TRAFFIC IMPACT OF THE ITS TIME EVENT

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ABSTRACT

The It's Time event held on April 22, 2017, is seen as the pinnacle of religious events in South Africa. The estimated attendance is one million people, classifying the event as a major transportation event. Major transportation events can lead to large influxes of traffic to the event area and have an enormous impact on the transportation infrastructure surrounding the event.

Analysed is the extent of the traffic impact on the event site, the city of Bloemfontein and wider surrounding network of the country. Further, is investigated the planning methodology followed by the organizers and if a one day event of this magnitude can be successfully managed from a transportation perspective. The organizers were faced with numerous transportation challenges. Identified is various principles followed by the organizers for the transportation planning and management of the event. These include information dissemination, management strategies and managing the travel demand.

The traffic impact is investigated by analysing two forms of traffic data namely, Comprehensive Traffic Observation (CTO) counts and Historical TomTom Probe Data. Factors such as delay time, queueing lengths and travel time are considered. CTO counts consider the traffic volumes on key access routes to determine the amount of event traffic from different origins over South Africa.

1 INTRODUCTION

Long vehicle queues and stationary traffic is conditions well known to motorists at any large transportation event, both before the event and after. In 1988 the National Highway Institute from the United States of America defined a major transportation event as an occurrence that abnormally increases traffic demand (NCHR, 2003). Major transportation events can lead to large influxes of traffic to the event area and have an enormous impact on the transportation infrastructure surrounding the event, even influencing non-event traffic. Furthermore, the increase of traffic volumes also increases the probability of accidents.

Due to the lack of public transport, this causes numerous traffic and parking problems at major transportation events held within South Africa. Some of the foremost problems are traffic volumes that exceed the capacity of the transportation

infrastructure surrounding the event area and a shortage of available parking. Key strategies for mitigating the traffic and parking problems are the transportation planning and management before and after the event. Transportation planning and management plays an extremely important role in the success of major transportation events and is equally the largest challenge, both from a logistical and engineering perspective.

The true traffic impact of major transportation events is still somewhat unknown to the research world and a better understanding of the impact of such events on the surrounding network and vehicle travel times is required, both from a transportation planning and management perspective. Information about the traffic impact of major transportation events can lead to better planning strategies, less traffic problems and even change future network designs surrounding the event area.

The aim of this research is to determine the impact of major transportation events on its surrounding network using two types of traffic data, namely, probe data and comprehensive traffic observation (CTO) counts. The traffic impact of the It's Time Event were analysed in this research. The It's Time Event took place on a farm near Bloemfontein on 22 April, 2017. The stipulated attendance was one million people, therefore classifying this event as a major transportation event.

With a limiting planning period of only six weeks the organizers were faced with numerous transportation challenges. Therefore, also identified is various principles followed by the organizers for the transportation planning and management before and during the event.

2 METHODOLOGY TO PLAN THE ITS TIME EVENT

To remain concise the methodology followed by the organizers while planning for the event is only discussed briefly in this paper. This is however thoroughly discussed in the full research project. Before starting the planning proses the organizers assumed one million people would attend the event. Therefore, it was further assumed that close to 200 000 vehicles would attend and that was taken as the planning framework by the organizers.

The Its Time Event posed great challenges from a transportation perspective. Three leading challenges among many were the estimated magnitude of the event, the constraint on access routes and the limited time period available to park the vehicles. Only six hours was available for parking if vehicles started parking at 06:00 AM. The organizers followed three principles identified by the NCHRP while planning for the event namely, information dissemination, management and control of traffic and travel demand management (NCHR, 2003).

2.1 Information Dissemination

The organizers created a colour coded ticket system, free of charge, to direct traffic from different origin on respective routes to separate parking areas. Figure 2 below displays all the different access routes with separated parking areas. The core objective of this was to ensure an even distribution of traffic approaching the event by

utilizing all the different access routes. A recommended parking timeslot was also given to drivers when obtaining a parking ticket to strive towards reaching a consistent inflow of traffic at maximum capacity over all the access routes. In addition relevant signs were erected on main access routes and around Bloemfontein to direct event traffic to the different parking areas.

