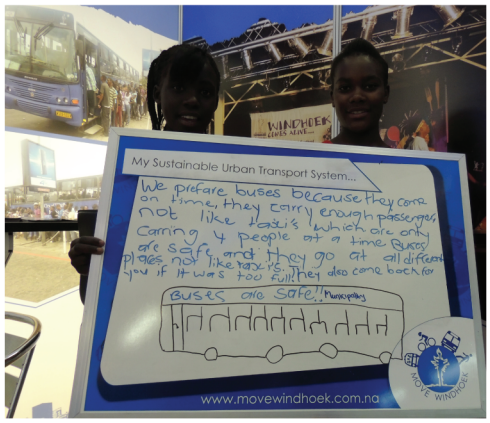
MOVE WINDHOEK

Sustainable Urban Transport Master Plan

for Windhoek including Rehoboth, Okahandja and Hosea Kutako International Airport



Final Report

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City of Windhoek

Master Plan of City of Windhoek including Rehoboth, Okahandja and Hosea Kutako International Airport

The responsibility of the project and its implementation lies with the Ministry of Works and Transport and the City of Windhoek

Consultancy services provided by

in consortium with

Project Team:

1. Ministry of Works and Transport
   Cedric Limbo
   Angeline Simana- Paulo
   Damien Mabengo
   Chris Fikunawa
2. City of Windhoek
   Ludwig Narib
   George Mujiwa Mayumbelo
   Clarence Rupingena
   Browny Mutrifa
   Horst Lisse
   Adam Eiseb
3. Polytechnic of Namibia
4. GIZ
   Prof. Dr. Heinrich Semar
   Frederik Strompen
   Gregor Schmorl
   Immanuel Shipanga
5. Consulting Team
   Dipl.-Volksw. Angelika Zwicky
   Dr. Kenneth Odero
   Dr. Niklas Sieber
   James Scheepers
   Jaco de Vries
   Adri van de Wetering
   Dr. Carsten Schürmann,
   Prof. Dr. Werner Rothengatter
   Roloef Wittink
   Dipl.-Ing. Olaf Scholtz-Knobloch
   Dr. Carsten Simonis

Editors: Fatima Heidersbach, Frederik Strompen

Contact: Cedric Limbo
Ministry of Works and Transport
Head Office Building
6719 Bell St
Snyman Circle
Windhoek

Clarence Rupingena
City of Windhoek

Deutsche Gesellschaft für Internationale
Zusammenarbeit (GIZ) GmbH
P.O Box 8016
Windhoek,Namibia,
www.sutp.org

Cover photo: F Strompen, Young Designers Advertising

Layout: Frederik Strompen

Windhoek, 15/05/2013

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Acronyms and abbreviations appearing in this Master Plan

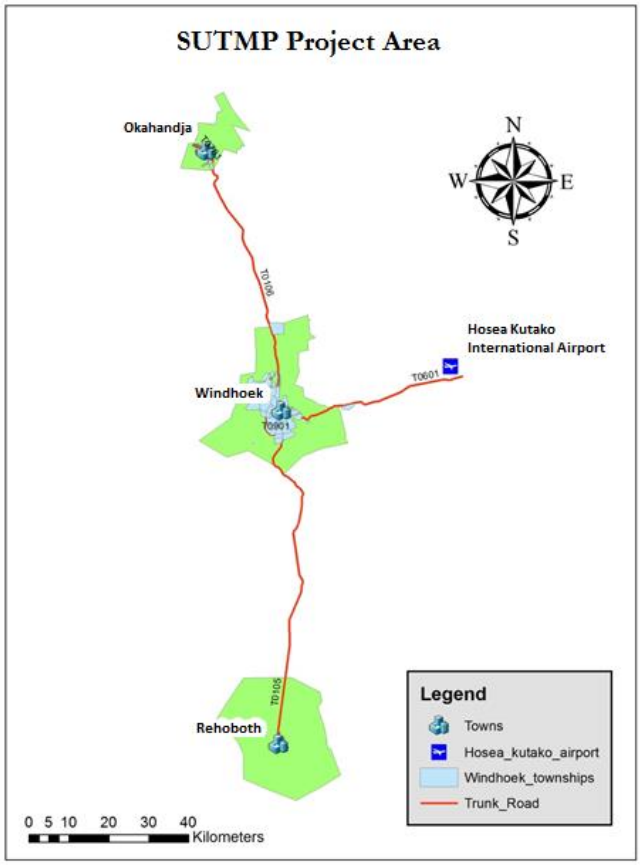
AfDB	African Development Bank
AGM	Annual General Meeting
BAU	Business as Usual
BEC	Bicycle Empowerment Centre
BEN	Bicycle Empowerment Network
BGIT	Bachelor of Geo-Information Technology
BRT	Bus Rapid Transit
CBD	Central Business District
CBS	Central Bus Station
CCC	Central Control Centre
CEO	Chief Executive Officer
CoW	City of Windhoek
CRS	Commuter Rail Service
DMU	Diesel Multiple Unit
DoT	Department of Transport
DoW	Department of Works
FENATA	Federation of Namibian Tourism Associations
FGD	Focus Group Discussion
GEH	Geoffrey E. Havers, inventor of a formular used in traffic planning
GIS	Geographical Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GVA	Gross Value Added
HOV	High Occupancy Vehicle
IFI	International Financing Institution (for technical and/or financial assistance)
ILFF	Institutional, Legal and Financial Framework
ITF	International Transport Forum
KfW	Kreditanstalt für Wiederaufbau
LAs	Local Authorities
LOV	Low Occupancy Vehicles
MLTRMP	Medium to Long Term Roads Master Plan
MRLGHRD	Ministry of Regional and Local Government, Housing and Rural Development
MTEF	Medium Term Expenditure Framework
MVA	Motor Vehicle Accident Fund
MWT	Ministry of Works and Transport
NABTA	Namibian Bus and Taxi Association
NAMPAB	Namibia Planning Advisory Board
NAMPOL	Namibian Police
NaTA	National Transport Authority (to be established)
NCCI	Namibia Chamber of Commerce and Industry
NCT	Namibia Consumer Trust
NDC	Namibia Development Corporation
ND-LUP	National Diploma in Land Use Planning

NDP 4	Namibia's Fourth National Development Plan 2012/13 to 2016/17
NEIA	Nachhaltige Entwicklung in Afrika e.V
NMT	Non-motorised Transport
NPC	National Planning Commission
NRSS	Namibia Road Safety Strategy
NTB	Namibia Tourism Board
NTTU	Namibia Transport and Taxi Union
N$	Namibian Dollar
OECD	Organisation for Economic Cooperation and Development
OMC	Okahandja Municipal Council
PAY	Physically Active Youth
pkm	Passenger Kilometer
PoN	Polytechnic of Namibia
PPP	Public Private Partnership
PSO	Public Service Obligation
PSP	Private Sector Participation
RA	Road Authority
RCC	Roads Contractor Company
RCs	Regional Councils
RFA	Road Fund Administration
ROW	Right-of-Way
RUC	Road User Charging
ILFF	Institutional, Legal and Financial Framework
SCST	Special Commission on Sustainable Transport (to be established)
SoE	State-owned Enterprise
ST	Sustainable Transport
SUT	Sustainable Urban Transport
SUTMP	Sustainable Urban Transport Master Plan
SWAp	Sector Wide Approach
TAs	Traditional Authorities
TIPEEG	Targeted Intervention Program for Employment and Economic Growth
TM	Transport Management
TDM	Transport Demand Management
TOD	Transit Oriented Development
ToR	Terms of Reference
WCPS	Windhoek City Police Service
WP	Work-Package
UK	United Kingdom
USA	United States of America

1 Introduction

1.1. Purpose

On July 18 2012, the City of Windhoek (CoW), jointly with the Ministry of Works and Transport (MWT) and other stakeholders, embarked on the process of developing a Sustainable Urban Transport Master Plan (SUTMP) for the City of Windhoek. The master plan is intended to provide for an efficient, affordable, equitable, safe and convenient public and non-motorised transport (NMT) for residents of the city and its surroundings. This includes improved linkages towards Okahandja in the north, Rehoboth in the south, and the Hosea Kutako International Airport to the east. Earlier, the CoW together with the MWT organised a Stakeholder Meeting in January 2012 where the proposal to develop a Master Plan for the city's transport system was discussed and endorsed.



The German Federal Ministry for Economic Cooperation and Development through the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH supports the development of this Sustainable Urban Transport Master Plan and employed a team of specialists with the following project objective:

A) A state-of-the-art master plan for sustainable transportation in Windhoek is elaborated which

- Produces a clear and realistic vision for the development of a sustainable urban transport system for the next 20 years.
- Generates strategies and policies to help make that vision a reality.
- Maximises the efficiency and safety of the existing public and non-motorised transport system.
- Develops a logical plan for prioritising and implementing the recommended policies and capital improvement projects that need to be addressed in short, medium and long term within the next 20 years.
- Recognises the role that public and non-motorised transport system shall have in contributing to different needs of user groups, in particular the urban poor.
- Subscribes to the concept of Avoid-Shift-Improve.
- Helps transportation system to contribute to environmental and climate change related issues.
- Serves as a basis for a national public transport master plan for Namibia.
- Serves as an example for regional and local public transport master plans in Namibia to follow.

B The foundation for a real shift towards a more sustainable urban transport system in Windhoek and beyond is laid.

- via starting a transparent, participative and on-going master planning process, and,
- via awareness creation, dissemination, technical assistance and capacity building during the master planning.

For further principle outlines of the concept of sustainability and how to make sustainable transport attractive are presented in chapter 3.5.

1.2. Background of the Master Plan

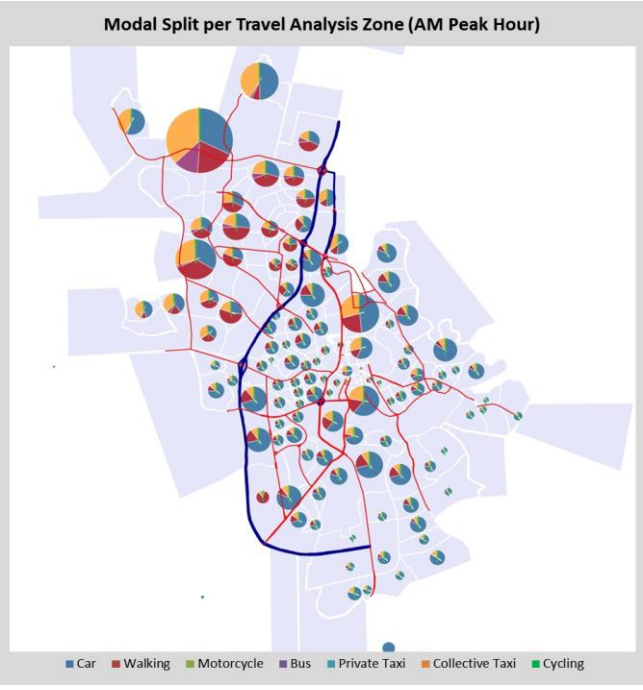
Windhoek's population is rapidly growing at 4.3 % per annum, above the national growth rate of 2.6 %. As a result, more housing, more jobs, new infrastructure and services will be required to meet such demand in the future. A key task of the Government of Namibia and the City of Windhoek is to cater for the growing population and future demand of the growing economy and to plan for the fast increasing transport needs.

Transport affects Windhoek's resident's daily lives in different ways, for instance in getting to and from work or being able to access essential services such as health, education, recreation in all areas of the City and for all parts of the population. Transport also affects private sector opportunities and the efficiency of the transport system can back-up or constrain business.

While the CoW operates on a smaller scale compared to most other cities in the world, the present trends observed are comparable: reduced accessibility and thus social isolation and exclusion caused by inadequate mobility of the urban poor, ever increasing traffic congestion, high road and parking facility costs, unacceptable high rate of traffic accidents, high consumer costs, energy dependence and pollution.

To better appreciate the transportation system of Windhoek, it is necessary to understand how the city's population is changing. Besides the high population growth, for a combination of historical, policy, and reasons of geography, densities in Windhoek remain relatively low compared to other African countries. This aspect of the urban form, when viewed together with the street configuration and density, the existence (or lack) of sidewalks and cycling lanes, the existing transport system and land use mix, is significant in terms of commuting behaviour, average commuting distances, time and costs. Below, Figure 1 shows the outcome of this configuration on modal split in Windhoek. The "north-south" divide in terms of the use of taxis and walking as the predominant mode in the northern higher density suburb of Katutura compared to the use of cars in the southern districts is dramatic.

Figure 1-1: Modal Split per Traffic Analysis Zone



These dichotomies are symptomatic of the Namibian society and are by no means confined to urban transport. As recent reviews of Namibia's economic and social performance aptly show,[1] the country has made tremendous progress in some areas, especially institutionalised democracy, peace and stability and a well-managed economy. But, in other areas there remain key challenges to be overcome. This includes addressing the related problems of inequality in income distribution and lack of employment opportunities.

The three key priorities identified under NDP 4 are (1) faster and sustainable economic growth, (2) creation of employment opportunities, and (3) enhance income equality. The government believes that addressing the triad goals would put Namibia on a sustainable development path. Also the Namibian Vision 2030 strives for a considerable growth in GDP and employment. Developing and implementing sustainable urban transport systems in the main urban areas, such as Windhoek, which are the engines of growth will enhance prospects of meeting those ambitious targets.

Representatives of the Namibian Employers Federation and the Namibian Association of Manufacturers stated that the unsatisfied mobility demand is meanwhile seriously hampering business in the capital. The business community is partly addressing the problem of mobility obstacles by providing own transport for their employees via hired private and company owned busses or via paying transport allowances. Transport allowances meanwhile are a major cost item raising the overall cost of labour for the business. An example might be the City of Windhoek itself: the transport allowances for their employees in last year's budget amounted to more than 40 million Namibian Dollar.

Indicated in Figure 1-1 above, the backbone of the public transport system in Windhoek is the taxi industry. Taxis account for more than 35% of all trips made, while only 4% make use of municipal bus services. This is not surprising as total car ownership is 114 cars per 1000 inhabitants[2] and concentrated on the households of the southern suburbs of Windhoek (please refer also to figure 9, existing vehicle ownership per dwelling).

However, it must be stated that taxis are the most uneconomic backbone one can think of considering that each taxi can only accommodate a maximum of 4 passengers and on average is transporting much less. Uneconomic in terms of high fuel consumption per passenger kilometre (pkm) and thus high pollution, high vehicle operation costs per pkm, higher space consumption per transported passenger and last but not least higher accident costs. Overall this adds to higher costs for the passengers and the overall society compared to an integrated public transport system delivering higher capacities on main transit corridors.

Aggravating is the fact that individual car users have a 97 times higher accident risk then public transport users on regulated bus and train systems. And, especially taxis are a frequent cause of endangering situations on Windhoeks roads as Namibian police officials' state[3].

Overall, the road safety situation in Windhoek is terrifying and benchmarked with international standards extremely high[4]. Some latest figures from 2012 support this statement: In the Windhoek Central Business District (CBD) just in one month (October 2012) there were a total of 486 accident cases taken note of by the Namibian Police, i.e. more than 16 accidents per day happen on a relatively small area of the city. Of course some of those accidents caused only minor damages, but some of them involved serious fatalities and people were suffering and dying. The Police reports that in the majority of accidents taxis were involved. Overall, according to the MVA statistic about

[1] See, for example, Republic of Namibia, 2012 *Namibia's Fourth National Development Plan 2012/13 to 2016/17*, Windhoek, NPC), "Introduction", pp. ix-xi

[2] Source: UITP – Report on statistical indicators of public transport performances in Sub-Saharan Africa, 2010

[3] Presently, the accident statistic is improved and will allow better analysis of accidents in the country.

[4] As a comparison: The low density country Sweden has vision zero for road fatalities and had last year just 28 road fatalities per million inhabitants compared to Namibia with 240 fatalities per million inhabitants.

fatalities and injuries from 1st of January up to 31st of December 2012 already 506 lives were lost in road accidents and 5289 injuries were reported to them.

Provisions for non-motorised transport the second most important means of transportation in the northern and central parts of Windhoek are in-adequate, interrupted and for bicycles almost non-existent (for more information please refer also to chapters 2.3 and 6).

In view of the on-going high increase of its population, Windhoek has the advantage of still being able to influence future settlement structures in a manner that transport also can be avoided before it is generated (for more information please refer also to chapters 2.1 and 2.5).

The City of Windhoek backed by the Namibian Government decided as a first step to embark on a sustainable urban master plan pro-actively addressing the problems, challenges and chances briefly indicated above. In chapter 2 the existing situation is more thoroughly analysed.

This draft master plan outlines the strategic approach for necessary investments, but also for enabling soft measures, thus allowing the decision makers to lead the Capital of Namibia towards an efficient, affordable, accessible, attractive and reliable public and non-motorised urban transport system. It paves also the way to cascade the system to other regions in Namibia and in the African continent.

1.3. Stakeholder Engagement Process

The involvement of stakeholders from the beginning was meant to ensure that the final Master Plan will have their mandate, that they would participate in developing measures suitable to improve public transport and non-motorised transport in the study area, and that eventually they would also support implementation of the Master Plan.

Also, stakeholders assisted in technical inputs such as data collection, data provision, data selection and data assessment; put forward general and or detailed ideas, measures and projects that should be assessed; and help in the shaping and selection of appropriate solutions. The main stakeholders as well as immediate counterparts and beneficiaries of the project are:

- The City of Windhoek
- Ministry of Works and Transport
- Ministry of Regional and Local Government, Housing and Rural Development

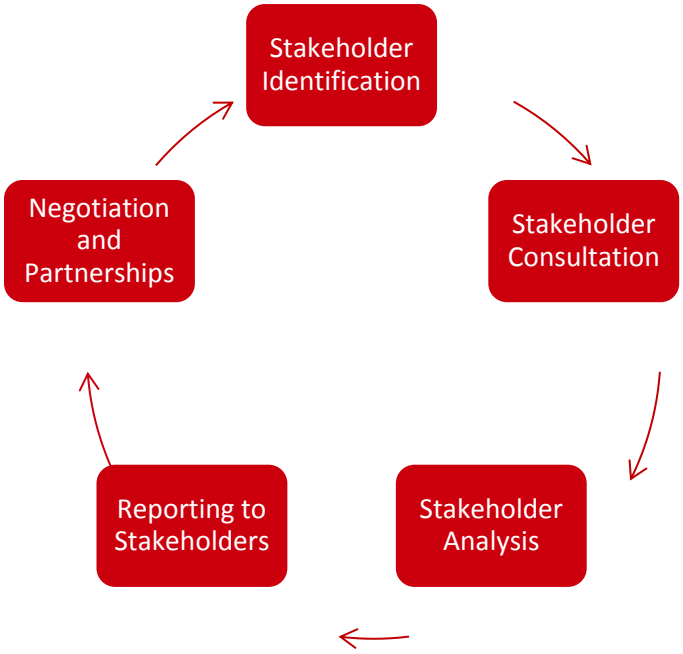
Other stakeholder comprised private and statal or parastatal groups and individuals directly or indirectly concerned such as the Namibian Employer Federation, representatives of the taxi industry, representatives of the bicycle community, urban planners and architects to name just a view of them.

The stakeholder engagement was a two way process, i.e. via the stakeholders the project team got a better understanding of the needs and ideas but vice versa the Consultant was in many of those meetings also able to contribute to capacity building and achieving a better understanding of international state-of-the-art discussion on sustainable transport.

It is important to note that the idea of the SUTMP project was very well received by all stakeholders contacted. In all discussions, workshops and also in individual gatherings, there was mostly positive feed-back to be observed, aside from some legitimate concerns of the taxi industry.

Stakeholder engagement during the development of the Master Plan followed a number of carefully thought out and iterative steps (see Figure 1-2), involving (1) stakeholder identification (2) stakeholder consultation (3) stakeholder analysis (4) reporting to stakeholders, and (5) negotiation and partnerships.

Figure 1-2: Stakeholder Engagement Process



Initial stakeholder identification was done by GIZ before the start of the project. This was then followed by the first consultative meeting held on January 2012 where the proposal to develop a Master Plan for the city's transport system was discussed and endorsed. Soon after the launch of the project in July 2012, further identification of additional stakeholders was done using engagement approaches built around communication, consultation, in-depth dialogue and working partnerships. The First Stakeholder Consultation Workshop after the launch of the project was held at 4th of September 2012, among other things, to raise awareness about the SUTMP, share information about the state of transport in Windhoek, provoke conversation about possible courses of action, and to generate sufficient interest and active involvement in the SUTMP process.

The Keynotes address was read by the Honourable Erkki Nghimtina, Minister of Works and Transport, Government of the Republic of Namibia. Her Worship Alderwoman Elaine Trepper, Mayor of the City of Windhoek gave the opening remarks and welcome while the Deputy Head of Mission in the German Embassy, Mr Andre Scholz gave a brief history of the relations and cooperation between Germany and Namibia. Some impressions from this workshop are given in the pictures below.

Figure 1-3 First Stakeholder Workshop with Honourable Erkki Nghimtina et al.

In the period leading to, during and after the first stakeholder workshop, a stakeholder analysis was carried out to identify and critically assess groups or individuals who can affect, or who can be affected by the Master Plan to participate in dialogue around key strategic issues in an effort to align mutual interests, reduce risk of stakeholder dissatisfaction, and improve the overall sustainability of the project. The outcome of this process was a Stakeholder Analysis Report, which was submitted to the client and shared with stakeholders. The stakeholder report also contains the complete documentation of the September Stakeholder Workshop.

Building on the various engagement platforms already developed, a structured and sustained process of stakeholder engagement was implemented based on accessible and responsive means for individuals and groups to provide inputs to, as well as raise concerns and interest, about the Master Plan through information sharing, (internal) SUTMP newsletters, focus groups, community consultations, standing stakeholder technical groups, online feedback and discussion forums (e.g. via the Facebook page: www.facebook.com/movewindhoek), high-panel meetings, etc.

Those engagement platforms delivered a healthy debate on various ideas and perspectives from different stakeholders which were carefully analysed, amended, evaluated and pulled together for inclusion in this draft report of the SUTMP.

