



**City of Tshwane  
Metropolitan Municipality  
Roads and Stormwater Division**

**GUIDELINES  
FOR THE DEVELOPMENT OF  
ROAD SAFETY MASTER PLANS**

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Metropolitan Municipality  
Roads and Stormwater Division

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# Executive Summary

The City of Tshwane Metropolitan Municipality is the administrative capital of the Republic of South Africa. The city is divided into 76 wards and a political representative (ward councillor) is elected for each ward. The city has a population of about two million people and is experiencing an annual population growth that is substantially higher than the national average for the country as a whole.

Tshwane is a city in transition and has a mix of established and historically disadvantaged areas. The disadvantaged areas are mainly situated to the north of the city. Since road safety in these areas was severely neglected in the past, the new municipality that came into being in 2000 was faced with the tremendous challenge of improving road safety and providing infrastructure in these areas. Fatality rates were high and the communities were discontented about the road safety situation.

The City of Tshwane acknowledged the problem and developed road safety master plans in collaboration with stakeholders and the community. The master plans mainly focused on the provision of engineering measures such as pedestrian bridges, walkways, raised pedestrian crossings, speed humps and loading facilities at schools, but due attention was also paid to education, awareness raising, law enforcement and evaluation.

The process has been found to be highly successful and has resulted in the City's receiving a number of national and international awards. The process has now been implemented in all previously disadvantaged areas of the city and is being integrated in the established areas in the city.

Most of the road safety improvements in the City of Tshwane are targeted at areas with high levels of pedestrian activity. Low-income or disadvantaged communities are particularly vulnerable to pedestrian accidents. These communities often experience fatalities that are disproportionately high compared to communities with lower levels of pedestrian activity. In the past, there has been a tendency to address only the needs of motorised traffic; pedestrian needs have often been neglected.

The purpose of these guidelines is to provide an overview of the process of developing, implementing and maintaining road safety master plans as applied by the City. The process described in these guidelines has been refined through experience with a number of projects. It is a process that has been found to be highly acceptable to communities and to have a high level of sustainability. The process can readily be replicated in new areas and can therefore be applied generally for the development of road safety master plans.

It is acknowledged that the identification of hazardous locations should preferably be based on accident data, but it was realised that accident data are not available in many of the disadvantaged areas in the city, because not all these areas have been formalised and street names have either not been allocated or are not displayed. This is a common phenomenon in many developing countries and economies.

Where accident data were not available, the City took a pragmatic approach and developed a process for identifying high-frequency accident spots through community consultation. Input is obtained from the elected ward councillors, ward committees and other role players such as the Metropolitan Police. The information obtained is then verified through road safety inspections. Basic data are recorded through this process, the problem is evaluated according to the conditions on site and alternative solutions are considered, taking specified guidelines into account.

Road safety projects are identified, mapped and listed for further investigation and evaluation. Relevant data such as the type of environment (schools, old age homes, centres for disabled people, high frequency pedestrian areas etc), vehicle volume and speeds are obtained. Existing measures (or the absence of appropriate measures) are also recorded to provide a holistic picture of the traffic and infrastructure conditions.

This data are then utilised to prioritise the proposed measures in order to ensure that the measures which would have the biggest impact on improving road safety are implemented. The preferred method of prioritising road safety treatments would be the economic appraisal method, where the benefits of the measures must exceed the cost of implementing them. A simplified method of prioritising low-cost improvements has also been developed. Once the projects have been prioritised and costed, funding is obtained through the budgetary process of the municipality.

When funding has been allocated, an implementation plan is prepared based on the priorities identified in the road safety master plans. One of the strategic objectives of the City is the fighting of poverty and unemployment. Implementation processes are guided by the Expanded Public Works Programme which aims to bridge the gap between the growing economy and the large numbers of unskilled and unemployed people who have yet to fully enjoy the benefits of economic development. The road safety measures are ideal projects which can be done by smaller emerging contractors, utilising local labour. The use of local labour has the added benefit of raising community awareness of the projects that are being undertaken.

Educational and awareness programmes are run in parallel with the implementation process. This is done through educational campaigns at schools such as the Youth and Road Safety Campaign, the Child in Traffic campaigns and scholar patrol training programmes. High awareness of road safety is promoted during Youth and Transport month. Road safety campaigns require political buy-in. These campaigns are spearheaded by political incumbents to demonstrate their commitment

towards improving road safety. Posters and reflective strips are distributed and safety programmes presented to help to create awareness.

Law enforcement plans are developed to complement the engineering, education and awareness processes. Law enforcement is focused on hazardous locations which are identified in master plans as well as locations identified by means of the accident data base. Other focus areas include speed enforcement through fixed and mobile cameras, drunken driving, moving offences, driver and vehicle fitness.

It is essential to monitor and review the impact and institutional effectiveness of the master plans. Impact effectiveness measures the effectiveness of safety improvements while institutional effectiveness measures progress with the implementation of all components of the road safety management system. Key performance areas and indicators (KPAs and KPIs) are developed and targets set to monitor and evaluate the implementation of safety measures as well as the reduction of fatalities and serious injuries. Community satisfaction is also measured when the road safety master plans are updated on an annual basis

This guideline document also provides examples of applicable road safety treatments which can be implemented and which have proved to be successful.

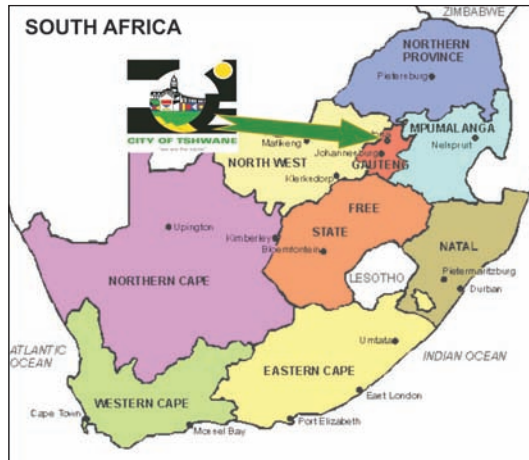
The road safety master plans have proved to be sustainable and are an excellent tool to integrate engineering measures, education, and enforcement, and to evaluate the effectiveness of measures and programmes which have been implemented. They also ensure community participation and buy-in to improve road safety.



# Introduction

## 1.1 Background

The Metropolitan Municipality of the City of Tshwane was established on 5 December 2000 by the amalgamation of various local governments, encompassing the following areas: Soshanguve, Centurion, Temba, Hammanskraal, Pienaars River, Crocodile River, Winterveld, Akasia, Mabopane, Ga-Rankuwa and Pretoria.



Location of the City of Tshwane

The city is the administrative capital of the Republic of South Africa. The country is a constitutional democracy with a three-tier system of government and an independent judiciary, operating under a Westminster-style parliamentary system. The national, provincial and local levels of government all have legislative and executive authority in their own spheres. Each sphere of government is defined in the South African Constitution as “distinctive, interdependent and interrelated”.

South Africa is currently divided into nine provinces. There are a total of 282 municipalities in South Africa. These include six metropolitan municipalities, of which the City of Tshwane is one. The municipalities are focused on growing local economies and providing infrastructure and services.

The City of Tshwane is divided into 76 wards with an elected political representative (Ward Councillor) for each ward. Ward committees are elected to assist the Ward Councillor with the management of the ward.

The municipality has a population of about two million people. The city is experiencing an annual population growth that is substantially higher than the national average.

## 1.2 Road safety master plans

Over the past decade the City of Tshwane has been very active in the promotion of traffic safety through the development of road safety master plans. The process has proved to be highly successful and has resulted in the city’s receiving a number of national and international awards. The process has now been implemented in all previously disadvantaged areas of the city and is being integrated in the established areas in the city.

Most of the road safety improvements in the City of Tshwane are targeted at areas with high levels of pedestrian activity. Pedestrians are particularly vulnerable



**Union Buildings: Seat of the South African Government**

to road accidents and accidents involving pedestrians normally have serious consequences. Pedestrian accidents have been identified as a major cause of deaths and injuries in South Africa. In the City of Tshwane, pedestrians account for approximately 38% of all road traffic fatalities. The master plans have therefore tended to focus on improving road safety for pedestrians, although attention has been given to the needs of all road users.

Low-income or disadvantaged communities are particularly vulnerable to pedestrian accidents. These communities often experience a disproportionately high number of fatalities compared to communities with lower levels of pedestrian activity. In the past, there has been a tendency to address the needs of motorised traffic only, while largely neglecting pedestrian needs. There has also been a marked increase in traffic in the disadvantaged communities with a corresponding increase in conflict between drivers and pedestrians. The result has

been a high level of discontent in the communities and protest actions such as the cordoning off of roads.

The City of Tshwane acknowledged the problems encountered by communities and responded by developing road safety master plans in collaboration with stakeholders and the community. The master plans mainly focused on the provision of engineering measures such as pedestrian bridges, walkways, raised pedestrian crossings, speed humps and mini circles, but also attended to educa-



**Tshwane Central Business Area**

tion, safety awareness, law enforcement and evaluation. In addition, the master plans were used to establish partnerships with other spheres of government as well as other non-government road safety organisations.

### **1.3 Hazardous locations**

One of the most important challenges facing safety professionals in South Africa is the identification of hazardous locations, particularly in the disadvantaged areas. Very limited accident statistics are available, and where such statistics are available, they are often neither reliable nor even usable, mainly because it is not possible to trace accidents to specific locations. There are various reasons for this. In many of the disadvantaged areas, street names have not been allocated or else sign-

boards have not been provided, which makes it difficult to indicate the location of an accident. Even where signboards are in place, the locations of many accidents are still recorded incorrectly.

To address the problem with limited accident information, a practical method was developed according to which the safety professional collects information from various sources, such as the local community, the police, the metropolitan police (traffic officers) and emergency services. Community inputs and participation are of particular importance and play a major role in this process. Community inputs are obtained primarily through ward councillors and safety committees. Information is obtained from the ward councillors and committees to assist in the identification of safety issues and the selection of safety measures.



**Industrial area in Tshwane**



**Jacaranda trees along a main road in the city**

## **1.4 Purpose of the guidelines**

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The purpose of these guidelines is to provide an overview of the process of developing, implementing and maintaining road safety master plans as applied by the City of Tshwane. The process described in these guidelines has been refined through experience with a number of projects in the city. The process has been found to be highly acceptable to communities and to have a high level of sustainability. It is a process that can readily be replicated in new areas and can therefore be applied generally in the development of road safety master plans.

These guidelines aim to describe the process used to develop road safety master plans, but they do not provide detailed technical information on aspects such as design standards or investigation methodologies. Where possible, national or international standards and methodologies are followed or applied in all road safety projects. Information on such standards and methodologies is available from various other documents. A bibliography of some of the documents used in the City of Tshwane is provided in this guideline document.

## **1.5 Organisation of the guidelines**

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The guidelines consist of the following chapters and appendices:

- Chapter 1: Introduction – serves as an introduction to the guidelines.
- Chapter 2: Safety Planning Overview – provides an overview of the safety planning process followed in the City of Tshwane.
- Chapter 3: Values, Goals and Objectives – describes the values, goals and objectives of the City in terms of road safety.
- Chapter 4: Community Involvement – describes processes used to involve the community in the identification of hazardous locations and safety treatments.
- Chapter 5: Data Requirements and Collection – provides an overview of the data typically required for the development of road safety master plans.
- Chapter 6: Road Safety Investigations – describes the typical road safety investigations required during the development of the master plans.
- Chapter 7: Safety Project Identification – gives information on the methodology followed to identify required safety projects.

- Chapter 8: Economic Appraisal and Prioritisation – provides technical information on economic appraisal and the prioritisation process based on economic considerations.
- Chapter 9: Prioritisation of Low-Cost Safety Treatments – describes a methodology for the prioritisation of low-cost safety treatments in situations where prioritisation based on economic evaluation cannot readily be applied.
- Chapter 10: Project Implementation – provides information on the procurement processes that have to be followed for the implementation of road safety projects.
- Chapter 11: Monitoring and Review – describes the processes being followed for the monitoring and review of implemented road safety master plans.
- Chapter 12: Road Safety Treatments – provides an overview of the road safety treatments that are typically applied or considered in safety investigations.
- Chapter 13: Education and Awareness – describes the education and awareness campaigns that may be included in road safety master plans.
- Chapter 14: Law Enforcement Plans – describes the law enforcement actions that could be considered for inclusion in the road safety master plans.
- Chapter 15: Bibliography – a list of references and road safety guidelines and documents used in the City of Tshwane.



**Residential township in Tshwane in a previously disadvantaged area, where the roads and storm water system has been upgraded.**



# Safety Planning Overview

## 2.1 Introduction

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An overview of the process of developing, implementing and maintaining road safety master plans is provided in this chapter. The process is described in greater detail in other chapters of these guidelines.

In the development of the road safety master plans, it is important to have a clear understanding of the different elements or components of the process. A systems approach is required which involves formulating a vision, goals and objectives, identifying road safety problems and alternative safety improvement measures, establishing evaluation norms and criteria, evaluating and ranking safety measures and implementing the selected solution.

## 2.2 Road safety project team

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In the City of Tshwane, the road safety project team normally consists of a multi-disciplinary group of professionals, including technical professionals from the Traffic Engineering Division, representatives from the Metro Police as well as safety professionals.

It is important that all the professionals involved should have the appropriate experience and qualifications for the development of the road safety master plans. The technical professionals should have knowledge and experience beyond that reflected by normal engineering design. Specifically, the professionals need to understand the impact of road design, the road environment and road safety measures on driver and pedestrian behaviour.

It is also important that the road safety project team should incorporate the

ward councillors and representatives from ward committees in the study area. The involvement of these councillors and representatives are crucial for the successful development of road safety master plans.

The road safety project team is responsible for all aspects involved with the development and implementation of the road safety master plan as discussed in these guidelines.

## 2.3 Process overview

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An overview of the process of developing road safety master plans is shown in figure 1. The process consists of the following steps:

- Establish values, goals and objectives that provide broad direction for the development of the master plans

and ensure that the plans are aligned with the broader strategic objectives of the city. Refer to chapter 3.

- Involve the community from the earliest stages of the project. The involvement of ward councillors, community representatives, committees, schools and safety professionals is an essential component of the process. Refer to chapter 4.
- Collect all the data and information required for the development of the road safety master plan. Where accident data are available, these should be utilised. Otherwise, other sources of information should be utilised for the identification of hazardous locations. Refer to chapter 5.
- Undertake road safety investigations and investigations with the purpose of identifying high-risk locations, possible causes of accidents at these locations and finding remedial measures. Refer to chapter 6.
- Identify road safety projects on the basis of collected data, road safety investigations and community inputs. Refer to chapter 7.
- Where necessary, undertake an economic appraisal of the identified road safety projects and prioritise on the basis of economic considerations.

This step is normally only undertaken for larger or high-cost safety projects. Refer to chapter 8.

- For low-cost safety projects, a simpler prioritisation methodology based on a point system is used. Refer to chapter 9.
- Once the road safety master plan has been developed, the next step is to implement the road safety projects. This includes securing funding for the projects. Refer to chapter 10.
- The final step in the process is to monitor and review the road safety master plan. This monitoring is undertaken to establish whether the road safety issues in an area have been successfully addressed and to identify possible new issues. Refer to chapter 11.

An overview of the road safety measures that could be considered for inclusion in the road safety master plan is also provided in figure 1. These measures include the following:

- Road safety treatments (engineering measures). Refer to chapter 12.
- Education and awareness campaigns. Refer to chapter 13.
- Law enforcement plans. Refer to chapter 14.

## 2.4 Tshwane safer city policy

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The Tshwane City Development Strategy (CDS) is aimed at establishing Tshwane as the leading African capital city and a place where the community can prosper in a safe and healthy environment. One of the key focus areas of the strategy is to ensure a safe and secure environment by making safety services available and accessible.

According to the CDS, safety and security are fundamental necessities that underpin economic and social development strategies. These factors are considered to be some of the most important in attracting investment into a city and fostering a positive culture of urban living.

