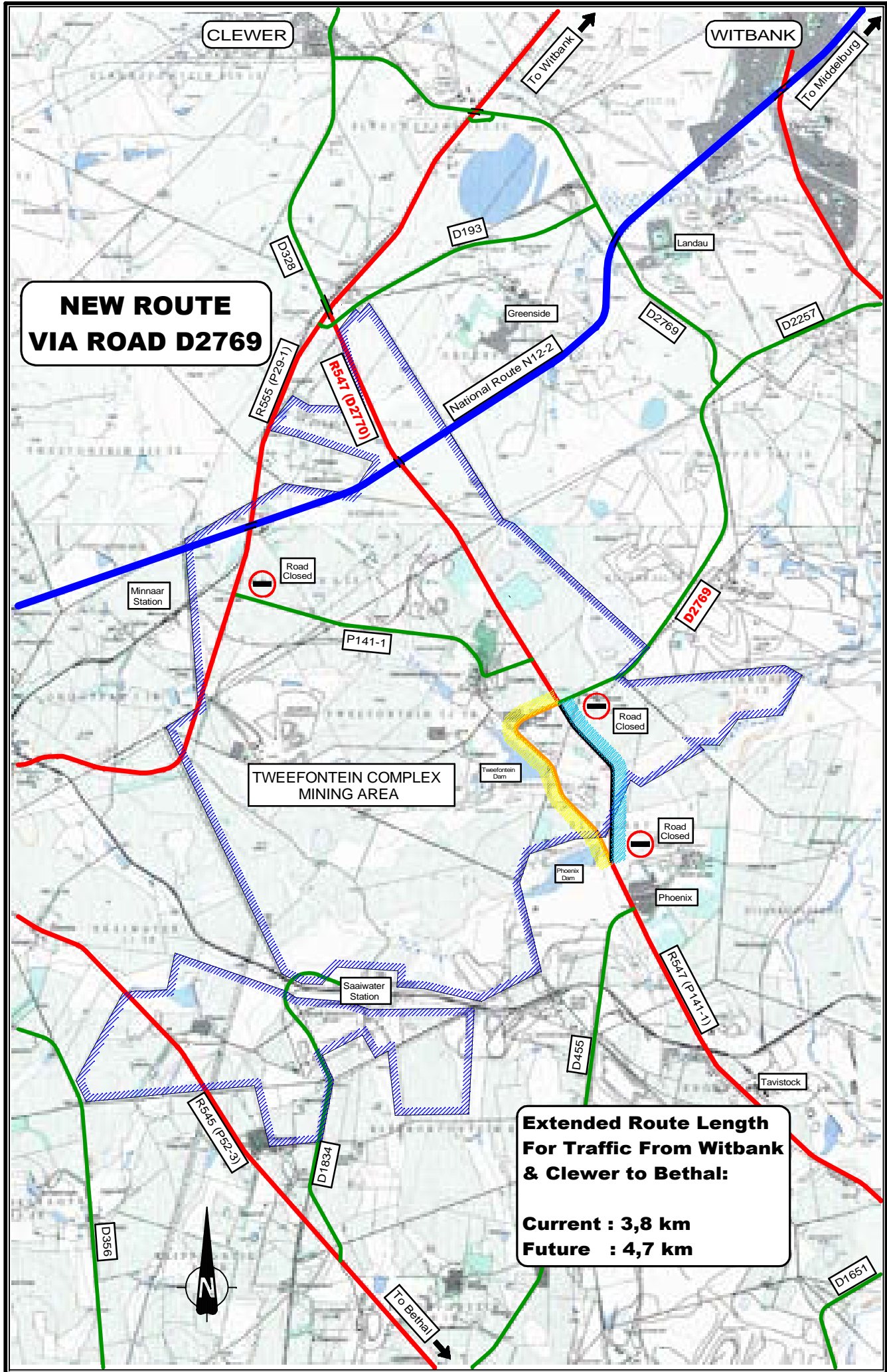
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FIG. TOP-TA-44



NEW ROUTE VIA ROAD D2769

Extended Route Length For Traffic From Witbank & Clewer to Bethal:
Current : 3,8 km
Future : 4,7 km

No tes No tes

LEGEND:

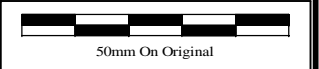
- National Road
- Prov. Primary Road
- Secondary Road
- Mine Boundary
- New Alignment
- Roads to be closed
- Current Routes
- Future Routes