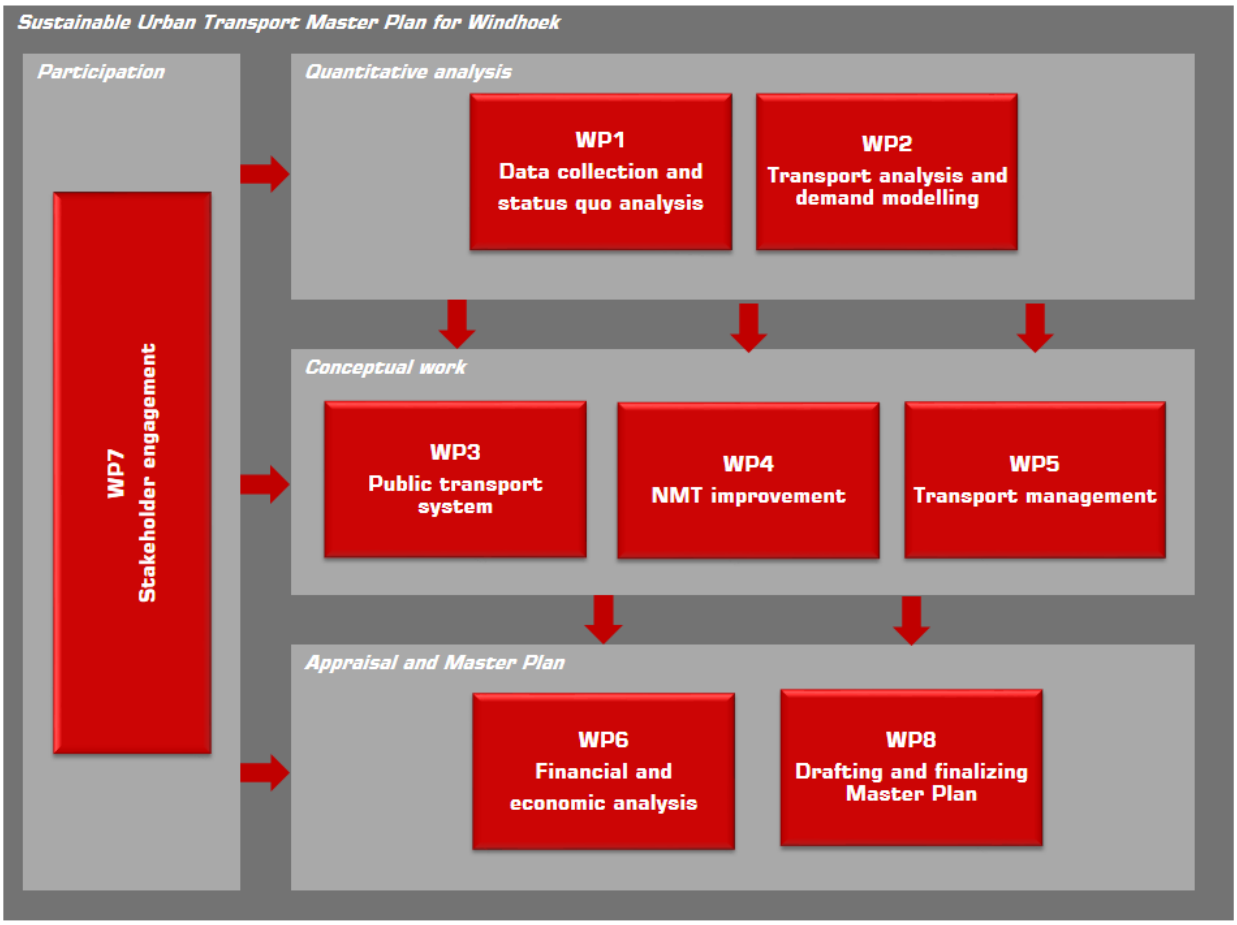
Once completed, the Draft Master Plan was presented to stakeholders for review and informed comments. They were incorporated to this final Master Plan. This final Master Plan will be the framework for negotiating and forging working partnerships to oversee its successful implementation. By all indication, it is anticipated that there will be the next stage of a healthy debate during the next stages of the master plan project, i.e. feasibility and design stages (please refer also to chapter 10).

An overview of major stakeholders engaged in the master plan development process is given in **Annex A** of the technical Annex Report– Contact list. Also the stakeholder report gives some more details about the role interest and involvement of all stakeholder involved.

1.4. Implementation Process

In order to achieve the project purpose given in chapter 1 and identifying and addressing the problems briefly scheduled in chapter 1.3, the SUTMP project execution was sub-divided into eight main tasks respectively work-packages (WP). All tasks within the elaboration of the master plan are strongly connected and interdependent and required a close cooperation within the team and with third parties.

Figure 1-4: The eight major tasks conducted in the Master Plan implementation process



The project contract started at 9th of July with the mobilisation of the project team and review of major relevant documents by the project team. A SUTMP kick-off meeting (1st Steering Committee Meeting) took place at 18th of July. Further major milestones during project implementation are given in figure below.

Figure 1-5: Major Milestones of SUTMP implementation:

The entire SUTMP implementation process was guided by a Steering Committee consisting of the key stakeholders of the project, i.e. representatives of the Ministry of Works and Transport (MWT), the Ministry of Local and Regional Government, Housing and Rural Development (MLRGHRD), the City of Windhoek, the Polytechnic of Namibia Department of Land Management and the GIZ Transport Project in Namibia. However, due to many other obligations of the delegates, the Steering Committee Meetings were only called upon in cases of major information and dissemination needs or up-front major project milestones. Additional cooperation and coordination needs were covered in day-to-day meetings with the individual steering committee members. All minutes of the Steering Committee Meetings are attached in Annex B of the Technical Annex Report.

The state-of-the-art technical master plan implementation process is given in more detail in the respective technical chapters and does not need any further description in this chapter.

A major achievement in this respect – via several project interventions – is that the necessity of combining land-use and transport planning is endorsed and also reflected in the last reorganisation of the City of Windhoek administration. This is unique for Sub-Saharan Africa and when properly applied and enforced will set benchmarks for the entire region as it increases the attractiveness and efficiency of public and non-motorised transport and contributes to considerable reductions in environmental damages.

As given already in the previous chapter in more detail, the entire master planning implementation process took place in a highly participatory and interactive approach. During numerous meetings, conferences, presentations, site visits, website consultations and other means, the project team captured all necessary data and information for the planning process; ideas were exchanged and the project team gained a thorough understanding of needs and realistic targets and directions. The media coverage attained was very satisfying and positive, e.g. in TV as well as all major Namibian newspapers.

It is important to stress again that all meetings were also used by the project team to raise awareness for and advise the counterpart entities and stakeholders about a more sustainable approach in urban transportation.

The foundation for a real shift towards a more sustainable approach in urban transport was also laid by the two strategic directions and decision-making workshops resulting in a Memorandum of Understanding forwarded to the councils of the City of Windhoek as well as the municipalities of Rehoboth and Okahandja as well as to the Permanent Secretaries of the MWT and the MRLGHDR for endorsement (Annex C of the Technical Annex Report). The outcome of the strategic directions workshops resulted also in a Cabinet Memorandum. For more details please refer to chapter 3 – Strategic Direction.

This awareness and cognisance on all Government levels and also in the broader public created a momentum and the process appears now to be irrevocable. However, this momentum can be lost again if implementation process starts to get lengthy.

In order to elaborate sustainable transport measures for the study area, best practices and lessons learnt world-wide were thoroughly taken into account and guided the work of the project team. For this purpose not only a view to the neighbouring countries of Namibia was taken but also our personnel experiences from European cities, South American cities and Asian countries. However, what works in one city does not necessarily work in another one. Windhoek and its neighbouring cities and regions are unique in terms of land-use patterns and in terms of its political culture which are reflected in its legal and institutional framework. Thus, it has to find its own way towards a sustainable urban transport system and intensive stakeholder engagement guaranteed that this way could be found.

The Sustainable Urban Transport Master Plan gives the overall picture, but again: it is just the beginning of a long way towards more sustainable transportation in the study area. The master plan

implementation process requires strong political commitment on all levels and ought to be managed and guided by renowned transport professionals. It needs to be accompanied by further stakeholder engagement and public hearings, by creating the enabling institutional and legal framework and last but not least by intensive capacity building measures as the proposed strategic measures, changes and investments are quite unique to Namibia and the respective know-how has to be established prior.

The Master Plan needs periodic up-date and refinements matching the planned and forecasted situation with the actual. Furthermore, it needs implementation capacities and implementation monitoring. The necessary up-dating and monitoring process will be described in the form of a separate policy paper before May 2013.

When implemented as suggested, the City of Windhoek will be one of the benchmarks in the SADC region. The City will become more attractive; more efficient; safer; highly accessible for all parts of the towns and for all parts of its inhabitants, with an enabling environment for the business and tourism sector and will contribute - direct and indirect – towards higher employment and growth (please refer also to chapter 9.4 Multi-criteria Analysis).

1.5. Report Format

The format of the SUTMP report was laid down already during the first stakeholder workshop in February 2012 where the GIZ Transport Project Namibia together with the main stakeholders were planning the overall outline of this SUTMP project.

This report format was confirmed in principal at the first Steering Committee Meeting and slightly adapted and finally agreed upon during the 3rd Steering Committee meeting.

For easier handling, the report is divided in three parts:

- The **Project Overview and Summary Report** giving the main background information, findings and recommendations in an easy to read format to be disseminated to a broader public.
- The **Main Report** describing in detail the methodology and the outputs to be disseminated to the steering committee members.
- The **Technical Annex Report** containing all further information, maps and calculations necessary to justify and evaluate the proposed measures and the implementation process. This technical annex is determined for the in-depth understanding of the tasks carried out and to be disseminated to the expert level of the steering committee members.

In this main report, the next chapter 2 describes in-depth the existing transport situation and the expected framework conditions and their implication on transport demand. Chapter 3 describes the development and creation of consensus among the main stakeholders and decision makers on the principal strategic directions for achieving more sustainable mobility patterns in the next 20 years' time horizon.

Chapter 4 gives the institutional and legal framework conditions before chapter 5 and 6 describe the process of elaboration and the main recommendations for the future integrated public transport system and improved non-motorised transport system. Thereafter chapter 7 relates to the transport management intending to make better use of capacities, strengthen the avoid-shift-improve measures and last but not least contribute to a considerable reduction in the terrifying road safety situation starting with the City of Windhoek, where 50% of all accidents happen. Chapter 8 makes then a brief excursion to relevant intercity transportation.

The evaluation of all of the proposed measures is given in chapter 9 and is cumulating in an implementation and financing plan given in chapter 10 of this report.

2 Existing and Future Conditions

In this chapter the existing transport situation in the study area and the expected framework conditions and their implication on transport scenarios as well as on traffic demand modeling and forecasting are described. Investigations were based on data collected and elaborated from numerous sources with CoW departments being the most important one. In the next paragraph just a view of the main data sources are outlined.

The initial information on transport networks (road/rail) and traffic analyses zones (TAZ), along with the necessary socio-economic data were already at hand with the consortium due to previous transport studies in Windhoek. Socio-economic and road data were updated with the help of data received from the CoW (Mr. Browney, Mr. Lisse), data on public transport networks (bus and rail lines, bus stops, taxi ranks, PT operational data) were updated by the consortium through field surveys (partially with support from Polytech) and information got from public transport department of the CoW (Mr. Rupingena) and from the Municipal Traffic Police (Mr. Eiseb). Updated information on road networks were also provided by Polytech on the basis of high resolution aerial photos. Traffic count data were obtained through actual traffic counts, organized by the consortium. Information on actual land uses and future land use schemes were provided also by the CoW. Further input data mainly for the socio-economic background was derived from a 2011 census and other material obtained from NPC as well as from latest traffic accident statistics from the MVA and other sources.

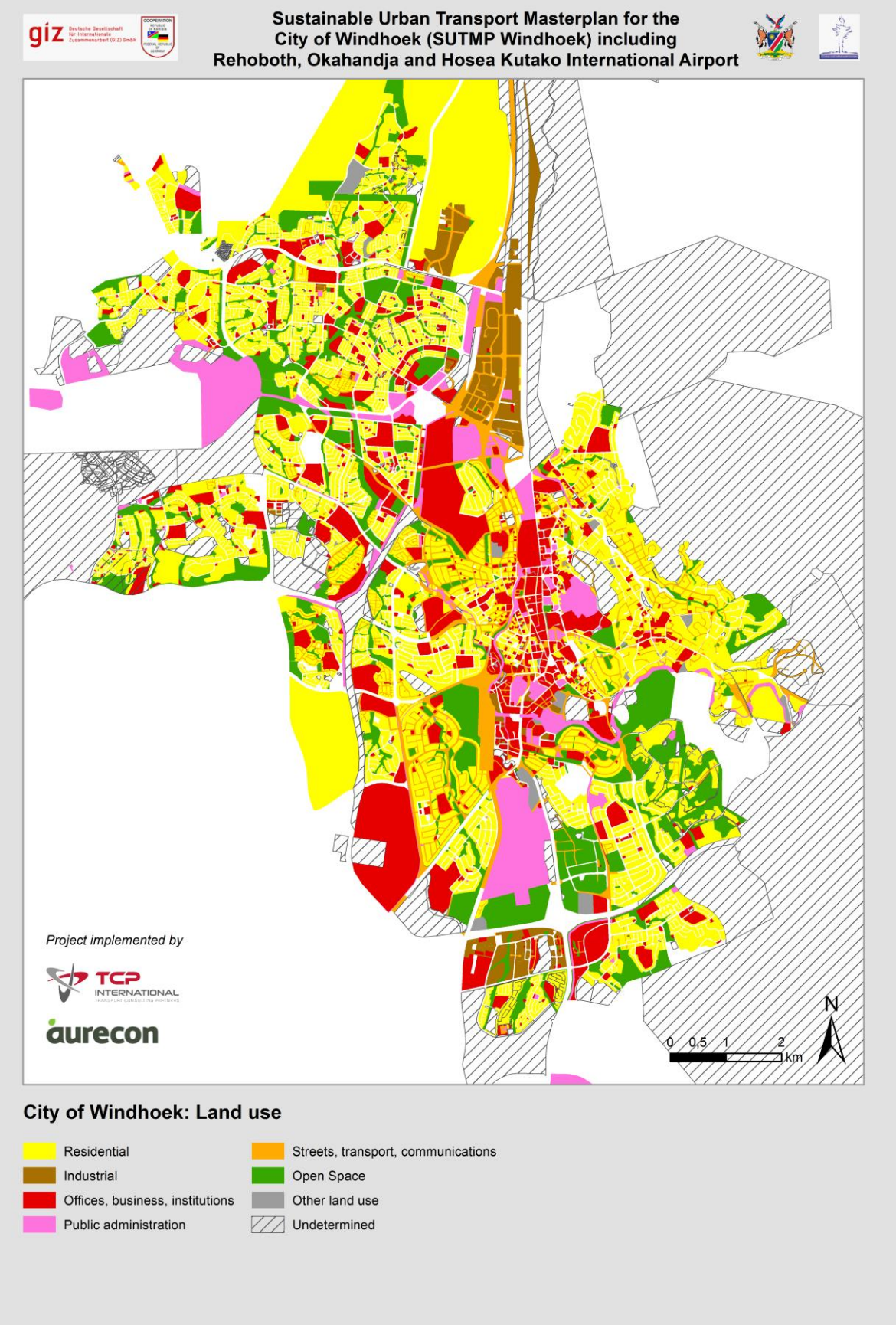
2.1. Existing Land-use and Actual Structure Plan

The City of Windhoek sits on a sloping plain on the northern side of the Khomas Highlands, surrounded by hilly and mountainous areas to the West, South and East. Windhoek´s settlement area covers almost the entire plain between these mountain ranges.

Windhoek has a broad distribution of residence areas across its territory (see Figure -2-1 on next page). Extensive residential areas can be found in the North, in the West and East, as well as in southern townships. If however one goes into further details, the settlement structures and the socio-economic characteristics of the different townships are not that unique as its spatial distribution suggests, since the socio-economic and socio-demographic characteristics of the different residential areas differ to a large degree.

Low income households with large household sizes in high population density areas can be found towards the North and North-West, most of them representing informal settlements, while affluent household live in low-density areas in single-family houses towards the East, with significantly lower population densities. Residence areas towards the South-West are predominantly characterized by middle-class households, with small to medium densities.

Figure 2-1: City of Windhoek – Present land use



There are two main industrial areas in Windhoek, one in the North (Northern Industrial, Lafrenz), another one in the South, where most of the manufacturers and companies reside.
Offices, business, and other types of institutions and areas of public administration are concentrating in the CBD of Windhoek, as well as in a North-South-corridor along the main railway line (south of Lafranz-main station-CBD-southern city centre-Prosperita/Olympia). In addition, some areas for public administration are also located in the North and, smaller patches, also elsewhere in the town. Presently, the retail sector is concentrating in the CBD, with some exceptions e.g. in Katutura and Olympia.
All these different types of settlement areas are separated by a connected system of open spaces, some of them which represent formal parks or sports facilities, many of them which are waterbeds kept free from development as drainage beds in the event of heavy rainfalls. The open space in Windhoek on the one hand can be seen as a structuring element to provide room for leisure activities and to ensure better micro-climates (wind circulation), on the other hand the open space can be used as interconnected system of paths or connectors linking the various townships with each other.

The three maps on the next pages show the existing population density and average income distribution in the suburbs of Windhoek and also the average number of vehicles per dwelling with some short explanations underneath:

Figure 2-2: The highest population figures can be found to the North-western part of the city of Windhoek. These areas are characterised by their informal structures. The areas with the highest population figures are Okuryangava, Wanaheda, Goreangab and Havana with population figures ranging from 4401 to 28 000.

Figure 2-3: A majority of the high–income areas are clustered around the City Centre. Typical urban models that are CBD centred show that the land values are greater around the CBD than the outskirts of the city. Thus, all the low-income earners are generally decentralised from the CBD and are located to the outskirts of the city centre.

Figure 2-4: From the map it is clear that there is no correlation between the number of vehicles and number of people in a defined area. The highest level of car ownership is in the low-density areas. There is however a strong correlation between car ownership and the level of income; the high income areas have the highest level of private car ownership.