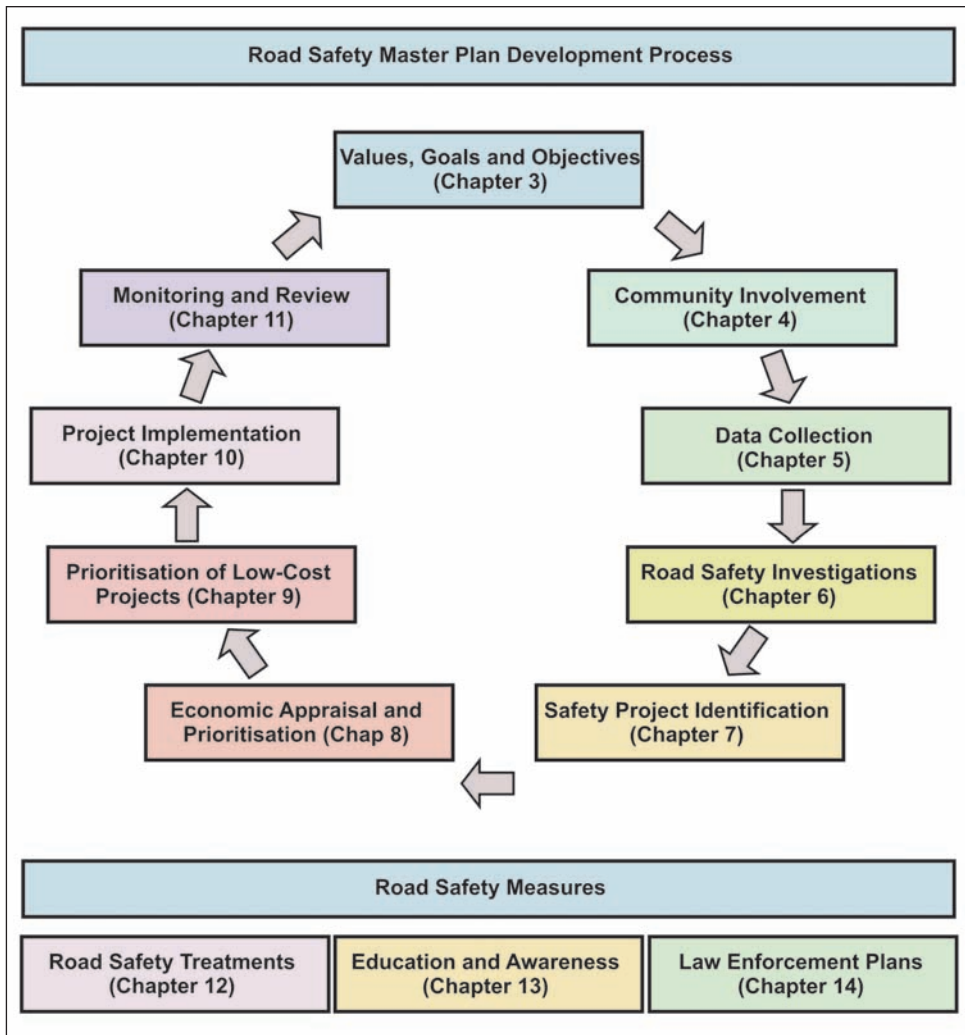


Figure 1: Development of Road Safety Master Plans

The City of Tshwane Integrated Transport Plan 2004-2009 has as its third goal: To improve the safety and security of the transport system. Associated objectives include the reduction of injuries and fatalities on all modes of transport.

In Tshwane, road safety is therefore considered to be one of the key strategies of the city. The development and maintenance of road safety master plans are therefore an important initiative of the city. These guidelines are intended to form part of this initiative.

## 2.5 Alignment with national programmes

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The National Department of Transport and the Road Traffic Management Corporation (RTMC) are actively involved in the development and implementation of road safety plans. One of the key objectives of these plans is to establish partnerships between national, provincial and local government bodies with the purpose of pooling resources and strengthening the available collective capacity.

The RTMC is in the process of developing the 2009 - 2015 Road Traffic Safety Management Plan for South Africa. The purpose of the plan is to update, review

and enhance the Road to Safety Strategy from 2006 onwards. It is essential that road safety master plans should be aligned with these strategies to ensure the coordinated implementation of all strategies.

The National Land Transport Strategic Framework (NLTSF) for public transport (2006 to 2011) also provides a framework for addressing the needs of non-motorised transport and requires the different levels of government to integrate facilities for pedestrians and cyclists within their transport plans.



# Values, Goals and Objectives

## 3.1 Introduction

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The identification of values, goals and objectives is an essential first step in the development of road safety master plans. The goals and objectives provide direction for road safety projects and values are used as a yardstick for measuring the effectiveness of plans.

## 3.2 Strategic objectives

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The City of Tshwane Metropolitan Municipality has drawn up a five-year plan and programme of action to develop and grow Tshwane into a successful city where residents can enjoy a good quality of life. This programme focuses on development opportunities within the city and the development challenges facing the city.

The five-year strategic objectives are:

- 1 Providing access to quality basic services and infrastructure throughout the city.
- 2 Accelerating shared and higher local economic growth and development.
- 3 Fighting poverty and ensuring clean, healthy, safe, secure and sustainable communities.
- 4 Fostering participatory democracy and applying the Batho Pele principles through a caring, accessible and accountable service.
- 5 Ensuring good governance and financial viability, building institutional capacity and optimising transformation in order to execute the Municipality's mandate.



**Pedestrians are particularly vulnerable to accidents**

Road safety projects in the City are aimed at achieving the third strategic objective, namely to ensure safe, secure and sustainable communities. The main goal is to improve road safety and reduce accidents. However, during the



**A second pedestrian accident**

process various other objectives are supported, such as fostering participatory democracy through the Batho Pele principles.

### 3.3 The Batho Pele principles (values)

The Road Safety Master plans are developed under the Batho Pele (putting the people first) principles, which include the following values and principles:

- Consultation – Customers should be consulted about the level and quality of the municipal services they receive and, wherever possible, should be given a choice regarding the services that are offered.
- Service standards – Customers should be told what level and quality of services they will receive so that they know what to expect.
- Access – All customers should have access to all services, and possible barriers should be done away with.
- Courtesy – All customers should be treated with courtesy, consideration and empathy.
- Information – Customers should be given full and accurate information about the municipal services they are entitled to receive.
- Openness and transparency – Customers should be given honest and open feedback on how the Municipality works, what the resources are and how they are used, and the level of efficiency.
- Redress – If the promised standard of service is not delivered, customers should be offered an apology, a full explanation and a speedy and effective remedy; and when complaints are made, customers should receive a sympathetic, positive response.
- Value for money – The Municipality should seek ways to simplify services and eliminate waste and inefficiency by ensuring that services are delivered in the most efficient way.



Accident on a high-speed road

These values and principles have resulted in the prioritisation of road safety projects in previously disadvantaged areas, focusing on vulnerable road users and non-motorised transport, such as

pedestrians. Projects were implemented in collaboration with the community and community structures and through the cooperation of various stakeholders within and outside the Municipality.

### 3.4 Goals and objectives for the road safety master plans

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The main goal for road safety master plans is linked to the City of Tshwane Integrated Transport Plan 2004 – 2009:

*Goal 3: To improve the safety and security of the transport system – To ensure a high level of safety and security for all users of the transport system. Associated objectives include:*

- **To reduce injuries and fatalities on all modes of transport.**
- *To improve personal security on the public transport system.*
- *In conjunction with other service sectors, to develop contingency plans for possible transportation emergencies.*

The main objectives of the road safety master plans are to:

- Integrate engineering measures, education, awareness and law enforcement to ensure reduction in fatal accidents and fatalities.
- Create an environment where all road users, including vulnerable groups, can travel freely and safely.



# Community Involvement

## 4.1 Introduction

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The involvement of the community and other stakeholders is a crucial and important step in the development of road safety master plans. To ensure the success of a project, it is essential to secure community acceptance of the project before it is implemented. A community needs to understand why certain measures are implemented as well as the safety benefits of these measures. The need to educate people and to make them aware of the potential dangers associated with traffic is also an essential part of such involvement.

The community can be a valuable source of information for identifying hazardous locations, particularly when accident statistics are inadequate. The community can provide information on locations where accidents often occur or where there is a high risk of accidents. This is not the only reason for involving the community, however. They need to be part of the process of developing measures aimed at addressing safety issues. Some of these measures would take the form of engineering improvements, but other measures such as education and information campaigns are also important.

The advantages of community involvement include the following:

- It ensures that the needs and input of the community are taken into account.
- It creates a sense of ownership and responsibility for the project.



Typical community meeting to identify needs

- Community involvement develops leadership and management skills.
- It enhances the chances of success of a project by ensuring that the proposed measures are acceptable to the community.

## 4.2 Community groups

Community inputs and participation are primarily undertaken through the ward councillors and ward committees. A ward committee, chaired by the ward councillor, is the statutory body with which discussions in the ward should take place.

Specific community target groups could include:

- representatives from community-based organisations
- road safety committees (such as those established in Atteridgeville and Mamelodi)
- schools
- informal traders
- taxi owners and drivers
- business owners in affected areas
- groups with special needs, such as old age homes

The ward committees usually have contact with these groups in their ward.



**Community participation during public meetings**

## 4.3 Consultation with community groups

Consultation with the community generally takes place through meetings involving the ward councillors. These consultations usually require more than one meeting with the councillors and other stakeholders and are combined with a site visit during which the stakeholders are given the opportunity to identify problems in their areas.

Although community members and councillors often have a good idea of where their road safety problems lie, they may be uninformed when it comes to finding solutions. Options identified by the community typically include pedestrian bridges, traffic lights and speed humps, which are not always the best solutions to their problems.

Ward councillors play an important role in the process of identifying hazardous locations and agreeing on the most beneficial and cost-effective solutions. They are therefore the primary group that should be involved in seminars and discussion sessions to sensitise them to the limitations and value of different engineering solutions. This also creates an understanding of the broader challenges and the need for community ownership and involvement. Such discussions often involve issues such as the following:

- The challenges of speed management, particularly in the context of the effective utilisation of speed humps.

- The vulnerability of pedestrians and other non-motorised transport and the different options that can be implemented.
- Problems created by motorists and taxi drivers as they affect pedestrians.
- Sharing of road safety information.

The ward councillors and other representatives from ward committees together with technical personnel from the Traffic Engineering Division and representatives from the regional office of the Metro Police should become members of the Road Safety Project Team responsible for the road safety investigations and inspections (as discussed in chapter 2).

Extensive community involvement requires that the technical team that are directly involved with the project should be sensitised to community development issues. It is of the utmost importance that the team should establish a relationship of trust with the community and ensure that this relationship is maintained over time. The Social Development Department of the municipality has experience of engaging with communities and they should be involved with the process.

## 4.4 Community involvement in project implementation

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Experience with road safety projects in Tshwane has shown that the success of the projects can be significantly improved if the community is involved in the implementation of the projects on a contractual basis. Such involvement is very important in that it creates a sense of ownership and responsibility for the project. This improves acceptability of the project by the community and reduces the occurrence of vandalism and other problems.

A further advantage is that, at a practical level, community members are given the opportunity to develop technical skills through participation, as well as to earn an income for the duration of the project.



# Data Requirements and Collection

## 5.1 Introduction

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Probably the most important challenge faced by safety professionals in South Africa is the availability of accident data for the identification of hazardous locations. Although this problem occurs in all areas of the country, it is of particular concern in the disadvantaged areas. The risk of road accidents is high in these areas owing to the high volumes of pedestrians, but very limited accident data are available for the identification of hazardous locations. Where such statistics are available, they are often neither reliable nor even usable, mainly because it is not possible to trace accidents because street names are often not available to locate the accidents. However, even where such names or signs are available, the accident records are often inadequate or unreliable.

Because of the lack of adequate accident statistics, it is not always possible to quantify or identify safety risks, which may give the impression that road safety is not an issue in a particular area. This could result in inadequate attention being given to traffic safety in these areas even though there might be an urgent need to address road safety. It is therefore important that alternative sources of information should be identified and utilised for the identification of hazardous locations. All available sources of information should be utilised, including any anecdotal information. Such information may not be regarded as objective accident data, but must be utilised when accident data are not available or are inadequate.



Example of an aerial photograph of an area

The following are examples of information sources that could be used to identify hazardous locations:

- Community and stakeholders
- Aerial photographs, maps, plans and reports showing information such as the road network, public transport facilities and routes and important developments in the area.
- Safety inspections, during which additional information could be collected or studies undertaken.
- Formal data collection processes, such as traffic counts and the gathering of accident statistics.

## **5.2 Community and stakeholders**

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The community and other stakeholders are an important source of information and should be utilised as far as possible for purposes of identifying hazardous locations and other road safety problems.

The following are important sources of information:

### **5.2.1 Community involvement**

The value of community input on road safety issues and hazardous locations should not be underestimated. Community members have first-hand experience and knowledge of the road safety situation in their community. Involving the community in the data collection process is also crucial in order to build trust, which would encourage community members to accept and use the countermeasures that have been implemented. Ward councillors, ward committees, community road safety committees and forums, community policing forums, and other community-based organisations and structures should be an integral part of the data collection process.

### **5.2.2 Officials from various departments in the municipality and province**

Sources of information include the departments responsible for the following:

- a) the provision of road infrastructure and storm water systems on municipal, provincial and national roads in the area
- b) the installation and maintenance of road and roadside furniture (e.g. road signs and markings, traffic lights, barriers, sidewalks, and other traffic and safety engineering measures)
- c) the provision of traffic law enforcement and crime prevention services such as the Metropolitan Police Department and the provincial and national traffic authorities
- d) the provision of road safety education and communication programmes within communities, schools, and the workplace
- e) the provision of emergency services, such as ambulance services and the fire brigade
- f) the planning of urban development and transport infrastructure

### **5.2.3 Complaints and requests**

Valuable information can be obtained from the complaints and requests reg-

istered by members of the community and non-governmental organisations (NGOs) such as Disabled People South Africa (DPSA).

All telephonic complaints and requests received by the municipality are registered on the complaints data-base. A reference number is then issued to the complainant. All written requests are registered on the electronic filing system.

Complaints are then referred to the ward councillor for comments and input. The complainant is informed accordingly. If the request is not on the priority list it is then listed for evaluation during the updating of the master plans.

#### 5.2.4 Perception and awareness surveys

Road safety perception and awareness surveys can be conducted at hazardous locations before (and after) safety improvements are implemented to assess the community's opinion of road safety issues. These could be conducted on site, and would include both drivers and pedestrians. Such surveys should be conducted at random sites to get a more general measure of community road safety perceptions.



Typical traffic counting team

Household surveys are a more expensive source of information but more detailed information (e.g. demographic information) could be collected to assist with more focused interventions.

### 5.3 Aerial photographs, maps, plans and reports

For the development of a road safety master plan, it is essential that aerial photographs and maps should be obtained which show information such as the following:

- Road network, including functional classification of roads. It must be kept in mind that roads are sometimes used for purposes other than their intended function and classification. For example, rapid population development next to a freeway or high order road could change the function of the road to that of a much more local road.
- Public transport facilities, including routes, termini and modal transfer facilities.
- Important developments in the area that could attract high volumes of traffic and pedestrians. Particular attention must be given to developments that attract high volumes of pedestrians, such as schools, shopping centres and public transport facilities.
- Locations where there is a high level of interaction between pedestrians and motorised traffic.
- Existing walkways, bus lay-byes and traffic calming measures.

Where as-built plans and drawings are available, the following information should be obtained:

- horizontal alignment and layout of facility
- vertical alignment
- road signs and markings
- traffic signal layout and phasing plans
- street lighting
- information on design standards and constraints
- orthophotos or topographical maps, where required

The following plans and reports can also be valuable sources of information:

- any previous road safety investigations or audit reports
- relevant road maintenance information

## 5.4 Safety inspections

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Additional information can be obtained during safety inspections and site inspections. This includes informal discussions with local community members as well as discussions with tow operators in the area. Traffic conflict studies can also be undertaken to obtain a greater insight into safety problems at particular locations. More information on safety inspections is provided in chapter 6.

## 5.5 Formal data collection processes

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Examples of data that may be required for the development of the road safety master plan are:

- a) Traffic counts (link, intersections and classified).
- b) Pedestrian counts (e.g. at street crossings and walkways).
- c) Speed observations (on roads where speeds may be high). The 85<sup>th</sup> percentile speed is of particular importance in safety studies.
- d) Accident data or statistics.

- e) Existing problem areas, proposed improvements and completed projects.

The municipality may already have traffic counts and other information available and such data should be utilised as far as possible.

Accident statistics can be obtained from the South African Police Services and Metropolitan Police Department. In some cases, emergency services also keep accident statistics.

## 5.6 Holistic approach to data collection

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An information management system should preferably be established and maintained to ensure that all relevant data are collected, and that information is integrated, accessible and available. A committee should oversee the implementation of the information management system. The committee could

consist of representatives of officials of various departments, councillors and community structures.

Members of the public should also have access to information and should be given the opportunity to provide inputs to enhance the effectiveness of the information management system.



# Road Safety Investigations

## 6.1 Introduction

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Road safety investigations are undertaken for various purposes, such as the identification of locations with high accident risks, the determination of probable causes of accidents at hazardous locations and the identification of possible remedial measures that could be implemented to improve road safety at a particular location or in a particular area. Road safety investigations should be undertaken by experienced road safety professionals.

During the road safety investigation, all relevant sources of information should be identified and utilised where possible. Such information might include informal discussions with local community members and with emergency services. Traffic conflict studies could also be undertaken to obtain greater insight into safety problems at particular locations.

## 6.2 Road safety investigation process

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The road safety investigation process involves the following:

- a) The wards are grouped into functional areas or townships to ensure an integrated approach for the area and optimal utilisation of funds within the area.
- b) A road safety project team is selected and established (as indicated in chapter 2).
- c) The community is consulted and available data are collected (as discussed in chapters 4 and 5).
- d) The project team identifies potentially hazardous locations on aerial photographs and maps. The maps should also contain information on existing traffic calming and road safety measures in the area.
- e) Site inspections are undertaken by the project team to confirm locations identified by means of maps and to identify additional locations. Additional information can also be collected during the site visits. During this phase obviously unwarranted requests are taken off the list. Alternative solutions are discussed for those locations where safety measures are warranted.
- f) Following the road safety inspections and data collection, locations that require safety measures are listed on a needs register.
- g) The need for additional information, such as data on land use, traffic and pedestrian counts and traffic speeds is identified and the data are collected (see for example the Low-Cost Measures Checklist attached as Annexure C).
- h) The proposed road safety measures are finalised and prioritised. This

forms the basis of the implementation plan and is one of the main outputs of the road safety master plan for the area.

