

THE OCCURRENCE OF TRANSGRESSIONS AT FREEWAY SERVICE AREAS

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1. INTRODUCTION

Freeway service area (FSA) facilities provide convenient access to fuel, vehicle services and refreshments for motorists on route to long distance destinations.

There are two such FSA facilities situated within freeway interchanges, along National Route N1 between Johannesburg and Pretoria. These urban FSA facilities are only linked to the freeway, and movements between the filling station and the crossroad at the interchange are not provided for. Vehicle movements across the median are not allowed and each FSA consists of separate facilities serving traffic on each side of the freeway.

This paper deals with the findings from surveys at the two FSA's as well as comparative surveys at two conventional access interchanges, also located along the N1. The surveys showed that “non-emergency” related stops and vehicle movement violations (transgressions), along the freeway and FSA ramp and lane shoulders, occur with regularity. The frequent occurrence of stops and transgressions is a major safety concern at these facilities.

2. METHODOLOGY

Surveys were performed at two FSA facilities during February 2000. The facilities are the Ben Schoeman Ultra City and the Starstop Egoli; both located along National Route N1 Section 21 in Midrand. Both service areas are located within access freeway interchanges, with each FSA consisting of a separate western and eastern facility.

Stops and transgressions at the FSA's were observed during daytime survey periods on weekdays. One such survey was performed at each separate side of each facility i.e. Ultra City West.

The actions monitored included stops by vehicles on the freeway and/or ramp shoulders, “wrong-way” or reverse movements and other illegal vehicle movements. These stops and movement actions (transgressions) were logged according to their type and frequency.

Similarly surveys were carried out at conventional access interchanges on the N1 at Olifantsfontein Road and D.F. Malan Road, to compare the extent of stops and transgressions to those at the FSA's.

3. FREEWAY SERVICE AREA SURVEYS

3.1 SURVEY LOCATIONS

The two FSA facilities surveyed are briefly described below:

- **Ben Schoeman Ultra City**

The Ben Schoeman Ultra City is located within a wide diamond interchange at Samrand Avenue as shown in Figure 3.1. Separate off-ramps to and from the facility are located within the interchange ramps on the N1 freeway. The facility on-ramps join the Samrand Avenue on-ramps before reaching the N1. Access to and from Samrand Avenue (M36) is not provided.

- **Starstop Egoli**

The Starstop Egoli is located within a single point urban interchange at New Road as shown in Figure 3.2. Shared on- and off-ramps provide access between the freeway and New Road or the FSA. However no access is provided to and from the FSA and New Road.