Figure 2-2: Existing population density in Windhoek

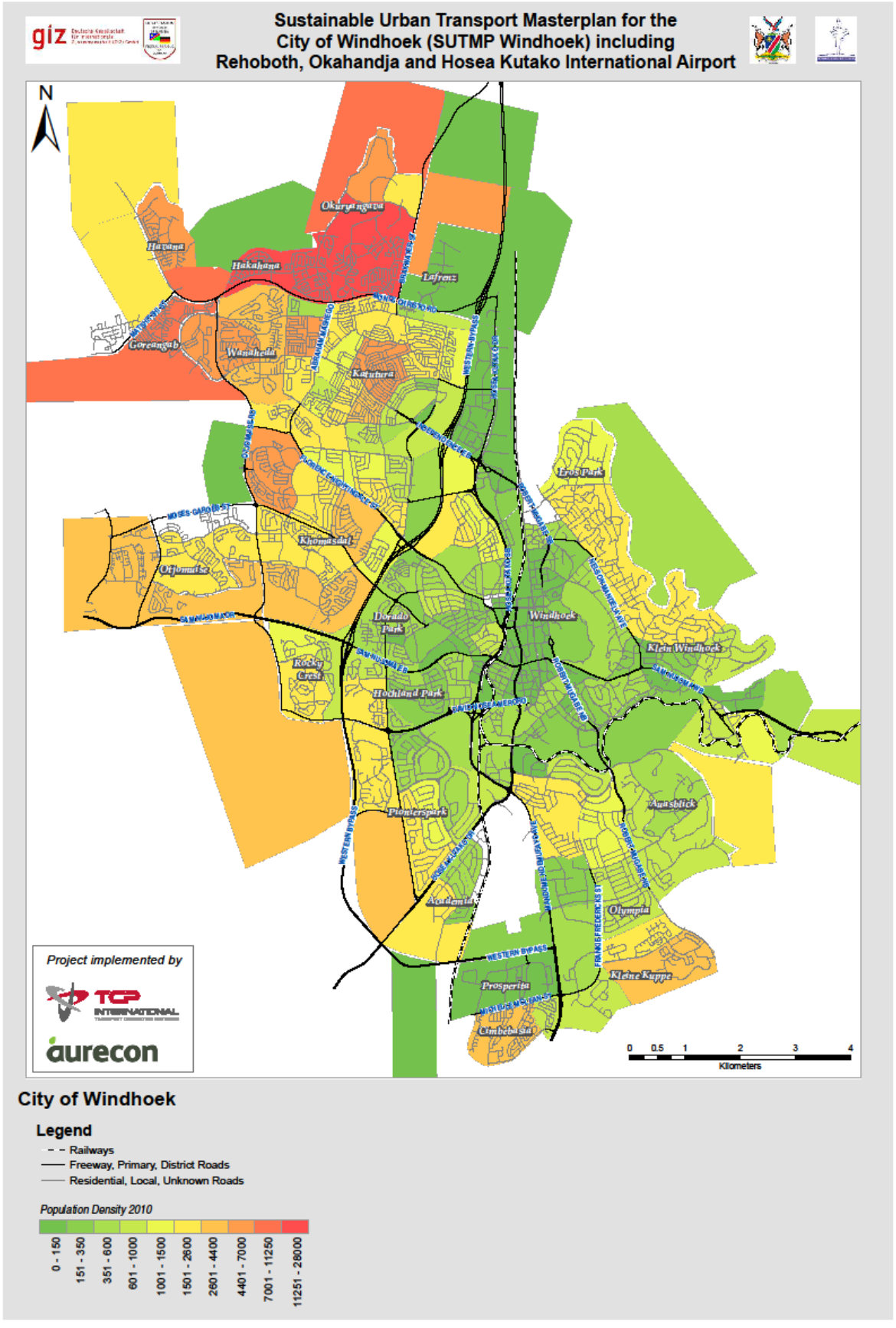


Figure 2-3: Existing average income distribution in Windhoek

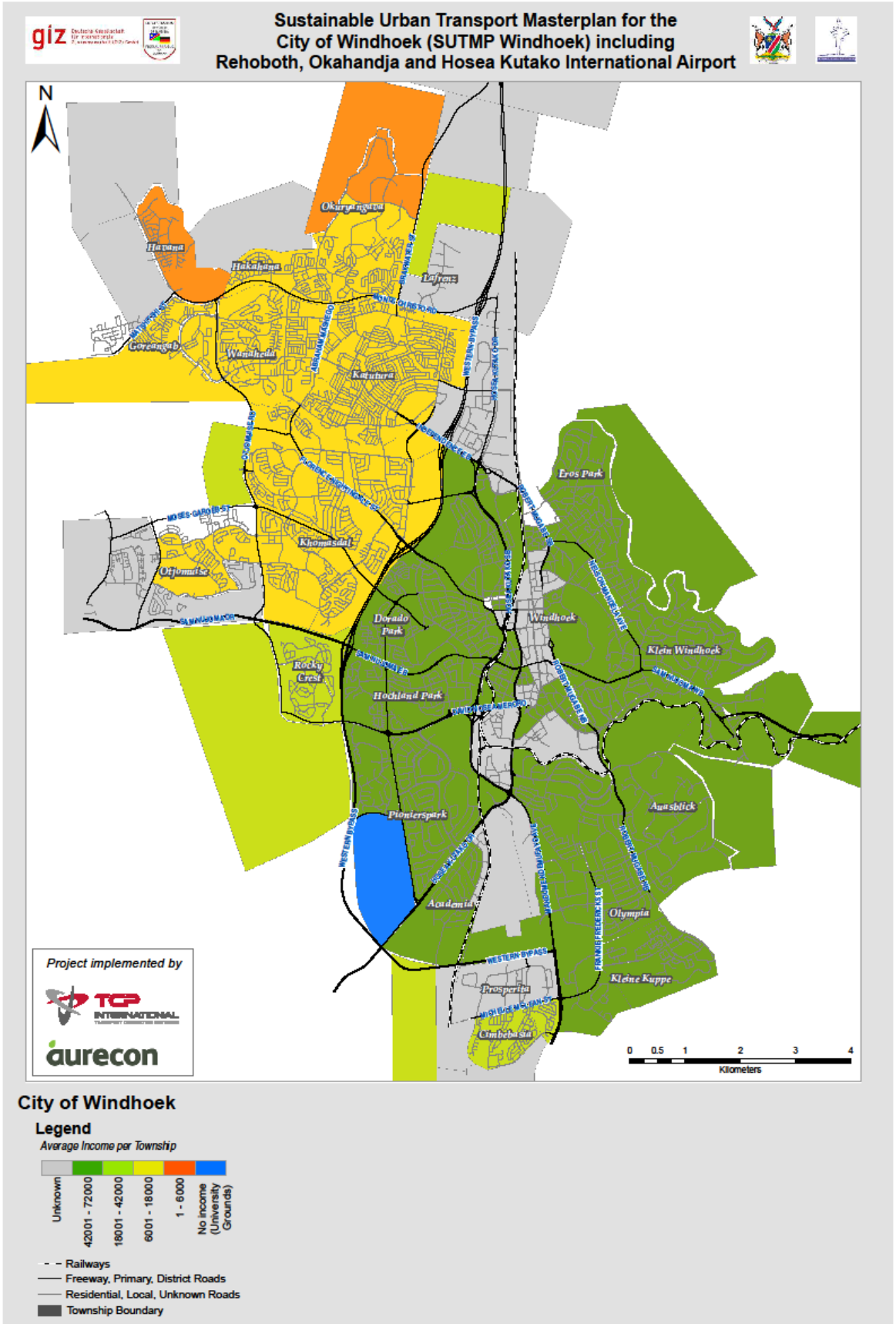
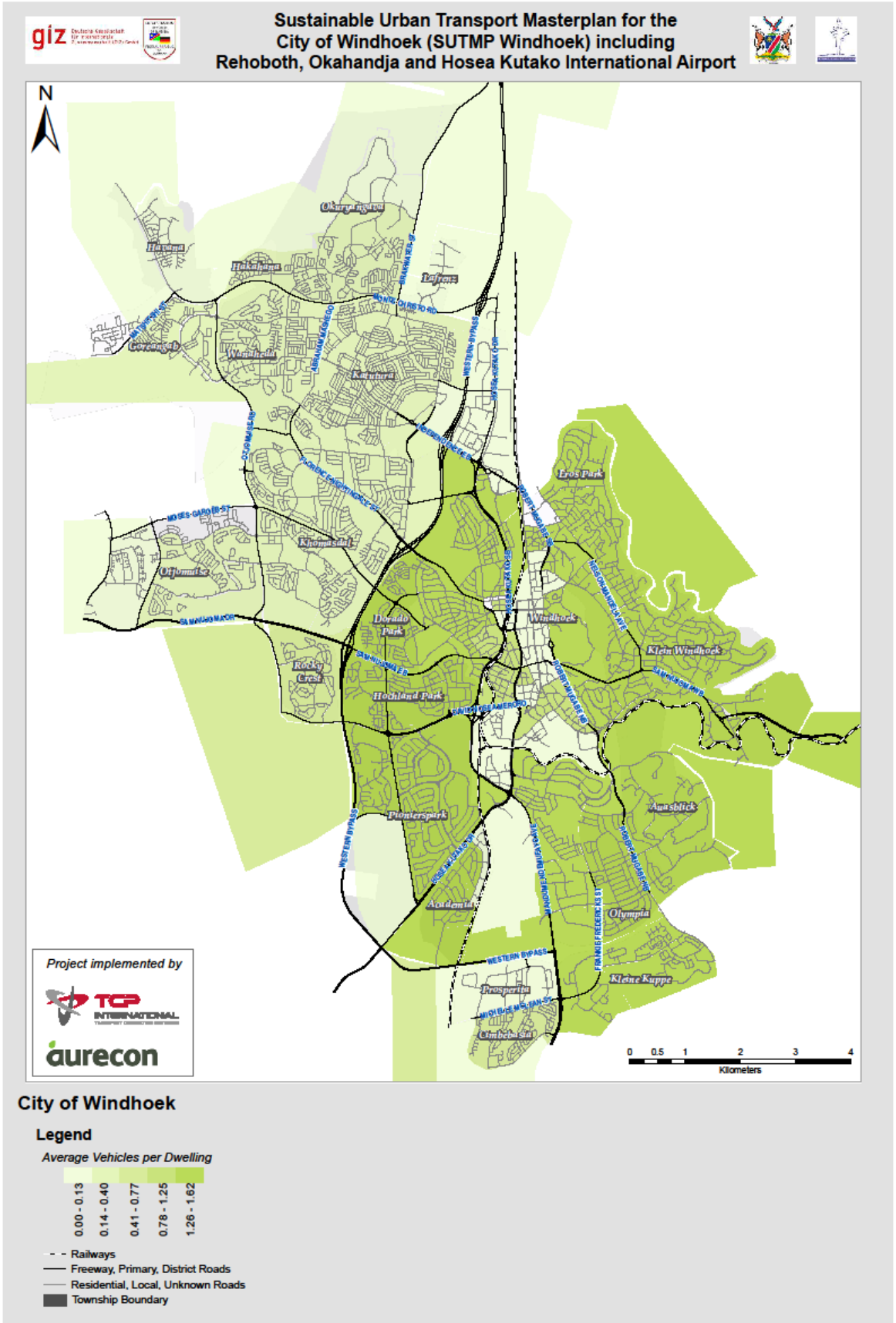


Figure 2-4: Existing average vehicles per dwelling



Some further maps are attached to the Technical Annex Report (Annex D). They give a further visual impression on the explanations above and are briefly introduced in the following Table.

Figure 2-5: Land-use and socio-economic patterns

Map	Title	Description
Map 1.1	Population density	The highest population figures can be found to the North-western part of the city of Windhoek. These areas are characterised by their informal structures. The areas with the highest population figures are Okuryangava, Kakahana, Wanaheda, Goreangab and Havan with population figures ranging from 4401 to 28 000.
Map 1.2	Land use	CBD, commercial, industrial and institutional land-uses, including retail and open spaces. As shown, it is evident that there is an adequate open space network in Windhoek that connects to all major land uses and retail centres. This is specifically important the formulation of attractive NMT routes.

Due to its geographical location, with rocky areas towards three directions (West, South, East), and due to the presence of underground aquifers under the southern townships, further city expansions for Windhoek are challenging, leaving vast Brakwater/Elisenheim area towards the North as the only feasible and reasonable option, apart from some minor settlement sides. By way of consequence, the actual Structure Plan of the City of Windhoek identifies the Brakwater / Elisenheim area at the northern fringe of the present settlement as the main city expansion area. Acknowledging that this Structure Plan is already 14 years old (approved in 1996), and given the expected population growth until 2032, it becomes evident that the expansion areas designated in the existing Structure Plan is not able to capture the entire expected population growth.
The chosen land-use scenario approach as described in Chapter 2.5.3 tries to further develop the land use schemes to cope with the expected population increase, based upon the present Structure Plan. A renewal of the structure plan is presently envisaged by the City of Windhoek and is expected to relate on the strategic decisions for the chosen land-use scenario (please refer also to chapter 3 concerning the strategic decisions taken).

2.2. Existing Transportation Systems and Characteristics

In this sub-chapter a brief abstract of the existing traffic situation in the urban road sector is given. The chapter is devided in urban roads, individual motorised transport and public motorised road transport. Non-motorised transport is further referred to in sub-chapter 2.3.

2.2.1 Urban Road Infrastructure

City of Windhoek's transport system is characterised by an extensive road network of 812 km with most roads having a good surface condition. Just in the new and mostly informal developing settlement areas there are still gravel roads to be observed[5]. Road widths for single lines in each direction are between 8 and 13 meters, delivering comfortable conditions for motorised road users and allowing fast speeds. In addition several arteries with four or six lanes deliver fast access to most

[5] The Integrated Business Plan 2011 - 2016 of the City of Windhoek addresses this issue by giving priority to the up-grading of informal settlement areas amongst others by road surfacing activities.

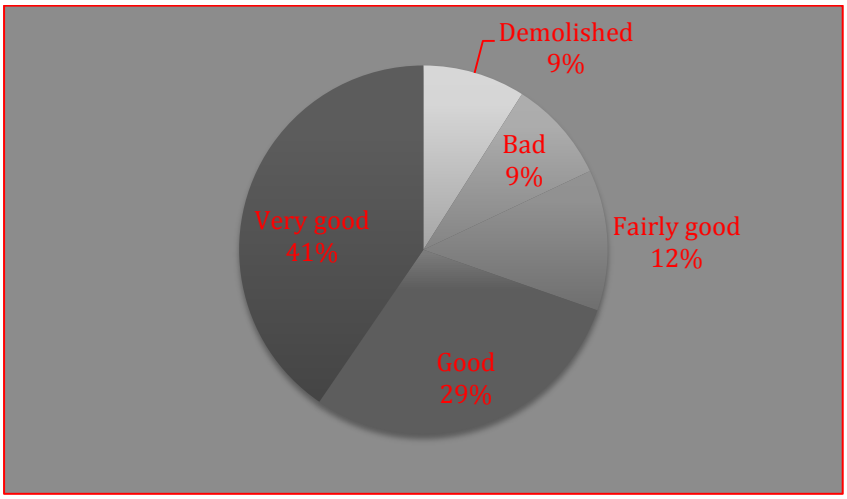
suburbs. On the entire network a speed restriction of 60km/h is applied (for details also refer to chapter 2.7). In some residential areas speeds levels are reduced by humps requiring the car users temporarily to slow down to 40 km/h. One of the arteries, i.e. the Western Bypass is a national road with no level crossings and speed limit is between 80 and 120 km/h. In all major junctions, there are robots installed which are partially interconnected. However, there is a severe lack of facilities for pedestrians and cyclists along the roads (for details refer to the following chapter 2.3). Also there is no exclusive or shared right-of-way for bus operations provided for in the road reserve.

2.2.2 Existing Public Transport Infrastructure - Bus and Rail

2.2.2.1 Infrastructure

In the entire city area, there is no dedicated bus lane in the road reserve observed. But, there are a total of 160 bus stops along the entire bus route network maintained by the City. Out of this number, 8% have "shelter in both directions", 47.2% have "shelter in one direction" and 44.8% have "no shelter". Results of a GIS based survey undertaken under the auspices of the project team by interns from the Polytechnic of Namibia are attached to the SUTMP technical annex report (see also the map table below). They show that none of the bus stops has either timetable or fare information and 85% do not have any bus stop sign. In terms of the condition of shelters, the majority of the shelters are either in "good" or "very good" condition, keeping in mind that 67 out of 160 have no shelters at all.

Figure 2-6: Shelter conditions at bus stops in Windhoek



Windhoek has the great advantage of a railway line passing the entire study area from Okahandja in the north crossing the Windhoek northern industrial area, the CBD and the southern industrial area

and going further on towards Rehoboth. Furthermore, one line is going from the CBD eastwards towards Hosea Kutako International Airport. However, this line is presently hardly used for passenger services and not at all used for innercity public transportation.

Further information about the existing bus and rail infrastructure is given in the Technical Annex Report in the form of maps as briefly described in the following table.

Figure 2-7: Public Transport Infrastructure for Bus Services and Rail

Map	Title	Description
Map 2.1	Bus stops and bus routes	The map shows the bus routes and bus stops. All scheduled buses depart from most areas of the north-western residential suburb of Katutura, including Goreagab and parts of Otjomuise to various employment locations in the east, the south and in the city centre.
Map 2.2	Type of Busstops	The map shows wether the bus stops on the road are marked or not or wether it is in the form of a bus cap.The majority is in the form of a bus cap.
Map 2.3	Availability of Signs indicating a bus stop	The map gives the location where bus stops are marked. 134 of the total are not signed at all and thus hard to recognise for the (potential) users.
Map 2.4	Availability of Shelters	The map shows where shelters for passenger convenience are provided at the bus stops.
Map 2.5.	Shelter conditions	The map shows the shelter condition of the bus stops. Very good and good condition stops can be found mainly in the central districts, no shelter at all or poor conditions are to be found mainly in the outer areas of Windhoek
Map 2.6	Current Advertisement	This map shows that presently only 19 out of the total of bus stops are used for the disposal of advertisements. This leaves room for future income generation via advertisements at additional stops.
Map 2.7	Current Bus Stop Service Areas	This map shows that the catchment area around municipal bus stops for 250, 400, 500, 700 and 1000 meter is fair. The majority of the population has access to a bus stop within an acceptable walking distance of 400 – 700 meter. However, it shows also very clear, that some outskirts and the entire Khomasdal area are not covered at all by municipal buses.
Map 2.8	Linear Distance of selected public facilities to the closest bus stop	This map shows selected public educational facilities such as Kindergardens, Schools, Polytechnic and University. The map clearly reveals that bus routes do hardly touch those educational facilities and distances are mostly more than 300 meter and more for the children and juveniles to overcome. Besides no buses are going after school hours.

Map 2.9	Railroads in Windhoek	The map shows the existing railway right-of-way crossing the entire Capital and the industrial lines distributed mainly at northern industrial area and along the eastern branch line.

2.2.2.2 Operations

The City of Windhoek operates the public passenger bus service, but faces a number of challenges, chief among them being that services are only available from Monday to Friday in early mornings and in the afternoons and are therefore not readily accessible to the commuting public throughout the day and at week-ends as in most other cities. Furthermore, there are no interchanges connecting different routes within the city and the present bus fleet cannot satisfy at all peak hour demands. The operations and maintenance of the bus fleet are also a challenge due to the poor conditions of the buses most of which are old and unreliable.

In the morning, buses depart from most areas of the north-western residential suburb of Katutura, including Goreangab and parts of Otjomuise to various employment locations in the east, the south and in the city centre. In the afternoon it is vice versa. In 2012, the Municipal Bus Division introduced one student after hour bus line for students of the International University of Management, Polytechnic of Namibia and University of Namibia. Students are picked up from the above mentioned campuses from Monday to Thursday at ca. 16:45 and ca. 19:45 with drop off at various bus stops in 14 city suburbs. The Khomasdal area is not served by any buses as a private bus operator holds the operating licence but is presently not offering any service in this area.

Currently, the municipal bus service has a fleet of 79 buses, although only about 55 are operational at any given time, due to the poor conditions of the buses most of which are old and unreliable. The majority, i.e. 59 of the buses were purchased before 1992 and there are just 20 buses bought thereafter (in 2010). Also, average mileage per bus is with 49 km per day or 17 178 km per bus per year very low compared to international standards[6], and, also keeping in mind that many bus km are run empty between the depots and the start respectively the end of the designated routes. In addition, the bus fleet does not allow for comfortable and fast embarking and disembarking thus excluding elderly, small children, mothers with trolleys and handicapped people from the system and leading to lengthy standing times at bus stops.

City of Windhoek bus fare is N$5 per trip for the Smart card which is available at 3 sales points in the Municipality in Independence Avenue, Katutura Customer care and Wanaheda. If the commuter pays in cash the fare is a fixed N$6 no matter where the destination is. Although this information is currently not publicised at bus stops as is the tradition in most other countries, it will soon be made available on the SUTMP Website via this link: http://www.movewindhoek.com.na/transport-type-categories/bus. Compared to average bus fares in other cities in Africa of US$0.31 per trip, passengers in Windhoek pay US$0.35 more per trip.

[6] For example in German Cities yearly average bus km is between 80 000 and 120 000 km depending from shape of the city and organisation of the bus company.

Figure 2-8: Average Bus Fares in US$ per Trip

User perception is key to understanding the quality of public transport systems. Users combine - conscious and unconscious - the following factors in their perception: route network, intervals, reliability, travel time, fleet, stops, stations, terminals, information, communication, customer service, travel experiences and interaction between passengers. So it is quite obvious that there is some room for improvement. Still, usage of public transport doubled from 1 to 2 million passengers between 1998 and 2011 according to statistics of the Public Transport Department of the CoW.

2.2.3 Existing Public Transport System by Taxi

The private taxi industry – explicitly favoured through the Government transport policy e.g. stated in the "White Paper"[7] of 1994 - has taken over and provide with small car units public transportation on specific routes and zones. So, taxis clearly dominate the market for urban public transport services in Windhoek and the surrounding region.

2.2.3.1 Infrastructure

In Windhoek, taxis are providing there services from 295 official taxi ranks. There is a concentration in the city centre as well as in the middle to low income areas of Khomasdal, Rocky Crest, Hochlandpark, Dorado Park, Hakahana, Wanaheda, Goreangab, Katutura and Otjomuise due to the high need for transport services and relatively low volumes of car ownership in those areas. Until recently, there were only a few or no taxi ranks at all designated in the upper and high income areas (such as Eros Park, Olympia, Pioneerspark, Klein Windhoek, Academia, Prosperita, Cimbebasia, Auasblick) due to the relatively high car ownership in these areas. However, the Public Transport Division of the City of Windhoek continues to designate and provide additional taxi ranks based on application received from stakeholders.

Figure 2-9: Transport Infrastructure for Taxis

Map	Title	Description
Map 2.10	Taxi Ranks	In Windhoek taxis are providing services from 295 official taxi stops. However, taxi drivers allow customers to board / deboard everywhere and not just at designated stops. This behaviour leads to many safety hazards on Windhoeks roads.

[7] Please refer to the White Paper of 1994, chapter 5 - transportation

2.2.3.2 Operations

The size of Windhoek's registered fleet is about 6,815 registered taxis, equivalent to 190 taxis for every 10,000 inhabitants. The fleet tend to be mostly Sedans, the most popular models are Japanese, imported second-hand through Botswana, although Volkswagen has a significant share of the market. The maximum capacity for these vehicles is four passengers, but most of the time they operate with less than full load except during the morning and evening peak hours.

Taxis are ubiquitous in Windhoek and given that they operate as shared taxi, they are reasonably accessible. The evidence seems to suggest that most taxi users are within easy geographic reach of a taxi rank. In addition, if the seating capacity relative to demand is considered, there are approximately 76 seats available per thousand residents. The average for most African cities is 31 per 1,000 inhabitants.

The fares for taxis range from N$9 per trip if there is a taxi rank at destination, to double the fare (N$18) if the desired drop-off-point is not around a designated taxi rank or along the envisaged route. While taxi fares in Namibia are regulated, they still are far higher than the average for most African cities. While the Windhoek taxi fares translate to 1 United States Dollar at current exchange rate, the average minibus fare per trip in nine African cities samples is USD 0.26, which is nearly a ¼ of a single trip taxi fare in Windhoek.

The Windhoek taxi industry is currently regulated by the Ministry of Works and Transport and the City of Windhoek. A major challenge is the low level of organisation and transparency within the taxi industry and the level of unregistered taxis offering their services. Presently, there is the Namibian Bus and Taxi Association (NABTA), a taxi owner's association and by extension an employer's federation; there is NTTU a workers organisations representing the interest not only of taxi drivers, but that of the drivers in the entire transport industry briefly trying to gain momentum and there is a recently launched organisation known as the Namibia Public Passenger Transport Association (NPPTA) registered with the Ministry of Trade and Industry.

However, being the most visible form of public transport in Windhoek, it is generally acknowledged by senior officials of Government and key advisors that the taxi industry will have a major influence on the SUTMP as taxi owners and operators are a key stakeholder with vested interest in the public transport subsector. Meetings were held with all key stakeholders (i.e., CoW, MWT and the taxi industry operators/officials) to discuss the Master Plan's strategic objective of integrating taxis in the new public transport system.

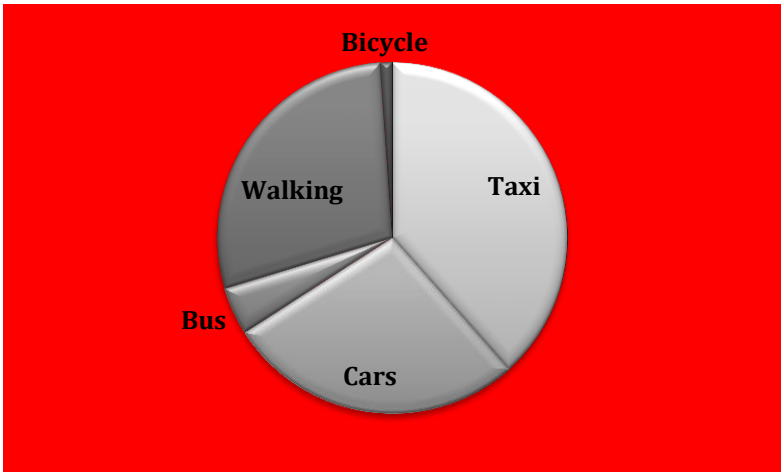
A glance at Letters to the Editor of most dailies as well as comments sent through to the SUTMP Facebook page (http://www.facebook.com/movewindhoek) reveals a general sense of user dissatisfaction with the predictability, level and quality of service provided by taxis. As one recent article summed it, "we expect a basic level of respect between the taxi driver and passenger when we take a taxi…We also should have somewhere to complain when we receive poor service from taxi drivers. There should be a governing board that holds drivers accountable and suspends or disciplines those who cannot comply…".

2.2.4 Overall Urban Mobility and Traffic Patterns in the Windhoek Area

As indicated already in the previous chapters, a significant portion of actual travel demand in Windhoek, including Rehoboth, Okahandja and Hosea Kutako Airport area is met by low occupancy vehicles (LOVs). The overall presently existing demand pattern is given in the following figure, the majority of travellers (ca. 40 %) currently use taxis and ca. 26 % use their private cars for their trips. Only 4% of the travel demand is met by municipal busses, while ca. 29% walk and ca. 1%

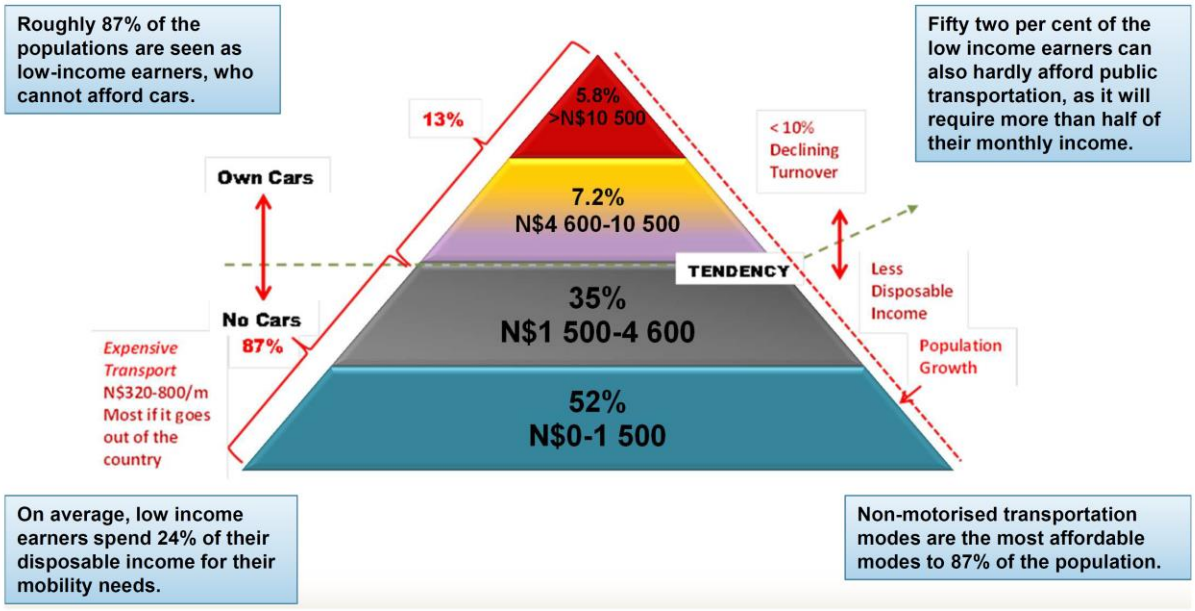
use bicycles. More details about existing and future mobility and traffic patterns are given in chapter 2.4.