### 6.3 Site inspections

Site inspections form an essential part of the road safety investigation process and are intended to supplement the information collection process. The purpose of a site inspection is to identify all the features and safety risks that should be addressed during the project. These site inspections should be undertaken by all members of the safety project team.

The inspection may involve the use of a *prompt* or *reminder* list, such as that provided in Appendix A, to ensure that all important safety problems have been identified. Lists like those given in the appendix must be used with caution, however, since there could be a tendency to simply check off all possible deficiencies in road design standards without considering relationships with accidents and road safety. The lists could also distract the inspecting team from their main tasks, namely the identification of hazardous locations and possible causes of accidents and the suggestion of possible remedial measures. *The list should therefore only be used as a reminder, preferably before and after the site inspection and not during the inspection.*

It is important that the site should be visited during the following times:

- in the day and at night
- during peak and off-peak periods

The site inspections should take all possible users of the facility into account,

including pedestrians, children, people with disabilities, public transport and heavy vehicles. The possible impact of bad weather, such as wind and rain, should also be considered.

### 6.4 Other investigations

During the investigation, the need for additional investigations and studies should be identified and these studies should be undertaken. The studies could include, but are not limited to, the following:

- Traffic counts, including pedestrian counts
- Speed surveys
- Gap availability surveys
- Sight distance investigations
- Queue length observations
- Warrant studies (signals and roundabouts)
- Topographical surveys if insufficient as-built information is available
  - *Origin/destination surveys*
  - *Traffic conflict studies*

The above surveys are not only time consuming, but could also be costly. The need for the additional surveys should therefore be critically evaluated



Site visit by project team



Site visit involving representatives of the Metro Police

to ensure that the information will contribute significantly to the understanding of the problem.

## **6.5 Traffic conflict studies**

Traffic conflict studies are one of the additional studies that could be undertaken to improve understanding of the problem. These studies do not always have to be undertaken formally and it is sometimes possible to identify issues by means of a relatively short and informal conflict study.

A traffic conflict is any potentially unsafe situation where accidents are likely to occur. There are two basic types of traffic conflict:

a) Evasive actions. These are actions undertaken by the driver to avoid a potential accident situation either by applying the brakes or by changing direction of travel. These two actions can be observed, respectively, by brake light indications or swerving actions.

b) Traffic violations. These are any transgression of the rules of the road that might result in a road safety risk, even if no other vehicle is in close proximity to the event. The following are examples of traffic violations that could be included in a survey:

- Number of drivers entering a signalised intersection on red.
- Stopping in a prohibited area.
- Overtaking on a barrier line.
- Pedestrians on road sections where they are prohibited.

## **6.6 Remedial measures**

During the site investigation, the team should also consider possible remedial measures that might provide a solution to the identified issues. The measures should be practical and should make a significant contribution to improving the road safety situation. During the investigation, particular attention should be given to the possible impact of the measures on driver behaviour.



# Safety Project Identification

## 7.1 Introduction

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Safety projects should preferably be identified and prioritised with the aid of accident data where such data are available. The use of accident data for such purposes requires specialised and sophisticated statistical techniques to ensure that priority is given to the most hazardous locations. A short overview of these techniques is provided later in this chapter.

However, when adequate accident data are not available to make it possible to identify hazardous locations on a purely scientific basis, an alternative approach is required for the identification of such locations. Whatever data are available must be used, supported by a high degree of judgement in selecting the locations that require the most urgent attention. Community input is an important source of information that can make a significant contribution to the identification of hazardous locations as well as road safety projects.

## 7.2 Community inputs

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Community members have first-hand experience and knowledge of the road safety situation in their community. It makes sense to draw on the practical experience of ward councillors, ward committees and schools to supplement the knowledge and experience of professionals such as traffic engineers and traffic police to identify hazardous locations or potentially dangerous areas.

Various participative techniques can be used by facilitators to extract accurate and useful information. Some examples are mapping and modelling, in which participants map out road safety problems in their area. Active participation and involvement of councillors and their ward committees in such processes can contribute to the understanding, accept-

ance and correct use of the safety measures implemented by the municipality.

The process followed in the City of Tshwane regarding the involvement of communities in road safety projects is described in chapter 4.



**Pedestrians walking and crossing a busy road**

## 7.3 Identification of hazardous locations by means of accident data

Where accident data are available, the identification of hazardous locations should be based on the average or expected number of accidents at a particular location rather than the accident count obtained over a certain period (e.g. a year). Expected accidents are an estimate of the long-range average number of accidents for a particular type of roadway or intersection.

Although there are many accidents on the road network as a whole, they are in fact rare and random events compared to the total amount of travel. Accident counts therefore fluctuate up and down around an average or mean value and this could result in so-called “regression-to-the-mean” bias in accident analysis. This bias means that if the accident count was high due to a random fluctuation, and even if no safety improvements

are made, it is likely that a following accident count would be lower.

A further issue is that it is often not possible to obtain a sample size of accident counts that is sufficient to estimate the expected accident rate at a site. Because of changing circumstances, it may only be possible to obtain two or three years of accident history which are appropriate to the current circumstances at a particular site.

The above two issues can be accounted for by means of the Empirical Bayes (EB) method. This method is used to increase the precision of the estimated expected accident count in situations where there is a limited sample size of where regression-to-the-mean bias could affect the estimate.



Pedestrians may involve all age groups



Near-accident situation involving pedestrians

## 7.4 Network screening by means of accident data

Where accident data are available, network screening techniques are used to identify and rank sites that are likely to benefit most from safety improvements on the basis of accident data and at which further investigation is required to determine whether such improvements would be cost effective.

A range of screening methods are available, including the following:

- a) Accident frequency (count) method, according to which sites are ranked based on the number of accidents. As an alternative to accidents, the Accident Equivalent Number can be used according to which a greater weight is given to fatal and severe accidents compared to damage-only accidents.
- b) Accident rate method, in which the accident frequency is normalised with traffic volumes. Sites are ranked from the highest to the lowest accident rate.
- c) Critical rate method in which the accident rate is compared to a critical rate for a particular type of site. The critical

rate is the average accident rate for sites with similar characteristics.

- d) Excess Expected Accidents method, in which Empirical Bayes (EB) methods are used to adjust the observed number of accidents and to compare the adjusted accident frequency with an accident frequency predicted using so-called safety performance functions. The difference between the two values is considered the “potential for improvement” (PI).

The preferred method is the Excess Expected Accidents method. However, this method requires considered development for local application. Information will be made available on the method when such development has been undertaken.



**Pedestrians attempting to cross a major freeway**



# Economic Appraisal and Prioritisation

## 8.1 Introduction

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The economic appraisal of safety improvements is undertaken to determine whether the proposed improvements are justified and to prioritise expenditure. The basic principle is to ensure that the benefits of a project exceed the cost and to ensure that the greatest possible benefits are achieved in relation to the cost of the safety improvements.

Economic appraisal is undertaken after a safety issue has been identified and safety improvements proposed. The appraisal requires the assessment of the monetary value of the reduction in accidents and the cost of implementing the improvement. Safety benefits require a quantification of the reduction in the number and/or severity of accidents that will result from implementing the improvement. These benefits are expressed in monetary terms and compared with the cost of the proposed improvement.

Safety improvements can result in other benefits such as improved travelling time or reduced fuel consumption. Such benefits should also be included in the benefit-cost evaluation.

## 8.2 Economic evaluation

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In order to evaluate and compare different alternatives or different projects in economic terms, it is necessary to measure benefits and costs, using a common time basis since money has a time value. This time value means that future benefits and costs become

increasingly smaller as the evaluation process incorporates values that lie further and further in the future.

The time value is taken into account by calculating the present worth of a benefit or cost with the aid of the following formula:

$$PW = \frac{FV}{(1+i)^n}$$

In which:

- PW = Present worth
- FV = Future value
- i = Annual discount rate as a factor (percentage divided by 100)
- n = Discount period in years

The net present value (NPV) and cost/benefit ratios of a particular project are defined as follows:

$$NPV = \sum PW_b - \sum PW_c$$

$$B/C = \frac{\sum PW_b}{\sum PW_c}$$

In which:

- NPV = Net present value
- B/C = Benefit/cost ratio
- $PW_b$  = Present worth of benefit b
- $PW_c$  = Present worth of cost c

A project is economically feasible if the net present value is positive or the benefit/cost ratio is greater than one (1).

Economic feasibility in itself does not, however, indicate the optimum time for implementing a project. To determine the best time to implement a project, a range of times should be analysed. When benefits are expected to grow in future (or at least remain the

same), then the first-year rate of return (FYRR) criterion must be used to determine whether the project should be implemented immediately or whether it should be delayed by another year, even if it is economically feasible. This criterion is met when:

$$\frac{\sum PW_{bf}}{\sum PW_c} \geq i$$

Or when:

$$\sum PW_{bf} \geq i \cdot \sum PW_c$$

In which:

- $PW_{bf}$  = Present worth of benefits b in the first year
- $PW_c$  = Present worth of cost c assuming that all costs are incurred in the first year
- i = Annual discount rate as a factor (percentage divided by 100)

In situations where the flow of benefits will at least remain constant or increase over time and where these benefits will be accrued over a very long period of time, the first-year rate of return is a sufficient test to deter-

mine whether a project is feasible and whether it should be implemented. In all other cases, it is necessary to test for both the net present value (alternatively the B/C ratio) and the first-year rate of return.

### 8.3 Project selection

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The economic appraisal method can firstly be used to select the most cost-effective safety improvement measure at a particular site and then to prioritise or rank safety improvements at different sites on the basis of monetary considerations. Where safety improvement measures at a particular site are not mutually exclusive, meaning that all these measures could be implemented, then these should be treated as different projects and prioritised or ranked accordingly.

In situations where safety measures are mutually exclusive, then the most cost-effective of these safety measures should be selected. The appropriate method of selecting such measures is the net present value (NPV) method. The improvement measure with the highest net present value is considered to be the one which is most cost-effective.

### 8.4 Project prioritisation

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Proposed safety improvement projects may be prioritised or ranked using economic appraisal principles to determine the most cost-effective projects, which should be implemented first. Generally, it is unlikely that available funds will make it possible to implement all safety improvements immediately and it is necessary to select those that have the greatest benefit.

The prioritisation or ranking of safety projects requires the selection of the optimum mix of projects that represents the most cost-effective approach to safety

improvement. This typically requires the use of very complex systematic ranking methods based on linear or dynamic programming techniques. These methods can only be applied on a large scale by means of computer software. One reason for the complexity involved is that the benefits and costs of a project may change when it is not implemented immediately and this effect should be taken into account when selecting projects.

A relatively simple approach is to base the prioritisation on the following net first-year value (NFV) for a project:

$$NFV = \sum PW_{bf} - i \cdot \sum PW_c$$

In which:

- NFV = Net first-year value
- $PW_{bf}$  = Present worth of benefits b in the first year
- $PW_c$  = Present worth of cost c assuming that all costs are incurred in the first year
- i = Annual discount rate as a factor (percentage divided by 100)

## 8.5 Accident reduction

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The estimation of accident reduction as a result of a safety improvement requires an estimate of the following information:

- Existing number of accidents, including the severity distribution of accidents.
- Accident reduction factors that depend on the type of safety improvement.

The existing number of accidents should preferably be based on actual existing accident data, adjusted according to the Empirical Bayes (EB) method to account for random fluctuations. This adjustment is undertaken with the aid of safety performance functions and dispersion parameters. Such functions and dispersion parameters require a detailed accident information system, however, and this is currently not readily available in South Africa.

The reduction in accidents can be estimated by means of accident reduction factors that are available for different treatment types. The factors can be used to estimate the accident rate after the implementation of the improvement by multiplying the existing number of accidents by the factors. Where multiple improvements are introduced, and these improvements do not reinforce or negate each other, the factors are multiplied together.

The dearth of information on accidents in the country is one of the biggest stumbling blocks in the application of the economic analysis method. The method can be applied where such information is available, but in many

cases an estimate must be made of the required information. In many situations, a considerable degree of judgement must be exercised to establish the required parameters.

## 8.6 Economic analysis parameters

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Some parameters for the economic analysis of safety improvement projects are given in Appendix B. The following parameters are provided:

- a) Discount rate for economic analysis
- b) Monetary value of accidents
- c) Typical accident type and severity level distributions for roads in urban areas
- d) Accident reduction factors

Where required, formulae are given in the Appendix for estimating the parameters or data required for the economic appraisal.

## 8.7 Non-monetary benefits

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Road safety improvements often result in benefits that cannot be expressed in equivalent monetary values, but that are nevertheless real. Examples of such non-monetary benefits include the following:

- General perception of road safety. There is an important need for communities to live in an environment which is perceived to be safe. The general perception of road safety is therefore an important consideration, even if there may not be a corresponding actual improvement in accident numbers.

- Developmental considerations. Certain road and safety improvements could result in improved opportunities for development and this could be an important spin-off from a safety intervention.

An example of safety measures that result in an improved perception of road safety is traffic calming. Traffic calming is usually cost effective in terms of road safety but could significantly increase other road user costs. Traffic calming measures would, however, be justified when there is a need to create an en-

vironment for a community that is perceived to be safe and liveable.

Another example is a roundabout, which is an effective measure for improving road safety at intersections. Because of the high cost of roundabouts (larger types), they may not always be cost effective to implement. A roundabout could, however, improve access to a surrounding area, which could improve the development potential of such an area. This could be an important factor in influencing a decision to install the roundabout.

## 8.8 Example of economic appraisal method

The following is an example of the application of the economic appraisal method as described above. The economic appraisal parameters provided in Appendix B are used with additional information to determine whether proposed road safety remedial measures are economic.

The example involves a community that is divided by a high-speed arterial that carries high volumes of traffic. The community has to cross the arterial to visit destinations on the other side of the road. Accident statistics obtained over a period of three (3) years have indicated that most of the accidents at the crossing location involve pedestrians. A total of 17 accidents involving pedestrians occurred over this period (5.67 per annum).

The following alternative solutions are being considered:

- Pedestrian bridge, barriers and walkways at a cost of R15 100 000-00
- Raised pedestrian crossing at a cost of R35 000-00

The arterial carries a traffic volume of 12 350 vehicles per day (AADT). This volume is expected to increase by a rate of 2% per annum. The number of accidents per annum is also expected to increase at the same rate.

The average speed on the road is 80 km/h. The expected vehicle operating cost due to the raised pedestrian crossing has been estimated as follows:

Vehicle operating costs	
Fuel consumption 40 ml @ R7-00/litre	28c
Vehicle operating costs	17c
Total per vehicle	45c

The following applicable economic appraisal parameters can be obtained from Appendix B:

- 8% discount rate
- Accident costs for accidents involving pedestrians (2008): R 445 246-00.

The following crash reduction factors were obtained:

- Pedestrian bridge: 86%
- Raised pedestrian crossing: 36%

An analysis of the expected accident and vehicle operating costs over an analysis period of 20 years is provided

in the table below. This table consists of the following columns:

- Year number
- Discount factor 1/1.08<sup>n</sup>
- Traffic and accident growth factor 1.02<sup>n</sup>
- Accidents per annum after application of growth factor
- Accident costs per annum after application of the discount factor
- AADT after application of the growth factor
- Vehicle operating costs per annum
- Discounted vehicle operating costs after application of the discount factor

Note that the analysis is performed in the middle of each year. Only half of the discount rate and growth factor was therefore applied to the first year.

Analysis of accident and vehicle operating costs over analysis period of 20 years								
Year	Discount factor	Growth factor	Accidents per annum	Accident costs	Discounted accident costs	AADT	Veh costs	Discounted vehicle costs
1	0.962	1.010	5.7	R2 548 291	R2 450 280	12474	R2 048 772	R1 969 973
2	0.890	1.030	5.8	R2 599 257	R2 314 153	12723	R2 089 748	R1 860 530
3	0.824	1.051	6.0	R2 651 242	R2 185 589	12977	R2 131 543	R1 757 168
4	0.763	1.072	6.1	R2 704 267	R2 064 168	13237	R2 174 174	R1 659 547
5	0.707	1.093	6.2	R2 758 352	R1 949 492	13502	R2 217 657	R1 567 350
6	0.654	1.115	6.3	R2 813 519	R1 841 187	13772	R2 262 010	R1 480 275
7	0.606	1.137	6.4	R2 869 790	R1 738 898	14047	R2 307 250	R1 398 038
8	0.561	1.160	6.6	R2 927 186	R1 642 293	14328	R2 353 395	R1 320 369
9	0.519	1.183	6.7	R2 985 729	R1 551 054	14615	R2 400 463	R1 247 015
10	0.481	1.207	6.8	R3 045 444	R1 464 885	14907	R2 448 473	R1 177 736
11	0.445	1.231	7.0	R3 106 353	R1 383 502	15205	R2 497 442	R1 112 307
12	0.412	1.256	7.1	R3 168 480	R1 306 641	15509	R2 547 391	R1 050 512
13	0.382	1.281	7.3	R3 231 849	R1 234 050	15819	R2 598 339	R992 150
14	0.354	1.307	7.4	R3 296 486	R1 165 492	16136	R2 650 306	R937 031
15	0.327	1.333	7.6	R3 362 416	R1 100 742	16459	R2 703 312	R884 973
16	0.303	1.359	7.7	R3 429 665	R1 039 590	16788	R2 757 378	R835 808
17	0.281	1.387	7.9	R3 498 258	R981 835	17123	R2 812 525	R789 374
18	0.260	1.414	8.0	R3 568 223	R927 288	17466	R2 868 776	R745 520
19	0.241	1.443	8.2	R3 639 587	R875 772	17815	R2 926 151	R704 102
20	0.223	1.471	8.3	R3 712 379	R827 118	18172	R2 984 674	R664 986
Total					R30 044 030			R24 154 766

The total discounted accident costs over a period of 20 years amounts to R30 044 030. The total discounted vehicle operating costs if a raised pedestrian crossing were installed would be R24 154 768, an amount almost equal to that of the accident costs.