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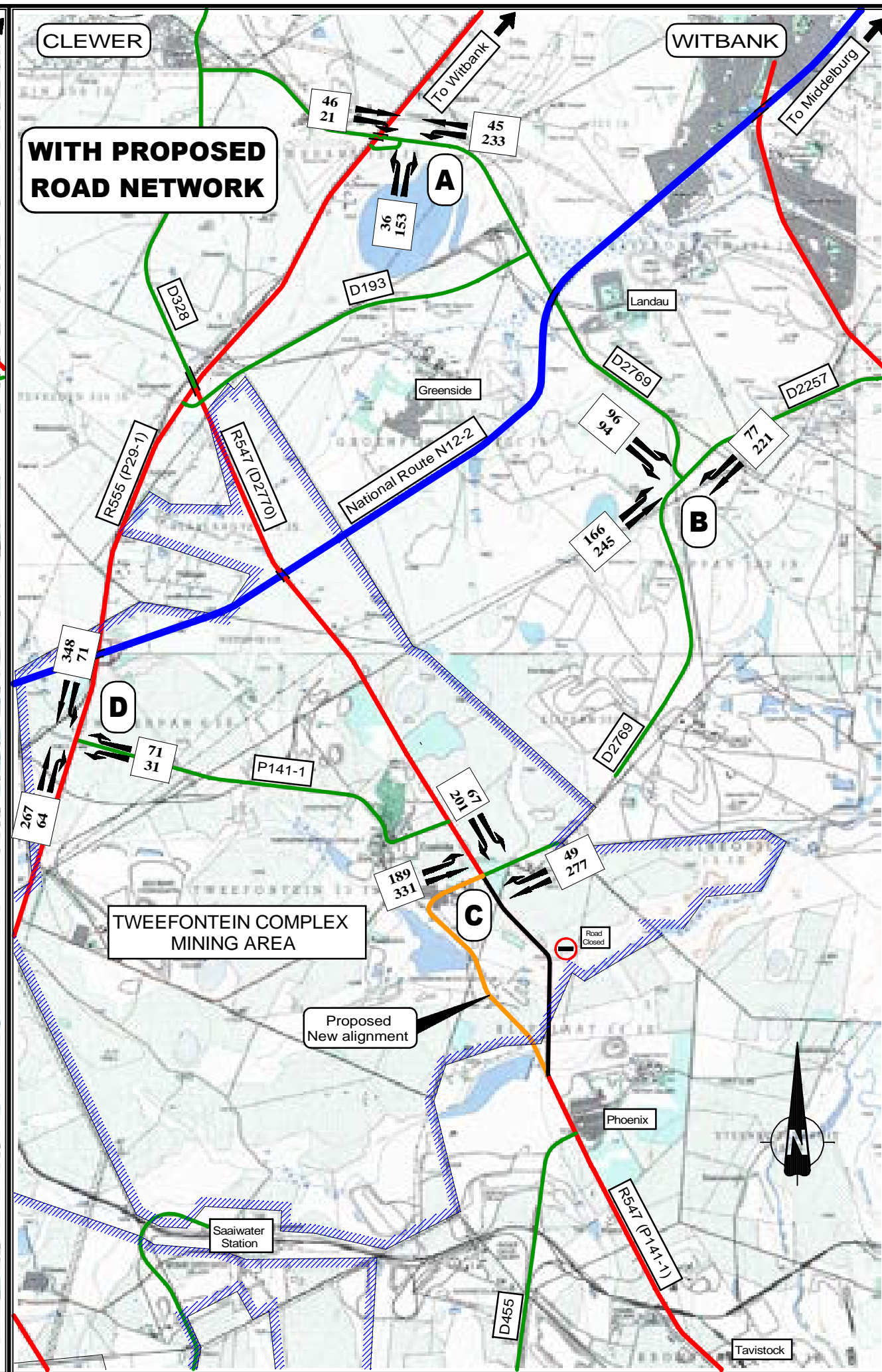