Figure 2-10: Transport Demand by Mode in the Project Area



It is obvious, that to date, infrastructure planning and investment has favoured motorised transport at the expense of non-motorised transport, traffic demand management and public transportation. However, only a minority of the population has access to private cars (see Figure 2-11 below and also Figure 2-3 - map income distribution per dwelling) excluding the majority of the population from necessary mobility needs and opportunities or imposing incredible high portion of their income to be spent for their most pressing mobility needs.

Figure 2-11: Income versus vehicle ownership in Windhoek



The Figure above gives a short situational analysis of the current condition that the economy is faced with. As shown, roughly 87% of the populations are seen as low-income earners, who cannot afford cars. Fiftytwo % of the low income earners can also hardly afford public transportation, as it will require more than half of their monthly income. Thus, in terms of the present economic situation that the population is faced with, it is evident that non-motorised transportation modes are the most affordable modes to 87% of the population. On average, low income earners have to spend 24 % of

their disposable income for their mobility needs. Opposite to these facts, public spending for non-motorised transport facilities was only 2% of the CoWs 2012 road repair and maintenance budget (for more details please refer also to chapter 10).

Summarising it can be stated that the current economic pricing structure[8] is inefficient and unfair due to the fact that it stimulates travel by car and taxis, resulting in

- Increased income inequality due to reduced disposable income for urban poor;
- a high accident rate per person (Windhoek is 20% above Namibia's average);
- ever increasing traffic congestion requiring more and more funds for widening existing and building new roads;
- increasing environmental hazards (pollution, noise, etc.);
- reduced liveability and attractiveness of the City of Windhoek.

The car dependency combined with a notorious undersupply of walkways and cycle paths and affordable public transport options throughout the city means that travellers have little to no modal choice in their travel behaviour.

The existing situation for non-motorised transport users are further outlined in the next chapter.

2.3. Existing Pedestrian and Cycling Facilities

Over the last decade, almost no attention has been given to develop interconnected pedestrian and cycling facilities as an option to car or bus usage. By way of consequence, today the City of Windhoek almost entirely lacks walkways or cycling routes. Remarkable exceptions are

- Hosea Kutako Drive
- Mandume Ndemfayo Avenue
- Various blocks in the Inner City
- Independence Road

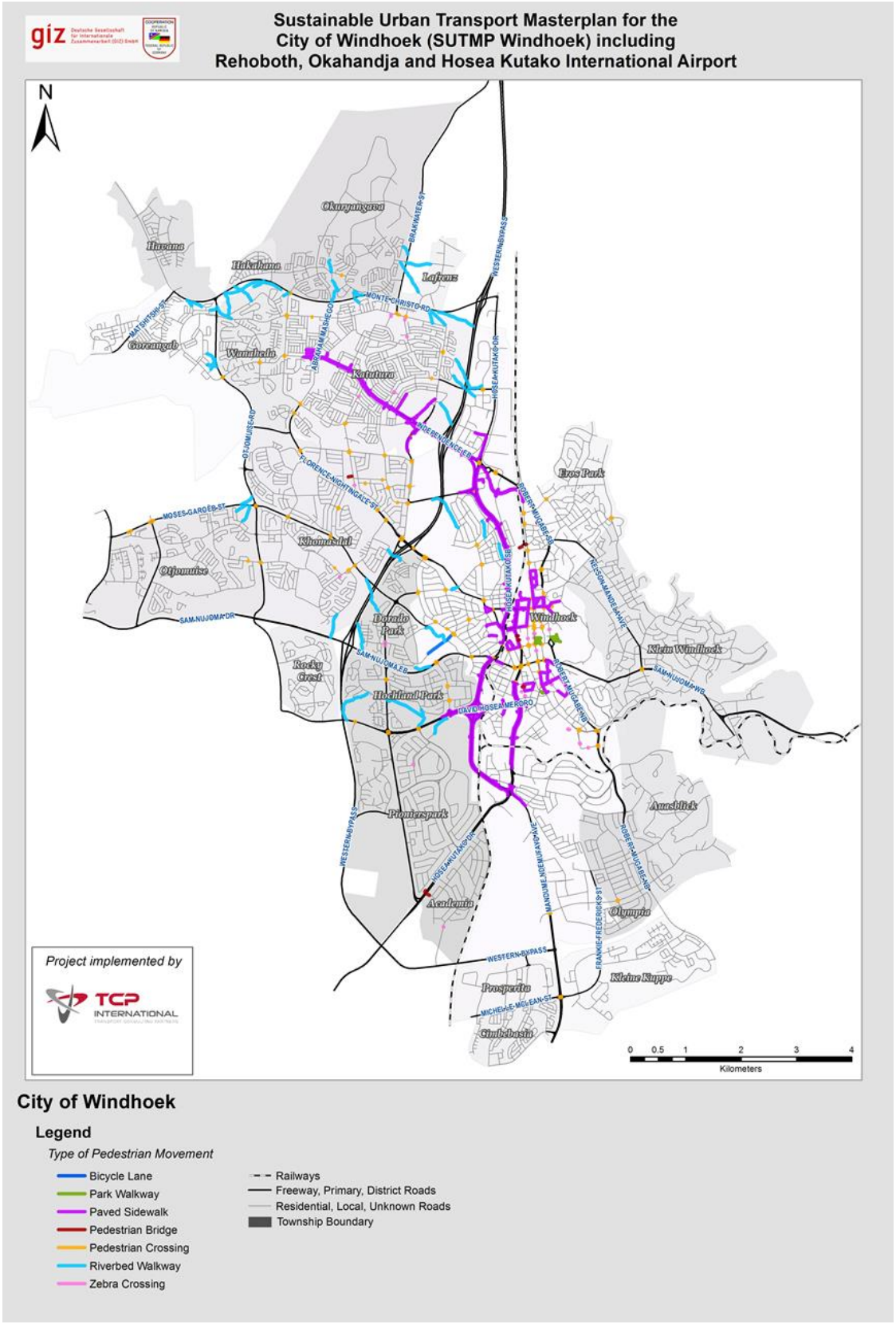
These routes are considered as routes that have some existing infrastructure for NMT users. The map below shows the extent of the fragmented existing NMT network.

Figure 2-12: Examples for prevailing NMT conditions along Windhoek roads



[8] Economic Pricing is a term used in macro-economic theory describing allocative efficiency in matching supply and demand. In markets with public good characters such as transportation, the state with its fiscal and other policies strongly influences the supply and demand and interventions need to be carefully targeted in order not to distort economic efficiency.

Figure 2-13: Existing NMT network



It is obvious that these few routes do not adequately provide safe and interconnected NMT infrastructures although the road reserve would easily accommodate s uch facilities. One of the consequences of absence of uninterrupted paved walkways and cycling paths is that walkers and cyclist are forced to use the roads, exposing themselves to car drivers who tend to overlook or even provoke walkers and cyclist, which leads to many fatal accidents and serious injuries.

As an alternative for NMT users to walk or cycle along roads, Windhoek´s extensive riverbed network is often used, even though paths through the riverbeds are not paved and people are exposing themselves to crime. Plans exist[9] to better interconnect the riverbed paths and to better integrate them with formal walkways and with origins and destinations, to become a backbone of the NMT network and attractive urban spaces in Windhoek.

Opposite to the walkers which have no voice despite their high modal share in the overall transport system of Windhoek, the leisure and sport cyclist community is quite well organised:

- Major cycling events are taking place and are being sponsored by leading Namibian private companies and banks.
- There are many private and non-governmental initiatives to promote cycling for recreational usage but also for commuter purposes and even for freight transportation.

Accessibility to various employment, health care, educational and recreational opportunities via NMT is seen as important aspects that were addressed in the formulation of future NMT routes.

2.4. Existing Transportation Demands

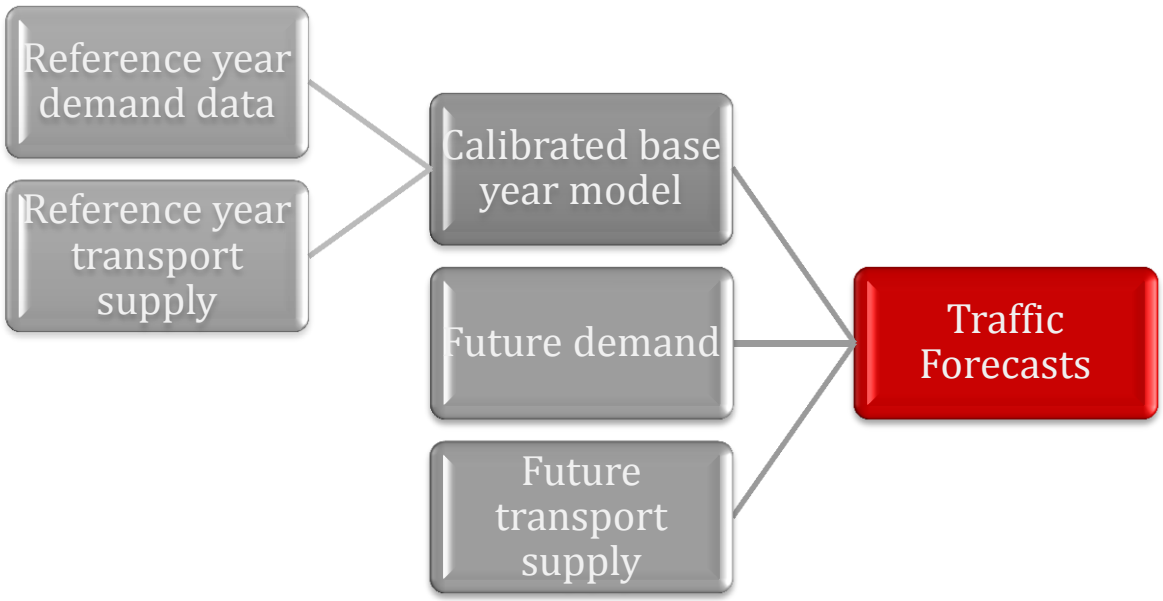
Transportation demand forecasting is the process of estimating the number of vehicles or people that will use a specific transportation facility in the future. Demand forecasting begins with understanding and quantifying the existing transport demands.

A traffic demand model was developed for the current situation. We call this the Reference Scenario (2012). This scenario depicts the actual situation in Windhoek. This scenario is only used as benchmark for the other scenarios, to compare with.

A transport demand model is a simplification of the real world. It replicates the transport system through mathematical equations based on some theoretical statements. When this model for the current situation is populated with forecast data for population and employment etc. the result is future transportation demand. The figure below illustrates the entire demand modelling and forecasting process. In this chapter 2.4 the reference year demand and transport supply is further described, chapter 2.5 gives an overview of the main key assumptions for future demand and transport supply scenarios and chapter 2.6 gives the result of the modelling and forecasting process.

[9] Urban architects presented their ideas for the river walk project to the CoW and plans exist for a pilot at the Klein-Windhoek riviere.

Figure 2-14: The transportation demand forecasting process[10]

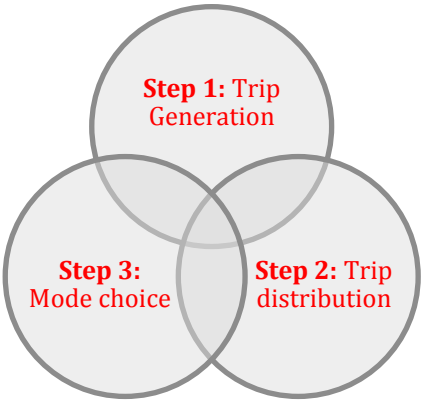


As part of the SUTMP the existing transport demand model for the City of Windhoek was updated. Transport models are problem and viewpoint specific. This newly created model is strategic in nature with a strong focus on the public transport component. The updated model was based on existing transport demand and supply model of Windhoek (2006). However, as the study area comprises now also Okahandja, Rehoboth and Hosea Kutako International Airport, the model was extended by those links.

The existing model is a trip-based demand model. A trip-based demand model is a behavior-oriented demand model which allows the planner to include all kinds of data/factors relating to socio-demography and traffic policy issues. Factors affecting passenger transport demand can be the location of work places, shops, housing areas, schools and other social facilities; the well-being of the community for domestic consumption (and this can be significantly affected by GDP and distribution of income); availability of transport modes; travel times; comparative comfort; reliability (incl. safety) or transport costs.

All traffic models work according to three inherent logical steps / work units as shown in the figure on the left, i.e they calculate the following:

- Trip generation: identification of volume of traffic at the origin
- Trip Distribution: mapping of the interlocking of traffic (origin-destination-relations)
- Modal Split / Mode choice: Percentage of transport mode used per origin-destination-relation and per purpose of trip of passenger as well as of good transports.



These three logical steps / work units are not processed separately in succession, but are interlocked. Especially steps 2 and 3, trip distribution and mode choice are carried out

[10] Source: Consultant's own illustration of general forecasting methodology

simultaneous in a single procedure. In all three work units two important concepts have been implemented: Calculation on the basis of groups with homogeneous behavior and activity chains.

2.4.1 Data for model update

The underlying data is crucial to a transport demand model. The model was updated with:

- Latest network information (chapter 2.4.1.1).
- New population and land-use information (chapter 2.4.1.2).
- Traffic surveys (chapter 2.4.1.3).
- Latest airport data and airport links (chapter 2.4.1.4).
- Inclusion of the Cities of Okahandja and Rehoboth (chapter 2.4.1.5).

Each step is explained in detail in the following chapters.

2.4.1.1 Latest network information

The existing model was updated with the latest GIS information received from the City of Windhoek. Maps attached to the Annex Report shows the updated network and are briefly introduced in the following figure.

Figure 2-15: Updated model network

Map	Title	Description
Map 2.11	Road Infrastructure / Number of lanes	The existing road network centreline information was provided by the City of Windhoek. The map shows the updated road network with the number of lanes per link. Windhoek has an extensive road network. The road width for single lines delivers comfortable conditions for motorised road users and allowing fast speeds. Several arteries with four or six lanes deliver fast access to most suburbs.
Map 2.1 / map 2.10	Bus stops and bus routes / Taxi ranks	For further descriptions please refer to chapter 2.2.2.1 Bus Infrastructure and 2.2.3.1 Taxi Infrastructure

The City of Windhoek has an Arterial Implementation Plan for 2030. This plan was developed in 2005. It incorporates ring routes, improved access in and out of CBD as well as improved east – west through movement. A 5-year first order implementation plan (First Phase) was also developed. Unfortunately the 5-year plan has passed by without securing funds to implement any of the projects. Maps attached to the Annex Report shows the *first to phases of the implementation plan*.

Figure 2-16: Arterial Implementation Plan

Map	Title	Description
Map 3.1	First Phase of the implement-tation plan	The First Phase of the implementation plan involves additional capacity on Sam Nujoma West (from Bach up to Bismarck); Monte Christo (from Hosea Kutako up to Hereford) and at the John Meinert / Hosea Kutako intersection on the left turn off ramp from Hosea Kutako onto John Meinert.
Map 3.2	Second Phase of the implementation plan	The map shows the Second Phase of the implementation plan. It includes capacity improvements on: • Sam Nujoma West (between the Western Bypass and Hendrik Witbooi Drive) • Sam Nujoma East (from Mission up to Gobabis District Road) • Florence Nightingale (from Bach up to Frans Indongo) • Aus Road (from Sean McBride up to Mandume Ndemufayo) • Hochland Road (from Mandume Ndemufayo up to Snyman Circle) • Otjomuise Road (from Independence up to Sam Nujoma); and • Independence Avenue from (Western Bypass up to Robert Mugabe Circle)

2.4.1.2 New population and land-use information

Land use[11] and population information are vital to both the trip generation and trip distribution phases in the modeling process.

The 2011 national population census data was used as the basis for determining the reference year population. The Namibia 2011 Population and Housing Census enumeration was successfully conducted from 28 August to 15 September 2011. The preliminary results were published in April 2012.

According to the 2011 Census data the population in Windhoek, Okahandja and Rehoboth combined was 384,400 in 2011. The Windhoek population of 333,100 is mainly concentrated in the North-western suburbs. The lowest population densities are found in the eastern and North-eastern suburbs and only a few people resides in the Windhoek CBD area.

The 2011 Census information was only available on constituency level at the time of the reference year model update. The population distribution was therefore based on the 2006 distribution among townships and then it was proportionally allocated to the traffic zones according to the number of residential erven. This appears to be justified because there were no major changes in the last 5 years concerning land-use in Windhoek. However, there might be some minor impreciseness concerning informal settlement growths in some of the townships.

The land use information from the existing model was used as basis for the land use information in the updated model. The base year information in the existing model was determined by taking the following into consideration:

- The erf size
- Property value

[11] Land-use is defined as the exploitation of land for agricultural, industrial, residential, educational, recreational, or other purposes.

- Improvement value
- Height of the building
- Coverage
- Zoning
- Bulk or density

Most of the information for the model and the mapping was obtained from the valuation roll, site inspections and by studying and incorporating information from the latest aerial photography of the city. The map in chapter 2.1 (figure 2-2) shows the population density. The Windhoek population is mainly concentrated in the North-western suburbs. The lowest population densities are found in the eastern and North-eastern suburbs and only a few people resides in the Windhoek CBD area.

The largest concentration of job opportunities is found within and around the Central Business District (CBD). Major job opportunities outside the CBD are found in the northern industrial areas and in the southern industrial as well as in Prosperitas.

2.4.1.3 Traffic surveys

Planning of the future transport system requires in-depth knowledge about present transportation demand. The City of Windhoek does not have a traffic counting programme and as a result these surveys have to be undertaken. Thus, for two weeks, starting on 25th September in all major arteries, more then 60 enumerators and their supervisors conducted various surveys and counts. It involved

- Classified intersection counts
- Link counts
- Vehicle occupancy counts
- Pedestrian and Bicycle link counts
- Origin destination surveys

The classified counts, vehicle occupancy survey and pedestrian surveys are of particular importance since the SUTMP will have a strong focus on public transport and non-motorised transport. The origin destination surveys are important as a result of the extension of the study area. The City of Windhoek does not have a traffic counting programme and as a result these surveys have to be undertaken.

A number of SUTMP partners and stakeholders have been closely involved in the traffic survey and traffic count, providing logistical support and technical input. These include the City of Windhoek (Public Transport, Planning, Design & Traffic Flow, and Traffic Management - City Police), Polytechnic of Namibia (Department of Land Management).

The traffic survey process involved the following:

- Supervisor training (theory)
- Trail supervisor survey (practical)
- Enumerator introductory training
- Conducting the surveys
- Data capturing, processing and analyzing

To prepare the survey team and ensure high quality results several training sessions as listed in the table below were conducted.

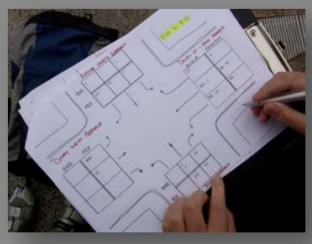
Figure 2-17: Traffic Surveys – Training Schedule

Date and Time	Training Session	Course Content
20th Sept 08:00-12:00	Supervisor Training	Theory Session
20th Sept 13:00-15:00	Trial Supervisor Survey	Practical Field Session
	Supervisor electronic capture of data	Practical individual session
21st Sept 08:00-11:00	Supervisor Training	Evaluation of the trial results
21st Sept 12:00-14:00	Enumerator-Supervisor Introduction Session	Joint session

Altogether nine supervisors were trained to perform and supervise five different types of surveys. Furthermore, more than 60 enumerators were trained and undertook the surveys. The surveys were undertaken at 34 locations over six days during end September to beginning October 2012.

For some of the counts the same survey locations were determined than for the original City of Windhoek traffic modell in order to have a timeline. New ones and especially the additional ones for bicycle and pedestrian surveys were determined in close cooperation with CoW technical experts. Maps attached to the Annex Report section D show the survey locations and are briefly introduced in the following figure.

Figure 2-18: Survey locations

Map	Title	Description	
Map 4.1	**Survey locations: Classified intersection counts**		The map shows the location of the 15 Classified Intersection Counts. The Consortium proposed that the counts and surveys be undertaken at the same locations as in 2004, with some additional counts proposed to improve the accuracy of the model.
Map 4.2	**Survey locations: Vehicle occupancy counts**		The map shows the location 6 Vehicle Occupancy Counts. Vehicle occupancy is of particularly important since the study will have a strong focus on public transport.

Map	Title	Description	
Map 4.3	**Survey locations: OD surveys and link counts**		The map shows the location 3 OD Surveys & Link Counts. OD surveys added great value especially since the study also focussed on longer commuter trips. 12-hour link counts were also carried out at these locations
Map 4.4	**Survey locations: Pedestrian and bicycle counts**		The map shows the location for the 10 Pedestrian & Bicycle Counts. It was proposed that 10 pedestrian/bicycle screenline counts be undertaken with the focus on the northern suburbs in particular between Katutura and the northern industrial area as well as Katutura and the Central Business District.

2.4.1.4 Latest airport data

The inclusion of Hosea Kutako International Airport necessitated the inclusion of the latest airport data. Hosea Kutako serves various national and international destinations such as Johannesburg, Cape Town, Walvis Bay, Accra, Berlin, Frankfurt, Luderitz, Lusaka, Maun, Ondjiva, Victoria Falls. On an average weekday there are 17 aircraft arrivals and 17 aircraft departures. Ninety % of these trips are international trips i.e. larger aircrafts.

For the model actual aircraft arrivals and departures with the associated aircraft and its capacity were used and occupancy of 60 % was assumed. This corresponds with the observed figure of a total of 750.000 passengers arriving and departing in 2011 and the observances from the OD surveys undertaken (please refer also to the next chapter 2.4.1.5). The forecast of airport travellers also relies on past statistics and prognosis done by the National Airport Company and its trendextrapolation.