The results of the economic appraisal are shown in the following table. Three alternatives are evaluated, namely “Do nothing”, “Pedestrian bridge” and “Pe-

destrian raised crossing”. The total implementation, additional vehicle operating costs and reduction in accident costs are shown together with the net present value (NPV) of the benefits and costs. The pedestrian bridge has a positive NPV while the raised pedestrian crossing has a negative NPV, mainly owing to the lower accident reduction factor and the high vehicle operating costs. The preferred alternative is thus the construction of the pedestrian bridge.

Alternative	Implementation cost	Additional vehicle costs	Accident reduction factor	Reduction in accident costs	NPV
Do Nothing	R0	R0	0	R0	R0
Pedestrian bridge	R15 100 000	R0	0.86	R25 837 866	R10 737 866
Raised crossing	R35 000	R24 154 766	0.36	R10 815 851	-R13 373 915

The first-year rate of return analysis is shown in the table below. The rate of return of 14% in the first year is significantly higher than the discount rate of 8%, implying that the pedestrian bridge should be implemented immediately.

First-year cost	First-year benefit	First-year rate of return
R15 100 000	R2 107 241	14.0%

The above is an example where a relatively high-cost road safety improvement measure was shown to be economically feasible and where the implementation of the low-cost measure would have increased total costs. This, however, is not necessarily always the case and

there are many examples where low-cost improvements can significantly reduce accidents and associated costs without significantly impacting on vehicle operating costs. In such cases, the low-cost measures are often the most economically feasible.



# Prioritisation of Low-Cost Safety Treatments

## 9.1 Introduction

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Road safety treatments should preferably be prioritised or ranked using economic appraisal principles to determine the most cost-effective projects. The economic analysis approach is a relatively complex process, however, requiring data and information that are not readily available. Such data include current accident rates and accident reduction factors which are not available or which have not been developed for local application. For this reason, a simpler and more pragmatic prioritisation method is required.

The prioritisation methodology described below is only applicable to relatively low-cost road safety improvements, and specifically only for the following two types of safety treatments:

- Pedestrian sidewalks
- Speed traffic calming treatments

The prioritisation methodology does not involve economic appraisal principles and was developed from logical considerations and on the basis of judgement.



## 9.2 Pedestrian sidewalks

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### Sidewalks required near a school

The pedestrian sidewalk is one of the most important facilities that can be provided for pedestrians. Sidewalks can contribute significantly to road safety and the improvement of mobility for pedestrians.

Priority should be given to streets and roads on which sidewalks are most urgently required, but the intention should be to provide sidewalks on all streets where this is feasible. In general, sidewalks should be provided as follows:

- Class 3 and higher roads (district and primary distributors) that are used by pedestrians – preferable both sides of the roads.
- Class 4a major collectors and Class 5a local non-residential streets (such as in central business districts) – on both sides of the street.
- Class 4b minor collectors (residential streets) – on one side of the street.
- Class 5b local residential streets – no sidewalks are normally provided.

The prioritisation methodology for the sidewalks is described below together with the methodology used for speed calming measures.



High concentration of pedestrians

### 9.3 Speed traffic calming

Speed traffic calming is aimed at improving the environment for pedestrians and residents and can make a significant contribution to road safety. Speed traffic calming measures are mainly those that are aimed at reducing traffic speeds, but which may not have an impact on traffic intrusion.

Speed calming measures can have a significant impact on traffic and care should be taken when implementing these measures on the high-volume higher-order roads. On these roads, it is possible to address speed by measures such as roundabouts, but these are high-cost measures that are not covered by the prioritisation methodology described below.



Speed calming measures on a residential street

The low-cost speed calming measures include the following:

- Speed humps: Speed humps are the most common form of speed calming. Speed humps are difficult to maintain, however, and result in significant vehicle operating costs. Because of these problems, speed humps should only be considered when no other alternative options are available.

- **Raised pedestrian crossings:** Raised crosswalks are provided with markings and signage to channelise pedestrian traffic and provide pedestrians with a level street crossing. These measures are effectively similar to speed humps, with similar disadvantages.
- **Mini-circles:** Mini-circles are one of the most effective means of reducing traffic speeds. Traffic circles do not require the same level of maintenance and do not have the same vehicle operating costs as speed humps. The disadvantage of mini-circles is that they are more costly to construct than speed humps or raised pedestrian crossings.
- **Chicanes.** These are measures that are introduced along a roadway ahead of a sharp curve on the road. Although more costly than speed humps, the chicanes have advantages similar to those of circles, namely that a lower level of maintenance is required while vehicle operating costs are lower. Construction costs are significantly higher, however.

Based on the above considerations, the low-cost speed calming measures can be implemented on the following classes of roads:

- **Class 4b Minor collectors (residential)** – mini-circles and chicanes only.
- **Class 5b Local streets (residential)** – preferably mini-circles and chicanes, but where cost is an issue, speed humps and raised pedestrian crossings.

Speed calming measures should not be installed unless the following conditions can be complied with:

- a) **High speed streets.** Speed calming measures should only be installed where the 85th percentile speed ex-



### Speed calming measures on a major road

ceeds any one of the following maximum values:

- i) A speed of 50 km/h on Class 4b streets.
- ii) A speed of 40 km/h on Class 5b streets.
- b) **Spacing.** The minimum spacing between any two adjacent speed calming measures is 100 m. The average spacing of speed humps on any one street, however, should not be less than a minimum of 150 m but the preferred minimum spacing is 200 m.
- c) **Driveways.** Speed calming measures should preferably not be installed directly opposite the driveway to a property.
- d) **Road signs.** There should be adequate space to install warning signs ahead of the calming measures. The warning signs should not interfere with the flow of other road signs on a road or street.
- e) **Street lighting.** Speed calming measures should preferably only be installed on streets where street lighting is available. The measures should be installed as near as possible to such street lights.
- f) **Road gradient.** The down gradient of the street should not be steeper than

8% over a distance of 50 m ahead of the calming measure. This is to allow vehicles to reduce speeds safely and comfortably.

g) Sight distance. The calming measure should be continuously visible over the minimum sight distance given in the table below.

Requirement	Speed limit		
	40 km/h	50 km/h	60 km/h
Minimum stopping sight distance	45 m	65 m	85 m

*Note: An eye height of 1,05 m and an object height of 0,15 m are used to determine stopping sight distances.*

## 9.4 Prioritisation methodology

A relatively simple prioritisation methodology is used for the prioritisation or ranking of sidewalks and speed calming measures. A point system is used and those projects with the highest points are used. A checklist for the application of the system is provided in Appendix C.

The points are provided in the tables listed below. Two sets of tables are provided, one for sidewalks and the second for speed calming measures. For each set, a table is provided for the following three environments:

- Locations used by scholars, senior persons as well as persons with disabilities.
- High volume pedestrian areas are locations where there is a significant concentration of pedestrians at certain times. Examples of such locations include modal transfer facilities, shopping centres, business nodes, etc.
- Residential areas are the typical residential neighbourhoods in the city.

The points depend on the traffic volume and operating speed on the road, as follows:

- The traffic volume is the two-directional annual average daily traffic (AADT) on the road. The AADT for Class 5b roads is typically less than

about 2 000 vehicles per day and for Class 4b roads it is less than 5 000 vehicles per day.

- The operating speed is the observed 85th percentile speed on the road (not the speed limit).

The points for sidewalks are generally higher than those for speed calming measures at higher traffic volumes but not at lower volumes. The reason for this is that preference is normally given to sidewalks on higher-volume roads, while speed calming measures are generally preferred on lower volume roads.

The highest points are allocated to locations used by scholars, senior persons and persons with disabilities owing to the vulnerability of these persons. Pedestrian exposure to traffic in residential areas is normally relatively low and the lowest points are therefore allocated to these areas.

The points depend on traffic volume and speed and increase with higher volume or speed. The increase with speed is exponential and significantly higher points are allocated when speeds are high. For speed calming measures, zero points are allocated for operating speeds of 40 km/h and lower.

On roads where speed calming measures have already been provided, the operating speed will be relatively low. This will reduce the need for the installation of sidewalks and consequently the points allocated.

On roads where sidewalks have been installed, the operating speed is unlikely

to be affected (and could even be increased). Even if sidewalks have been installed, speed calming measures will still be required to provide a generally safer environment and to provide for pedestrians who may be crossing the road. The points for speed calming measures are therefore not reduced if sidewalks have been provided.

Ranking System for Sidewalks and Speed Calming						
Sidewalk Point Assignment				Speed Calming Point Assignment		
<b>Scholars, Senior and Disabled Pedestrians</b>						
85 <sup>th</sup> Speed	40	50	60	70	80	
Traffic Vol (AADT)	200	1.0	1.8	2.9	4.4	6.4
	500	1.1	2.3	4.2	6.9	10.5
	1000	2.1	4.0	6.7	10.5	15.4
	2000	2.6	5.3	9.3	15.0	22.6
	5000	3.6	7.8	14.5	24.2	37.4
	7500	4.5	9.8	18.1	30.2	46.8
	10000	7.0	13.6	23.3	36.8	54.8
	20000	10.0	19.6	33.8	53.7	80.2
	30000	12.0	23.8	41.7	66.7	100.2
<b>High Volume Pedestrian Areas</b>						
85 <sup>th</sup> Speed	40	50	60	70	80	
Traffic Vol (AADT)	200	0.7	1.2	1.9	2.9	4.1
	500	0.7	1.5	2.7	4.5	6.9
	1000	1.4	2.6	4.4	6.8	10.0
	2000	1.7	3.4	6.0	9.7	14.7
	5000	2.3	5.1	9.4	15.7	24.3
	7500	2.9	6.4	11.8	19.6	30.4
	10000	4.6	8.8	15.1	23.9	35.6
	20000	6.5	12.7	22.0	34.9	52.1
	30000	7.8	15.5	27.1	43.4	65.2
<b>Residential Streets</b>						
85 <sup>th</sup> Speed	40	50	60	70	80	
Traffic Vol (AADT)	200	0.3	0.4	0.7	1.1	1.6
	500	0.3	0.6	1.0	1.7	2.6
	1000	0.5	1.0	1.7	2.6	3.9
	2000	0.7	1.3	2.3	3.7	5.7
	5000	0.9	2.0	3.6	6.0	9.4
	7500	1.1	2.4	4.5	7.6	11.7
	10000	1.8	3.4	5.8	9.2	13.7
	20000	2.5	4.9	8.5	13.4	20.1
	30000	3.0	6.0	10.4	16.7	25.1
<b>Scholars, Senior and Disabled Pedestrians</b>						
85 <sup>th</sup> Speed	40	50	60	70	80	
Traffic Vol (AADT)	200	0.0	1.9	4.3	6.9	9.8
	500	0.0	2.8	6.4	10.3	14.6
	1000	0.0	3.7	8.5	13.9	19.6
	2000	0.0	5.0	11.4	18.5	26.2
	5000	0.0	7.1	16.3	26.6	37.6
	7500	0.0	8.3	19.0	30.8	43.6
	10000	0.0	9.1	20.9	34.1	48.1
	20000	0.0	11.3	25.9	42.1	59.4
	30000	0.0	12.4	28.4	46.2	65.3
<b>High Volume Pedestrian Areas</b>						
85 <sup>th</sup> Speed	40	50	60	70	80	
Traffic Vol (AADT)	200	0.0	1.2	2.8	4.5	6.4
	500	0.0	1.8	4.1	6.7	9.5
	1000	0.0	2.4	5.6	9.0	12.8
	2000	0.0	3.2	7.4	12.0	17.0
	5000	0.0	4.6	10.6	17.3	24.4
	7500	0.0	5.4	12.3	20.1	28.3
	10000	0.0	5.9	13.6	22.1	31.3
	20000	0.0	7.3	16.8	27.3	38.6
	30000	0.0	8.0	18.5	30.1	42.4
<b>Residential Streets</b>						
85 <sup>th</sup> Speed	40	50	60	70	80	
Traffic Vol (AADT)	200	0.0	0.5	1.1	1.7	2.4
	500	0.0	0.7	1.6	2.6	3.6
	1000	0.0	0.9	2.1	3.5	4.9
	2000	0.0	1.2	2.8	4.6	6.5
	5000	0.0	1.8	4.1	6.6	9.4
	7500	0.0	2.1	4.7	7.7	10.9
	10000	0.0	2.3	5.2	8.5	12.0
	20000	0.0	2.8	6.5	10.5	14.9
	30000	0.0	3.1	7.1	11.6	16.3



# Project Implementation

## 10.1 Introduction

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The implementation of road safety projects follows the normal budgetary and procurement processes of the municipality. These processes consist of the following:

- a) Securing of funding required for the implementation of the projects through the budgetary process of the City.
- b) The actual implementation of the projects can be undertaken departmentally or by contractors.
- c) Monitoring of the implementation of the road safety measures is undertaken by means of divisional scorecards.

## 10.2 Project funding

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Funding for road safety projects must be obtained through the normal budgetary process of the municipality. The proposed projects will be subjected to the needs analysis that is undertaken as part of the overall budgetary process. The budget is informed by the Integrated Development Plan (IDP) for the city and all needs are recorded in the IDP through the business plans of divisions and departments. These include the needs identified in road safety master plans.

The process requires the preparation of a consolidated list of proposed road safety projects. Such a list should therefore be developed as part of the road safety master plan. The proposed safety measures must be ranked according to the priorities allocated to each measure and the following information must be provided for each project:

- location of the project
- ward number

- ward councillor
- type of road safety measure
- estimated cost of the measure
- priority index

The cost estimate for safety measures is normally based on the actual “average” cost of measures implemented over the previous financial year, adjusted for inflation.

Because of the amount of detail included in the road safety master plans in the consolidated list, the individual projects are grouped together according to the type of measure, for example pedestrian sidewalks, traffic calming, parking bays at schools, pedestrian bridges, etc.

The grouped projects are then captured in the business plan of the Roads and Stormwater Division of the City and submitted as input to the Integrated Development Plan (IDP). This plan is then submitted to the City Council for approval.



**Aerial photograph showing proposed road safety measures**

An annual budget is prepared by the City based on the approved IDP. This budget is submitted to the Budget Committee of

the City where funding is allocated to particular project groups according to the city's priorities.



**Labour-based construction involving community members**



**Another photograph of a labour-based construction project**

## WHAT IS AN INTEGRATED DEVELOPMENT PLAN (IDP)?

Based on: <http://www.etu.org.za/toolbox/docs/localgov> – Integrated Development Planning for Local Government

All municipalities in South Africa have to produce an Integrated Development Plan (IDP). The municipality is responsible for the coordination of the IDP and must draw in other stakeholders in the area who can impact on and/or benefit from development in the area. The executive committee or executive mayors of the municipality have to manage the IDP or they may assign this responsibility to the municipal manager.

An Integrated Development Plan provides the overall framework for development in an area. It aims to coordinate the work of local and other spheres of government in a coherent plan to improve the quality of life for all the people living in an area. It should take into account the existing conditions and problems and resources available for development. The plan should look at economic and social development for the area as a whole. It must set a framework for how land should be used, what infrastructure and services are needed and how the environment should be protected.

Once the IDP is drawn up, all municipal planning and projects should happen in terms of the IDP. The annual council budget should be based on the IDP.

There are six main reasons why a municipality should have an IDP:

- *Effective use of scarce resources.*
- *Helps to speed up delivery.*
- *Helps to attract additional funds.*
- *Strengthens democracy.*
- *Helps to overcome the legacy of apartheid.*
- *Promotes coordination between local, provincial and national government.*

Stakeholders

- *Municipality.*
- *Councillors.*
- *Communities and other stakeholders.*
- *National and provincial sector departments.*

## 10.3 Implementation programme

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Once the City's budget has been approved, an implementation programme must be prepared for the road safety measures based on the funds allocated and the priorities identified. Decisions are made on whether work should be undertaken departmentally or by contractors.