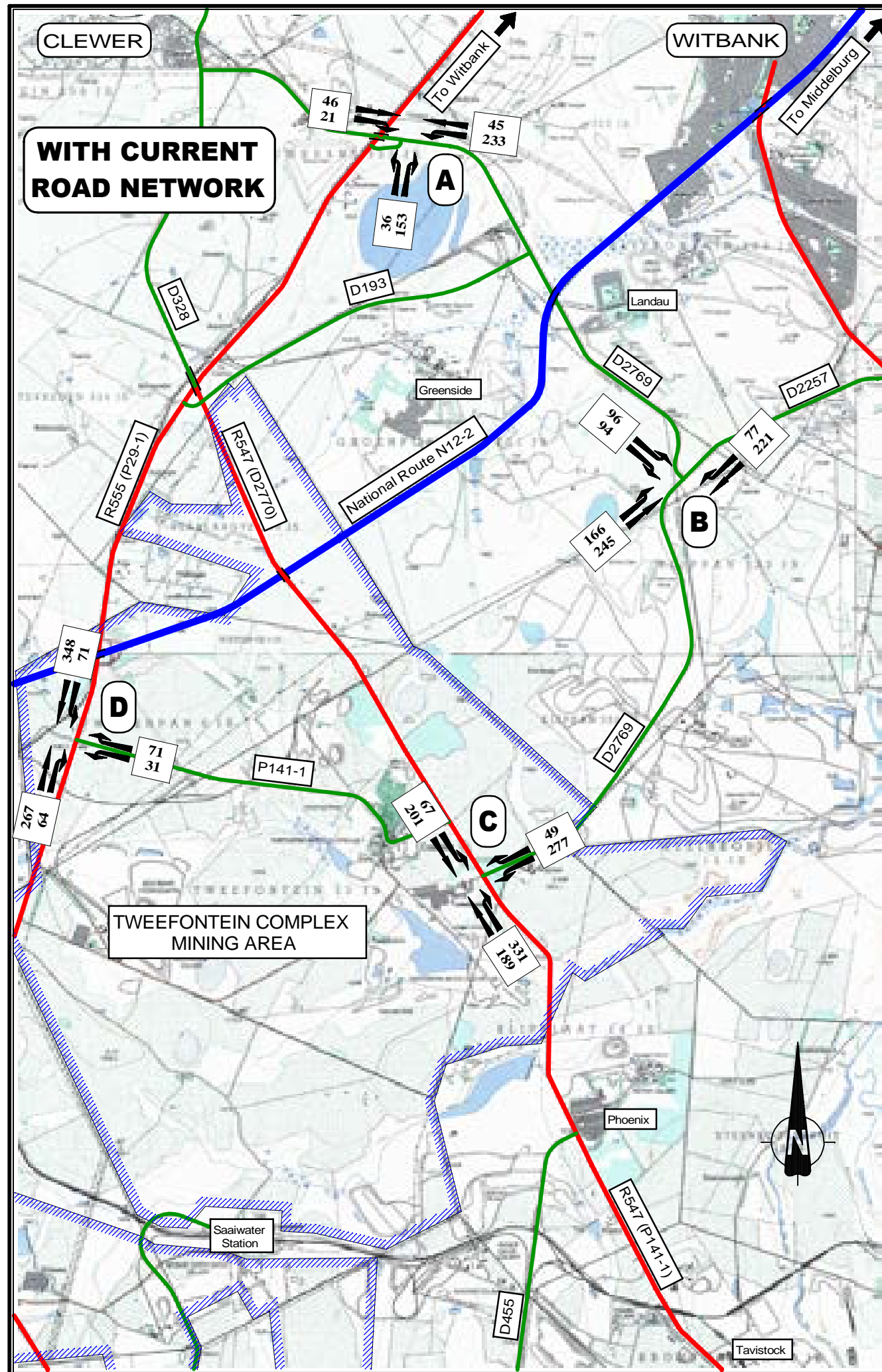
TWEEFONTEIN EXPANSION PROJECT TRANSPORTATION ASPECTS