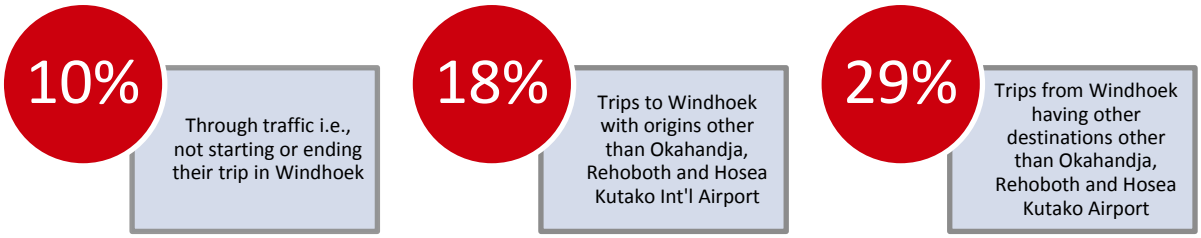
2.4.1.5 Inclusion of Okahandja and Rehoboth and Hosea Kutako International Airport

Due to the increase of land prices and housing rents in Windhoek over the last decade, Okahandja and Rehoboth became 'residential satellite towns' to Windhoek, seeing many people commuting to Windhoek on a daily or weekly basis. In consequence of the steep population increase in these two towns, traffic between Windhoek and Okahandja (Northern corridor), as well as between Rehoboth and Windhoek (Southern corridor) significantly increased, most of which served by informal and formal taxis. Although both cities do have a train station, there are no commuter trains connecting them to Windhoek.

Both cities were then subdivided into appropriate traffic analysis zones, and the required statistical data for each of these zones were gathered. The same applies to the link towards Hosea Kutako. The following table gives the survey results of the origin destination

Figure 2-19: Traffic Counts and Origin Destination Survey Results

		Okahandja to Windhoek	Rehoboth to Windhoek	Hosea Kutako International Airport to Windhoek
Daily public transport passengers		1,400	900	-
Morning hour peak traffic		10%	25%	14%
Main trip purpose	"To work"	34%	71%	"From Aiport"
	"Other"	66%	29%	67%



More information about traffic pattern is given in Chapter 2.6 – Projected Transportation Demand and about the current and future intercity demand in Chapter 8 – Intercity Transportation.

2.4.2 O/D Matrix Development and Up-date

Most of the traffic parameters such as employment zones and residential areas used in the previous model will still be used in the new model update assuming that although travel patterns may have changed due to population and land use changes, the underlying travel characteristics (in terms trip generation, destination choice and mode choice) of individuals will not have changed significantly since 2005.

The matrix development, i.e. the origin and destination within the traffic zones was followed by assignment to the model network. A matrix adjustment technique was applied to match the traffic counts and surveys as closely as possible.

2.4.3 Model Validation

The model validation aims at depicting whether the actual and observed traffic flows correlate with the predicted values. R square measures this correlation. The so-called linear goodness tells us whether the results of the model are useful or robust. In the case of the study area model, a comparison of observed link traffic flows (the traffic between 2 defined links with the modeled morning peak hour flows at 33 bi-directional count locations (thus 66 stations) yielded a linear goodness of fit R2 = 0.87 for private vehicles and R2 = 0.89 for public transport vehicles. This is

considered robust considering that the model developed for strategic purposes with a strong public transport focus.

This was however not the only means of model validation. Additional validation criteria were applied using the GEH test on individual link flows[12].

The GEH statistic is defined as:

$$GEH = \sqrt{(M - C)^2 / (0.5(M + C))}$$

Where M = the modelled flow

C = the observed flow

Eighty mine % of individual link flows for private vehicles resulted in a GEH statistic of 10 or less and 96 % of individual link flows for public transport vehicles resulted in a GEH statistic of 10 or less. This is considered good considering that the model was developed for strategic purposes therefore no matrix adjustment techniques were required to improve the comparison.

Summarising it can be said that both methods to check the validation of the strategic model proved the model to be adequately representing existing traffic patterns.

2.4.4 Reference 2012 Scenario Results

The Reference Scenario (2012) depicts the actual situation in Windhoek. This scenario is used as benchmark for the other scenarios, to compare with.

Annex D of the Technical Annex Report contains maps showing the AM peak hour vehicles and AM peak hour public transport passengers for the reference scenario. The main features of the existing traffic demand are discussed here.

Figure 2-20: Reference Scenario (2012) Results

Map	Title	Description
Map 5.1	Reference Scenario (2012) AM Peak Hour Vehicle Volumes	The map shows the AM peak hour vehicle volumes for the Reference scenario (2012). There are high volumes of traffic from the north and north-west of Windhoek moving towards the CBD. There is also a clear difference between the volumes moving from the north and north-west to the CBD, and the volumes originating from the south-east.
Map 5.2	Reference Scenario (2012) AM Peak Hour Public Transport Passengers	The map shows the AM peak hour public transport passenger volumes for the Reference scenario (2012).

[12] The **GEH Statistic** is a formula used in traffic engineering, traffic forecasting and traffic modelling to compare two sets of traffic volumes. The GEH formula gets its name from Geoffrey E. Havers, who invented it in the 1970s while working as a transport planner. The mathematical form is not a true statistical test, rather, it is an empirical formula that has proven useful for a variety of traffic analysis purposes.Using the GEH Statistic avoids some pitfalls that occur when using simple percentages to compare two sets of volumes. This is because the traffic volumes in real-world transportation systems vary over a wide range.

In the following figures 2-21 and 2-22, excerpts of those maps for Windhoek without new development areas are given.

Figure 2-21: Excerpt from Map Reference Scenario (2012) AM Peak Hour Vehicle Volume

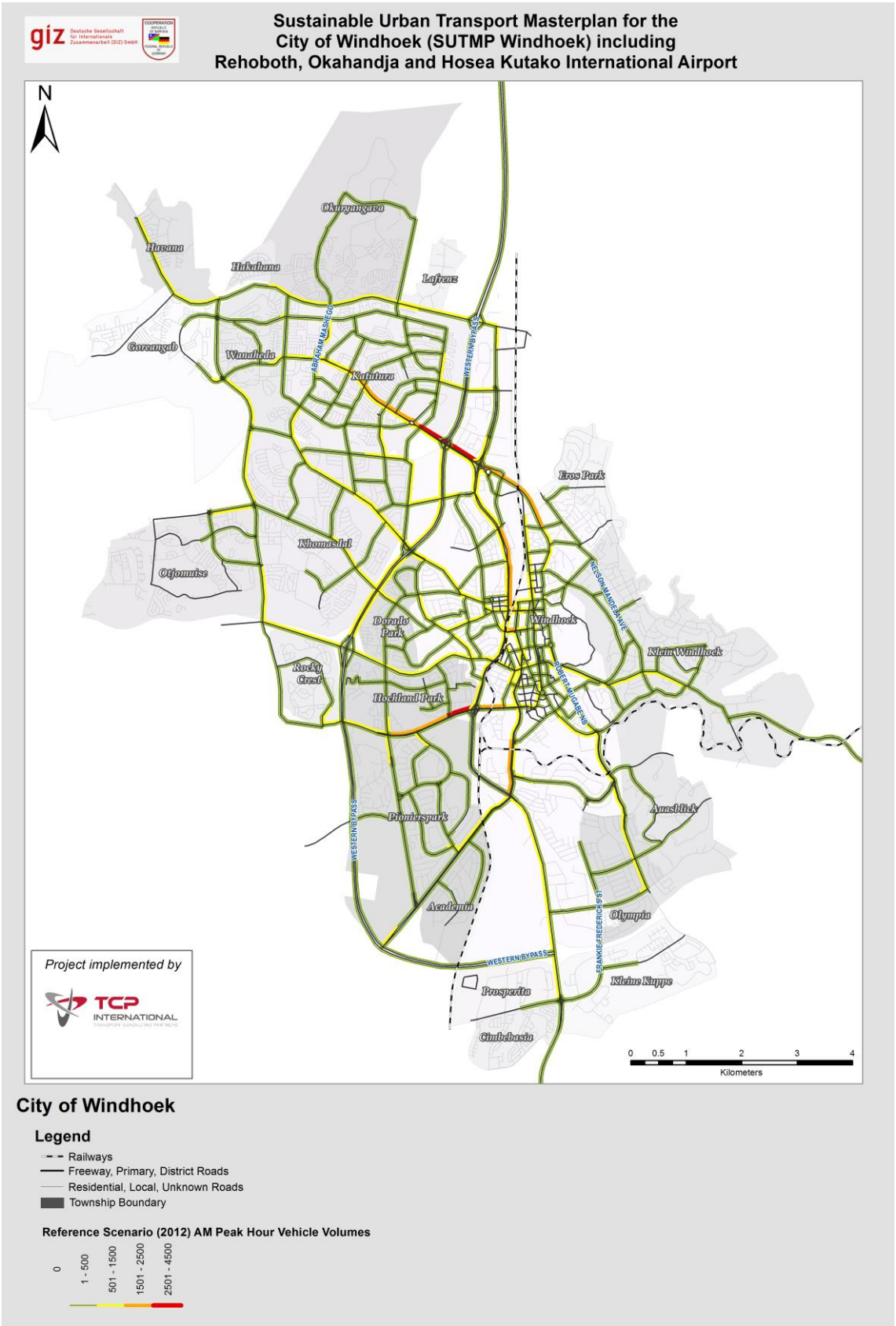
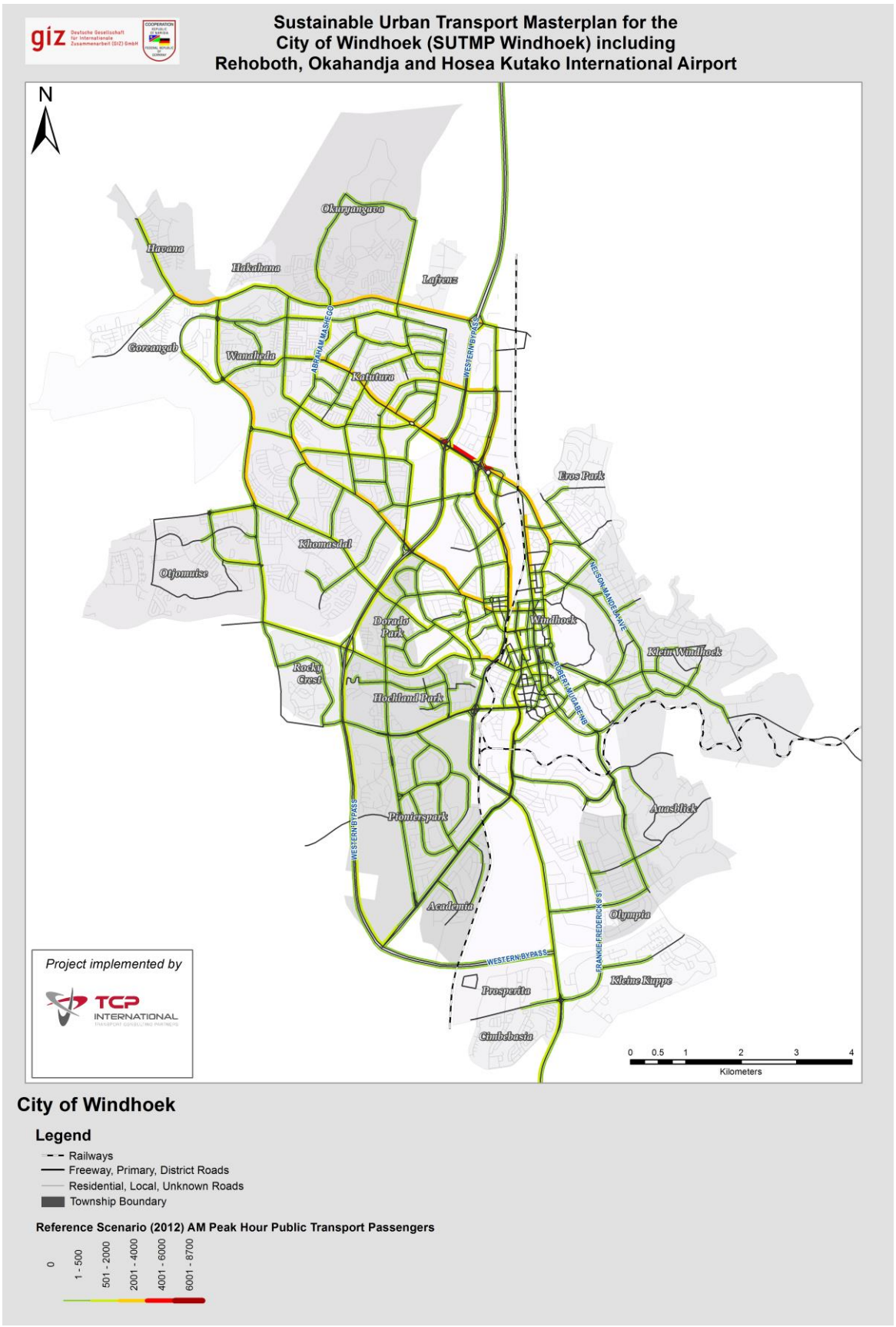


Figure 2-22: Excerpt from Map Reference Scenario (2012) AM Peak Hour Public Transport Passengers



There are high volumes of traffic from the north and north-west of Windhoek moving towards the CBD. This is due to the combined effect of high population densities in the north and north-west and the fact that the majority of job opportunities are located in and around the CBD.

There is a clear difference between the volumes moving from the north and north-west to the CBD, and the volumes originating from the south-east. This is due to the difference in population density and income levels between these two areas, with the majority of the Windhoek population residing in the north-west. Please refer also to the maps in chapter 2.1 (figure 2-2 to 2-4).

Public Transport passenger volumes reflect this movement from the north-west moving towards the CBD. It is noticeable that there are very few public transport users in the rest of the city besides those in the north-west. The PT-taxi dominates the public transport sector and the bus service is underutilized.

There are pedestrians in the whole Windhoek area, but the larger numbers of pedestrians are located in the north due to low vehicle ownership in those areas and lower income levels. Pedestrians include scholars walking to school, which explains the wide spread of pedestrian demand.

2.5. Population and Employment Forecasts

2.5.1 Framework Data

The demand for transportation is dependent on the population, the composition and location of the population as well as on the level and location of economic and socio-economic activities measured e.g. via GDP developments.

Thus, in close cooperation with the National Planning Commission and various stakeholders of the City of Windhoek and its neighboring cities this framework data was collected, reviewed, analysed and amended. The figure below summarises the expected demographic, social and economic development in the study area - if relevant in 5-year steps - until the study horizon 2032.

Figure 2-23: Framework Data as Input for Scenario Calculations

Framework data	Unit	Year	Value	Source/comment
Population development in Windhoek, Khomas region, Okahandja and Rehoboth (Trend)	Inhabitants	2011	384,400	Census data for 2011, CoW projections, trend projections
		2017	462,500	
		2022	555,500	
		2032	808,000	
Household Size Khomas Region	Persons/hh	2011	3.7	Population Census NIES 2009-2010; basic assumption is that in-migration mainly due to lower income households with larger household
		2020	4.1	
Household Size Hardap Region (Rehoboth)		2011	3.9	
		2020	4.3	

Household size Otjozondjupa region (Okahandja)		2011	4.1	sizes
		2020	4.1	
Economic growth rate Windhoek	GDP/Capita growth rate	Recent years	3-4%	City of Windhoek
		2011-2017	3.5%	expert evaluation
		2017-2022	4.0%	expert evaluation
		2022-2032	4.5%	expert evaluation
Income Khomas Region Income Windhoek Income according to quintiles	N$/capita p.a. 2011 price level	2009	36238	NIES 2009-2010
		2011	38819	Estimate
		2017	47719	Estimate
		2022	58057	Estimate
		2032	90161	Estimate
Unemployment rates	Unemployment rate	2000-2012	29.4%	NIES 2009-2010 Assumption: In-migration of unemployed
		2012-2032	29.4%	
Discount rate		2012-2032	3%	Used to discount net present value of costs and benefits

This set of framework input data was presented and discussed during the 3rd Steering Committee Meeting and agreed upon as a thoroughly elaborated and reasonable basis for all further calculations.

The following table gives some further information on the population assumptions summarised in column one of above table for the entire study area.

Figure 2-24: Framework Data as Input for Scenario Calculations

	2011	2017	2022	2032
Windhoek	333,100	406,000	495,000	737,000
Rehoboth	28,800	31,500	34,000	40,000
Okahandja	22,500	25,000	26,500	31,000
Sum	***384,400***	***462,500***	***555,500***	***808,000***

The scenarios differ in how the allocate population growth to the traffic zones However, it has to be stated that especially the estimate for the population figures is very conservative and sticks to official census, CoW projections and trends extrapolated from past developments. Unofficially the present population figures as well as the population forecasts are reported to be much higher and some statements estimate up to 1 Million inhabitants in the study area at the end of the study horizon. So in fact it can be stated that calculated trip figures are rather higher than lower resulting in even

higher positive impacts of PT and NMT measures (refer also to Chapter 9 for more details on the impacts) and some measure might become due earlier as given in the implementation schedule in chapter 10 subject to SUTMP up-date investigations.

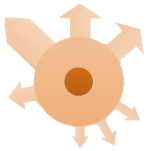
2.5.2 Land Use Scenarios

Future transport demand and traffic patterns are also heavily determined by future land use schemes. New settlements, densification of existing settlements, and other land use measure influence travel behavior of households and firms, so as new transport infrastructures influence location decisions of households and firms.

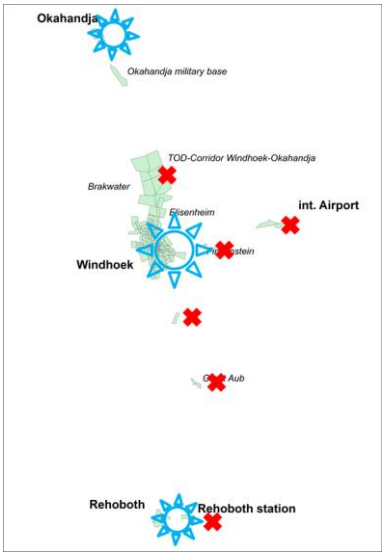
By way of consequence, when estimating future transport demand, considerations need to be given for developing integrated land use and transport planning schemes. For this purpose three land-use scenarios were developed. The land-use scenarios combine different settlement patterns with appropriate transport interventions based on existing structures and already envisaged developments such as Elisenheim or Kleine Kuppe. An expert assessment presented the possible impacts in a matrix form that allowed decision makers to choose scenarios according to their preferences at the Strategic Planning Workshop in November (for details please refer also to Annex E on strategic direction workshop presentations).

Besides the reference scenario for 2012, the following land use scenarios have been evaluated:

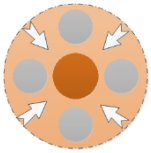
Scenario A: Business as Usual (BAU)



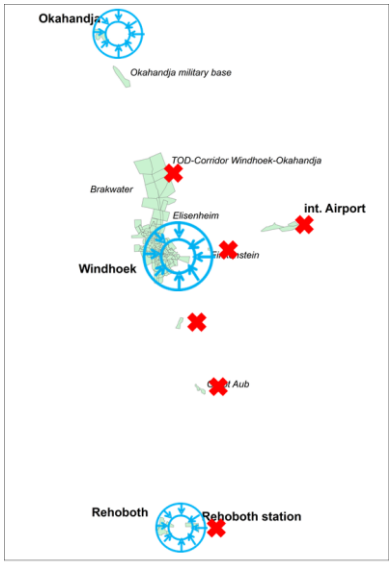
This scenario assumes a continuation of the present land use development trends. This will include further urban sprawl and the ongoing, independent developments of Okahandja and Rehoboth. Concerning public transport, only a loose integration of Elisenheim will be envisaged. No further developments are assumed in Finkenstein, Groot Aub, Omea beyond those that are currently ongoing. PT in Windhoek will be completely based upon bus systems. Only minor improvements to the current bus timetables / service quality will be implemented. Urban sprawl predominantly concentrates on the North-Western fringe of Windhoek. As this scenario just represents the current trends, no particular changes in land use and transport policies are required. There is, however, danger that the Daan Viljoen game reserve and other high ecological values areas such as water reserves are negatively affected.



Scenario B: Densification of Windhoek



This scenario will allocate the in-migration into the City of Windhoek by increasing population densities in existing settlements, and by creating higher density settlement schemes in vacant areas. In addition, public services, jobs of different kind and shopping facilities will be created in residence areas to achieve a higher mix of functions. This scenario will as well apply an urban edge around Windhoek, mixed land use and a moderate development of Okahandja and Rehoboth, where Okahandja and Rehoboth apply the concept of urban edges

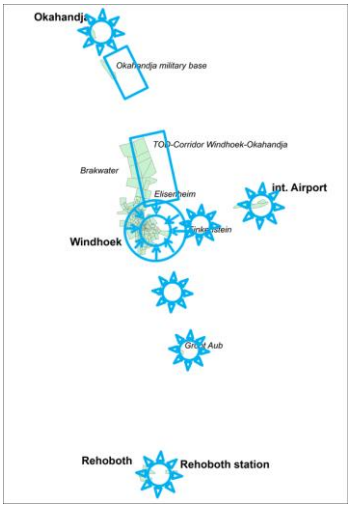


and mixed land uses as well. This scenario requires a step change in town planning schemes:

a) Development of high-raised buildings in mixed areas along major transport arteries (road and rail).
b) Conversion of industrial sites into residences and offices.
c) Conversion of 'traditional' low-density housing areas into dense settlement areas, including the demolition of existing buildings, based upon smaller land plots.
d) In order to cope with the extreme general population increase, this densification needs to be applied to the entire city area, to accommodate all new citizens (i.e. all blocks are affected). This will lead to very high population and settlement densities.

Scenario C: Polycentric Development

This scenario implies a moderate densification of the City of Windhoek where possible, moderate mixed-land use, and generally the implementation of the concept of decentral concentration. The major urban development area will be the strong transit corridor oriented development (TOD) towards Okahandja accommodating almost all population growth. Brakwater and Elisenheim will be tightly connected to the TOD corridor by high-quality PT. Additional development knots in this polycentric scenario could be small locations in the vicinity to Windhoek, such as Finkenstein, Groot Aub, Omea, international airport, Aris and Kappsfarm and others, which will be also well connected to Windhoek via public transport.



Expert Assessments based on intensive research and experience in all 5 continents reveals advantages and disadvantages for the different scenarios as given in the following table.