One of the other key priority projects in the City of Tshwane is to fight poverty and unemployment through a structured programme of job creation and training. This is also in line with the Government's Expanded Public Works Programme, which aims to bridge the gap between the growing economy and the large numbers of unskilled and unemployed people who have yet to fully enjoy the benefits of economic development. The road safety measures are ideal projects which can be done by smaller emerging contractors,

utilising local labour. The use of local labour has the added benefit of raising community awareness of the projects that are being undertaken. Where possible, preference is therefore given to the implementation of projects that use local labour.

Traffic enforcement and awareness programmes are included in the implementation phase, to ensure that communities understand what measures are being implemented and to keep them informed of progress.

## 10.4 Monitoring of project implementation

Monitoring of the implementation of the safety projects is undertaken by means of divisional scorecards. The projects in the budget are captured under the specific strategic objectives of the city, grouped under the key performance area developed for the projects as well as the key performance indicators (KPIs). Targets are then developed for the respective KPIs linked to projected

monthly performance, which is monitored on a monthly basis. The table below gives an example of a typical section of a scorecard related to the traffic safety programme.

The measures which are implemented are captured on a geographic database and on the base map for the area. The updated map is then used in the annual revision of the road safety master plans.

Strategic objective	KPA	Division/ Unit	KPI	2008/09 Target	Evidence required
To fight poverty and build clean, healthy, safe and sustainable communities	Ensure safety on our roads and in communities	Traffic Engineering and Operations Section	Km of walkways and cycle tracks constructed	13,76 km constructed	Report on infrastructure elements provided, including "as built" drawings
			Number of road safety measures provided	87 road safety measures (*)	Report on infrastructure elements provided, including samples of work orders issued and signed off

(\*) The road safety devices included raised pedestrian crossings, speed humps, mini circles and loading facilities at schools.



# Monitoring and Review

## 11.1 Introduction

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An essential component of the road safety master plan is to monitor and review the plan to ensure that the objectives are being achieved. Given that funds are limited, it is imperative that funds should be utilised on the most cost-effective safety improvement schemes.

Two types of monitoring and review are required, namely impact and institutional effectiveness. Impact effectiveness measures the effectiveness of safety improvements by observing changes in accident rates and severity, as well as other measurable outcomes, resulting from the implementation of the improvements. Institutional effectiveness measures progress with the implementation of all components of the road safety management system.

The City of Tshwane Metropolitan Municipality has a performance management system that provides a framework for the collection, processing, organisation, analysis, auditing, reflection and reporting on performance information. This information equips leaders, managers, workers and stakeholders with a set of tools and techniques that will enable them to regularly plan, continuously monitor, and periodically measure and review the performance of the organisation in terms of indicators and targets for efficiency, effectiveness and impact. The performance management system is built around the processes of identifying priorities, setting objectives, identifying key performance indicators and setting targets.

## 11.2 Monitoring of particular safety improvements

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The monitoring of particular safety improvements is important to ensure that safety improvements do in fact have a beneficial impact on road safety. This requires that before- and-after studies should be undertaken to determine whether the improvements have in fact

been successful. Although the impact can only adequately be measured when comprehensive accident statistics are available, various other outcomes can be monitored through appropriate studies and assessments.

### 11.2.1 Accident studies

Accident studies can only be undertaken when comprehensive accident statistics are available, which is often not possible owing to the lack of accident data.

When before-and-after accident studies are undertaken, it is essential that the Empirical Bayes (EB) method should be used to account for regression-to-the-mean and other effects. The method requires that accident statistics at a particular site should be compared with accident statistics at locations with similar traffic and physical characteristics.

For a safety improvement to be rated as successful, the number of accidents actually observed should be lower than the number of accidents expected for a site without the implemented improvements. The process requires the establishment of so-called safety performance functions (SPFs) and overdispersion parameters.

The SPF is a mathematical model that predicts the number of accidents for a particular location. These functions must be developed from accident data collected at sites with physical charac-

teristics similar to those of the site before the improvement was implemented. This model is simply a regression formula linking the number of accidents to traffic information and certain roadway characteristics.

For the estimation of the SPF, it is necessary to assume an underlying statistical distribution for the number of accidents. Historically, it was often assumed that accident frequencies follow the Poisson Distribution, but accident research has indicated that this assumption is not always true. The research has shown that the Negative Binomial Distribution is more representative of accident frequencies.

One of the parameters used to determine whether the underlying probability distribution is correctly identified as Negative Binomial is the overdispersion parameter. The distribution is said to be overdispersed when the variance exceeds its mean. In many investigations, it has been confirmed that the variance in fact exceeds the mean and that the distribution is therefore overdispersed.

### 11.2.2 Outcomes measurements

Desired outcomes indicate the change that safety improvement strategies have accomplished within the target audience if successfully implemented. For example, what changes have taken place in the behaviour, attitudes, knowledge, skills, circumstances and level of functioning of road users after the implementation of the road safety master plan?

Desired outcomes can only be achieved through the involvement and participation of all the various disciplines and stakeholders. A possible example of a desired outcome in terms of behaviour and attitude change is the following:

*Road user behaviour and attitudes have changed towards a culture of responsibility and compliance with traffic regulations, that is pedestrians and drivers are behaving correctly in the traffic environment.*

To measure the success of this outcome, before-and-after observational studies should be conducted on behavioural and attitude changes:

- a) Measuring behaviour change entails conducting traffic offence surveys that would indicate the level of compliance relating to a number of offences, such as speeding, drinking and driving, failure to wear seatbelts, ignoring traffic lights and signs, etc.
- b) Measuring attitude change entails conducting surveys that require respondents to answer questions relating to their attitude towards specific issues, such as social acceptance of drinking and driving, acceptable levels of law enforcement, presence of pedestrians on freeways, etc.

However, to effect any change in road user behaviour and attitudes, numerous improvement programmes would have to be implemented, involving a large number of disciplines and stakeholders. Before road users can be expected to change their behaviour, the correct engineering measures would have to be appropriately placed and maintained, and road users would have to be adequately informed, trained and educated to use the measures correctly. In addition, effective law enforcement programmes and prosecution processes should be in place to detect and punish those who do not comply. Each of these service provider programmes must be evaluated for institutional effectiveness.

### 11.3 Institutional effectiveness

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Institutional effectiveness monitoring is aimed at measuring progress towards the implementation of the road safety management system. It is essential that each component of the system should be monitored.

Institutional effectiveness also includes the operational effectiveness of the different institutions involved in the implementation of the road safety master plan, such as an evaluation of whether the planned law enforcement, education and awareness activities did take place, the intensity of these actions and the organisational effectiveness of the different divisions and institutions involved in these actions.

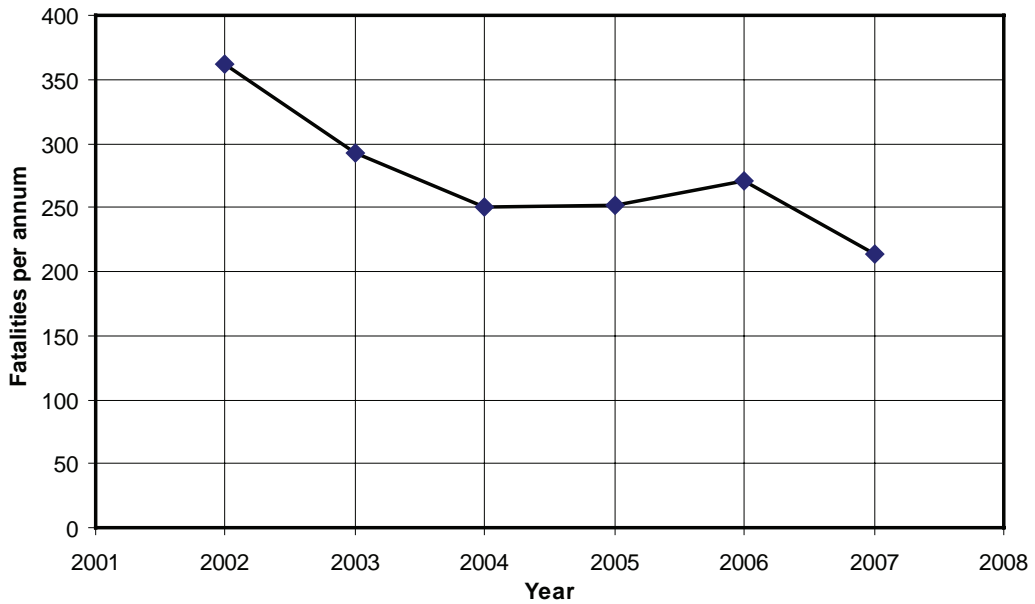
The implementation of road safety measures is monitored by means of divisional scorecards, as described in chapter 10. Targets for the road safety measures are established and evidence must be provided that these targets have been achieved.

A departmental scorecard has also been developed to measure and monitor the overall reduction of fatalities in the city. Although accident statistics for the city are not reliable in terms of location of accidents, owing to the constraints mentioned, fatality rates are captured fairly accurately. This information is then captured and monitored through the scorecard system. The table below gives a typical example of the scorecard which has been developed for the reduction of fatalities in the city.

Strategic objective	KPA	Division/ Unit	KPI	2008/09 Target	Evidence required
To fight poverty and build clean, healthy, safe and sustainable communities	Road policing operations and auxiliary services, rendering specialised functions and coordination with internal as well as external partners (e.g. regions, the province and the RTMC), with the primary focus on enhancing road safety.	Metro Police Department	Reduction in fatal accidents per 10 000 registered vehicles	5% reduction in fatal accidents per 10 000 registered vehicles per annum	Accident statistic from Accident Database.  Record of registered vehicles in the city.

The above KPA represents the collective effort of all the measures which were implemented during the year to reduce road fatalities in the city and includes all road policing and engineering interventions and operations (e.g. speed law enforcement, overload control, roadblocks, drink-and-drive roadblocks, Arrive Alive Campaign, the Youth and Road Safety and the Pedestrian-in-Traffic campaigns, engineering measures and education).

It is also important to compare year-on-year statistics of fatalities to get an indication of the trend and of whether the measures and processes are sustained over a period of time. The figure below shows the trend in the reduction of fatalities due to road traffic accidents in the City of Tshwane over the past five years. Fatalities decreased from 362 in 2002 to 214 in 2007, a reduction of 40%. Part of this decrease can probably be ascribed to the safety measures that have been implemented in the city.



Fatalities in the City of Tshwane from 2002 to 2007

## 11.4 Community response

In view of the lack of detailed accident statistics the process of updating the road safety master plans provides the ideal opportunity to obtain feedback from the community regarding the effectiveness of measures that have been implemented. The community repre-

sentatives would be asked to indicate where safety has been improved and what effect engineering measures have had on the behaviour of motorists and pedestrians. This would then also be used to guide further educational and awareness programmes.



# Road Safety Treatments

## 12.1 Introduction

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When selecting safety remedial measures, it is important to select those measures that will be most cost-effective in addressing the particular safety issue at a site. This could require more than one measure or a combination of measures.

The most cost-effective safety measures are those that will result in the greatest reduction in accidents compared to the cost of the measure. A low-cost measure may not have the same impact as a high-cost measure, but it may be more cost effective than the high-cost measure.

## 12.2 Road safety treatments

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A list of safety measures that are normally considered in urban areas are provided in the table below. This list does not imply that there are no other safety measures that might be more appropriate for a particular safety issue. The list does, however, provide an overview of measures that are likely to be effective when addressing particular safety issues in urban areas.

The low-cost safety measures listed in the table are of particular interest. These are the measures that seem likely to be more cost effective. For example, the introduction of chevron signs on a sharp curve could significantly reduce run-off accidents in return for a relatively small investment. At locations where there are problems with unsafe overtaking, the use of centreline rumble strips could be an effective alternative to the provision of passing lanes. In locations where large volumes of pedestrians are using a roadway, the provision of walkways and

traffic calming measures can be effective in addressing road safety issues.

In the selection of road safety measures, it is important to realise there is no single solution that can address all issues. One measure will seldom provide a complete solution to a safety issue and it will often be necessary to apply a combination of measures.



**Pedestrian sidewalk and raised crossing**

<b>Examples of road safety improvement treatments in urban areas</b>				
<b>Issue</b>	<b>Safety measures</b>	<b>Implementation cost</b>		
		<b>Low</b>	<b>Medium</b>	<b>High</b>
Pedestrians	Separate pedestrians and traffic		X	X
	Public transport facilities, e.g. bus bays	X	X	
	Pedestrian barriers on high-speed roads		X	
	Pedestrian median refuge	X	X	X
	Pedestrian bridges/subways			X
	Walkways and cycle tracks	X	X	
	Pedestrian walkway network		X	X
	Street lighting		X	X
	Remove parking near pedestrian crossings	X	X	
	Traffic calming (speed and traffic intrusion)	X	X	
	Speed related	Traffic calming measures	X	X
Speed law enforcement cameras		X		
Intersections and accesses	Access management	X	X	
	Intersection closure or relocation	X	X	
	Roundabouts		X	X
	Right- and left-turn lanes		X	X
	Road signs, markings and studs	X		
Traffic signals	Sight distance	X	X	X
	Remove unwarranted traffic signals	X	X	
	Provide right- and left-turning lanes		X	X
	Ensure SARTSM compliance	X	X	
	Ensure correct signal timing	X		
	Provide overhead traffic signals		X	
Other	Parking restriction	X		
Run-off road	Remove fixed objects (incl drainage structures)	X	X	X
	Breakaway devices	X	X	
	Safety devices		X	
	Guardrails (incl correct installation)	X	X	
	Trees near to roadway			
	Poles (electrical, telephone, etc)			
	Road signs, markings, delineators	X		
Accidents on curves	Sharp curve chevrons	X		
	Flatten sharp curves			X

## 12.3 Human factors and road safety treatments

In the engineering design of road safety measures, it is essential that particular attention should be given to human factors. Two aspects are of special interest:

- accommodation of human limitations in engineering design
- how human behaviour is influenced by engineering design

The engineering design of a road safety measure should not only accommodate human limitations but could also be used to influence human behaviour. Experience has shown that road improvements can lead to unexpected changes in driver behaviour which could have a significant impact on road safety, sometimes in unexpected ways. For example, widening of a roadway will tend to increase speeds and unless the roadway design is adjusted to accommodate such speeds, this could result in an increase in accidents even though road widening is generally considered to improve road safety.

It is particularly important to take the information needs of road users into account. Safe decisions can only be made when road users have sufficient information to inform them of hazardous conditions. The following procedures are important:

- Provide sufficient information on hazardous conditions.
- Do not overload drivers with information. A series of simple decisions is better than a few complex ones.
- Do not provide the information too early without reinforcement close to the hazardous conditions. Because of short-term memory retention, drivers may forget information if it is provided too early without reinforcement.

There are two types of information that can be provided to road users, namely formal and informal information. Formal information is provided by means of road signs and markings while informal information is obtained from the road itself and the environment. Where possible, both types of information should be utilised to inform the driver regarding possible hazardous conditions.

It is of critical importance to ensure that road users do not receive wrong or misleading information regarding possible hazards. An example of misleading information is where a row of trees or poles adjacent to a road continues in a straight line while the road curves away from this row. Drivers would then expect the road to continue in the same straight line.



Pedestrian walkway near to school

## 12.4 Pedestrian safety



**Innovative pedestrian bridge over freeway**

When considering pedestrian safety, it is essential to recognise that pedestrians are one of the road user groups that are most vulnerable and most at risk in accidents. The safety problem is not only the result of pedestrians being “softer” and therefore in greater danger of being seriously injured or killed, but also because of basic incompatibilities between pedestrians and motorised traffic. Walking is the most basic form of transportation, but in spite of this, the needs of pedestrians are frequently neglected in road provision.

In order to accommodate vehicular traffic, major roads, including freeways, are provided in a city which allows relatively high volumes of traffic to travel at higher speeds. An unfortunate result of such roads is that they sometimes pass through a community, with the result that residents need to cross the road. Pedestrians have to cross the road to get to destinations on the other side of the road. This is a particularly dangerous situation which could result in severe or fatal accidents.

The above problem is often the result of a lack of integrated planning which allows communities to settle along major roads (and even freeways) with no consideration of the consequences of such settlement. In disadvantaged areas, the problem is further aggravated by the lack of general amenities such as schools, healthcare facilities and shops, which adds to the need to cross the major road or freeway.

The fundamental principle in the accommodation of pedestrians is to provide separation between pedestrians and vehicular traffic. It is not possible to accommodate pedestrians safely on the same roadway, except perhaps when vehicular speeds and volumes are reduced to the minimum. High accident rates and severities can be expected on roads where pedestrians and cyclists are required to share the same roadway as vehicular traffic travelling at high speeds and in high volumes.

Separation can be achieved by providing a separate pedestrian walkway system. Walkways can be provided within a road reserve, but with adequate separation between the walkway and the



**More details of the innovative pedestrian bridge design**



**Lower-cost pedestrian bridge**

roadway. The need for road crossings should be minimised and should where possible be provided for by means of pedestrian bridges or subways. Where it is not possible to provide such structures, it may be necessary to reduce speeds, preferably by means of traffic calming measures.

Another important principle that should be taken into account is the security of pedestrians and cyclists. Any facilities provided will not be used if there is a real or perceived security problem. This is a typical problem with pedestrian subways but in some areas also a problem on pedestrian bridges where criminal activity poses a threat.