EXPECTED REVISED ROUTES WITBANK & CLEWER TOWARDS BETHAL

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 DATE :



Scale **1 : 75 000**



LEGEND:

- National Road
- Prov. Primary Road
- Secondary Road
- Mine Boundary

ALIGNMENT PROPOSALS:

- New Alignment
- Roads to be closed

INTERSECTION DETAIL:

B Nr of Intersection

83 / 175 ⇄ Peak hour traffic volumes

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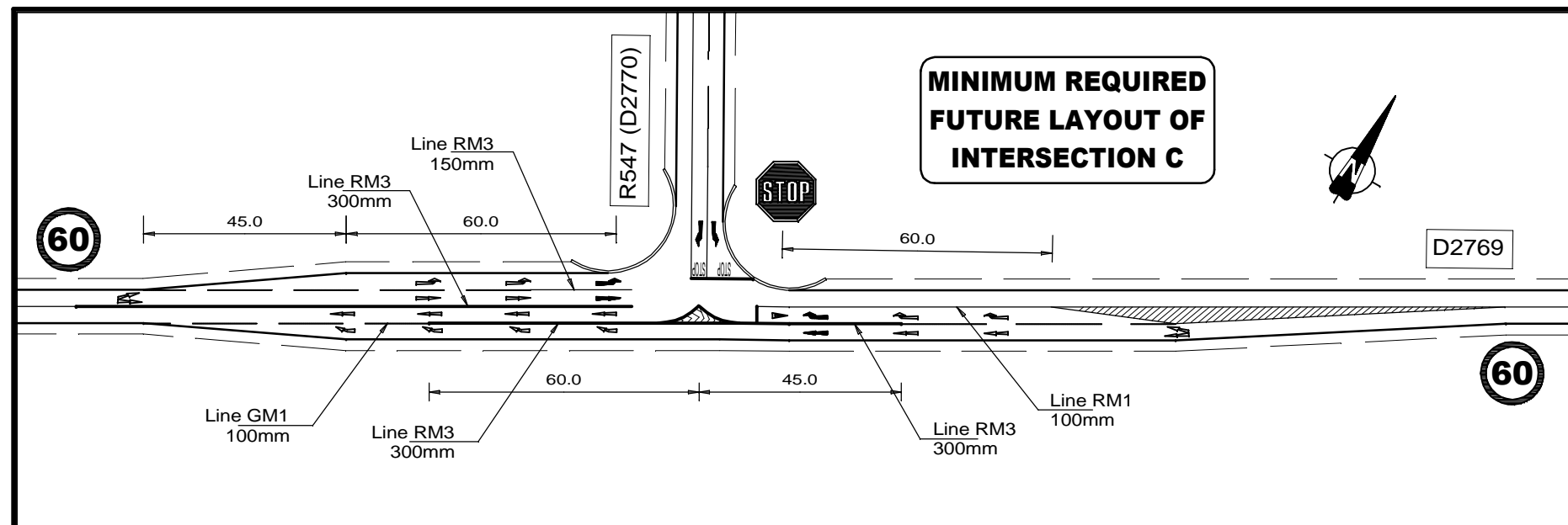
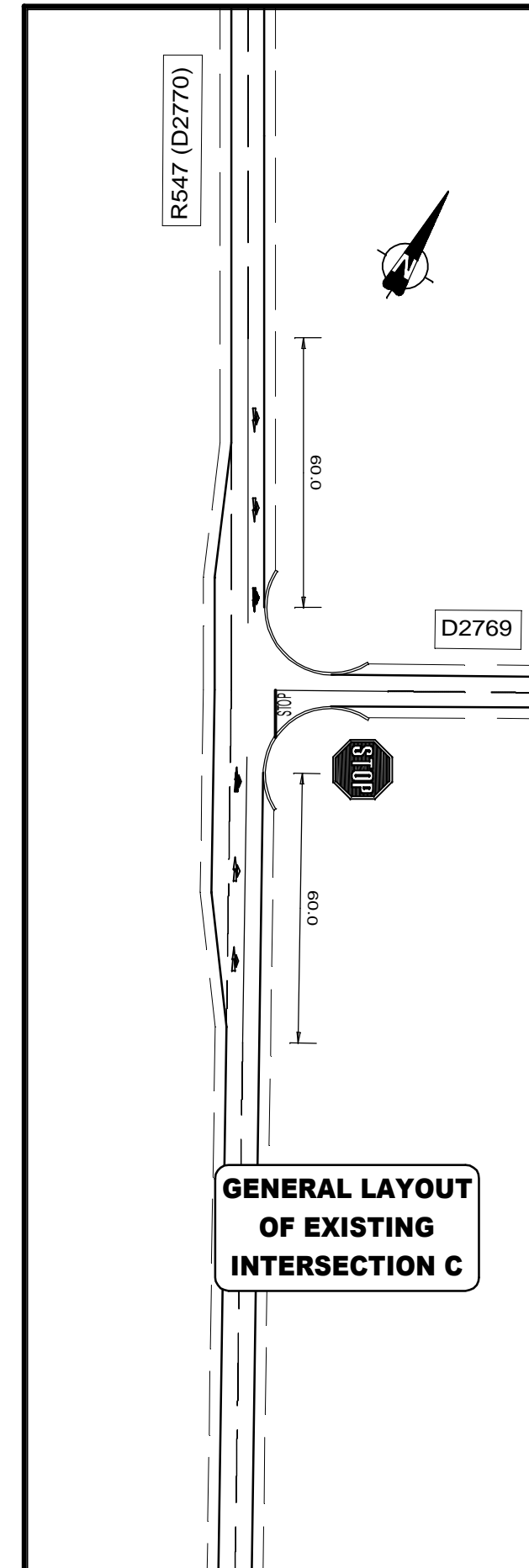
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TRANSPORTATION ASPECTS