Figure 2-25: Comparison of Land-use scenarios

	A: BAU	B: Densification	C: Polycentric
Time spent in traffic	3-4 > Scenario B	3-4 < Scenario A	1-2 > Scenario B
Transit accessibility	< 15% of pop less than 15 min to next PT	>80% of pop less than 15 min to next PT	> 60% of pop less than15 min to next PT
External costs	3x higher than in compact cities	Only 1/3 of Scenario A	n/a
Fuel use per capita	60,000 – 80,000 l	2,000 – 10,000 l	15,000 – 40,000 l
Per capita car use	12,000 – 14,000 km	1,000 – 4,000 km	6,000 – 8,000 km
Modal split PT	3 – 10 %	40 – 60 %	20 – 40 %
Modal split NMT	0 – 5 %	10 – 40 %	10 – 30 %
Costs for transport	Double as Scenario B	Half of Scenario A	n/a
Daily greenhouse gas emissions	8 – 10 kg	0 – 4 kg	4 – 8 lg
Activity density (pop & jobs per ha)	< 20	> 35	35
Road death rates (deaths per 100,000 pop)	26	6	n/a

At the stakeholder workshop Scenario C: Polycentric Development was selected as the most favorable one, with some adaptation towards Scenario B, i.e. mainly a slightly higher densifcation in the Central Parts of Windhoek where applicable and along the TOD corridor. Apart from this general strategic decision, the following town planning principles were agreed in supporting efficient use of public transport and reducing mobility needs of people and households:

a) Efforts should be made to achieve a higher degree of mixed land uses for existing settlements, but all the more for new settlement areas.
b) Existing settlements should also be densified, both in terms of population and jobs. Foremost, the blocks in and around CBD of Windhoek should be densified, but also other parts of the town.
c) Town planning in Windhoek should strive to implement the concept of ABC locations[13], with ABC locations acting as attractors for offices / retail, with high PT accessibility, high densities, mixed land uses and efficient land use schemes.
d) Given the topographic situation around Windhoek, the Northern Corridor towards Okahandja was considered as the only feasible area for future settlement expansions that can cope with the expected population growth. This urban development area should be developed along the existing Windhoek-Okahandja road following the concept of Transit Oriented Development (TOD), with higher densities around public transport stations.

For the chosen scenario C – polycentric development, detailed population and employment forecasts were developed for each traffic zone for 2017, 2022 and 2032, following the basic land use schemes as outlined above (please refer to the next chapter 2.5.3).

2.5.3 Population forecasts

Following the principles of selected land use scenario C, the overall future population growth as shown in figure 2-24 in the previous chapters were allocated to the blocks, townships and city districts as follows:

- Development starts in zones along the PT (railway and bus) axis.
- Zones directly located along this axes will have high densities (TOD concept).
- Decreasing densities the farther away a zone is located from the PT axis.
- For new developments the ones closest to Windhoek and directly next to the transport corridor will develop first and only at a later stage spread out.
- Densification of zones will start in the CBD first, followed by densification along the railway axis, followed by densification of zones along the Western bypass and lastly densification of remaining zones with densification potential.

An overview about the population growth and densification process over the time horizon is given in the next figure.

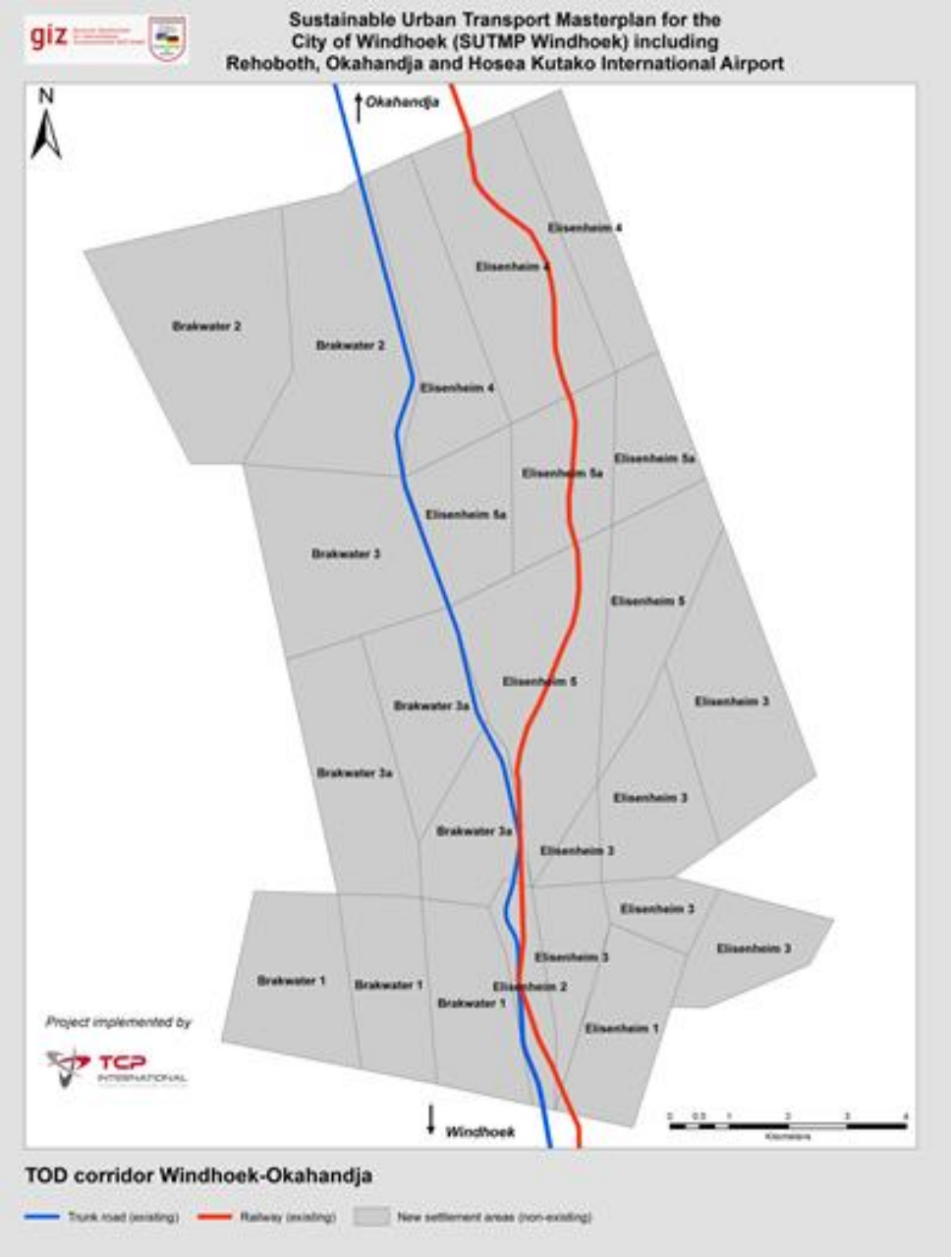
[13] ABC locations are a location policy of cities and regions striving for locating businesses and public services in accordance with their transport needs and with a view to reduce car and truck traffic.

Figure 2-26: The transportation demand forecasting process

In terms of future population characteristics, the following assumptions were applied to the new settlement areas along the TOD corridor towards Okahandja and the locations are given in figure 2-27 thereafter:

- Elisenheim 1 and 2: middle and high income households (like CBD, Eros)
- Elisenheim 3: middle and high income households (like Olympia, Auasblick or Ludwigsdorf)
- Elisenheim 4 and 5a: middle income households, young age groups, small households
- Elisenheim 5: middle income households (like Olympia)
- Brakwater 1 and 3a: middle income households (like Rocky Crest)
- Brakwater 2: low income households like informal settlements in Katutura.
- Brakwater 3: low income households (like Khomasdal)

Figure 2-27: The new settlement areas along the TODcorridor



Furthermore, it was assumed that zones next to the PT axis will have higher densities, probably a higher share of high-rised apartment buildings with small flats rather than detached houses, thus a higher proportion of single and two-person households with lower age groups.

Land-use developments in the projected areas have started already. However, it needs a firm policy laid down in a binding structure plan with adequate enforcements in order to achieve expected impacts.

2.5.4 Employment Forecasts

Very little detailed information was available in terms of future places of employment. Due to a lack of other indicators, the projected GDP was used as the only indicator of growth in employment opportunities (please refer to Figure 2-23 in chapter 2.5.1).

For the industrial sector the following assumptions were used with regard to the spatial allocation of new jobs according to the selected land use scenario:

- Most new industrial jobs will be created in the Lafrenz Industrial area, Northern Industries and Windhoek North.
- New industrial jobs at Hosea Kutako International Airport, the airport estate and Sungate Retail and communication.
- Some new industrial jobs will be created in existing industrial sites such as Prosperitas.
- New industrial jobs will be created in Brakwater & Elisenheim along the main road Windhoek-Okahandja (i.e. in the TOD corridor).
- New industrial jobs in Okahandja as well as Rehoboth industrial area (both cities plan for them)

For the allocation of new jobs in the office sector the following was assumed:

- Following the Windhoek's strategy for densification and improvement of the CBD, there will be growth in employment opportunities in the CBD. Most office jobs will be allocated here.
- New jobs in the service sector along the Brakwater and Elisenheim TOD corridor allocated along the PT link in the vicinity of the new PT stations.
- New office places will be developed at the Eros airport site.
- In order to implement the desired mixed land use schemes smaller local units of office buildings will be develoedp in the more affluent areas in Windhoek i.e. zones to the East and South as well as towards the university area.

For the spatial allocation of new jobs in retail sector the following assumptions were made:

- Following the Windhoek's strategy[14] for densification and improvement of the CBD, there will be growth in employment opportunities in the CBD
- New jobs in the retail sector along the Brakwater and Elisenheim TOD corridor will be allocated along the PT link next to PT stations.
- The new surrounding settlements (zones Finkenstein, Groot Aub) are mainly for residential purposes; however, there may be also a limited number of new jobs created in future in tourism sector and service sector.
- Following more mixed land use schemes smaller local shops will develop in the middle income areas of Windhoek.

Concerning the former industrial site Ramatex which is a major concern, it is part of a bigger model traffic zone. As the strong growth rates for population and GDP suggests, there is a certain pressure for additional available land-use and it was assumed for the future that there will be north of Moses Garoeb and West of Otjomuise Road about 4000 employment opportunites and additional population settling there.

Annex D of the Technical Annex Report contains maps showing the projection over time.

[14] Please refer also to the Windhoek Business Plan for 2012 – 2017 and already founded working groups involving City officials and the CBD business community as well as urban planners.

Figure 2-28: Workplace Projection

Map	Title	Description
Map 7.1	Workplace Projection	The map shows the workplace projection over time following the basic land use schemes for the chosen scenario C – polycentric development.

2.5.5 Schools Forecasts

The new settlements along the TOD corridor towards Okahandja should also accommodate the required schools. In order to reduce the mobility needs, it was proposed that the schools should be located closest to the PT corridor. No new schools and tertiary institutions were projected for other areas in the study area. However, also for existing schools additional scholars and thus travel activity was assumed within the next 20 years.

2.6. Projected Transportation Demands

The up-dated and calibrated traffic demand model was used to forecast future transportation demands. Feeding the demand model with forecast data for population, employment, etc. results in estimates of future transportation demand. These traffic forecasts are used for several key purposes:

- Network capacity analysis;
- Identifying corresponding (potential) projects and estimating their viability;
- Calculating environmental impacts;
- Input for the measurement of impacts of the traffic system on the economic performance in Windhoek.

The transport scenarios were calculated on the basis of the selected 'Polycentric Development' land-use scenario (refer to Chapter 2.1 and chapter 3). Two transport scenarios have been developed to assess the overall impacts of the various transport interventions:

- **Business As Usual for the year 2032 (BAU 2032):**
  This scenario assumes a continuation of the present policies with no major improvement of roads, public or non-motorised transport. It includes all measures already planned today mainly with a view to capacity enhancements at crossings. The BAU 2032 is used to assess the impacts of ST 2032.
- **Sustainable Transport for the year 2032 (ST 2032):**
  This scenario assumes major improvement of the transport system as further described in the chapters 5 for PT, 6 for NMT and 7 for TM and safety measures. It was determined in several iterative steps in order to determine optimum service levels via different intervention measures, consisting of:
  - Public transport network that will consist of a suitable mix of high-volume traffic systems combined with adequate feeder systems and interchanges
  - NMT Network including pedestrian zones
  - Road Reclassification for safety reasons

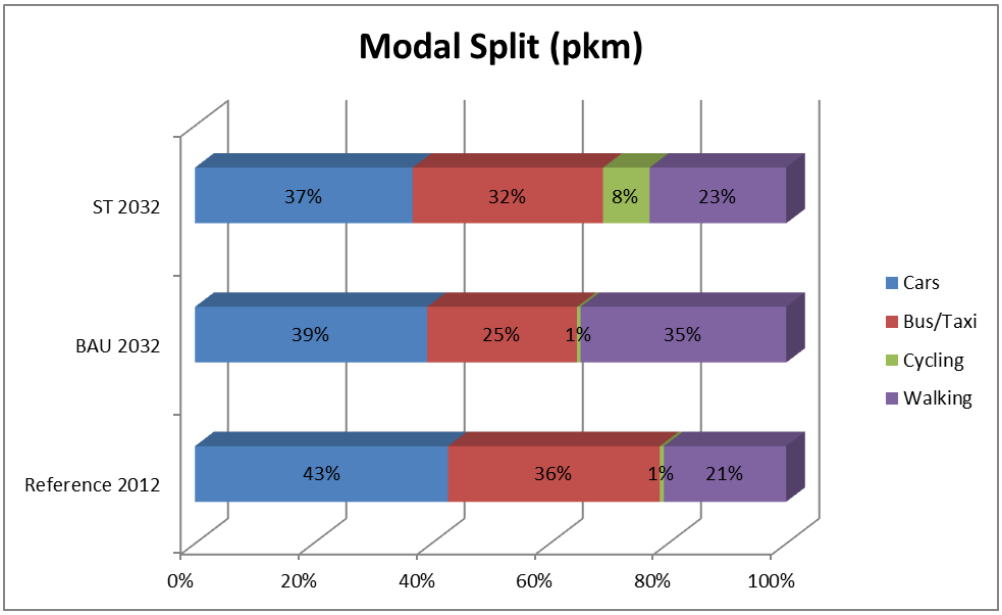
Annex D contains maps showing the AM peak hour vehicles and AM peak hour public transport passengers for the Business As Usual for the year 2032 (BAU 2032) scenario as well as the Sustainable Transport for the year 2032 (ST 2032). The main features of the projected traffic demand are discussed here.

Figure 2-29: Projected Transportation Demands

Map	Title	Description
Map 8.1	Business as Usual Scenario (2032) AM Peak Hour Vehicle Volumes	The map shows the AM peak hour vehicle volumes for the Business as Usual Scenario (2032). The results reveal very high vehicle volumes from the Brakwater area towards Windhoek as a result of a lack of formal public transport in the Northern Corridor (please refer also to chapter 2.7 screenline capacities and network deficiencies)
Map 8.2	Business as Usual Scenario (2032) AM Peak Hour Public Transport Passengers	The map shows the AM peak hour public transport passenger volumes for the Business as Usual Scenario (2032). The results shows limited public transport passengers from the Brakwater area towards Windhoek as a result of a lack of formal public transport in the Northern Corridor.
Map 8.3	Sustainable Transport Scenario (2032) AM Peak Hour Vehicle Volumes	The map shows the AM peak hour vehicle volumes for the Sustainable Transport Scenario (2032). The results reveal reduced vehicle volumes from the Brakwater area towards Windhoek as a result of the introduction of a formal mass-transit public transport system in the Northern Corridor.
Map 8.4	Sustainable Transport Scenario (2032) AM Peak Hour Public Transport Passengers	The map shows the AM peak hour public transport passenger volumes for the Sustainable Transport Scenario (2032). The results show an increase in public transport passengers from the Brakwater area towards Windhoek as a result of the introduction of a formal mass-transit public transport system in the Northern Corridor.

An important outcome of the demand modeling is the future modal choice of passengers. The Figure below shows the modal split for the Reference Scenario (2012), Business as Usual Scenario (2032) and Sustainable Transport Scenario (2032).

Figure 2-30: Calculated Modal Split



From the Reference Scenario (2012) to Business as Usual Scenario (2032) there is a marked change in the modal split. The main change is the dramatic increase in walking trips. This is as a result of densification, thus shorter distances between place of residence and place of employment. This will make it possible for more persons to walk to work even though they can afford other modes of transport.

Figure 2-31 gives performance figures such as vehicle-km, passenger-km CO_2 emissions etc. for all passenger transport modes.

Figure 2-31: Performance figures

Performance Indicator	Performance		
	Reference Scenario (2012)	Business as Usual Scenario (2032)	Sustainable Transport Scenario (2032)
Annual Vehicle-km			
Car	337 000 000	771 000 000	699 000 000
Public Transport	148 000 000	338 000 000	41 000 000
Annual Passenger-km			
Car	539 000 000	1 172 000 000	1 049 000 000
Public Transport	451 000 000	757 000 000	917 000 000
Cycling	9 000 000	18 000 000	225 000 000

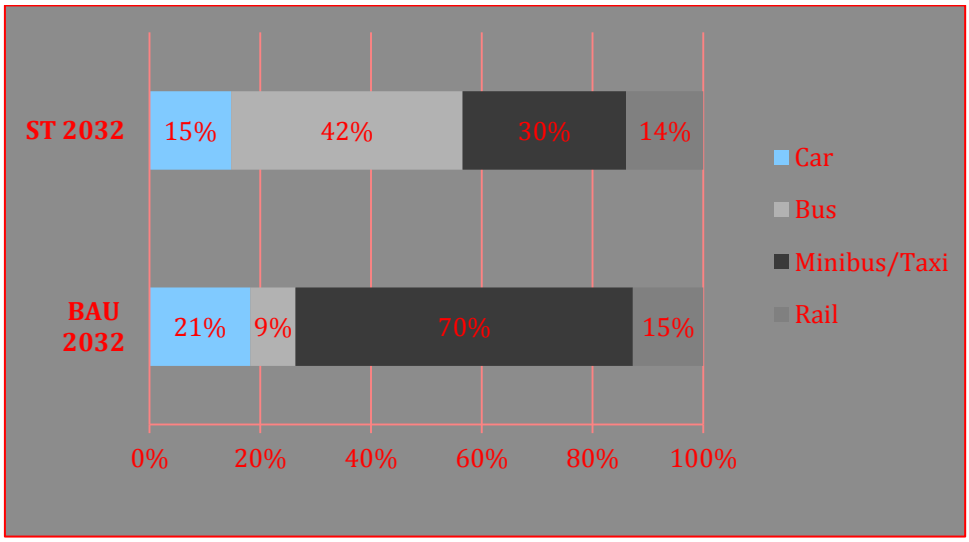
Performance Indicator	Performance		
	Reference Scenario (2012)	Business as Usual Scenario (2032)	Sustainable Transport Scenario (2032)
Walking	260 000 000	1 038 000 000	657 000 000
Annual Emissions			
CO_2 (tonnes/year)	200 000	470 000	320 000
NOx (kg/year)	140 000	300 000	180 000
CO (kg/year)	470 000	1 500 000	740 000
SO_2 (kg/year)	20 000	60 000	30 000
HO (kg/year)	60 000	190 000	90 000
Trip duration (travel time per trip)			
Cars	9min16s	54min42s	23min22s
Public transport	13min30s	1hr16min	11min44s
Cycling	1hr51min	1hr43min	18min30s
Walking	50min12s	46min46s	44min24s

The results show the following highlights:

- There is a marked increase in vehicle-km from Reference Scenario (2012) to Business as Usual Scenario (2032). This is due to the increase in travel demand resulting doubling of the population in the study area as well as assumed economic growth per capita within the time horizon.
- The Sustainable Transport Scenario (2032) shows a decrease in car vehicle-km as a result of mode shift from cars to public transport.
- Although passenger-km increases by more than 20% compared to the BAU scenario, the increase might be lower than expected due to shorter trips made per passenger. However, no induced traffic was assumed, so ridership prognosis can be stated to be on the conservative side.
- The vehicle-km for public transport is very drastically reduced due to the system change in ST2032 from public transport being supplied by small low occupancy vehicles (average 2.2 passenger per vehicle/km) to larger vehicles with a higher passenger capacity (average 22.4 passengers per vehicle / km. With other words, taxis are supposed to change their roles towards door-to-door call taxi services (not specifically calculated as PT) or on short distances as integrated feeder services (please refer also to chapter 4.5 and 5.5). Vice versa in the reference and BAU2032 case taxis are treated as a form of public transportation.

- As a result of substantial investment in NMT in the Sustainable Transport Scenario (2032), a considerable proportion of cycling is assumed to be induced traffic, based on international experience after introduction of a cycle friendly infrastructure and environment. The main mode shift stems from people having walked before, also due to an increase of GDP per capita.
- The Sustainable Transport Scenario (2032) shows a decrease in passenger-km for walking when compared to the Business as Usual Scenario (2032) due to the mode shift from walking to cycling and public transport but also due to the transport avoiding urban planning measures that generate shorter walking trips. This is especially true for the majority of the low income households in the north as the figure after this para indicates. In addition, in the BAU scenario there is limited modal choice and high congestion, both leading to increased walking activity. The latter corresponds also with experiences in other African cities.
- All emissions show a marked reduction in the Sustainable Transport Scenario (2032) due to the decrease in vehicle-km for both cars and public transport vehicles.
- There is a striking increase in travel time per trip from the Reference Scenario (2012) to Business as Usual Scenario (2032) for public transportation. This is due to the increase in travel demand and the lack of public transport provision. Thus, severe congestion is expected in Business as Usual Scenario (2032) which is also due for the PT System. When comparing BAU with ST, there will be own right of ways for buses and priorities at junctions, and comparing reference scenario with ST, then there is no congestion and in average shorter distance trips because of altered settlement structures.
- The Sustainable Transport Scenario (2032) shows much improved travel times per trip as a result of major improvement of the transport system. From those reductions motorized individual transport profits as well.

Figure 2-32: Modal Share of Low-Income-Households per Scenario



2.7. Screenline Capacity and Network Deficiencies

If there is no major improvement to the current transport system there would be a seven time increase in annual travel time spent in congested situations (refer to Figure 2-33). The proposed Sustainable Transport Scenario (2032) could improve this situation dramatically by reducing travel time spent in congested situations to even lower levels than what is currently experienced.

Figure 2-33: Time in traffic

Title	Title		
	Reference Scenario (2012)	Business as Usual Scenario (2032)	Sustainable Transport Scenario (2032)
Time in traffic (in hours)			
Annual Travel Time in Congested Situations (V/C[15]>80%)	7 200 000	50 200 000	6 400 000

Annex D contains maps showing the AM peak hour vehicles and AM peak hour public transport passengers for the Business As Usual for the year 2032 (BAU 2032) scenario as well as the Sustainable Transport for the year 2032 (ST 2032). The main features of the projected traffic demand are discussed here.

Figure 2-34: Projected Transportation Demands

Map	Title	Description
Map 8.1	Reference Scenario (2012) AM Peak Hour Volume Capacity Ratio	The map shows the AM peak hour Volume Capacity Ratio. It shows that most of the network is currently operating at acceptable levels of service in terms of capacity
Map 8.2	Business as Usual Scenario (2032) AM Peak Hour Volume Capacity Ratio	The map shows the AM peak hour Volume Capacity Ratio for the Business as Usual Scenario (2032). It shows that the network, in particular the northern corridor would be under severe pressure by 2032 if there is no major improvement to the current transport system. Other links that would be under pressure are those from the north-west (in particular from Katutura and Khomasdal areas) towards the CBD and other places of employment
Map 8.3	Sustainable Transport Scenario (2032) Volume Capacity Ratio	The map shows the AM peak hour Volume Capacity Ratio for the Sustainable Transport Scenario (2032). It shows a much improved situation in terms of volume capacity ratio. It does however reveal that there would still be some congestion on the northern corridor.

In the following three figures, excerpts of above maps for Windhoek without new development areas are given.