3.2 TRANSGRESSIONS

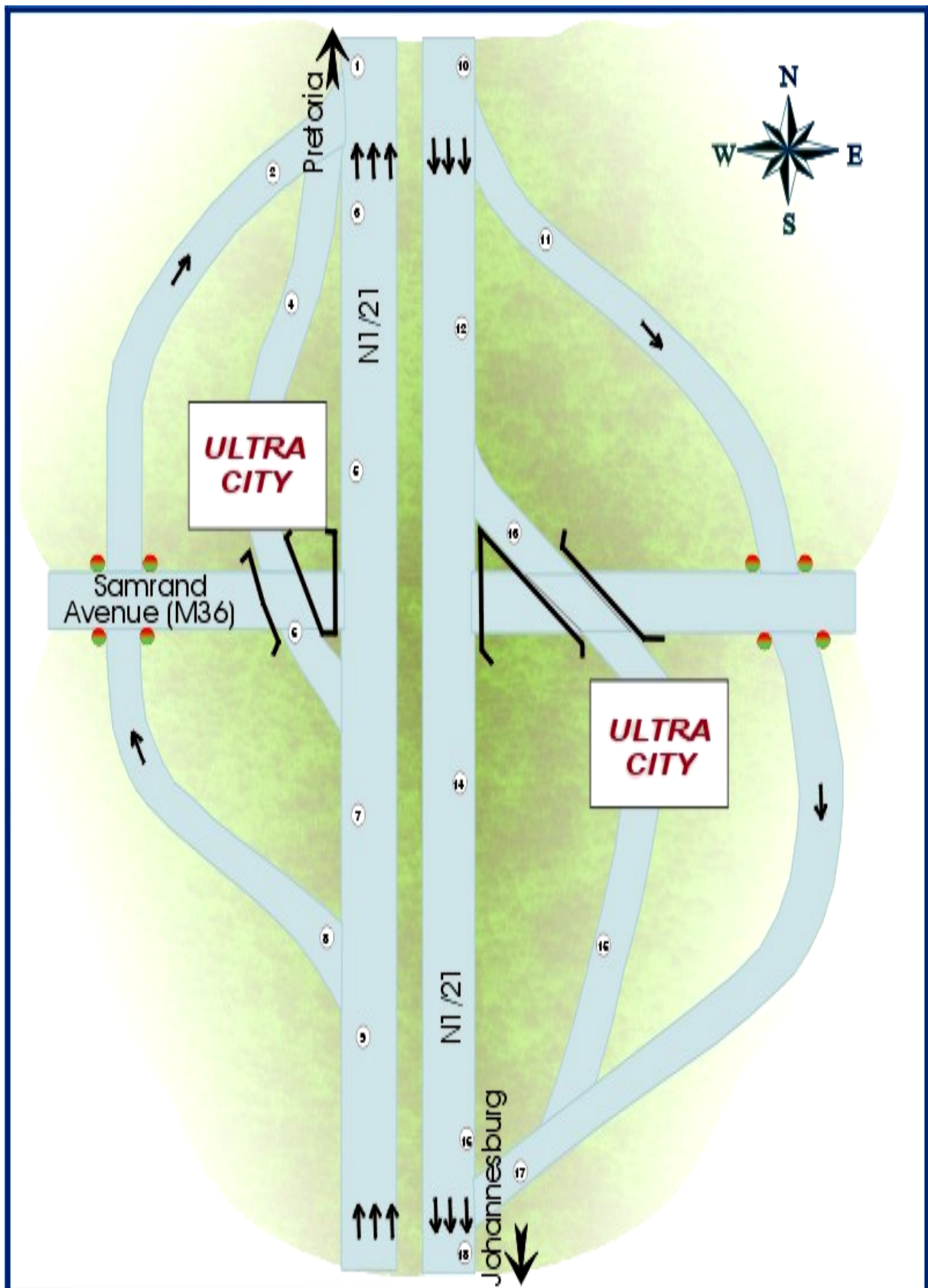
The transgressions observed at each FSA facility are described below. Also refer to the summaries included in Tables 3.1 and 3.1.

- **Stops**

There are no apparent reason for the high number of stops observed at the FSA's. However, it was clear was that the stops were generally not related to emergency situations or mechanical problems.