2.2 Management and Control of Traffic

The key objectives of the management and control of traffic is to facilitate traffic on recommended routes, develop strategies to handle forecasted event traffic on these routes, reduce congestion and increase intersection traffic handling capacities (Rheede, 2017).

Traffic approaching the event was managed and controlled by traffic control points. Each traffic control point had a marshal tent and was equipped with an adequate crew consisting of marshals and security. Each traffic control point had numerous responsibilities. Some key responsibilities were to direct traffic to their respective parking areas, increase intersection capacity, reducing congestions and resolving any issues, incidents or emergencies that occur. Traffic flows on certain access routes were also increased by blocking off away lanes, directing both lanes towards the parking areas.

2.3 Travel Demand Management

Travel demand management on the event day was seen as one of the critical aspects to ensure event success. The focus of the organizers was to maximise the efficiency of the access routes, thus reducing traffic volumes and peak demands that would lead to congestions (Rheede, 2017).

Key travel demand management strategies implemented were the making available of camping areas, separate parking areas for each access route and using effective parking strategies. The camping areas allowed attendants to arrive a day early and this would directly decrease the travel demand on the event day. Separate parking areas ensured less transportation conflict point. Conflict point between vehicles and pedestrians were avoided as far as possible. These conflict points could cause major

delays. Figure 2 displays all the separate access routes, parking areas, camping areas and stage area.

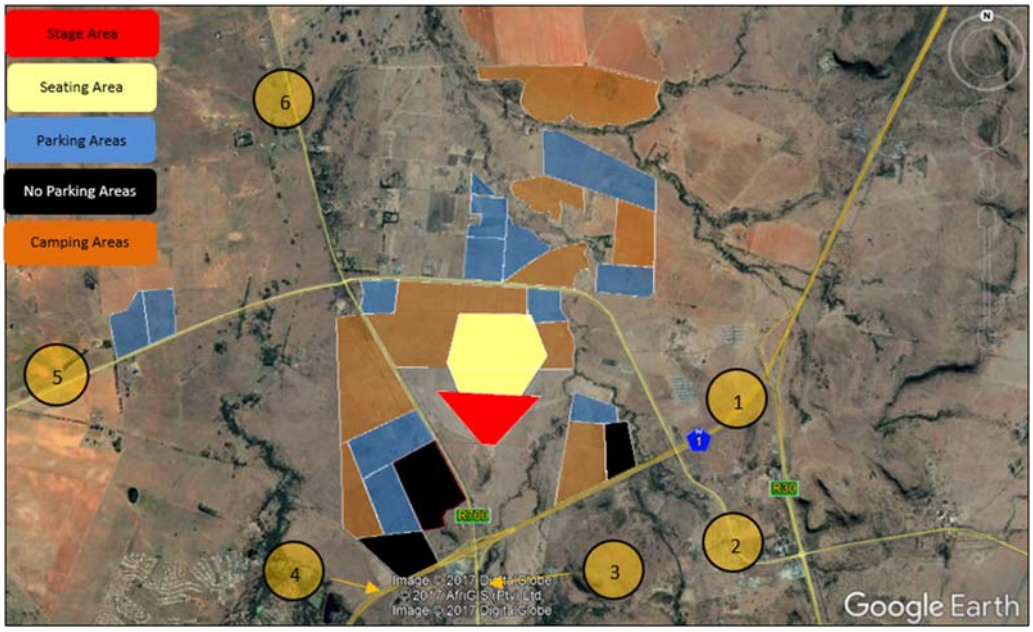


Figure 1 - Overall area of network surrounding the event area

One of the strategies followed for effective parking was to let the traffic flow into parking areas at an angle and not at 90 degrees. The entrance would split into two lanes and then split again depending on the size of the parking area. The aim was to achieve optimum inflow capacities on all the access routes.