Comfort and convenience are also important considerations in the provision of pedestrian and cyclist facilities. Pedestrians desire quick, direct and convenient routes to their destinations and detours and delays will deter them from using the facilities. Pedestrian bridges are particularly inconvenient, requiring pedestrians to climb stairs or walk long distances to reach the bridge. The natural action for the pedestrian or cyclist is to cross the road at the desired point.

In areas where it is not possible to achieve the required separation between pedestrians, cyclists and vehicular traffic, it may be necessary to introduce traffic calming measures. On higher order mobility routes, however, such measures can significantly affect the flow of traffic and increase travelling costs. In such cases, a detailed investigation will be required to establish the most cost-effective safety measures which do not involve traffic calming.



**Mini-circle with raised pedestrian crossings**

## **12.5 Traffic calming**

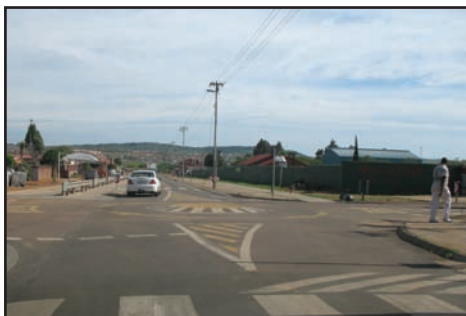
Traffic calming is fundamentally aimed at reducing the adverse safety and other impacts of traffic on built-up areas, particularly residential areas. Traffic calming emphasises the needs of pedestrians, cyclists and residents by placing restrictions on vehicles. Road safety, particularly for pedestrians and cyclists, can be significantly improved by the introduction of traffic calming measures. Lower vehicle speeds resulting from such measures reduce the likelihood of accidents as well as their severity. Generally, the need for traffic calming stems from an increase in the need for more liveable residential areas. There are,

however, other areas such as business nodes where there is a high concentration of pedestrians and where traffic calming could be implemented to protect pedestrians from the adverse impacts of motorised traffic.

Some of the more important objectives of traffic calming are:

- improved traffic safety of communities
- calmer, quieter and more tranquil neighbourhoods, reduced noise and air pollution
- improved scenery, neighbourhood revitalisation and stability
- increase utilisation of streets for purposes other than travel, such as playing, social gatherings, functions, etc

In the planning and design of traffic calming, it is important to recognise that different classes of roads have certain important functions and that these functions should not be compromised by the traffic calming measures. These functions are mobility and local access. It is very difficult to implement traffic calming on mobility roads without significantly affecting traffic flow and measures should therefore mostly be considered on access roads. On higher order roads, traffic calming should only be considered



**Mini-circle with provision for pedestrians**

under exceptional circumstances, such as when the functional integrity of the roads has been compromised by excessive development and the provision of accesses.

The functional road classification system should be used to resolve the competing needs of mobility and traffic calming of the city in the following way:

- **Mobility roads.** Priority will be given to the needs of through traffic or the need of the larger community, but with due consideration for the needs of the local community where it is possible to address such needs.
- **Access roads.** Priority is given to the needs of the local community and residents, but with due consideration for the needs of the larger community where it is possible to address such needs.

Traffic calming measures can be subdivided into the following two classes of measures:

- speed calming measures aimed at reducing traffic speeds
- traffic intrusion methods aimed at reducing traffic volumes through residential and other sensitive areas

The following measures are those that are typically introduced when there is only a need for speed calming. Although these measures have some impact on traffic intrusion, they are generally not very effective for that purpose.

- **Speed humps:** Speed humps are the most common form of traffic calming in communities in many countries. Speed humps are difficult to maintain, however, and result in significant vehicle operating costs. Because of these problems, speed humps should only be considered



### Provision of a mini-circle at a T-Junction

- when no other alternative options are available.
- Raised pedestrian crossings: Raised crosswalks are provided with markings and signage to channelise and provide pedestrians with a level street crossing. These measures are effectively similar to speed humps, with similar disadvantages. Raised crossing should therefore only be considered when no other alternative options are available.
- Traffic circles. Traffic circles are one of the most effective means of reducing traffic speeds. The advantage of traffic circles, in contrast to speed humps, is that the circles are introduced at intersections which are generally the points at which most traffic accidents occur. Traffic circles do not require the same level of maintenance and do not have the same vehicle operating costs as speed humps. The traffic circle should therefore be the general measure of choice for speed calming.
- Chicanes. These are measures that are introduced along a roadway ahead of a sharp curve on the road. Although more costly than speed humps, the chicanes have advantages similar to those of circles, namely that a lower level of maintenance is required while vehicle operating costs are lower.

The measures used for speed calming can have some impact on traffic intrusion, but are generally not very effective for this purpose. The only really effective measure for addressing traffic intrusion is either by reducing the capacity of a road or by means of street closures. The following measures have been found to be effective:

- Chokers. A choker consists of closing one lane of a road over a short section of roadway (20 to 50 m). Traffic can then transverse this section one vehicle at a time per direction. This measure is very effective for reducing the capacity of the road, but only

- if the traffic volumes in the two directions are balanced. The capacity reduction also depends on the length of the choker – a higher reduction can be achieved by implementing the measure over a longer section.
- Semi-closures. This type of calming measure is implemented at intersections to change the two intersecting roads into two separate roads. Traffic cannot proceed through the intersection and must turn either left or right, depending on the direction of the semi-closure. The disadvantage of the measure is that it may divert traffic to streets that did not previously experience high volumes of traffic. A high degree of resistance can therefore be expected, with the result that the measure is not often implemented.
  - Full closures. The full closure of streets is probably the most popular measure with most residents. This measure will effectively address traffic intrusion, but it could result in the diversion of traffic to other streets. Detailed studies are required to ensure that street closures will not result in traffic intrusion problems in other areas.

## 12.6 Law enforcement cameras

Law enforcement cameras can be used on high-speed roads where a sudden reduction in speeds is required and where it is not possible to install traffic calming measures. A typical application is where a major road or freeway enters an urban area and where drivers find it difficult to immediately adjust to the changing conditions. The above situation can effectively be addressed when

drivers are made aware of the presence of speed law enforcement cameras and not by hiding the camera, as is normally the case. The camera installation itself must be visible and road signs warning drivers of the camera must be installed. Consideration can also be given to providing transverse road markings (COSBI line markings) to further focus the attention of drivers on the camera.



Law enforcement camera with Cosbi lines

## 12.7 Traffic signals

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There is often a perception that the installation of traffic signals will solve all accident problems in an urban area. This perception is not correct since the inappropriate installation of signals could in fact increase the number of accidents (particularly rear-end accidents).

Traffic signals also do not always improve traffic flow and alleviate delays, and an inappropriate signal could in fact lead to severe disruption of traffic and result in lengthy delays, particularly on main roads. Excessive delays result in significant fuel wastage, higher vehicle costs and air pollution. Another potential disadvantage of a traffic signal is that it could lead to diversion of arterial traffic into residential streets, which could significantly affect road safety on and the liveability of the streets.

It is for reasons such as those given above that warrants for the introduction

of signals have been developed. These warrants are provided in Volume 3 of the South African and SADC Road Traffic Signs Manual. No signals should be installed unless these warrants are met. According to the manual, traffic signals should in fact be removed where they have been installed and are no longer warranted.

Road safety at traffic signals can be improved by introducing improvements such as those described below:

- Ensure that traffic signals are warranted.
- Provide right- and left-turning lanes, particularly on higher speed roads.
- Ensure that the traffic signals comply fully with the requirements of the South African Road Traffic Signs Manual.
- Ensure optimum traffic signal phasing and timing. Check that yellow and all-red intervals are appropriate.
- Provide overhead traffic signals (particularly on major roads).

## 12.8 Road maintenance

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A factor that often contributes to traffic accidents is the inadequate maintenance of road infrastructure. Timeous replacement of damaged or faded road signs and safety barriers, and repair of potholes and edge break along roads are extremely important to ensure safe road conditions. For this reason it is essential to develop and maintain appropriate road infrastructure maintenance systems. It is also important to develop KPIs in this regard, set targets and monitor performance. Typical examples of targets are as follows:

- Percentage of complaints related to dangerous traffic signal problems responded to within 4 hours: Target 97%.
- Percentage of potholes repaired within 24 hours of reporting of pothole: Target 87%.



Provision of mini-circles at staggered T-Junctions

# Education and Awareness

## 13.1 Introduction

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Road safety improvements cannot be achieved by engineering measures alone, and a combination of engineering measures, education and awareness campaigns and law enforcement is required to address road safety issues. The Road Safety Master Plans should therefore make provision for specific education and awareness actions.

The main objective of education and awareness campaigns is to ensure that communities understand the dangers of road traffic and the purpose of the proposed road safety measures. Owing to the high vulnerability of scholars to road accidents, specific provision must be made for the involvement of schools in the road safety master plan.



High level political and stakeholder involvement in safety project

## 13.2 Visible political support

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Road safety projects in the City of Tshwane are normally undertaken on the basis of a partnership of technical practitioners, traffic law enforcement agencies, educational institutions and non-governmental organisations (NGOs). Through this action, the role of these other institutions and organisations is acknowledged and a platform is created for the inclusion of innovative inputs into the awareness campaign. Where a local road safety forum exists, such as ASTRASA (Atteridgeville and Saulsville Traffic Safety Association), they are also invited to become actively involved in all phases of the project.

Large-scale regional projects are nor-

mally launched by a political incumbent of the province or city, such as the MEC (Member of the Executive Council) of the province and the Executive Mayor of the City. At the launch, the project is officially handed over to the community by the MEC and the Mayor of the City.

The launches normally involve a series of dramatic plays and recitals on the theme of the promotion of road safety. This has been found to be a highly effective and popular method of making the public aware of the project and of the potential dangers posed by traffic. It is believed that such awareness campaigns can contribute significantly to road safety in disadvantaged communities.



Poster used for road safety projects

Follow-up awareness campaigns focus mainly on schools and community centres and should coincide with the implementation of the proposed engineering measures. Further campaigns depend on the success of the implemented measures.

### 13.3 Educational and awareness programmes

The following are examples of educational and awareness programmes that can be introduced and incorporated into road safety master plans:

- Road safety promotion and education at schools.
- Distribution of educational and awareness pamphlets to the public.
- Road safety education of residents in areas where specific road safety issues have been identified.

- Driving along the street with a PA system to assist individual road users in displaying safe traffic behaviour.
- Community meetings and workshops aimed at the promotion of road safety
- Involvement of local print media in the marketing of the project.
- The erection of information billboards along streets.

During a previous evaluation study of the effectiveness of the different awareness programmes, it was found that the provision of sign boards (61%), the activities of road safety forums (35%), the distribution of pamphlets (25%), and the use of a PA system (18%) contributed to the improved level of awareness among drivers.



Billboard informing residents of road safety project



Youth and Road Safety Campaigns





The use of reflective strips to increase visibility

### 13.4 Youth and road safety campaign

The City of Tshwane has introduced a successful “Youth and Road Safety” campaign. The programme is modelled on a similar programme by the World Health Organisation. This campaign consists of the following:

- Visits to schools by a team consisting of the ward councillors and officials from the Traffic Engineering Section and the Metropolitan Police Department.
- Presentation on traffic hazards and tips on how to improve road safety.
- Distribution of posters, flyers and reflective strips. Examples of these are shown in the various photographs included in this chapter.

The Tshwane Metropolitan Police Department is actively involved with education programmes at schools. These programmes are presented with the assistance of provincial road safety officers, NGOs and road safety forums. Examples of the education programmes include the “Child-in-Traffic” and “Danny Cat” projects as well as discussions on cycle safety, road safety issues relevant

to the specific target groups and scholar patrol programmes.

### 13.5 Scholar patrols

Scholar patrol standards and requirements are managed through strict national guidelines in regard to the approval and registration of scholar crossings, administrative and operational procedures, training and regular inspection of scholar patrols. A scholar patrol manual for South Africa has been formulated through the Road Traffic Management Corporation (RTMC) and is available on the [arrivealive.co.za](http://arrivealive.co.za) website.

Traffic enforcement officers are very closely involved with the inspection of the specific sites and the training of scholar patrol teams and their supervisors. Training of scholar patrols provides an opportunity to convey various road safety issues to children and at the same time create a relationship of trust between the children and the traffic law enforcement function.

The duties of the traffic authority with regard to scholar patrols are as follows:

## **ROLE OF THE TRAFFIC AUTHORITY WITH REGARD TO SCHOLAR PATROLS**

Source: Road Traffic Management Corporation Manual on scholar patrols

- Completion of mandatory registration forms and forwarding of the forms to the province.
- Recommendation that a scholar patrol be instituted where justified and submission of the application to the province.
- Assistance with the training of teams and adult supervisors/volunteers.
- Regular inspection to ensure that the patrols function correctly and that all regulations pertaining to the Road Traffic Act are complied with.
- Supplying of the necessary pre-warning signs and ensuring that these are used correctly and meet all the requirements of the Road Traffic Act.
- Indication of the places where temporary pre-warning signs have to be placed should these be used.
- Ensuring that the crossings are marked properly and in accordance with prescriptions.
- Recommendation that curb stones be placed or that safety zones be erected / marked at each crossing.
- Assistance with the delivery of the required equipment as supplied by the province to the schools.
- Handling of all representations or complaints with regard to the implementation and functioning of scholar patrols before they are referred to the province.
- Reporting to the province on any collision in which scholar patrol members might be involved whilst they were on duty.
- Ensuring that vehicles are not parked in such a way that they impede visibility and endanger members of the scholar patrol.
- Resumption of traffic control when the traffic becomes so dense that it becomes dangerous for the scholar patrols to operate.



Scholar patrols at Tshwane schools



Child-in-Traffic Campaign



# Law Enforcement Plans

## 14.1 Introduction

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Law enforcement is an essential element of road safety and specific provision should be made for law enforcement plans in the road safety master plan. It is not possible to address all road safety issues by means of engineering measures or education and awareness campaigns alone; proposals should therefore be included for specific law enforcement actions.

The Tshwane Metropolitan Police Department (TMPD) is responsible for the implementation of the law enforcement plans. The department will not address the proposed law enforcement plans in isolation but will integrate the plans into their overall operational plans. The department should be closely involved in the development of the law enforcement plans to ensure that it will be possible to implement and integrate these plans within overall departmental strategy.

The Metropolitan Police department should be involved in most stages of the development of the road safety master plan. Initially, the department could help identify problem areas by drawing on their accident information system as well as their day-to-day experience of traffic issues in specific communities. The department could also assist in the planning of road safety measures and provide support for the successful implementation of engineering measures.

## 14.2 Law enforcement strategy

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The general law enforcement strategy of the Tshwane Metropolitan Police Department is primarily aimed at creating a sense of ownership within communities, with the emphasis on the following:

- Changing the perceptions of the community in regard to traffic enforcement so that they no longer see it solely as law enforcement. Enforcement should be seen as including education and assistance to the community in finding solutions to traffic problems.
- Creating ownership of the issues so that a sense of self-enforcement and protection of infrastructure is instilled into the community.
- Establishing a good working relationship between the community and the authorities to ensure that communities trust the intentions and plans of the City.
- Maintaining a constant link with the community, after implementation of the road safety master plan.
- Regular, well organised and effective enforcement to put positive action in place against those road users who refuse to adhere to regulations.

The law enforcement strategy is therefore not only directed at enforcing the National Road Traffic Act and Regulations, but includes an important component of education with regard to the need for self-enforcement and the positive aspects of enforcement, both of which are essential for improving road safety.



Traffic officer communicating with motorist

### 14.3 Law enforcement plans

Provision should normally be made in the road safety master plan for law enforcement as one of the measures required to improve road safety. The law enforcement aspects would typically focus on matters such as:

- Speed: fixed and mobile cameras
- Drunken driving
- Moving offences
- Driver and vehicle fitness

Although provision is made in the National Road Traffic Act for pedestrian offences (e.g. jaywalking), there is some difficulty in enforcing the legislation for reasons such as the following:

- Pedestrians are not required by law to carry identification on their person.
- Pedestrian offenders are mostly community members going about their day-to-day business and arresting them (e.g. taking them to a police station for a few hours) is not really a socially acceptable course.

Pedestrian-related issues should therefore preferably be addressed by engineering measures or through education and awareness campaigns.

It is particularly important that the law enforcement plan should not focus on law enforcement alone but also engender community support for law enforcement. The plan should make provision for informing the community of the need for and importance of law enforcement in road safety.

The law enforcement plan should provide for the following:

- a) Awareness and education.** The plan should make provision for making the community aware of the dangers and consequences of disregarding traffic regulations. It is important that the community understands why there is a need for orderly traffic behaviour.
- b) Road safety committees.** Road safety committees have been established in some communities (with the assistance of the private sector and provincial road safety officers). Such communities can facilitate programmes to educate residents on road safety and traffic legislation issues and can assist two-way communication between the Metro-

politan Police and residents. Political role players and these committees should interact regularly. Ideally, ward councillors should form part of such committees. Officers of the Metropolitan Police provide the formal link between the road safety committee and the Council, and are the formal representatives of the City Council on these structures.

- c) Integrated involvement of role players.** The City of Tshwane supplies the community with different services, such as the provision of water and electricity, drainage systems, solid waste removal, certain health systems, road and transport infrastructure, security, and land use

planning. Traffic enforcement officers also enforce various by-laws and these roles should, where possible, maintain the positive perception created through the road safety master plans.