- **Illegal movements**

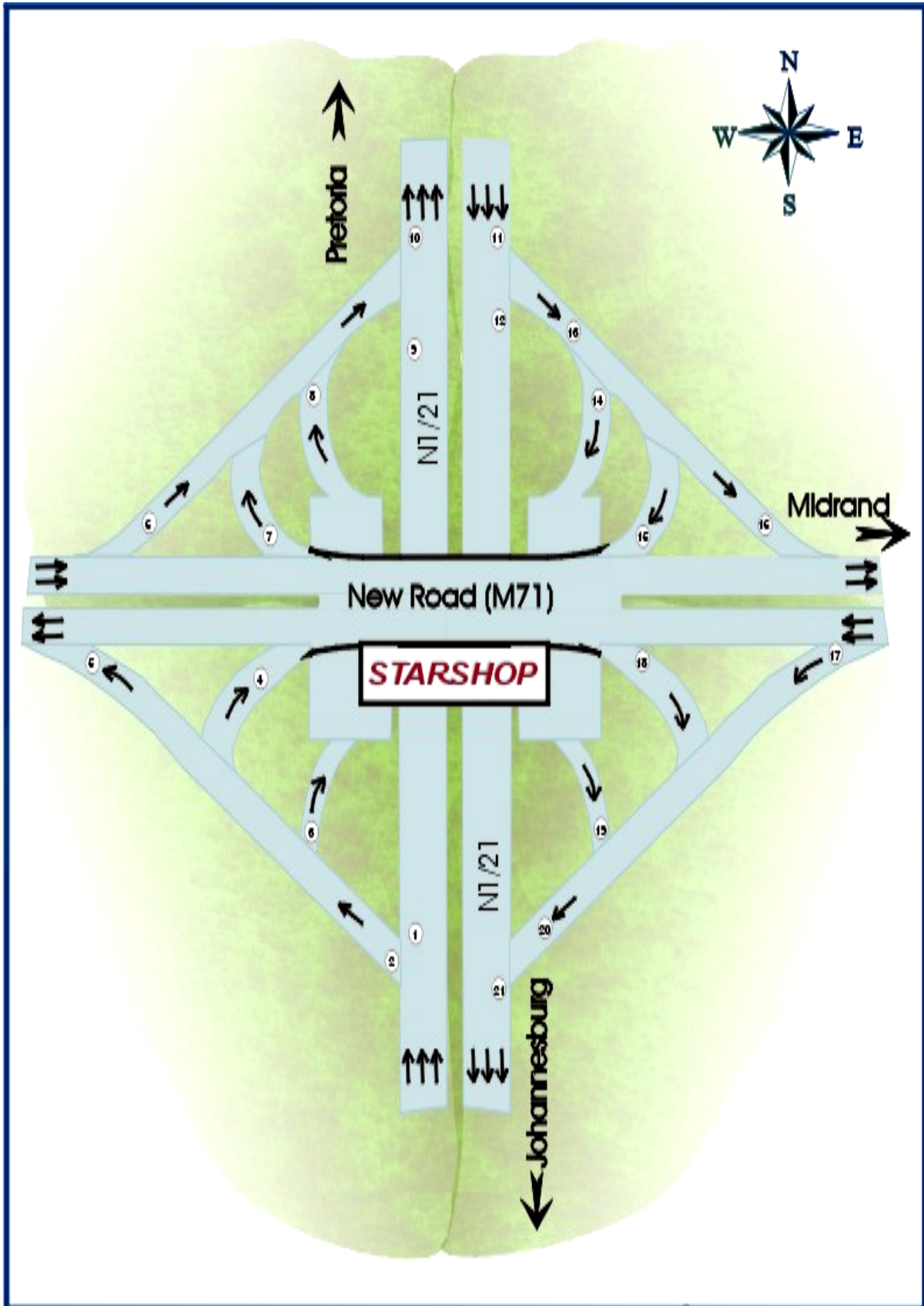
Illegal movements occurred at both FSA facilities. The transgressions ranged from reverse movements on the outer freeway shoulders to serious and blatant ignoring of driving rules and road signs. Some motorists deliberately drove in the wrong direction along ramps to gain access to the freeway or crossroads. The majority of the movements observed can be ascribed to deliberate violation of the rules of the road.



**Observed Traffic Transgressions
Samrand Avenue and N1/21 Interchange
(Exit 118)**

Legend
20 Position of stop and/or transgression movement

Figure 3.1



**Observed Traffic Transgressions
New Road and N1/21 Interchange
(Exit 111)**

Legend
 ○○ Position of stop and/or transgression movement

Figure 3.2

Table 3.1. *Summary of survey at the Ultra City FSA (N1/21 & Samrand Avenue)*

Type	Description (see Figure 3.1)	Quantity
Stops	N1 offramp shoulder (i.e. positions 8 & 11)	2
	Freeway shoulder (i.e. positions 5 & 14)	23
	N1 onramp shoulder (i.e. positions 2 & 17)	6
	FSA exit lane shoulder (i.e. position 15)	5
<i>Total stops observed</i>		<i>36</i>
Transgressions	Return to FSA from onramp (i.e. 15-17-15)	2
	Missed offramp to crossroad, deliberately used onramp (i.e. sequence 18-17)	1
	Deliberate access to FSA via N1 onramp	20
	Deliberate access to crossroad from FSA	5
	Used wrong interchange offramp, returned to N1	2
	Used wrong offramp to FSA, corrected movement (i.e. sequence 9-8-7-6)	2
<i>Total transgressions observed</i>		<i>32</i>

Table 3.2. *Summary of survey at the Starstop Egoli (N1/21 & New Road)*

Type	Description (see Figure 3.2)	Quantity
Stops	N1 shoulder before offramps	10
	N1 shoulder past onramps	8
	N1 shoulder between ramps	10
	N1 (FSA) offramp shoulder	2
	N1 (FSA) onramp shoulder	18
<i>Total stops observed</i>		<i>48</i>
Transgressions	Missed shared offramp to FSA (reversed)	5
	Deliberate access to FSA via N1 onramps	12
	Deliberate access to FSA from crossroad	19
	Returned to FSA from onramp	2
	Missed N1 offramp to crossroad (confused)	4
	Turned to wrong side at offramp split	9
	Deliberate access to crossroad from FSA	30
	Missed offramp to crossroad, considered using onramp	1
<i>Total transgressions observed</i>		<i>82</i>

3.3 TRANSGRESSIONS RELATIVE TO TRAFFIC FLOW

The approximate annual average daily traffic (AADT) on the N1, at both the FSA facilities, is 100,000 vehicles per day. The stops and transgressions observed during the survey period account for approximately 0.07 per cent and 0.13 per cent of the AADT, at the Ultra City and Starstop, respectively.