2.4 Foreseen problem

A foreseen problem that occurred was the six available access routes would not be capable of handling the amount of incoming traffic on the event day. Taking into account the access routes at full capacity, it was calculated that 22 hours and 30 minutes were needed to get the 200 000 vehicles to the parking areas and only six to eight hours were available. Therefore, any strategy put in place to reduce the travel demand on the event day was crucial for the event success. There was no space for any incident or error to occur.

3 TRAFFIC DATA

Over the world and especially in South Africa a rising problem from a transportation perspective is the increasing traffic and scarcity of road funds. This has increased difficulties confronting road authorities and therefore, preparations for road building and management of limited natural resources has become a great responsibility (Slavik, 1994).

The most important variable in the allocation of road funds and transportation engineering is traffic. Therefore, reliable traffic data is the most important aspect when advancing in any transportation section (Slavik, 1994).

For this research project, two types of traffic data were obtained to determine the extent of the traffic impact of the Its Time Event namely Comprehensive Traffic Observation (CTO) counts and historical Probe Data from TomTom.

3.1 Comprehensive Traffic Observation Counts in South Africa

In a transportation research study conducted in 1994 by the Department of Transport (DOT) found three purposes for the implementation of CTO counts namely, input into a road management system, input into road recovery legislation and input into road safety analyses (Slavik, 1994).

The study on CTO counts was conducted on a 600km route between Johannesburg and Durban for a period of more or less two years. Due to the successful results of the study, the National Transport Commission decided on implementing CTO stations on all national roads in South Africa. BKS Incorporated was given the responsibility to plan, build and operate the network for five years and there after assign it to the DOT (Slavik, 1994). Traffic count data gives the actual data and numbers of traffic that pass a specific point, and is not estimated (Currin, 2001).

3.2 Accuracy of CTO counts

Permanent CTO stations operate almost throughout the whole year except when there are interruptions such as power failures, breakdown of equipment or vandalism. Despite these interruptions most information of permanent stations is still seen as very accurate and the errors are seen as negligible (Slavik, 1994).

3.3 What is Probe Data?

Any traveling road vehicle with sensors on it is called a probe car, and the data collected by those sensors is called probe data (Satoshi, 2011). Probe data can be produced by Global Positioning Systems (GPS) and this is obtained from personal navigation devices where users have agreed to share travel information on an anonymous basis. Probe data includes information about the device's geographical position and time stamp (Vasudevan, 2013).

If probe data is obtained for a number of vehicles, it enables users to monitor the state of traffic at a specific location and point in time (Satoshi, 2011). This can be used to determine queueing length and travel time delays over certain route segments.

3.4 Probe Data Quality

TomTom NV, the traffic, navigation and mapping company, currently own the largest historical database of probe data with over 6 trillion data points. This database has been accumulating from the year 2007 and is still expanding at an enormous rate with over 6 billion new data sets being added daily (TomTom, 2012).

Each year TomTom Traffic data's quality is also tested and validated externally by the German independent quality institute TÜV. They have awarded TomTom Traffic with a certificate for their precision and accuracy on data coverage on highway and secondary roads (reference paper). Researchers from the University of Michigan

Transportation Research Institute did a study on the most accurate navigation application and it was found that the TomTom App installed on an iPhone gave the most accurate results (Belzowski & Ekstrom, 2014).

4 METHODOLOGY

4.1 Event Analysed

The Its Time Event was hosted on a farm just outside Bloemfontein called Wilde Als on 22 April, 2017. Bloemfontein is the most centrally located city within South Africa and is therefore, accessible on a number of separate access routes from mostly all parts of the country. Thus making it the perfect location for a major transportation event. Figure 2 displays the event area with surrounding access routes.

4.2 Data Collection

4.2.1 CTO Counts

CTO counts were used to analyse the access routes leading to Bloemfontein and especially towards the event. The CTO counts were obtained from the CTO Data Centre which is owned by the South African National Roads Agency (SANRAL). Available CTO stations were chosen on access routes leading to Bloemfontein and smaller secondary roads surrounding the event area. Counting information from 29 stations was obtained.

CTO stations give traffic information in the form of vehicles per hour (traffic volumes) in each direction of traffic flow on the road that passes that certain CTO station. The only input parameter that is needed to get CTO counts is the time frame when traffic counts is required.