[15] V/C is the volume-to-capacity-ratio is an approximate indicator of the overall sufficiency of an intersection. It is subjective in that levels that are considered acceptable in a large city might be unacceptable in a rural areas. It is assumed that all levels above 80 % are unacceptable level of travel times spend in congested situations and thus all hours spend in relations with V/C > 80% were summarized.

Figure 2-35: Excerpt AM Peak Hour Volume Capacity Ratio, Reference Scenario 2012

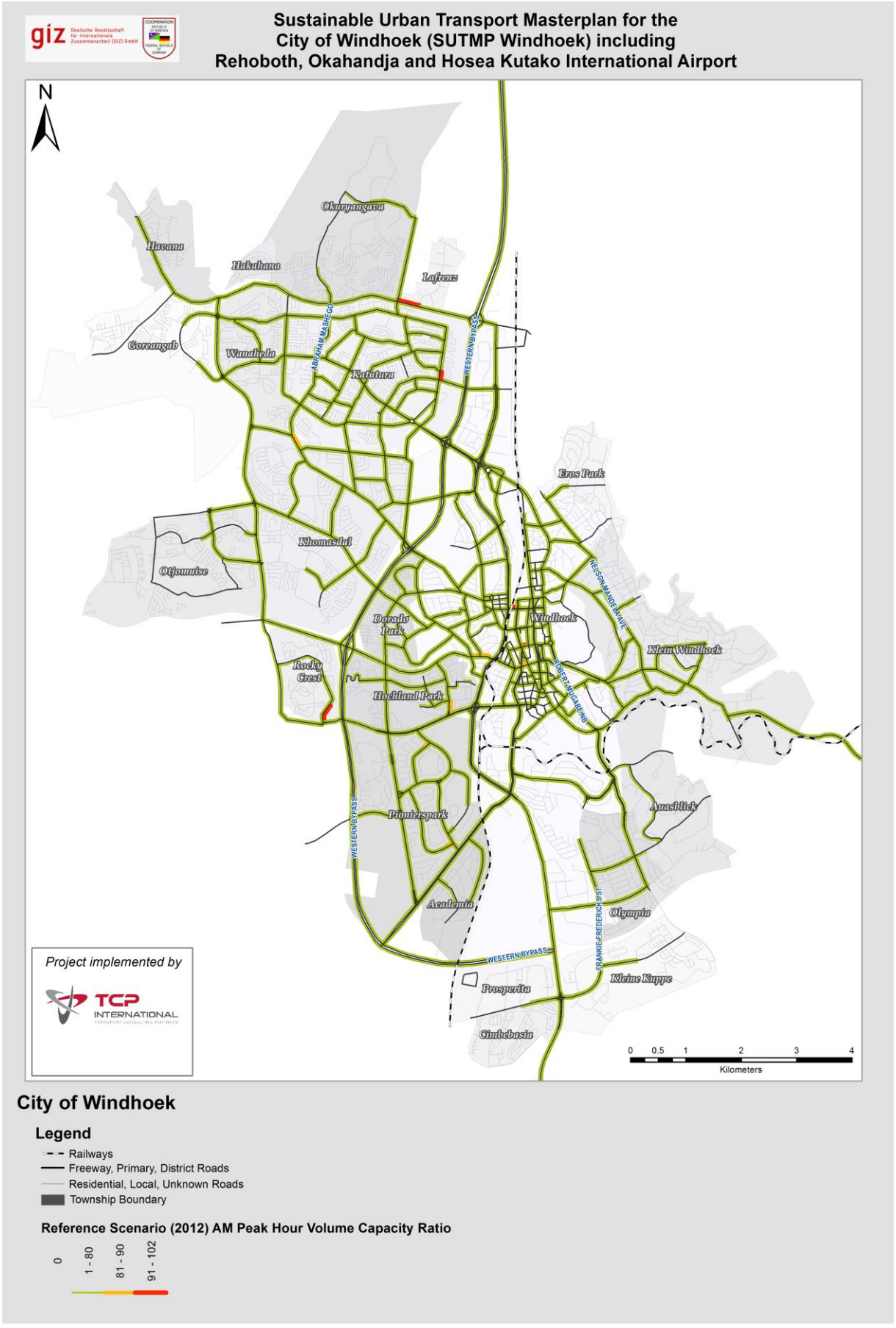


Figure 2-36: Excerpt AM Peak Hour Volume Capacity Ratio, BAU Scenario 2032

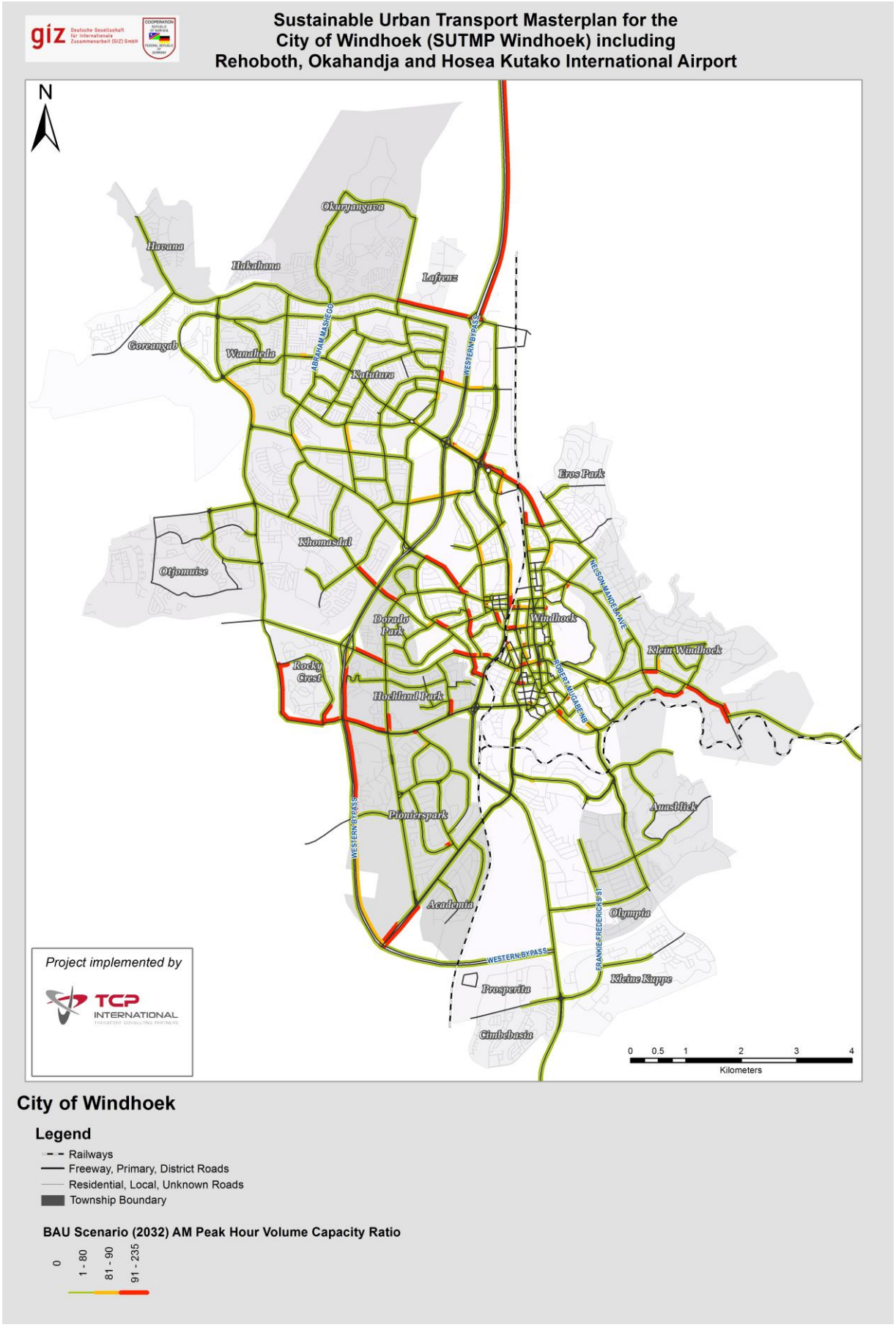
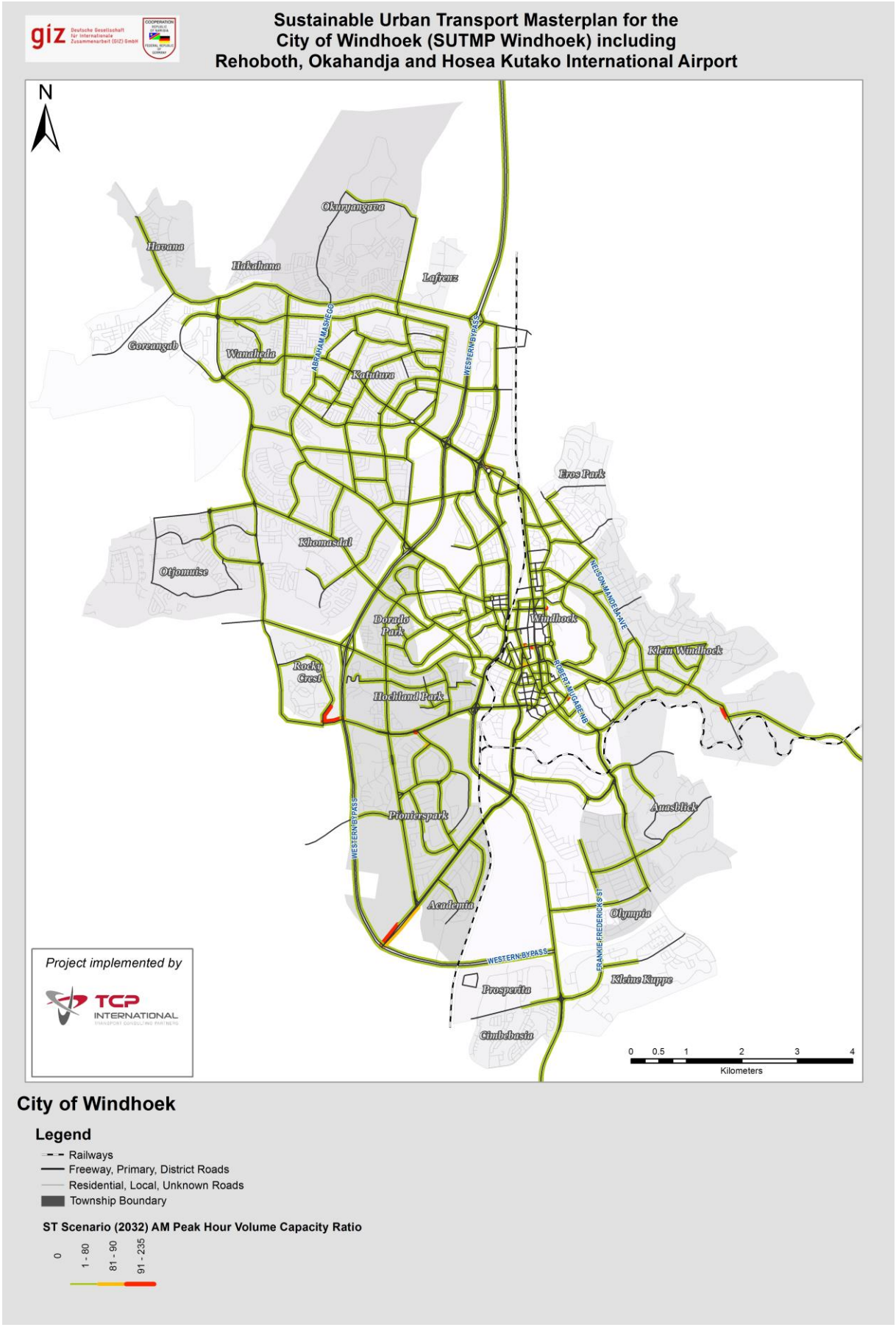


Figure 2-37: Excerpt AM Peak Hour Volume Capacity Ratio, ST Scenario 2032



It is clear that from a capacity standpoint major network improvements would be required if there is no major improvement to the current transport system (BAU Scenario 2032). The following proposed improvements as indicated in the Arterial Implementation Plan (2005) would be required:

- Sam Nujoma West (from Bach up to Bismarck) (1.3km);
- Monte Christo (from Hosea Kutako up to Hereford) (3.2km);
- Sam Nujoma West (between the Western Bypass and Hendrik Witbooi Drive) (1.3km);
- Sam Nujoma East (from Mission up to Gobabis District Road) (0.5km); and
- Florence Nightingale (from Bach up to Frans Indongo) (3.8km)

In addition to this, improvements would be required to:

- Robert Mugabe Avenue (from Hosea Kutako to Eros Road);
- The Western Bypass (from Sam Nujoma Avenue to Brent Carlson);
- The B1 (from Independence Avenue to Brakwater); and
- Other minor improvments

As a result of a much improved situation in terms of volume capacity ratio the Sustainable Transport Scenario (2032) would require much less network improvements in terms of capacity. None of the proposed projects in the First Phase or the Second Phase of the implementation plan would be required as a result of capacity constraints. But certain strategic upgrading will still be required to ensure continuity and required circulation. Network continuity and circulation is especially important on a network that will by and large be used by public transport. This means that the following projects from the Arterial Implementation Plan (2005) would be applicable for both the BAU and the ST scenarios:

- Sam Nujoma West (from Bach up to Bismarck) (1.3km);
- Monte Christo (from Hosea Kutako up to Hereford) (3.2km);
- Sam Nujoma West (between the Western Bypass and Hendrik Witbooi Drive) (1.3km);
- Sam Nujoma East (from Mission up to Gobabis District Road) (0.5km);
- Florence Nightingale (from Bach up to Frans Indongo) (3.8km);
- Aus Road (from Sean McBride up to Mandume Ndemufayo) (3.6 km)
- Otjomuise Road (from Independence up to Sam Nujoma) (9.4 km)

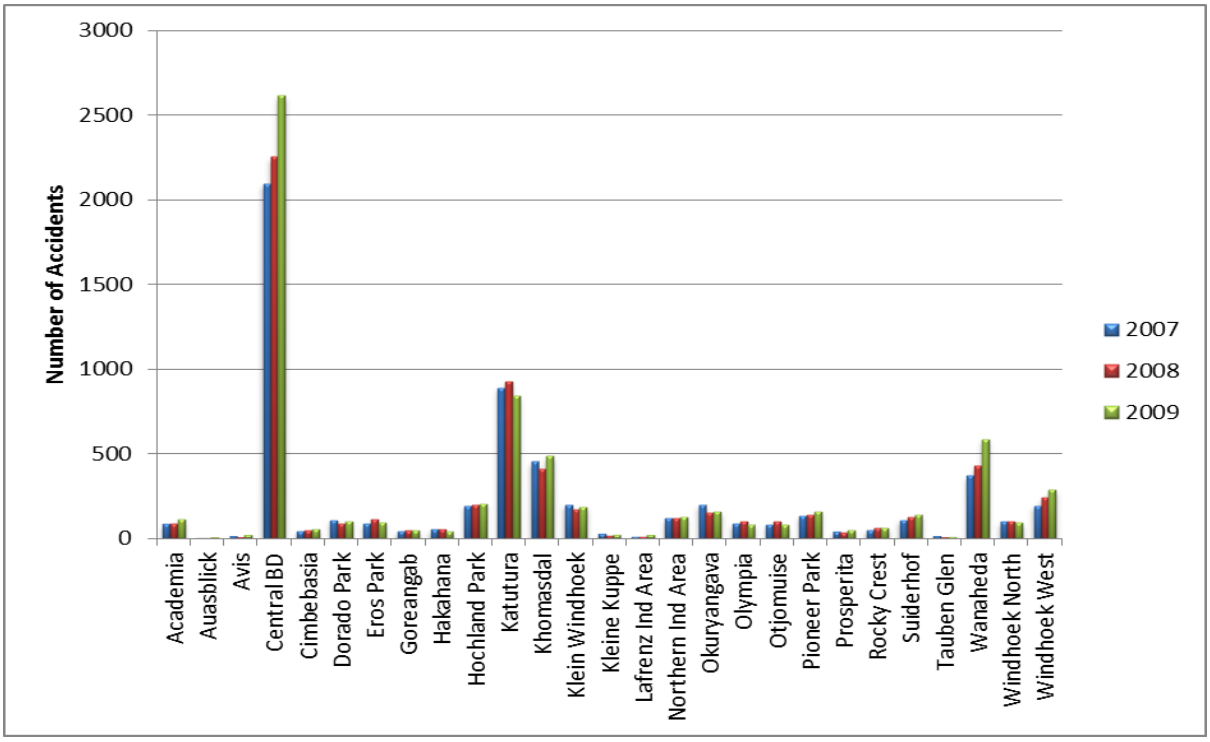
2.8. Traffic Safety

The National Road Safety Council (NRSC) of Namibia completed in 2011 the *Transport Safety Plan for the Khomas Region Nambia* report. This report was prepared by the SUTMP Consortium Partner Aurecon and is predominantly based on accident data available between 2007 and 2009. In lieu of more recent data, the following is summarised from the 2011 *Transport Safety Plan for the Khomas Region Namibia* report:

- Approximately 21,000 crashes were recorded between 2007 and 2009 within the Khomas region;
- 52% of all crashes and the highest number of fatalities occurred at uncontrolled intersections;
- Most incidents involving pedestrians occurred at pedestrian crossings;

- The CBD, greater Katutura area and Khomasdal have the highest number of crashes and highest number of fatal pedestrian incidents per suburb;
- Okuryangava and Hakahana have the highest number of pedestrian crashes;
- The number of fatalities per suburb correlates with the suburbs where the highest number of pedestrians can be expected;
- Major roads, such as Independence Avenue, Sam Nujoma Avenue, Mandume Ndemufayo Avenue or Western Bypass within Windhoek linking the north and south have a high number of incident occurrences.

Figure 2-38: The Number of Accidents per Year per Suburb from 2007 to 2009



The above figure shows that the CBD displays the highest number of accidents. Whilst the level of crashes has remained relatively stable in the majority of suburbs, the CBD, Wanaheda and Windhoek West show that from 2007 to 2009 the annual crash occurrence has been increasing.

Presently NRSC together with the GIZ is working on improvement of data collection and capturing systems for traffic accidents in Namibia so that it satisfy better future analyse needs. However, latest available figures strongly suggest that the trends observed in the Khomas Regional Study got even worse, e.g. as already mentioned in chapter 1.2 just in the CBD in just one month 486 accidents were reported.

The following figures from the 2011 Transport Safety Plan for the Khomas Region illustrates very clearly that the spatial distribution of the number of fatalities correlates with the highest number of pedestrians, i.e. Katutura and CBD.

Figure 2-39: Graphical Representation of the Number of Fatalities per Suburb from 2007 to 2009

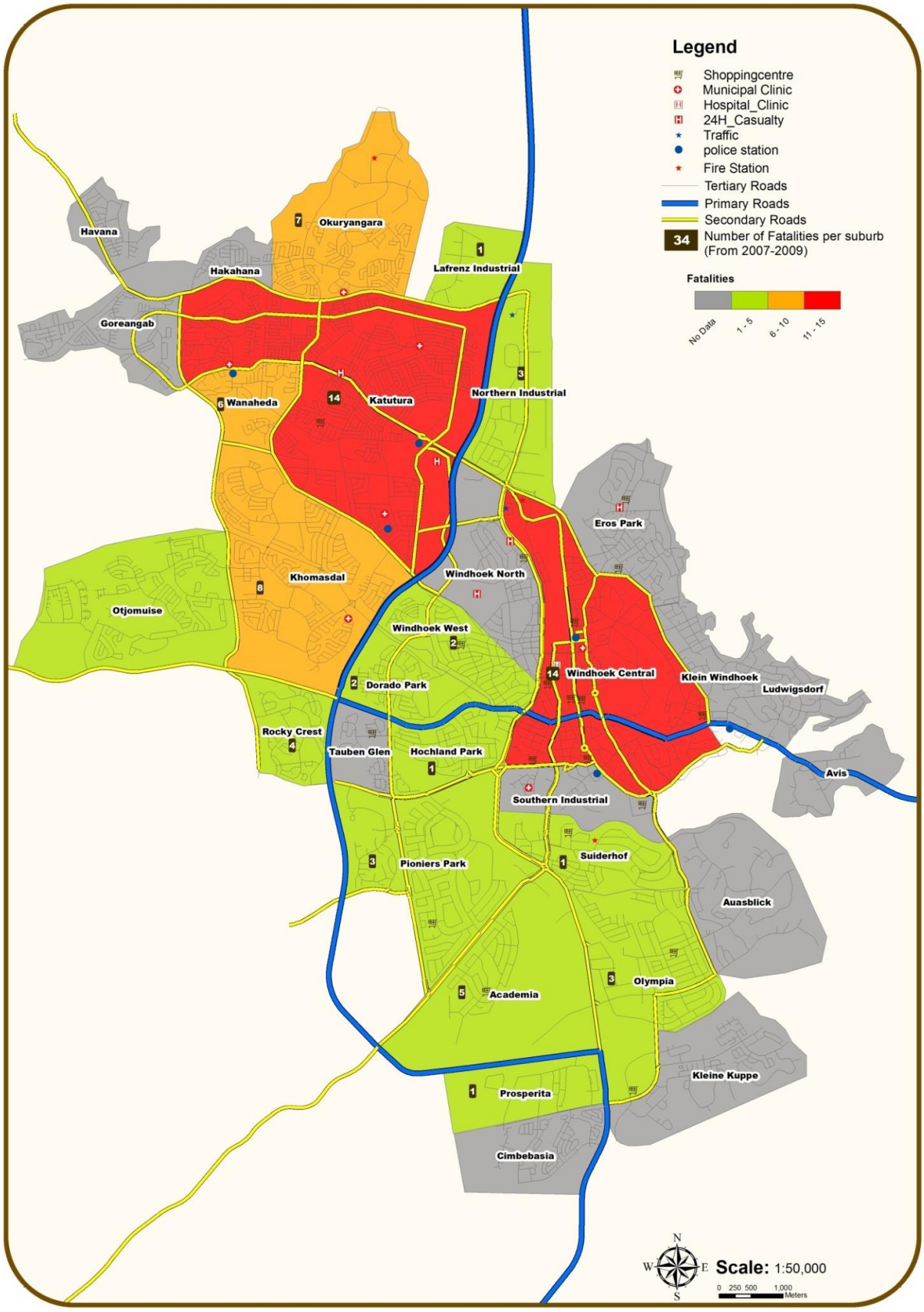
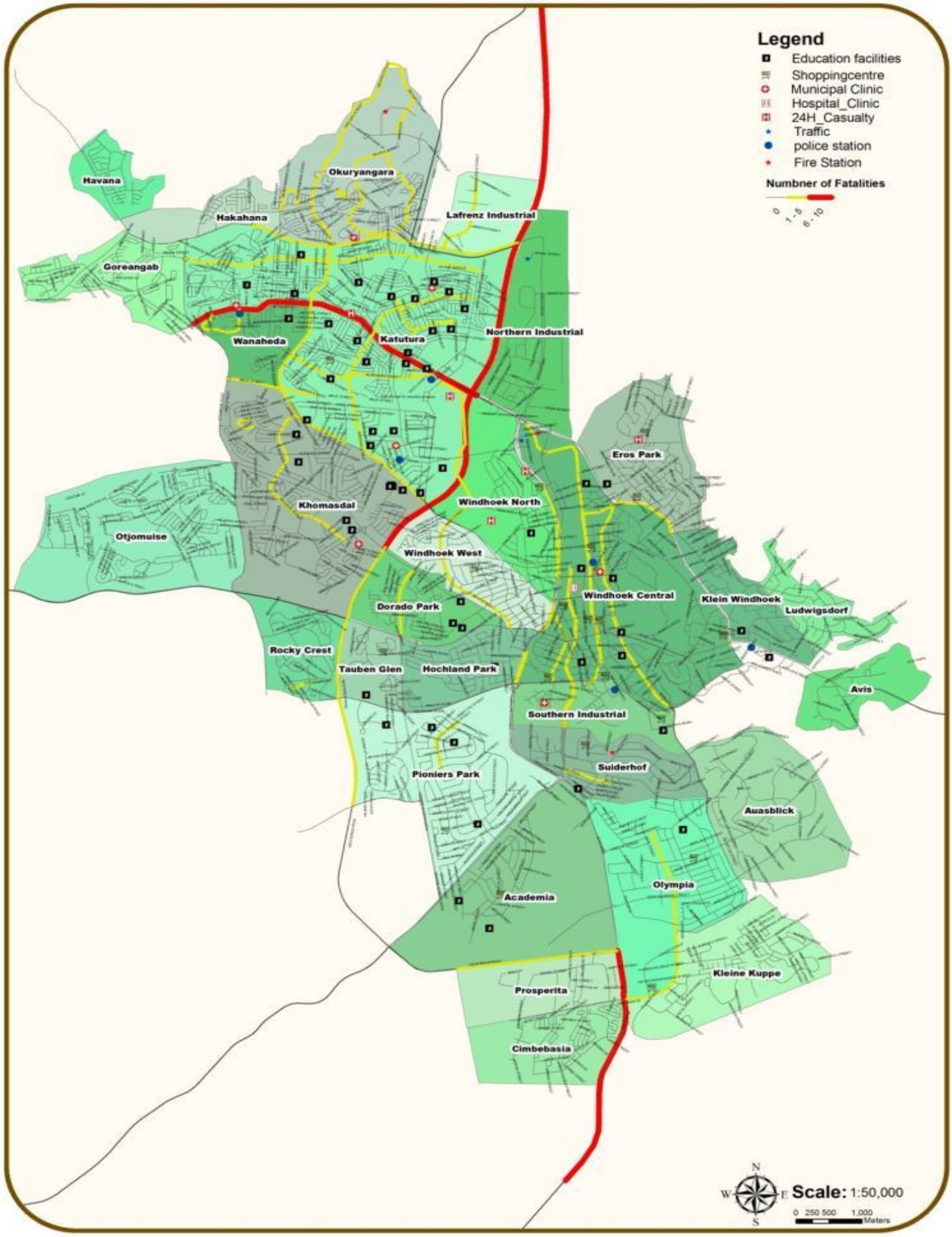