Attraction to both facilities are assumed to be approximately four per cent of the AADT, or 4000 vehicles. The stops and transgressions as percentage of facility traffic are estimated to be 1.7 per cent and 3.3 per cent, at the Ultra City and Starstop, respectively.

4. SUMMARY OF TRANSGRESSIONS AT FREEWAY SERVICE AREAS

Only one 11-hour daylight survey was held at each of the FSA facilities. From the relatively high number of transgressions observed, it is however apparent that these transgressions occur with regularity.

The transgressions related specifically to the illicit movements between the FSA, crossroad and freeway is summarised in four categories as listed in Table 4.1 below.

Table 4.1. Summary of FSA transgressions (specific movement violations only)

Type	Entrance Side		Exit Side	
	Ultra City	Starstop	Ultra City	Starstop
Facility to crossroad	1	27	4	3
Crossroad to facility	0	1	18	24
Freeway to facility	n.a.	n.a.	3	8
Freeway to crossroad	n.a.	n.a.	1	0

The illegal “crossroad to facility” type movement had a high occurrence at both facilities’ exit sides. The lack of a direct access between the facilities and crossroads is the apparent reason for the transgressions by motorists between the crossroad and facility and *vice versa*.

The occurrence of deliberate transgressions may be linked to the lengths of ramps and the perceived risk (of conflicts) to the motorist. Ease and duration of illicit movements appear to influence the number of transgressions.

- Only one transgression from the Ultra City via the entrance ramp to crossroad, was observed. This is a very long movement.
- At the Starstop, a large number of entrance side transgressions (27) to the crossroad occurred because the shared off-ramp from the N1 makes this movement relatively short and easy to execute.

The high occurrence of the “facility to crossroad” movement at the Starstop, may also be locational in nature due to the wider choice of destinations served by New Road, compared to Samrand Avenue which currently is lightly trafficked, presently serving only Kosmosdal and The Reeds.

Only a small number of the “freeway to facility” and “freeway to crossroad” type transgressions occurred at the exit sides of the facilities. These transgressions, although deliberate, occurred after the driver missed the correct ramp and/or access.

The observations at the facilities show that more transgressions occurred at the Starstop compared to the Ultra City, possibly due to geometric and layout differences. At the Starstop the unusual right-turn into the facility from the off-ramp, and poorly visible filling station, could account for the higher number of transgressions observed.

5. SURVEYS AT CONVENTIONAL INTERCHANGES

5.1. RANDJIESFONTEIN INTERCHANGE (N1/21 & R562), MIDRAND

An 11-hour daylight survey was performed in May 2000 at the Olifantsfontein Road (R562) Interchange (Randjiesfontein) located in Midrand. The interchange was chosen for this survey due to its proximity to the FSA facilities surveyed, Samrand Avenue Interchange and New Road Interchange.