4.2.2 Historical Probe Data Sets

Probe Data was obtained from TomTom's Traffic Stats Portal, by using the Custom Area Analysis (CAA) and Custom Travel Time (CTT) tools. The aim of the CAA is to determine the traffic impact of the event by evaluating the area surrounding the event and the aim of the CTT is to determine the traffic impact on specific route segments. The parameters needed to conduct a CAA are the location area, date and time periods. The CTT uses the same last two input parameters as the CAA with a specific route segment.

The average travel times and average speeds on certain route segments can be obtained from the above mentioned tools. The delay can also be determined from the average travel time results. Delay is defined in traffic terms as the additional travel time experienced by a motorist, due to conditions that infringe on the desirable movement of traffic.

4.2.3 Study Timeframe

Traffic counting data was obtained over the whole event weekend. A numerous amount of traffic came to the event area on the Friday and only left the event area and Bloemfontein on the Sunday. The event weekend traffic volumes are compared to the

average of five other typical weekend traffic volumes to obtain the magnitude of the event traffic volumes.

Two time periods were analysed on the event day with the CAA. Each time period analysed seven hourly time sets. The first time period was from 08:00 – 15:00 (before the event) and the second from 16:00 – 23:00 (after the event). The aim of these time periods is to determine when the largest traffic impact occurred before and after the event. In this research study the traffic impact is measured in queueing length, delays on route segments, differences in average speeds and travel times on the event day compared to the typical. Two route segments was analysed with the CTT after studying the results obtained from the traffic counting information and CAA. These two route segments were a 10 km segment of the S1066 west of the event area and a 15 km segment on the N1 north of the Vaalplaza tollgate. The two route segments were analysed for time periods both before the event. Each time period analyse four to five time sets of which the base set is one. These sets are compared to a typical Saturday.

4.3 Method

The proposed methodology followed was too first evaluate the impact of the event traffic on major arterials with CTO counts. Secondly, to determine the traffic impact on the network surrounding the event area and on Bloemfontein with a CAA. Thirdly, to evaluate the traffic impact on certain route segments with a CTT after evaluating the event traffic volumes and CAA results.

5 TRAFFIC IMPACT OF THE ITS TIME EVENT

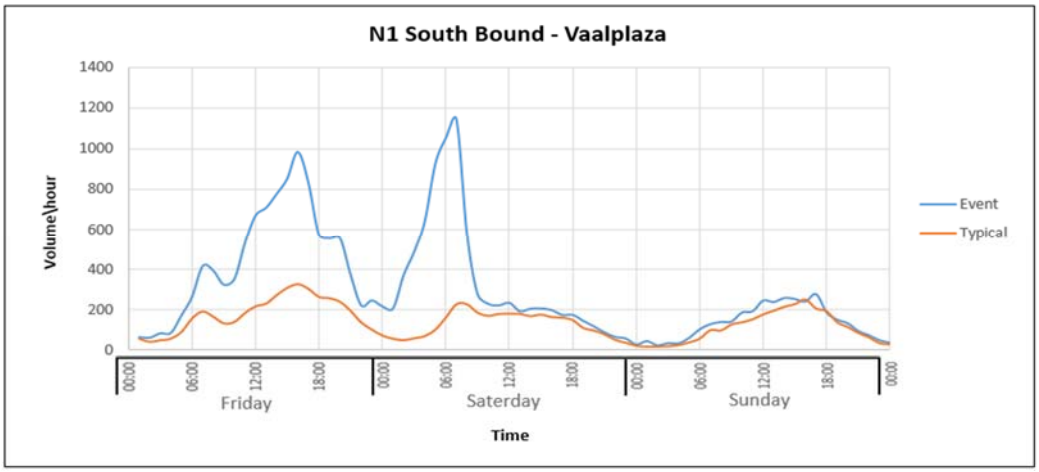
Thousands of vehicles flowed into the event area from all the access routes on the morning before the event. Different sources stipulated that over one million South Africans attended the event. Figure 4 displays the event area on the morning before the event.