Topic Title **EXPECTED RE-DISTRIBUTION OF TRIPS**

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FIG. TOP-TA-46

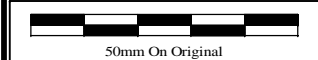


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Projek **TWEEFONTEIN EXPANSION PROJECT** Project
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Tek. Titel **REQUIRED REVISION OF INTERSECTION C** Drw. Titel

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Tek. Nr. **FIG. TOP-TA-47** Drw. Nr.

ANNEXURE A

SIDRA RESULTS



Intersection Summary

INTERS. C: Current Traffic Current Layout

Performance Measure	Vehicles	Persons
Demand Flow	1114 veh/h	1671 pers/h
Degree of Saturation	0.540	
Capacity (Total)	5768 veh/h	
95% Back of Queue (m)	43 m	
95% Back of Queue (veh)	6.2 veh	
Control Delay (Total)	2.92 veh-h/h	4.38 pers-h/h
Control Delay (Average)	9.4 s/veh	9.4 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	627 veh/h	940 pers/h
Effective Stop Rate	0.56 per veh	0.56 per pers
Travel Distance (Total)	673.3 veh-km/h	1008.5 pers-km/h
Travel Distance (Average)	604 m	604 m
Travel Time (Total)	14.0 veh-h/h	21.0 pers-h/h
Travel Time (Average)	45.3 secs	45.3 secs
Travel Speed	47.9 km/h	47.9 km/h
Operating Cost (Total)	379 \$/h	379 \$/h
Fuel Consumption (Total)	66.7 L/h	
Carbon Dioxide (Total)	171.8 kg/h	
Hydrocarbons (Total)	0.290 kg/h	
Carbon Monoxide (Total)	12.28 kg/h	
NOX (Total)	0.389 kg/h	

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Movement Summary

INTERS. C: Current Traffic Current Layout

Two-way stop

Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost (\$/h)
South Approach										
2	T	189	1950	0.097	0.0	LOS A	0	0.00	60.0	50
3	R	331	1288	0.257	10.3	LOS B	11	0.72	46.6	118
Approach		520	3238	0.257	6.5	LOS A	11	0.46	50.7	168
East Approach										
4	L	277	513	0.540	20.0	LOS C	43	1.04	39.5	114
5	R	49	91	0.538	19.8	LOS C	43	1.10	39.5	20
Approach		326	604	0.540	20.0	LOS C	43	1.05	39.5	134
North Approach										
7	L	67	481	0.139	9.0	LOS A	0	0.70	48.0	23
8	T	201	1444	0.139	0.0	LOS A	0	0.00	60.0	53
Approach		268	1926	0.139	2.3	LOS A		0.18	56.5	76
All Vehicles		1114	5768	0.540	9.4	LOS A	43	0.56	47.9	379