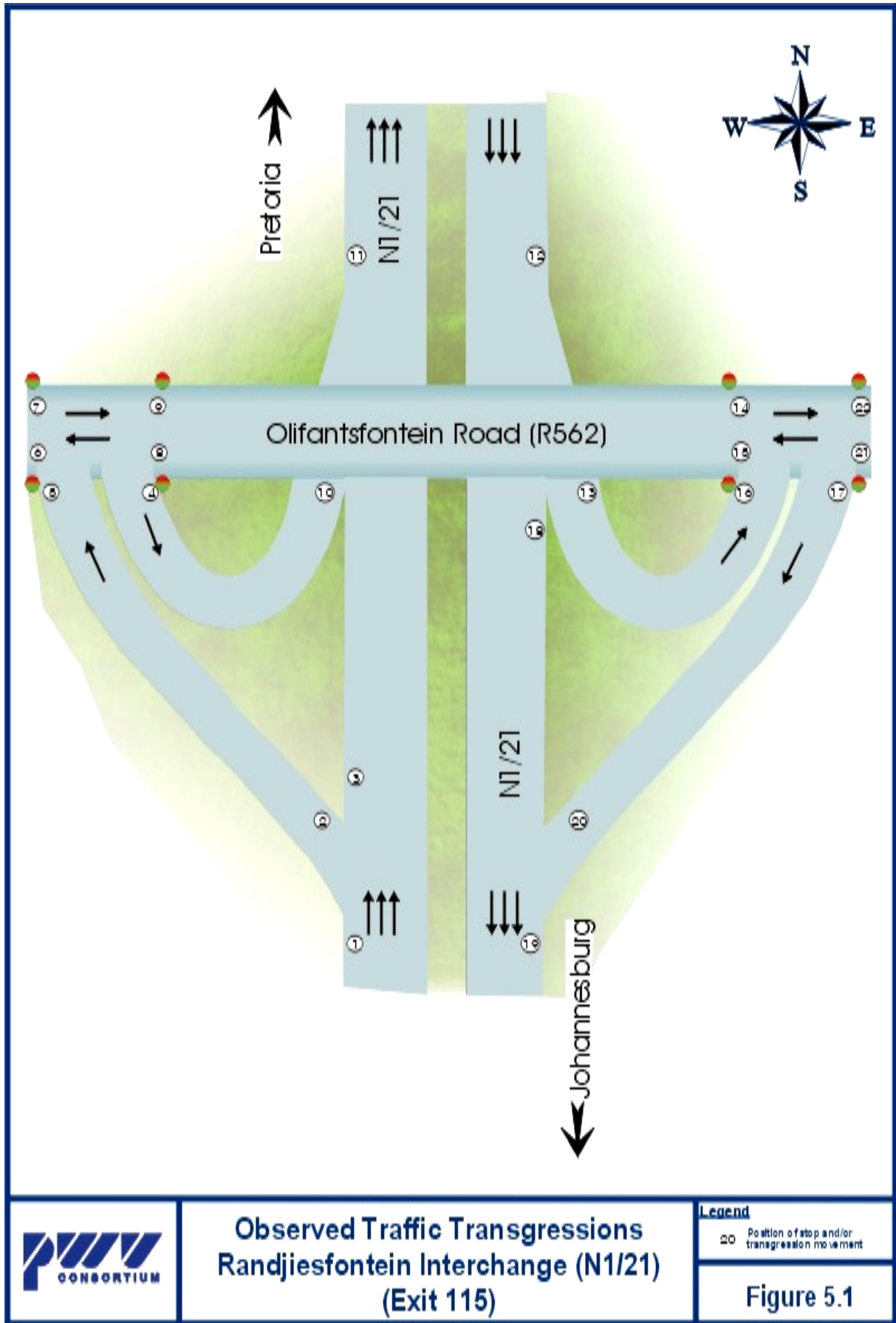
The traffic movements at this parclo interchange (see Figure 5.1) are somewhat unconventional, as the northbound on-ramp loops require drivers to turn in a southern direction. A summary of the stops and transgressions observed at the Randjiesfontein interchange is indicated in Table 5.1 below.

The occurrence of stops appears to be in the same order as those observed at the two FSA’s. As expected the observed transgressions were much lower than those observed at the FSA’s.

The transgressions appeared to be due to driver confusion rather than deliberate actions e.g. motorists turning southwards onto on-ramp; unexpectedly finding that the on-ramp loop served the northbound movement.

Table 5.1. *Summary of survey at the Randjiesfontein Interchange (N1/21 & R562)*

Type	Description	Quantity
Stops	Ramp terminals (e.g. positions 4 & 5)	9
	Off-ramp (e.g. at position 2)	19
	Onramp (e.g. at position 10)	14
<i>Total stops observed</i>		<i>42</i>
Transgressions	Missed onramp (i.e. movement sequence 1-3-2)	3
	Wrong way at ramp terminal from crossroad	3
	U-turn on crossroad	1
<i>Total transgressions observed</i>		<i>7</i>



The average AADT on the N1/21 in the vicinity of the R562 interchange is approximately 97,000 vehicles. The stops and movements therefore relate to approximately 0.05 % of the AADT.