Figure 2 - Event area on morning before the event

5.1 Impact on Major Arterials

The impact of the event on major arterials can be visualised by comparing the actual traffic volumes over the event weekend to traffic volumes over a typical weekend. This is to determine the actual event traffic volumes and the increase in traffic volumes in percentages compared to normal conditions. Event traffic volumes are calculated as the difference between traffic volumes over the event weekend and traffic volumes on a normal weekend.

Significant increases in traffic volumes were observed on the N1 north and south of Bloemfontein. Figure 5 compares traffic volumes over the event weekend to a typical weekend from CTO Station 2041, located near Vaal plaza tollgate on the N1 at coordinates 26°52'1.66"S and 27°37'50.54"E.



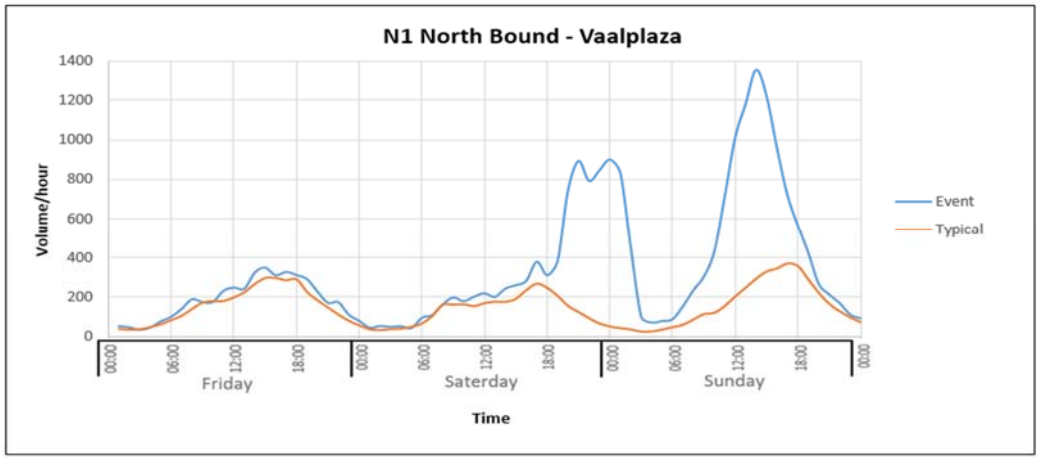


Figure 3 - Traffic volumes from Gauteng

It can be seen that there was a substantial increase in traffic volumes from Gauteng and the Northern part of the country. Traffic volumes increased to more than 400% than that of typical traffic volumes, this can be seen on the South bound graph at about 07:00am, on the Saturday morning.

The second biggest increase in traffic volumes was observed at Colesberg in the Eastern Cape, but not nearly as large as that from Gauteng. Traffic volumes from the

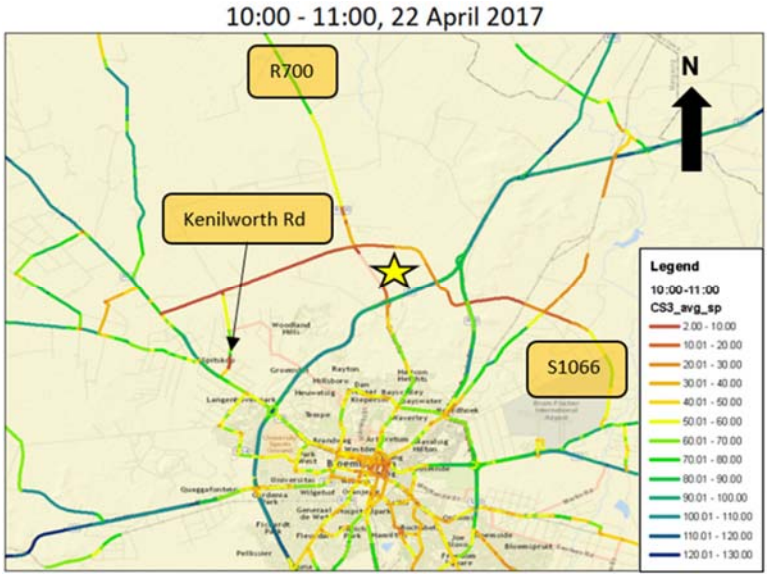
southern region of the country did not show such a significant increase on the event weekend. This is not displayed due to this short research paper.