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Intersection Summary

INTERS. C: Future Traffic Future Layout

Performance Measure	Vehicles	Persons
Demand Flow	1114 veh/h	1671 pers/h
Degree of Saturation	0.432	
Capacity (Total)	7817 veh/h	
95% Back of Queue (m)	25 m	
95% Back of Queue (veh)	3.6 veh	
Control Delay (Total)	2.12 veh-h/h	3.18 pers-h/h
Control Delay (Average)	6.9 s/veh	6.9 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS C	
Total Effective Stops	450 veh/h	676 pers/h
Effective Stop Rate	0.40 per veh	0.40 per pers
Travel Distance (Total)	673.5 veh-km/h	1010.2 pers-km/h
Travel Distance (Average)	605 m	605 m
Travel Time (Total)	13.3 veh-h/h	19.9 pers-h/h
Travel Time (Average)	42.8 secs	42.8 secs
Travel Speed	50.8 km/h	50.8 km/h
Operating Cost (Total)	354 \$/h	354 \$/h
Fuel Consumption (Total)	62.3 l/h	
Carbon Dioxide (Total)	155.7 kg/h	
Hydrocarbons (Total)	0.251 kg/h	
Carbon Monoxide (Total)	0.49 kg/h	
NOX (Total)	0.335 kg/h	

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Movement Summary

INTERS. C: Future Traffic Future Layout

Two-way stop

Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	90% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost (\$/h)
East Approach										
5	T	277	1950	0.142	0.0	LOS A	0	0.00	60.0	73
6	R	49	1030	0.048	10.9	LOS B	2	0.72	46.1	18
Approach		326	2980	0.142	1.6	LOS A	2	0.11	57.4	91
North Approach										
7	L	67	565	0.119	16.0	LOS C	5	0.92	42.5	26
9	R	201	465	0.432	21.5	LOS C	25	1.10	38.5	84
Approach		268	1030	0.433	20.1	LOS C	25	1.05	39.4	110
West Approach										
10	L	189	1857	0.102	9.0	LOS A	0	0.70	48.0	65
11	T	331	1950	0.170	0.0	LOS A	0	0.00	60.0	87
Approach		520	3807	0.170	3.3	LOS A		0.36	55.0	153
All Vehicles		1114	7817	0.432	6.9	LOS A	25	0.40	50.8	354

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Intersection Summary

INTERS. C: 5-Year Traffic Future Layout

Performance Measure	Vehicles	Persons
Demand Flow	1292 veh/h	1938 pers/h
Degree of Saturation	0.574	
Capacity (Total)	7620 veh/h	
95% Back of Queue (m)	39 m	
95% Back of Queue (veh)	5.5 veh	
Control Delay (Total)	2.85 veh-h/h	4.27 pers-h/h
Control Delay (Average)	7.9 s/veh	7.9 s/pers
Level of Service	LOS A	
Level of Service (Worst Movement)	LOS D	
Total Effective Stops	549 veh/h	823 pers/h
Effective Stop Rate	0.42 per veh	0.42 per pers
Travel Distance (Total)	781.1 veh-km/h	1171.6 pers-km/h
Travel Distance (Average)	605 m	605 m
Travel Time (Total)	15.7 veh-h/h	23.6 pers-h/h
Travel Time (Average)	43.9 secs	43.9 secs
Travel Speed	49.6 km/h	49.6 km/h
Operating Cost (Total)	419 \$/h	419 \$/h
Fuel Consumption (Total)	72.9 L/h	
Carbon Dioxide (Total)	182.2 kg/h	
Hydrocarbons (Total)	0.295 kg/h	
Carbon Monoxide (Total)	11.08 kg/h	
NOX (Total)	0.390 kg/h	

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Movement Summary

INTERS. C: 5-Year Traffic Future Layout

Two-way stop

Vehicle Movements

Mov No	Turn	Dem Flow (veh/h)	Cap (veh/h)	Deg of Satn (v/c)	Aver Delay (sec)	Level of Service	95% Back of Queue (m)	Eff. Stop Rate	Aver Speed (km/h)	Oper Cost (\$/h)
East Approach										
5	T	321	1950	0.165	0.0	LOS A	0	0.00	60.0	85
6	R	57	951	0.060	11.3	LOS B	2	0.75	45.7	21
Approach		378	2901	0.165	1.7	LOS A	2	0.11	57.3	105
North Approach										
7	L	78	505	0.154	17.3	LOS C	6	0.96	41.6	31
9	R	233	406	0.574	27.0	LOS D	39	1.19	35.2	106
Approach		311	911	0.573	24.5	LOS C	39	1.13	36.6	136
West Approach										
10	L	219	1857	0.118	9.0	LOS A	0	0.70	48.0	76
11	T	384	1950	0.197	0.0	LOS A	0	0.00	60.0	101
Approach		603	3807	0.197	3.3	LOS A		0.26	59.9	177
All Vehicles		1292	7620	0.574	7.9	LOS A	39	0.42	49.6	419

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