Traffic enforcement officers involved in community safety programmes should receive focused training, over and above their normal operational training. This should involve a basic understanding of community development issues, communication, and the education of children. When required, provision should be made in the law enforcement plans for such training.



**Law enforcement road block**



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# Appendix A

## Assessment/Audit Prompt List

It is important that road safety assessments and audits should take into account all possible operating conditions, and all types of road users. The operating conditions that should be considered include the following:

- **Day and night time.** The visual information available to road users can be markedly different at night than during the day. Many features on a road may be obvious in daylight, but can be deceptively hidden at night time.
- **Peak and off-peak periods.** It is essential that possible road user reactions should also be evaluated under congested flow conditions.
- **Adverse weather conditions (wind and rain).** Many accidents occur under adverse weather conditions. Drivers are distracted by the weather conditions, visibility is reduced, and skid resistance is affected. This combination of conditions should be considered when evaluating the plan or design.

It is also important to consider all possible users of the facility, including the following:

- Pedestrians, including persons with special needs. Such persons include children, the elderly and the disabled.
- Cyclists and motorcyclists.
- Public transport.
- Heavy vehicles.

### A.1 Network Impact and Project Stages

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#### A.1.1 Network impact

- Will traffic volume and mix on other roads in the network change as a result of the project, and would such changes create safety problems? This includes the possibility of traffic intrusion through sensitive areas (residential neighbourhoods)?

#### A.1.2 Project phases

- Will road safety be affected by planned project stages and phases?
- If provided, are transitions between different stages or phases of the project safe? Has advance warning been provided? Do transitions occur near to hazards?

## A.2 Design Standards

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### A.2.1 Road classification

- Is the road classification that has been selected for the road appropriate?
- Are there excessive changes in the road classification on the network or on the same road that may be unsafe? Are transitions between different road classes in the network or on the same road safe? Has advance warning been provided? Do transitions occur near to hazards?

### A.2.2 Geometric design standard

- Is the current or selected design standard (as opposed to the design itself) appropriate for the class of road, expected volume and mix of traffic, pedestrians and cyclists, environment, driver expectancy?
- Is the design standard flexible enough to accommodate unforeseen changes?
- Are there excessive changes in design standards on the network on the same road that may be unsafe? Are transition zones between different design standards on the network and on the same road safe? Has advance warning been provided? Do transitions occur near to hazards?

### A.2.3 Design speed

- Is the current or selected design speed appropriate for the class of road, expected volume and mix of traffic, pedestrians and cyclists, environment, driver expectancy?
- Are there excessive changes in design speed on the network or on the same road that may be unsafe? Are transition zones between different design standards on the network and on the same road safe? Has advance warning been provided? Do transitions occur near to hazards?
- Has a design/operating speed profile been developed for the project? Should one be developed?

### A.2.4 Design vehicle

- Have the appropriate design vehicles been selected for the project?
- Can unforeseen future changes in design vehicle mix be accommodated?

## A.3 Sight distance

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Attention should be given to all possible obstructions to sight distances, including the following:

### Permanent obstructions

- Natural features, cuts and fills.
- Bridge abutments and traffic barriers.
- Overhead structures, such as bridges on sag vertical curves.
- Street furniture, fencing, services, road signs.
- Landscaping, plants or expected future plant growth.

## **Temporary obstructions**

- Parked or loading vehicles, public transport vehicles.
- Queues of vehicles (including right-turn queues).
- Construction equipment, vehicles and material.

### **A.3.1 (SSD) Stopping sight distance**

- Is stopping sight distance adequate for light and heavy vehicles over the full length of the road (every single metre of the road)?
- Will the sight distance be affected by permanent or temporary obstructions?

### **A.3.2 (DSD) Decision sight distance**

- Is decision sight distance adequate for light and heavy vehicles at each intersection, access or decision point on the road?
- Are there any possible locations in future where decision sight distance may become necessary and where it would be inadequate?
- Will the sight distance be affected by permanent or temporary obstructions?

### **A.3.3 (GSD) Gap acceptance sight distance – Motorised vehicles (All stages)**

- Is gap acceptance sight distance adequate for vehicles at each intersection and access on the road (all turning movements, including right-turning vehicles)?
- Are there any possible locations in future where gap acceptance sight distance may become required and where it would be inadequate?
- Will the gap acceptance sight distance be affected by permanent or temporary obstructions (including queues of vehicles opposite right-turn movements)?

### **A.3.4 (PSD) Gap acceptance sight distance – Pedestrians and cyclists**

- Is gap acceptance sight distance adequate for pedestrians and cyclists at each possible location where they may cross the road?
- Will the gap acceptance sight distance be affected by permanent or temporary obstructions?

### **A.3.5 (XSD) Overtaking sight distance**

- Is overtaking sight distance adequate wherever overtaking is permitted?
- Will the sight distance be affected by permanent or temporary obstructions?

## **A.4 Road Alignment**

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### **A.4.1 Element co-ordination**

- Is the interaction of horizontal and vertical alignments safe (i.e. roller coaster alignments, sequencing of horizontal and vertical curves, etc.)?
- Are there any trees, poles or other lines that do not follow the road alignment or will there be any lights at night, including vehicle headlights, that do not follow the road alignment and which could create driver confusion?

#### **A.4.2 Horizontal alignment**

- a) Horizontal curves
  - Are there an excessive number of horizontal curves on the road that contributes to safety problems?
  - Are there any curves that are excessively long?
  - Are there any curves that would require an excessive change in operating speed? Are there excessive curve radii that would cause skidding in adverse weather conditions? Has advance warning been given?
  - Are horizontal curves visible and readable by drivers?
- b) Transition curves
  - Will transition curves lead to drivers' underestimating the radius of a curve? Has advance warning been given?
- c) Chevrons
  - Are chevrons provided along curves at adequate spacing?
- d) Tangents
  - Are there any tangents that are excessively long and which could result in boredom and safety problems?

#### **A.4.3 Vertical alignment**

- a) Vertical curves
  - Are there an excessive number of vertical curves on the road that contribute to road safety problems?
- b) Gradients
  - Are there excessive gradients on the road that could be unsafe, particularly for heavy vehicles? Has advance warning been given?
  - Are there any excessive speed changes required on such gradients, such as at intersections and accesses?

#### **A.4.4 Passing opportunities**

- a) Overtaking areas
  - Is there adequate provision for passing opportunities?
  - Are the overtaking areas safe? Are they visible and readable by drivers?
- b) Climbing and passing lanes
  - Have climbing and passing lanes been provided and are they required? Is the number and spacing of the climbing and passing lanes adequate?
  - Is the design of the climbing and passing lanes safe? Are the end treatments safe? Has adequate warning been given? Are they readable by drivers?

### **A.5 Cross Section**

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#### **A.5.1 Divided and undivided road section**

- Is the number of carriageways appropriate for the road?
- Is future expansion possible and could it affect future safety?
- Are transitions safe where the number of carriageways changes? Is there no opportunity for driver error (both day and night)? Has advance warning been given? Do transitions occur near to hazards?

### **A.5.2 Number of lanes**

- Is the number of lanes appropriate for the road and volume of traffic?
- Is future expansion possible and could it affect future safety?
- Are transitions safe where the number of lanes changes? Is the lane drop given on the slow or fast lane, and is there sufficient provision for driver error (both day and night)? Has advance warning been given? Do transitions occur near to hazards?

### **A.5.3 Lane width**

- Is the lane width appropriate for the class of road, design speed, traffic volume and mix of traffic?
- Has lane widening been provided on sharp curves to accommodate vehicle off-tracking?
- Has lane widening been provided at intersection to accommodate turning vehicles?

### **A.5.4 Disused pavement**

- Is there any disused road pavement that could cause driver confusion?

### **A.5.5 Crossfall and superelevation**

- Has sufficient crossfall been provided? Is crossfall adequate for drainage?
- Has adequate superelevation been provided? Will superelevation result in water running across the road?

### **A.5.6 Median**

- If a median has not been provided, is there an increased safety risk because of this?
- Is the width of the median adequate for road signs and pedestrians?
- Is the design of the median safe? Are slopes on the median safe?
- Is there a risk for vehicles crossing the median into the path of opposing vehicles?
- Have median barriers been provided or should they be provided?
- Have median openings been provided for emergency vehicles?

### **A.5.7 Median ends**

- Are median ends/transitions safe? Has advance warning been given? Do median ends occur near to hazards? Are they visible and readable by drivers?

### **A.5.8 Kerbs**

- Is the type of kerb used appropriate to requirements and speeds? Have barrier or semi-mountable kerbs been used when the speed limit exceeds 80 km/h?
- Are there any unsafe abrupt changes in the kerblines?
- Are the kerbs in an acceptable condition? Have any loose kerbs been provided?

### **A.5.9 Road shoulders**

- Have paved shoulders been provided or are they required?
- If wide paved shoulders have been provided, can the shoulders safely be used by slow-moving vehicles?
- Is the shoulder adequate for broken down vehicles?
- Are the shoulders adequate for use by road maintenance vehicles?
- Are the shoulders adequate for use by emergency vehicles?
- Are the paved shoulders adequate for use by pedestrians and cyclists? Should they be using the shoulders?
- Is the shoulder crossfall adequate for drainage?
- Are transitions safe where the shoulder width and construction changes (such as at over bridges)? Is there sufficient provision for driver error (both day and night)? Has advance warning been given? Do transitions occur near to hazards?

### **A.5.10 Road verge, cut and fill**

- Is the road located in an area in which the topography is of such a nature that it does affect road safety? Can the road be realigned to avoid the area?
- Is the road verge adequate to provide safe recovery? Is it of sufficient width and are batter slopes too steep? Are there any embankments on the road verge that are unsafe?
- Are cuts stable, or is there a possibility of loose material falling onto the road?

## **A.6 Intersections and Accesses**

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### **A.6.1 Intersection/Access management (Intersection and access location and spacing)**

- Does the location of intersections and accesses serve the needs of the community and thus contribute to road safety?
- Is the intersection and access spacing (degree of access) appropriate for the class of road (as well as the intersecting road)? Are there an excessive number of intersections and accesses that affects road safety?
- Is road safety not adversely affected by excessive access management?
- During construction, have all intersections and accesses been located at well-defined positions? Are any accesses provided over long undefined distances?

### **A.6.2 Intersection consistency**

- Is the intersection control type, layout and other features consistent with other intersections, on the road and on the intersecting road?

### **A.6.3 Intersection control**

- Will intersections and accesses be able to cope with traffic demand? Will congestion result in traffic safety problems?
- Is the intersection and access control appropriate for the class of road and design speed (as well as that of the intersecting road)? Traffic signals may not be used on roads with a speed limit higher than 80 km/h.

#### **A.6.4 Intersection layout**

- Are there any features that could affect safety, such as parking, signs, etc?
- Is the angle of intersection nearly perpendicular?
- Can intersections accommodate all design vehicle types, including swept paths?
- If two-stage gap acceptance is necessary, is there adequate median width?
- Are intersections visible and readable by drivers?

#### **A.6.5 Intersection gradient**

- Are approach gradients too steep on approaches to intersections or accesses?

#### **A.6.6 Auxiliary lanes**

- Have left-turn and right-turn auxiliary lanes been provided and are they required?
- Are they of adequate length? Can right-turn auxiliary lanes accommodate right-turn queues?
- Are their designs safe? Has adequate warning been given?
- Are there any trap lanes? These are basic lanes that do not continue through an intersection and where only turning movements are allowed.

#### **A.6.7 Slipways**

- Is the design of slipways safe for vehicular traffic? Are angles nearly perpendicular and are such angles desirable?
- Is the design of slipways safe for pedestrians?
- Are the island size and offset adequate?

#### **A.6.8 Traffic circles**

- Has adequate deflection been provided to reduce approach speeds?
- Have splitter islands been provided or are they needed? Is their design safe?
- Is the central island prominent? Is the design of the island safe? Is the circle visible and readable by drivers?
- Are traffic circles visible and readable by drivers?
- Is sufficient provision made for pedestrians to cross at the traffic circle?

#### **A.6.9 Railroad crossings and bridges**

- Would rail bridges be justified?
- At level crossings, have adequate sight distances for approaching trains been provided? Has adequate warning been given?
- Are there any hazardous features at the crossing or bridge?

### **A.7 Interchanges**

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#### **A.7.1 Interchange location and spacing**

- Does the location of interchanges serve the needs of the community and thus contribute to road safety?

- Is the interchange spacing adequate and is there adequate distance for weaving?

#### **A.7.2 Interchange type**

- Is the interchange type appropriate in respect of topographical and operational requirements?
- Is the interchange type consistent with other interchanges on the road?

#### **A.7.3 Interchange design and layout**

- Does the design of the interchange meet design requirements?
- Is lane balance and continuity maintained at all locations?
- Has provision been made for access by maintenance and emergency vehicles?

## **A.8 Pedestrian and Cyclist Facilities**

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### **A.8.1 Pedestrian crossings**

- a) Intersections
  - Has proper provision been made at the intersection for pedestrians?
- b) Midblock crossings
  - Have midblock pedestrian crossings been provided or are they required? Are midblock crossings appropriate for the class of road?
- c) Crossing design
  - Has sufficient provision been made for the volume and queues of pedestrians?
  - Have pedestrian refuge islands or a median been provided on wide crossings? Are these islands of sufficient size?
  - Have kerb ramps been provided? Are transitions smooth without lips that could create a hazard for persons in wheelchairs, or pedestrians with crutches?
  - Are crossings visible for and readable by drivers?

### **A.8.2 Bridges/subways**

- Would pedestrian bridges/subways be justified? Are these bridges/subways on desire lines and will they be used?
- Are the bridges/subways safe? Has security been taken into account?

### **A.8.3 Sidewalks and walkways**

- Has a paved sidewalk been provided for pedestrians, or is one required? If provided, are such sidewalks suitable for the class of roads?
- Are sidewalks discontinued at any location, including bridges and high fills?
- Are sidewalks continued through the work zone during construction?
- Are the sidewalks or footpaths in a useable condition? Do objects (such as plants) obstruct the sidewalks and result in pedestrians having to use the road or street?

- Do the sidewalks or footpaths have an adequate hard, vibration-free surface? Vibration-free surfaces are required for persons in wheelchairs.
- Has a buffer strip been provided between the sidewalks and the roadway?

#### **A.8.4 Bicycle roads and lanes**

- Have bicycle roads or lanes been provided, or would they be required? If provided, are such roads or lanes suitable for the class of road?
- Are the facilities discontinued at any location, including bridges and high fills?
- Are facilities continued through the work zone during construction?
- Are the facilities in a useable condition? Do objects (such as plants) obstruct the facilities and result in cyclists having to use the adjacent roadway?
- Is the treatment of bicycle roads and lanes at intersections safe?

## **A.9 Bridges, Drainage and Engineering services**

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### **A.9.1 Bridges**

- a) Bridge width and clearance
  - Is the road cross-section continued over the bridge? If not, have safe transitions with adequate warning been provided?
  - Are pedestrian walkways continued over the bridge?
  - Are sufficient horizontal and vertical clearance distances provided?
  - Are bridges visible for and readable by drivers?
- b) Bridge railings
  - Is the design of bridge railings adequate and safe? Does the railing pose a safety hazard for vehicles and pedestrians?
  - Is transition between different types of barriers safe?
  - Are bridge ends properly treated and anchored? Have proper energy attenuators been provided?
  - Have reflectors been installed on railings?

### **A.9.2 Road drainage**

- Have sufficient drainage structures been provided? For all road users, including pedestrians and cyclists?
- Is there a possibility of surface flooding or could ponding occur? Is the crossfall on the road surface and shoulder adequate for drainage?
- Is there a possibility that pedestrians will be sprayed by water from the road surface?
- Is there a possibility that storm water may result in silting of the roadway?
- Are there factors that could lead to blocking of drains (e.g. vegetation)?
- Are the drainage structures safe? Are there any unprotected walls, channels, etc?

### **A.9.3 Engineering services**

- Is the recovery zone clear of engineering services or have safety devices been provided? Hazardous objects may include electricity and telephone poles, electricity substations, etc.

## **A.10 Road Surface**

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### **A.10.1 Skid resistance**

- Is the skid resistance of the road surface adequate, particularly at intersections, steep grades and on curves?
- Have skid resistance tests been undertaken?

### **A.10.2 Loose material**

- Is there any loose construction and other material, or excessive bleeding on the road surface that could affect road safety?

### **A.10.3 Pavement defects**

- Are there any defects of the road surface, such as potholes, rutting, bleeding, etc, and are these unsafe?
- Are there any unsafe drop-offs on the road edge?
- Are there any manholes and other features that are unsafe?

### **A.10.4 Headlight glare**

- Will headlight glare have an impact on night time operations?

## **A.11 Safety Barriers**

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### **A.11.1 Temporary safety barriers**

- Is the type of safety barrier appropriate to its use?
- Is the design of safety barriers adequate and will they function as intended? Have they been installed correctly? Are all segments fixed to each other? Have sufficient deflection distance been provided behind the barrier?
- Is transition between different types of barriers safe?
- Are the ends of the safety barriers safe? Have proper energy attenuators been provided?
- Have reflectors been installed on barriers?
- Does the barrier pose a safety hazard for vehicles, pedestrians and other users?