5.2. D.F. MALAN INTERCHANGE (N1/20 & M5), RANDBURG

A survey was performed at the D.F. Malan Road interchange in Randburg during September 2000 between the hours of 07h00 and 18:00 (11 hours). The interchange was chosen for its standard diamond type configuration (see Figure 5.2).

A summary of the stops and transgressions observed at the interchange is indicated in Table 5.2.

Table 5.2. *Summary of survey at D.F. Malan Road Interchange (N1/20 & M5)*

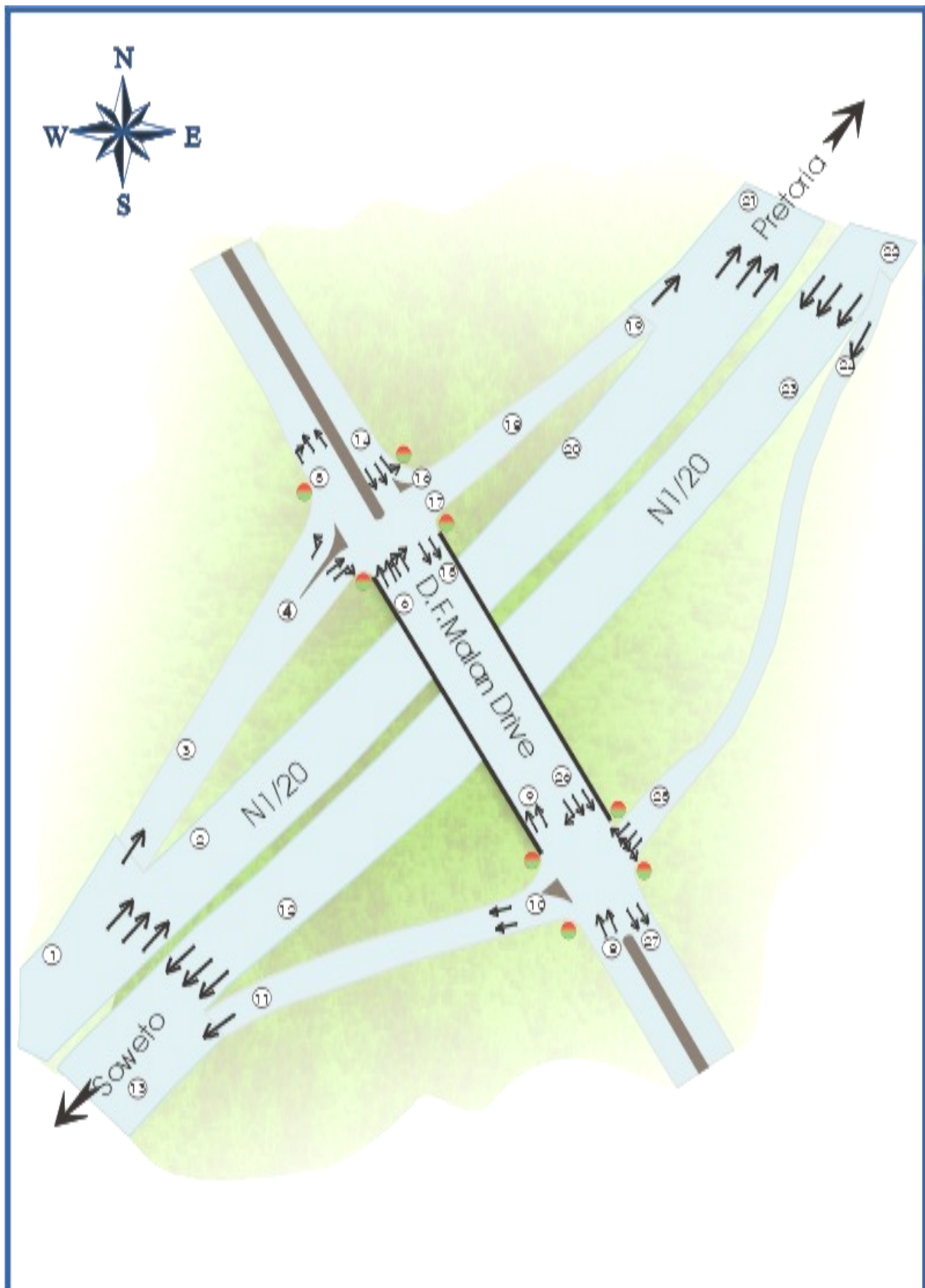
<i>Type</i>	<i>Description</i>	<i>Quantity</i>
Stops	Ramp terminals (e.g. positions 4 & 5)	48
	Off-ramp (e.g. at position 2)	56
	Onramp (e.g. at position 10)	47
	On freeway under bridge	34
<i>Total stops observed</i>		<i>185</i>
Transgressions	Missed onramp (i.e. movement sequence 1-3-2)	12
	Wrong way at ramp terminal from crossroad	0
	U-turn on crossroad	6
<i>Total transgressions observed</i>		<i>18</i>