5.2 Event Attendance

Traffic volumes from CTO stations located on most of the access routes gave an estimation of the magnitude of people that attended from each province. The traffic volumes indicated that most traffic originated from Gauteng, secondly from Kwazulu-Natal and then from the Western Cape. Interesting to note was that the summation of the traffic volumes from the CTO counts were much lower than expected. Not nearly the amount of traffic volumes estimated to have been at the event is reflected in the CTO counts. The only plausible solution for this is however found in the amount of busses that attended the event. In an interview one of the event organisers stated that way more busses arrived at the event that what was anticipated for. For example 5000 vehicles can carry 20 000 people compared to 5000 busses that can carry 400 000 people. Therefore busses can be seen as one of the crucial elements for success in major transportation events.

5.3 Traffic Impact on Bloemfontein

The traffic impact on Bloemfontein can be visualised by comparing the average traffic speeds on the network of Bloemfontein of the event day to a typical Saturday. The average speeds between 10:00 and 11:00 AM is compared to a typical Saturday in Figure 6. This time period showed the largest increase in traffic for the whole morning before the event. The event area is displayed with a star.



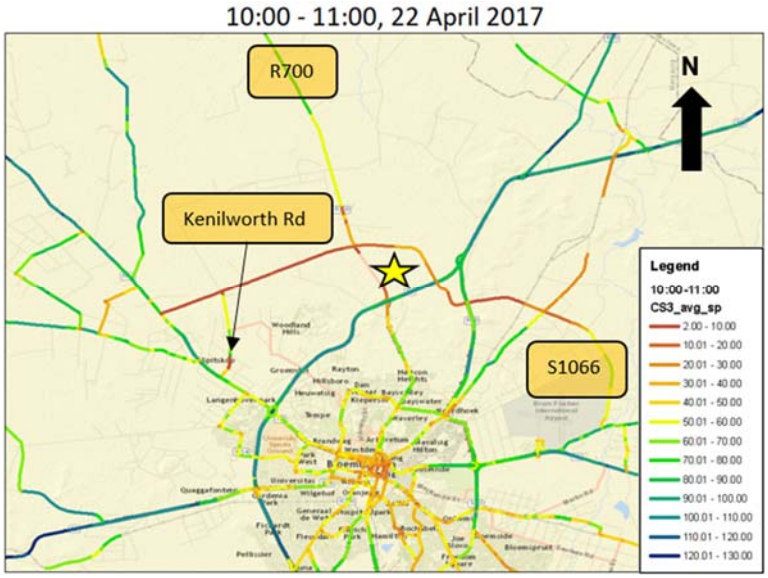


Figure 4 - Average speeds between 10:00 and 11:00, event compared to typical Saturday

The most significant traffic speed reductions were observed to the East and West on the S1066 route was between 5 and 20 km/h, while on a typical Saturday speeds were usually between 60 and 90 km/h. Interesting to note of this reduction is speed, is the negligible impact on Bloemfontein and the N1. By comparing average travel times of traffic on the 9 km segment of the S1066 west of the event the delay was calculated as 1 h 7 min 10 sec between 10:00 and 11:00 AM.

Two concerns the organisers had were that the access routes didn't have the capable capacity to handle the incoming traffic before the event and that large congestions would form as traffic leave the parking areas after the event. The reason for the latter was due to the fact that the parking strategy was only aimed at getting vehicles into the parking areas as quickly as possible and not out. This was however not the case and from observing the average traffic speeds after the event it can be seen that traffic queues cleared up between 10:00 and 11:00 PM. The average traffic speeds also displayed that incoming traffic queues cleared up between 02:00 and 04:00 PM, indicating that all the traffic were cleared up when the event commenced.