### **A.11.2 Safety barriers (hazardous object protection)**

- Is the type of safety barrier appropriate to its use?
- Is the design of safety barriers adequate and will they function as intended? Have they been installed correctly? Are all segments fixed to each other? Has sufficient deflection distance been provided behind the barrier?
- Is transition between different types of barriers safe?
- Are the ends of the safety barriers safe? Have proper energy attenuators been provided?
- Have reflectors been installed on barriers?
- Does the barrier pose a safety hazard for vehicles, pedestrians and other users?

### **A.11.3 Guardrails (hazardous object protection)**

- Are guardrails used where appropriate?
- Have guardrails been installed properly? Has sufficient deflection distance been provided behind the guardrails? Are post spacing and post depth adequate? Are rail overlaps correct?
- Is transition between different types of barriers safe?
- Are guardrail ends properly treated and anchored? Have proper energy attenuators been provided?
- Have reflectors been installed on guardrails?
- Does the guardrail pose a safety hazard for vehicles, pedestrians and other users?

### **A.11.4 Pedestrian barriers**

- Is the separation of vulnerable road users and vehicles required?
- Is such separation appropriate to the class of road?
- Will the barriers be (or are they) effective?
- Will the barriers be (or are they) safe?

### **A.11.5 Fences**

- Are road reserve fences provided and are they required?
- Are the fences effective?
- Are fences safe? Do they contain dangerous horizontal elements?

## **A.12 Traffic Calming**

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### **A.12.1 Traffic intrusion**

- Is traffic calming required to reduce or prevent traffic intrusion?
- Is such traffic calming appropriate for the class of road?
- Are the traffic calming measures effective?
- Are the traffic calming measures safe? Are they visible and readable, particularly in the long run considering maintenance requirements?

### **A.12.2 Speed calming**

- Is the road used by significant numbers of pedestrians or cyclists and are operating speeds too high? Are speed calming measures required?
- Are speed calming measures appropriate to the class of road?
- Are the speed calming measures effective?
- Are the speed calming measures safe? Are they visible and readable, particularly in the long run considering maintenance requirements?

## **A.13 Roadside Facilities**

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### **A.13.1 Parking and loading**

- Has on-street parking or loading been provided? Are it safe? Are it suitable for the class of road and operating speeds?

- Does illegal parking or loading occur? Is it safe?
- Has provision been made for safe access to the parking areas by pedestrians?

#### **A.13.2 Bus stops (Public transport stops)**

- Have adequate public transport stops been provided or are they required?
- Do illegal activities occur that are unsafe?
- Has provision been made for safe access to the bus stops by pedestrians?

#### **A.13.3 Refuse collection**

- Can refuse safely be loaded at properties along the road?

#### **A.13.4 Law enforcement**

- Is there space available along the road for law enforcement activities?

#### **A.13.5 Truck stops and escape ramps**

- Have truck stops been provided or are they required? Have adequate warning signs been posted?
- Have escape ramps been provided or are they required? Have adequate warning signs been posted?

#### **A.13.6 Rest areas**

- Are rest areas desirable on the road? Is the number of rest areas adequate?
- Are the rest areas placed at appropriate locations?
- Do the rest areas have safe access? Has adequate warning been given?

## **A.14 Road Signs, Markings, Traffic Signals and Lighting**

### **A.14.1 Traffic accommodation plan**

- Is a traffic accommodation plan available for use during construction?
- Does the plan comply with the requirements of the Road Traffic Signs Manual?

### **A.14.2 Road signs**

- Have road signs been provided in accordance to the requirements of the RTSM?
- Have sufficient road signs been provided? Are there any signs that are redundant? Are there any road signs missing or have any been removed?
- Are all road signs properly located?
- Have sufficient vertical and horizontal clearance distances been provided? A minimum clearance height of 2,1 m must be provided where there are pedestrians.
- Are all road signs and letter sizes adequate?
- Are all road signs visible and readable? Has the visibility been obscured by other signs, structures, vehicles or vegetation?
- Is the condition of the road signs adequate? Are they faded or damaged?
- Are all important road signs retroreflective at night? Are some signs not too reflective?

- Are road sign supports safe? Have they been located outside of the clear zone? Have signs been mounted using safe methods (not in sand-filled drums). Have frangible or slip-base poles been used on large signs? Have they been protected by safety barriers?
- Are there any advertising and other signs located near to the road signs that could confuse drivers?

#### **A.14.3 Pavement markings**

- Have road markings been provided in accordance to the requirements of the RTSM?
- Have sufficient road markings been provided? Are there any markings that are redundant?
- Are all road markings marked properly?
- Are all road markings visible? Under all adverse weather conditions? At night? Is the condition of the road markings adequate? Are they faded?
- Are all important road markings retroreflective at night? Are some markings not too reflective?
- Have unused and old pavement markings been adequately removed? Do such markings create a safety hazard?

#### **A.14.4 Road studs**

- Are road studs provided or will they be required?
- Are the road studs in an acceptable condition?

#### **A.14.5 Speed limits and advisory speeds**

- Are speed limits appropriate for the road?
- Would speed limits result in a large reduction in speeds? Is such reduction reasonable, credible and safe?
- Have transitions in speed limits been posted at intervals?
- Are signs placed at the correct location and not removed from where needed?
- Have speed limit signs been posted at each intersection on the road?
- Are there considerable variations in speed limits that could cause confusion? Is adequate warning given for speed limits?
- During construction, are speed limits properly managed? Are speed limits removed or covered when not required?
- Have advisory speeds been provided where required? Are the advisory speeds suitable? Is sufficient distance provided to enable motorists to react to the warning signs?

#### **A.14.6 Traffic signals**

- Have traffic signals been provided in accordance to the requirements of the RTSM?
- Have all primary and secondary signal faces been provided and properly positioned?
- Have overhead signals been provided and are they necessary?
- Is the design of the traffic signals consistent at all intersections along a route?

- Are there any signal faces that are not in accordance with the RTSM?
- Are slipways properly controlled? Have signals been provided on such slipways and has care been taken to prevent conflicting greens?
- Are the intergreen (yellow and all-red) periods adequate?
- Have adequate turning phases been provided?
- Is the timing of the traffic signals satisfactory?
- Are the signals visible and readable by drivers?
- Have warning signs been provided where visibility is poor?
- Will traffic signals be affected by a setting or rising sun?
- Has adequate provision been made for pedestrians, also in the timing of the traffic signals? Are all pedestrian buttons working?
- Are traffic signals located outside the clear zone? Are they safe?

#### **A.14.7 Lighting**

- a) Has lighting been provided or is it necessary? This includes the following:
  - Intersections or pedestrian crossings (particularly traffic signals).
  - Sidewalks and footpaths, and crossings (also required for security reasons).
  - Areas where there is a sudden transition from light to dark conditions.
  - Gores at diverging areas. Merging areas.
  - Construction areas.
- b) Is the road lighting effective? What is the effect of features like trees, bridges, etc? Are there any lighting black patches?
- c) Can luminaries create glare for road users? Have lighting black spots been created?
- d) Is the transition in lighting safe? Will the lighting not create vision problems?
- e) Are the light poles in the clear zone? Have frangible or slip-base poles been used or have other safety measures been implemented?

## **A.15 Land use and development**

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### **A.15.1 Traffic generators**

- Is the road located adjacent to developments that would generate traffic that could cause congestion and safety problems on the road?
- Will the development generate unusual types of vehicles, such as agriculture, abnormal loads, etc?

### **A.15.2 Pedestrians and cyclists at developments**

- Will the project result in the division of a community, or will it cut the community off from basic commodities such as water, firewood and retail facilities, so that pedestrians will have to cross the road?
- Is the road located adjacent to developments (e.g. schools) that generate a large volume of pedestrians and cyclists? Can such pedestrians and cyclists be accommodated safely? Should barriers and fences be erected?

### **A.15.3 Development access control**

- Will access control measures result in queue spill back onto the street system?
- Are throat lengths of adequate length to accommodate queues?

### **A.15.4 Off-street parking and loading areas**

- Have adequate off-street parking and loading areas been provided?
- Are such parking and loading areas visible from the street?

### **A.15.5 Distractions at developments**

- Is the roadside visually cluttered to such an extent that it would distract drivers?
- Is there a need to provide glare protection from lighting of adjacent developments?
- Are there any other aspects that could distract drivers? These could include advertisements, low-flying aircraft, etc.
- Will there be any special events that could distract drivers?

### **A.15.6 Hawkers**

- Are there any hawkers adjacent to the road that create safety problems?
- Do these hawkers attract pedestrians that could cause safety problems?

## **A.16 Environment**

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### **A.16.1 Day/night and weather**

- Will traffic safety be affected at night?
- Will traffic safety be affected by a setting or rising sun?
- Has the effect of weather (wind, mist, fog, etc.) been adequately taken into account?

### **A.16.2 Landscaping and plants**

- Do existing landscaping and plants affect clearances and sight distances?
- Will future plant growth affect clearances and sight distances?
- Can landscaping obscure pedestrians, cyclists, vehicles and animals?
- Will plants result in shade which obscures road signs and other features?
- Will plants result in leaves and litter on the road that could affect safety?
- Are trees located within the clear zone? If so, has adequate provision been made for safety measures?

### **A.16.3 Animals and stock**

- Are there any known animal travelling/migration routes which could affect the road?
- Have fencing and animal underpasses been provided where required?
- Has proper signage been provided?

## **A.17 Construction and Maintenance**

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### **A.17.1 Construction**

- Will road safety be affected by construction? Can construction be undertaken with an acceptable degree of safety?
- Will road safety during construction be affected by the planning and design of the project?

### **A.17.2 Maintenance**

- Can all elements of the road be maintained (including medians and intersections)?
- Have median openings been provided for road maintenance vehicles to turn?

### **A.17.3 Construction and maintenance activities**

- Is the clear zone between construction activities and the roadway adequate?
- Are there any hazardous objects near to the roadway?

Note: This list as been developed by Dr SC van As and has been included in various documents in South Africa.



# Appendix B

## Economic Appraisal Parameters

The following economic appraisal parameters are provided in this Appendix:

- Discount rate for economic analysis
- Monetary value of accidents
- Typical accident type and severity level distributions for roads in urban areas
- Accident reduction factors

### **B.1 Discount rate for economic analysis**

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The discount rate for economic analysis will be prescribed. Where no such rate is available, a discount rate of 8% will be used.

### **B.2 Monetary value of accidents**

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Two tables of monetary values of accidents are given below. The first table provides accident unit costs per accident type while the second table provides accident costs per severity levels.

The cost rates provided in Table 1 were obtained from the document by De Beer and Van Niekerk listed below. The rates for 2008 were adjusted by applying of the Consumer Price Index at the midpoint of the year.

The cost rates in Table 2 were obtained from the document by Schutte listed below. The rates for 2008 were adjusted by a factor which increased the average cost for all accidents to the cost rate provided in Table 1.

The references are:

*De Beer EJH and van Niekerk EC, 2004, The estimation of unit costs of road traffic accidents in South Africa, Contract Report CR-2004/6, Department of Transport, Pretoria.*

*Schutte IC, 2000, An estimate of the unit cost of road traffic collisions in South Africa for 1998, Contract Report CR-2000/4, Department of Transport, Pretoria.*

<b>Table 1: Accident unit costs per accident type</b>		
<b>Year</b>	<b>2002</b>	<b>2008</b>
<b>CPI</b>	<b>114.6</b>	<b>160.8</b>
Single-vehicle accidents		
Overtuned	R345 130	R 484 266
Fixed object	R33 711	R 47 301
Animal	R20 132	R 28 248
Pedestrian	R317 321	R 445 246
Multiple-vehicle accidents		
Head-rear end	R23 523	R 33 006
Sideswipe same direction	R26 484	R 37 161
Sideswipe opposite direction	R57 150	R 80 190
Head-on	R273 129	R 383 239
Turn from wrong lane	R32 177	R 45 149
Turn in front of oncoming traffic	R97 442	R 136 725
Both straight	R85 444	R 119 890
Both turning	R41 283	R 57 926
Reversing	R3 988	R 5 596
All accident types		
All accident types	R55 245	R 77 517

<b>Table 2: Accident unit costs per accident severity</b>					
<b>Year</b>	<b>All severities</b>	<b>Fatal Accidents</b>	<b>Severe Accidents</b>	<b>Injury Accidents</b>	<b>Damage Only</b>
1998	R24 817	R 388 487	R 88 248	R 23 723	R 15 694
2008	R77 517	R1 213 456	R275 647	R74 100	R49 021

The severity levels are defined as follows:

- Fatal accident: An accident resulting in the death of one or more persons. The death must have occurred during or immediately after an accident, or within 6 days after an accident happened as a direct result of such accident.
- Severe accident: An accident in which one or more persons are seriously injured. Serious injuries are those for which hospitalisation is required.
- Injury accident: An accident in which one or more persons are slightly injured. Slight injuries are those that can be treated at the scene of the accident or outside a hospital.
- Damage only accident: An accident in which no-one was killed or injured and which resulted in damage to vehicles and/or other property only.

### B.3 Accident type and severity level distributions (urban roads)

The following table shows average accident type and severity level distributions for urban roads. This information was derived from the Tshwane Municipality accident database (2002 and 2003).

Accident types and severities		Accident severity			
Accident type	Distribution	Fatal	Serious	Slight	Damage
Head-on	0.8%	5.8%	17.0%	21.4%	55.2%
Sideswipe opposite direction	5.0%	0.4%	3.8%	14.6%	81.2%
Head/rear end	32.7%	0.2%	2.1%	12.9%	84.8%
Sideswipe same direction	10.4%	0.2%	2.1%	7.4%	90.2%
Turn left from wrong lane	1.0%	0.0%	1.0%	7.7%	91.0%
Turn right from wrong lane	1.2%	0.2%	2.7%	11.3%	85.6%
Turn right opposite	3.5%	0.5%	9.4%	21.9%	68.1%
Angled straight	5.4%	0.9%	8.6%	22.7%	67.8%
Angled turn	3.2%	0.3%	4.6%	13.2%	81.8%
Reversing	5.7%	0.1%	0.3%	1.9%	97.6%
Single overturned	1.7%	4.2%	20.0%	33.4%	42.4%
Pedestrian	5.7%	4.6%	29.5%	48.1%	17.8%
Animal	0.6%	0.3%	1.9%	7.8%	90.0%
Train	0.0%	0.0%	10.0%	15.0%	70.0%
Fixed object	9.1%	0.6%	4.8%	11.5%	83.1%
Other accidents	7.7%	0.5%	3.6%	11.8%	84.1%
Total	100.0%	0.7%	5.0%	14.0%	80.3%

### B.4 Accident reduction factors (AMF)

Accident reduction factors for the purposes of the economic appraisal can be obtained from the following document:

*Bahar G; Masliah M, Wolff R and Park P, 2007, Desktop Reference for Crash Reduction Factors, FHWA-SA-07-015, Federal Highway Administration, Washington DC.*

This document can be downloaded from one of the following websites:

<http://www.transportation.org/?siteid=35&pageid=1490>  
<http://www.ite.org/safety/default.asp>  
<http://safety.fhwa.dot.gov/tools/crf/>



# Appendix C

## Low-Cost Measure Checklist

Location:
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Installed sidewalks and speed calming measures			
Installed sidewalks	<input type="checkbox"/> None	<input type="checkbox"/> One side	<input type="checkbox"/> Both sides
Installed calming measures	Distance to nearest upstream measure		
	Distance to nearest downstream measure		

Environment, traffic volumes and speeds	
Environment	<input type="checkbox"/> Scholars, senior persons and persons with disabilities
	<input type="checkbox"/> High volume pedestrian area
	<input type="checkbox"/> Residential area
Traffic volume (AADT)	
85th percentile speed (km/h)	

Pedestrian sidewalks		
Road class	Sidewalk location	Check
Class 3 and higher (district and primary distributors)	Both sides of roads	<input type="checkbox"/>
Class 4a and Class 5a (major collectors and streets)	Both sides of streets	<input type="checkbox"/>
Class 4b (minor residential collector)	One side of street	<input type="checkbox"/>
Class 5b (residential streets)	Normally not provided	<input type="checkbox"/>

Speed calming measures: Preferred measure		
Road class	Preferred measure	Check
Class 4b (residential collector)	Mini-circle or Chicane	<input type="checkbox"/>
Class 5b (residential streets)	Circle, chicane, speed hump, raised crossing	<input type="checkbox"/>

Speed calming measures: General requirements		
Road class	Requirement	Check
85th percentile speed	See chapter 9	<input type="checkbox"/>
Minimum spacing	100 m min, 150-200 m preferred	<input type="checkbox"/>
Driveways	Not installed directly opposite driveway	<input type="checkbox"/>
Road signs	Space for warning signs	<input type="checkbox"/>
Street lighting	Only on streets with street lighting	<input type="checkbox"/>
Road gradient	Maximum 8% gradient	<input type="checkbox"/>
Sight distance	See chapter 9	<input type="checkbox"/>

Point allocation	Points allocated
Sidewalk point allocation	
Speed calming point allocation	

Recommended measure(s)