The occurrence of stops is of a much higher frequency than those observed at the two FSA's and at the Randjiesfontein Interchange. The main reason is the higher side road traffic volume compared to the side road traffic flow at the other facilities. The ADT is approximately 52,000 vehicles on D.F. Malan Road compared to 22,000 vehicles on Olifantsfontein Road, whilst the approximate ADT's at the two FSA's side roads is 10,000 and 5,800 vehicles, at New Road and Samrand Avenue, respectively.

Reasons for the stops at D.F. Malan include informal trading (i.e. selling of hands-free cell phone kits) at the offramp terminals, loading and offloading of passengers, mechanical problems, confusion (drivers missing off-ramps), etc.

As expected the observed transgressions were lower than those observed at the FSA's. They are mainly due to driver error and/or driver confusion and generally not deliberate actions.

The average AADT on the N1/20 in the vicinity of the D.F. Malan Road (M5) interchange is approximately 64,000 vehicles. The stops and movements related to approximately 0.3 % of the AADT.



**Observed Traffic Transgressions
D.F. Malan and N1/20
(Exit 85)**

Legend
20 Position of stop and/or transgression movement

Figure 5.2

6. CONCLUSIONS

Stops and transgressions were observed during one daylight survey at four conventional freeway interchange and freeway service area facilities, as summarised in the table below.

Facility	Route	Description	Stops	Transgressions
Freeway service area facilities within interchanges				
Ultra City (Samrand Avenue)	N1/21	FSA within diamond interchange	36	32
Star Stop (New Road)	N1/21	FSA within single point urban interchange	48	82
Conventional interchanges				
Olifantsfontein Road (R562)	N1/21	Parclo interchange	42	7
D.F. Malan Road (M5)	N1/20	Standard diamond interchange	185	18

The following conclusions can be made:

- i. A large number of stops were observed during the surveys.
 - the occurrence of stops is of similar magnitude (± 40) at Ultra City, Starstop and Olifantsfontein Road,
 - A much larger number of stops (185) were observed at D.F. Malan Road. Three possible reasons include:
 - ✓ the higher side road volume on D.F. Malan Road,
 - ✓ informal trading activity at the intersections, and
 - ✓ loading and offloading of passengers.
- ii. The large number of transgressions, especially at FSA facilities, whether resulting from confused or deliberate movements, is a safety risk.
 - a lower occurrence of transgressions were observed at the two access interchanges: Olifantsfontein Road and D.F. Malan Road,
 - freeway service area transgressions were of a much higher order,
 - the highest number of transgressions was observed at the Starstop facility (New Road). A higher number of transgressions were wilfully made between FSA and crossroad and *vice versa*.
- iii. Deliberate transgressions occur frequently at both FSA facilities. Improved road signage is unlikely to reduce these transgressions as illicit movements are made wilfully. Ease of illegal movements where ramps are short, appears to influence the number of transgressions. Law enforcement is required to reduce these deliberate transgressions.

- iv. Misinterpretation or “confusion” occurred mostly at the Starstop FSA facility. Factors that may contribute to this confusion include:
- inadequate sight-distance on freeway,
 - unusual right-turn into facility from off-ramp, and
 - freeway service area turnoff not clearly visible or signed.

Improved road markings and signage may reduce this type of transgressions.

- v. Night-time transgressions were not covered by these surveys. It is surmised that poor visibility during night-time driving may contribute to more of the “confused” transgressions. Less traffic on the ramps might result in more deliberate transgressions and will need to be confirmed by night-time surveys.

7. REFERENCES

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Technical papers include:

- Sampson, J D & T M Ueckermann (1999). *The Importance of Access Spacing in Maintaining Major Road Operating Standards*. SAICE & ITE Road Access Management Symposium, Midrand, February 1999.
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He is in the process of completing a Masters degree in Transportation Engineering at the University of Pretoria.