5.4 Approximate queueing length

The approximate queuing lengths can be determined by evaluating the average traffic speeds on specific routes. A queue is identified on a route when there is a sudden drop in the average traffic speeds of 40 km/h or more. The longest identified queues on the day of the event were between 10:00 and 11:00 AM on the S1066, 9 km and 9.5 km respectively. Refer to Figure 6.

5.5 Impact on the Wider Network

The largest traffic volumes on the event weekend were observed at CTO station 2014 located next to Vaalplaza Tollgate on the N1 national route. Therefore, specific emphasis was placed on traffic conditions surrounding Vaalplaza Tollgate on the event weekend to determine the traffic impact on a national level. Delays on major arterials like

the N1 can impact non-event traffic and lead to large financial loss for transportation companies.

The traffic impact on the wider network can be visualised by comparing the average traffic speed on the morning before the event over a 15 km segment north of the Vaalplaza Tollgate to the average traffic speed on a typical Saturday morning.

A significant reduction in average traffic speed is observed 3 km upstream of the Vaal plaza Tollgate, on the day of the event between 04:00 and 08:00 AM. This is visually presented in Figure 7. From this can be observed that the approximate queuing length upstream of Vaalplaza Tollgate was 3 km long.

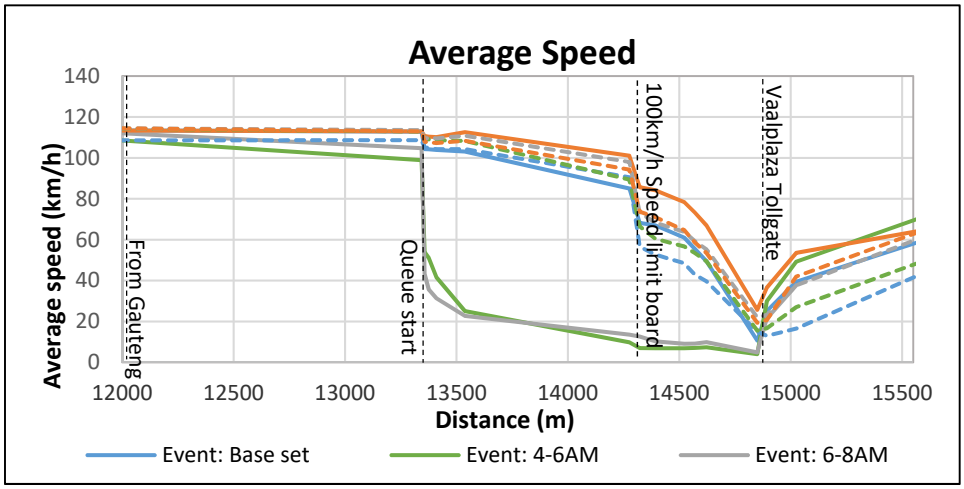


Figure 5 - Average traffic speeds north of Vaalplaza on N1 towards Bloemfontein

6 CONCLUSION

The methodology of this research study was aimed at investigating the magnitude of the traffic impact of the It's Time Event on Bloemfontein and its surrounding network. Traffic Data in the form of CTO counting information and historical TomTom Probe Data were utilized to determine the impact. The methodology behind the planning process of the organisers is also investigated.

The results clearly indicated the magnitude of the impact on the event area and surrounding network. The results also indicated the amounts of traffic that attended from different origins all over South Africa. Traffic volumes, average traffic speeds and average travel times were the key data parameters used to determine the extent and magnitude of the traffic impact. Delays and estimated queueing lengths were also identified and these two parameters were used to define the traffic impact. Results further indicated that the event was a success from a transportation perspective. This shows that the organisers did a good job in planning for the event and it is recommended that the planning principles are used by event organizers while planning for future major transportation events.

It is further recommended that the information and conclusion obtained from this paper is used by other interested parties such as road authorities, law enforcement, disaster management and emergency services to get a better understanding of the traffic

impact of major transportation event. It is also preferred that more research is still to be done on following major transportation events to increase the depth of research and knowledge on these type of events.

7

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