Figure 2-40: Graphical Representation of the Roads with Highest Fatalities from 2007 to 2009



Amongst other recommendations, the 2011 Transport Safety Plan for the Khomas Region Namibia proposed the following:

- Improved Accident Information
    - Establish a crash bureau for the Khomas Region
    - Improve quality of injury information
    - Establish a crash data technical committee
    - Utilise technology to improve the NAMPOL / NRSC data system
    - Training and capacity building
    - Improvement of Hazardous Locations
- Road Safety Management, Coordination, and Harmonisation
    - Establish a Road Safety Committee for Khomas Region
    - Establish a regional coordinating body for traffic and related enforcement for the region
    - Review current infrastructure planning protocols and infrastructure standards relating to provision of roads and streets
- Establishment and Maintenance of Community Structures
    - Develop a model for community involvement which includes ward-based road safety initiatives and training of councillors.
- Capacity Building
    - Revise existing and develop new curricula related to road safety capacity building by means of training
    - Establish a vehicle inspectorate
    - Establish a specialised accident investigation unit
- Transport Plan with special focus on Non-Motorised Transport (NMT) and Public Transport
    - Develop a NMT master plan for the Khomas region
    - Develop a transport master plan for Khomas region
    - Develop a public transport plan and operating licence strategy for the Khomas region

Amongst others, this SUTMP resulted from the above recommendation and most of the proposed measures directly or indirectly address the identified problem areas such as NMT infrastructure along major black spot ateries. In addition, in the framework of the on-going Namibian – German Development Cooperation the accident information and road safety management and capacity problem areas are addressed in another project.

Whereas municipal buses are hardly involved in any serious accidents, Namibian Police Officials report major safety hazards stemming from taxis and minibuses. In general individual car users have a 97 times higher accident risk then public transport users on regulated bus and train systems. Aggravating the accident situation in Windhoek is the fact that in the taxi industry the income risk is almost entirely on the taxi driver and not shared evenly between the owners and the drivers. The resulting aggressive and fast driving in the run for customers, leads to many accidents and endangering situations on the roads of Windhoek. But it has also to be stated that customers tend to stop taxis everywhere also in the middle of the road instead of sticking to the designated taxi ranks and taxi stops. Other reasons are addressed already in the outline of the recommended measures listed above.

SUTMP Stakeholders also often refer to the unsatisfying traffic enforcement system which does not help to prevent drivers and more specifically taxi drivers from ruthless and often illegal driving behaviour. Presently, there are even two institutions responsible for traffic enforcement, the Namibian Police and the Municipal Police. Especially the municipal traffic police established 6 years

ago have contributed significantly to improve the situation, even if there is still some overlapping of tasks with the national police to be reported. In addition, the fines for traffic offenses were increased significantly. However, the bottleneck appears to be the overburdened court systems and its resources to handle the sheer amount of traffic offenses due to the fact that even minor offenses are dealt with as criminal case instead of a subject to be fined. MWT efforts to decriminalise traffic offenses are the right way forward.

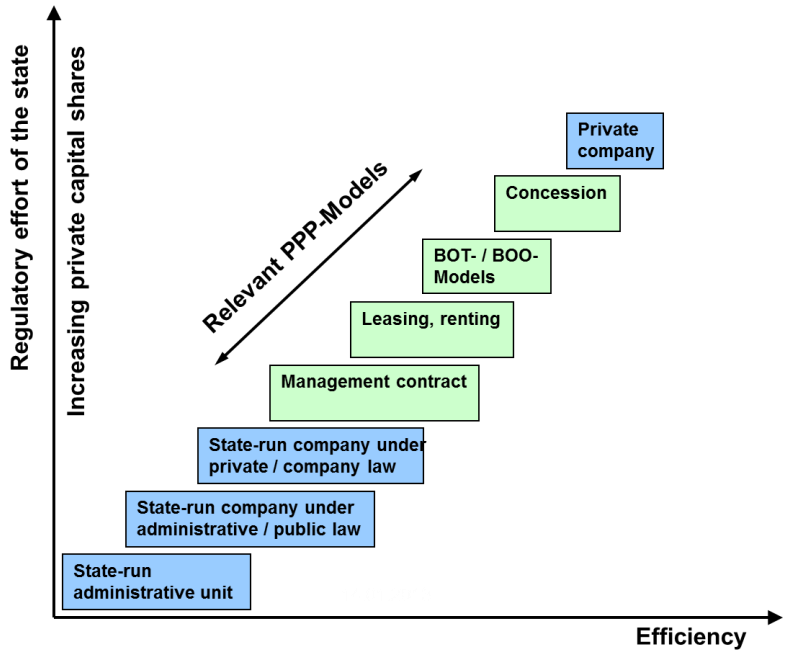
The partially unsatisfying enforcement situation is also due to some infrastructural facts e.g. the amount of off-loading zones for taxis or the design of the urban roads encouraging speedy driving to name just a view.

2.9. Other Deficiencies and current legal and institutional discussions

In this chapter other deficiencies are briefly mentioned which were not targeted at the chapter before but being also the basis for some of the SUTMP improvement measures suggested later on in the respective technical sub-chapters 4, 5, 6, 7, 8 and 10.

In principal service provision for public transport can range from total statal provision up to total private provision of infrastructure and services. The following graph indicates the possibilities to organise the transport services and the relating regulatory effort of the state and observed degree of efficiency. There are lesssons learnt and best practice examples for each of the possible organisational set-ups along the scale (please refer also to chapter 4.5 for advantages and disadvantages of possible sector organisations), so each government has to select - consciously - its own institutional set-up.

Figure 2-41: Principal Organisation of Transportation Services



Presently, in Windhoek, urban public transportation is presently determined by both ends of the scale. There are municipal bus services, a division of the public service department, delivering the service desired by the political level and there is the taxi industry and parts of the bus industry such as Emangweni acting totally private within certain rules set by the City of Windhoek in order to uphold a minimum standard for safety, security and accountability for the customers. As stated in meetings with manufacturers, only very few of the bigger companies provide there own in-house

staff company transport either by renting buses (e.g. Namibian Diaries) or by employing own buses (e.g. Namibian Airport Company).

In addition there is the TransNamib, a state-owned company delivering presently no inner-city and neglectable intercity passenger transportation. There are also some private minibus operators offering unscheduled intercity respectively interregional services. Whereas the private taxi industry is blossoming, the municipal bus company as well as TransNamib require subsidisation in considerable amounts.

Responsibilities for planning, financing, operation and supervising, regulating and monitoring public transport and non-motorised transport are somehow diluted within the City of Windhoek departments, but also between the City its line ministry and the Ministry of Works and Transport. However, it is positive to note that the last reorganisation of transport within the city lead to the merger of the responsibilities of land-use planning and transport planning under the department of urban planning and public transportation planning and operation was subsumed under community services which it actually is. With some necessary refinements, the structure of the CoW appears now to be adequate to cope with the future challenges. In other words, coping with the idea that roads are not mainly for upper income citizens' cars, but that they are public spaces and a safe and secure place for all citizens whether they just meet, or walk, or cycle, or use public buses or cars.[16]

However, as many ideas and measures going to be suggested in this SUTMP are rather unique compared with African standards (e.g. systematically combining land-use with transport planning or introduction of a regulated and highly integrated public transport system or the systematic road re-categorisation), there is a need for capacity strengthening on all Governmental levels. It is also necessary to accompany them with promotion of the ideas of sustainable urban transportation among the broader public in order to raise awareness that all can win with the envisaged re-orientation of the urban transport system.

When referring to capacity strengthening we do not only refer to training measures but also towards the adequate policy and legal framework. The White paper for transport stems from the beginning of the nineties, i.e. briefly after independence relating to by that time problems and priorities. Also many legal transport relevant acts still stem in their entirety or with some revisions from SA times. Also especially to mention is a gap in the field of public transport regulation and clear regulation of public service obligations[17].

Some examples might highlight above statements:

- There is no special requirement for public transport drivers including private bus and taxi industry to have a specialised training and driver license for being allowed to drive third party passengers in a safe, secure, defensive and respectful manner and with a view to preserve their vehicles as an asset.
- The TransNamib is a self-regulating entity meaning that there is no independent entity checking the safety and security of its tracks, waggons, signalling and other relevant issues.
- There is no adequate legal basis existing for a transparent determination of politically and socially wishful level of services and the amount of budget provisions required to deliver this service by private, parastatal and statal companies. This is relevant e.g. when the Ministry of

[16] Please refer also to GIZ Sourcebook for sustainable transport, The Role of Transport in Urban Development Policy, July 2005

[17] Even in a completely liberalised transport sector environment the Government has to ensure that there is the legal basis for free entry and fair competition in the market and the Government is responsible for safety and environmental monitoring preferably to be undertaken by a specialist agency.
Public Service Obligations is an arrangement in which a governing body or other authority offers an auction for subsidies, permit the winning company a monopoly to operate a specified service of public transport for a specified period of time for the given subsidy. This is done in cases where there is not enough revenue for routes to be profitable in a free market, but where there is a socially or environmentally desirable advantage in this transport being available.

Education intends to have a better school bus service or a remote village want to have access to public transport systems.

Last but not least it has to be stated that within existing level of funding a move towards more sustainable urban transport is not possible. Again some facts and figures might highlight this statement:

- The existing level of investments in NMT infrastructure is 2 % of the total municipal road repair and maintenance budget.
- The envisaged NMT budget of the MWT for the next fiscal year is in the promille range.
- The present budget of the road fund is not sufficient to maintain the existing road network. Thus, there is no possibility to channel road fund means for public transport as it is the case in many European Countries.
- Road Fund contribution to the CoW road and stormwater maintenance budget for roads within the municipal boarders was 11% of the total budget.
- TransNamib losses of the last years amounts to billions and TransNamib asked for 2bN$ bailout.
- The direct operational costs of the municipal bus service are covered only by 60% revenues. Total PT costs are only covered with 31%.

More information on financial and funding options is given in chapter 10.

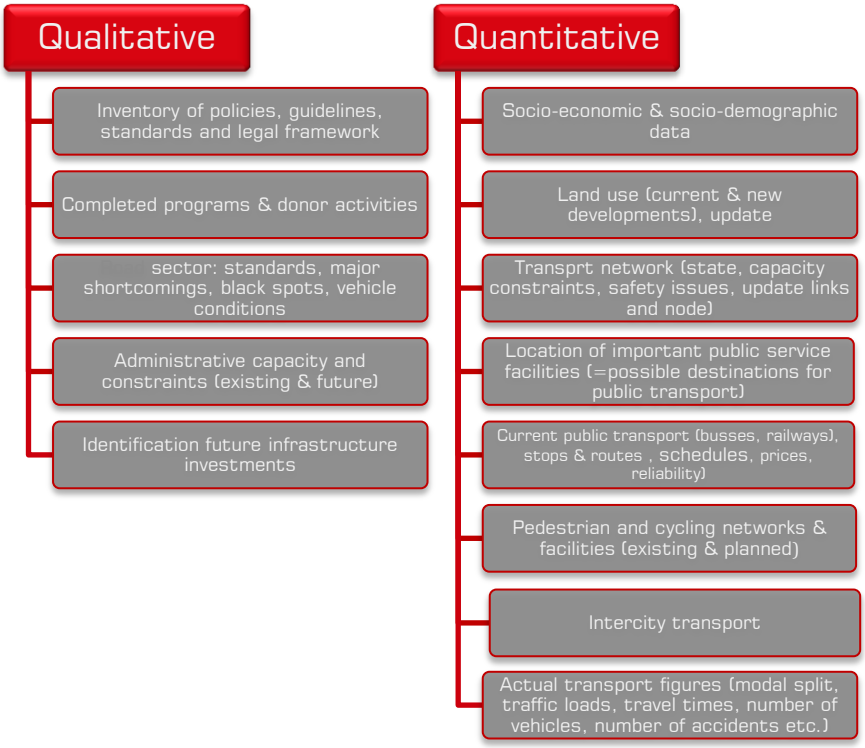
3 Strategic Direction

In this chapter the development and creation of consensus among the main stakeholders and decision makers on the principal strategic directions for achieving more sustainable mobility patterns in the next 20 years' time horizon is further described and how the SUTMP relates to other policies.

3.1. Developing the Strategic Direction

Work started with in-depth familiarisation with existing and future conditions for planning in Windhoek as a basis for transport demand modelling, scenario development and traffic forecasting. Different types of quantitative and qualitative data were collected to fulfil all tasks of this study.

Figure 3-1: Data collection - overview of data sets and information gathered



Specific attention was given to future settlement structures that are targeting on transport avoidance; thereafter on public and political acceptance of push measures which are able to restrict individual motorised road transport, and last but not least on pull measures, which could enhance the usage of public transport.

Furthermore, specific attention was given on realistic institutional and legal changes such as coordination between city and regional transport planning, public private partnerships, regulative authorities and the financial framework for transport infrastructure and vehicle investments. On the preliminary findings more thorough analysis on the issues of public transport, non-motorised transport, inter-city transport, transportation management and the institutional and legislative framework was conducted, including development of potential technical and organizational concepts for the improvement of the transport system in Windhoek.

The intensive stakeholder engagement – especially to mention in this respect is the stakeholder workshop in September, several council briefings and the vibrant discussion on the project's Facebook website - and the numerous contacts of individual SUTMP project team members with

individuals or groups of stakeholders resulted in an internal list of investment and soft measures and ideas which was frequently up-dated after each meeting and each workshop.

This internal list of ideas served also as an internal planning tool for determining further data, investigation and analysis requirements.

Finally, this internal list of potential measures was compiled and then amended by team members' inputs reflecting international experience of best practice and lessons learnt but also reflecting the results of the intensive analysis of the existing situation and the room for improvement and manoeuvre perceived.

In the next step, this overall list of potential measures was reviewed against existing policies and coordinated with other relevant and on-going studies and projects described in the next chapter 3.2.

3.2. Reference to National Strategies and Master Plans and other Studies

The SUTMP is aligned with relevant policy instruments at regional, national and global scales.

a) In an international policy context, the public transport system has an important role to play in greening the economy in the context of sustainable development and poverty alleviation on Namibia. Development of a long-term Master Plan for public and non-motorised transport is recognised as an aspect for both.
b) In line with national policies, implementing measures intended to increase the supply of PT and NMT infrastructure and services such as is proposed under the polycentric land use supports faster and sustainable economic growth, creation of employment opportunities, and enhanced income equality – the three key priorities identified under the Fourth National Development Plan (NDP4).
c) At a regional level, the existing transport demand for the City of Windhoek was evaluated and its future development estimated supported by a validated transport demand model. The model was

based on existing transport demand model of Windhoek (2006), but was up-dated and expanded to include Okahandja, Rehoboth and Hosea Kutako International Airport.

For this purpose, several documents have been reviewed and considered during the preparation of this Master Plan such as the Namibia Vision 2030; the Poverty Reduction Strategy; et al. They are given in the reference list at the end of this technical report. Relevant parts of each of them were taken into consideration when developing the strategic directions.

However, it became also obvious that for some of those documents up-dating are required, e.g. the White Paper on Transport Policy or the Windhoek Structure Plan have to be aligned in view of the latest policy statements and also with a view to the measures envisaged in this SUTMP. Furthermore, the Consultant strived for a close coordination with the National Transport Master Plan developed in parallel to this SUTMP.

Most important for the Assessment of the SUTMP Master Plan's impacts is the Vision 2030 document, which lays down the long-term strategic goals for the whole country. The relevant goals and basic enablers were selected and used to assess the impacts of the proposed transport measures in a multi-criteria analysis (please refer also to chapter 9.4).

3.3. Identification of Strategic Directions Scenarios

Based on the thorough analysis and stakeholder engagement as described in chapter 3.1 and reviewed against existing policies and strategies as described in chapter 3.2, for each of the four main SUTMP intervention areas, i.e. Public transport, NMT, Transport Management including road safety and institutional, legal and financial affairs different feasible and realistic but also innovative options were elaborated.

Core part of the strategic directions was the development of three land-use scenarios. The background for the development of land-use scenarios is the fact that land-use patterns determine transport more than any other factor. The project team is of the strong opionion that a combined approach of transport and land-use planning is needed for a sustainable plan. Contrary to European cities, where settlement structures are fairly stable, Windhoek has the advantage of being able to influence future settlement structures in a manner that transport is avoided before it is generated. The idea - immediately shared by the key stakeholders - is to locate new citizens and industries in a manner that reduces the overall transport demand and volume. For this purpose Land-Use Scenarios for 2032 were developed as described already in detail in chapter 2.5.3. and the selection process is further described in the next chapter 3.4.

3.4. Selection of the Preferred Strategic Direction

The selection of the preferred strategic direction was supposed to take place in form of a strategic direction workshop with key decision-makers of the main stakeholders concerned. In the third steering committee meeting (please refer to the meeting notes attached in the Technical Annex Report - Annex B) it was decided that there is a need for two strategic direction workshops, one preparatory meeting for in-depth discussions on the technical level and one high-level meeting for decision-making. The Agenda and the List of Participants of both Strategic Direction workshops are attached in Annex E of the Technical Annex Report.

The strategic directions proposed by the Consultant can be viewed also in the Technical Annex Report - Annex E. The preparatory meeting took place at 5th and 6th of November in the Kalahari Sands Hotel; the high-level meeting took place one week later at 13th of November in the Hilton

Hotel. The in-depth discussions on those meetings resulted in a Draft Memorandum of Understanding representing the consensus achieved among the participating members.

The latest version of the MoU is attached in its entirety in Annex C in the Annex Report. Relevant excerpts are given at the beginning of the respective technical chapters in this Draft SUTMP report. The signature of the Memorandum of Understanding (MoU) required approval by the Councils of the cities of Windhoek, Rehoboth and Okahandja and further approval procedures within the involved Ministries and is still outstanding.

Furthermore, in the aftermath of this high-level workshop and also on the basis of the MoU, a Cabinet Memorandum was drafted and forwarded for the recognisance of the project outputs by the Government of Namibia.

During the high-level strategic direction workshop a clear instruction was given to the project team to go on with modelling, forecasting and other elaborations and calculations on the basis of land-use scenario C – Polycentric development along the northern corridor toward Okahandja. Furthermore, the project team aligned all further elaborations along the directions determined by the Workshop MoU.

It can be stated that this protracted development and selection process for the principle strategic direction of the future transport system in the study area contributed considerably to the anchoring of the idea of a more sustainable transport system in Windhoek and helped to get an even broader acceptance of the need for change on all levels of the Government.

3.5. Making Sustainable Transport Attractive

Most transport projects, plans, concepts or policies have the goal to achieve sustainability. "Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs." Sustainability is the long-term maintenance of well-being, which has environmental, economic, and social dimensions. For each of these aspects, transport plays a specific role to achieve the goal.

Social Sustainability:

Income and social disparities are issues related to transport that affect many countries, as well Namibia. Good access to markets, places of employment and social services is a crucial element of sustainability. Citizens from Katutura often live long away from their places of employment and taxis - carrying the largest share of Katutura's inhabitants - are expensive. Consequently, low income households in Windhoek spend up to one quarter (25%) of their income on transport. They often use non-motorised means of transport - walking and cycling - but safety is low due to missing or inappropriate infrastructures.

Less than one fifth (20%) of Windhoek's households has enough income to afford an own a car. Simply providing roads is not enough to secure social sustainability and actually widens the huge already existing income inequality. Human beings need to be in the centre of transport planning. Hence, the Minister of Works and Transport Erkki Nghimtina has called for an "urgent need for a complete new planning approach", which provides transport options for all citizens, especially the poor, children, elderly and disabled.

Environmental Sustainability

The World Health Organisation estimates that about two million people are dying annually from air pollution. Transport is contributing considerably to bad air quality not only world-wide, but as well

in Windhoek. Presently the problems are not apparent, since the population is small, few households own a car and thus congestion problems appear to be negligible except from morning peak hours in central locations. However, until 2032 Windhoek's population is expected to double and per capita income will increase as well by 130%. Given the fact, that usually increased income results in higher motorisation, it is expected that the number of vehicles on Windhoek's roads will rise considerably causing major congestion and environmental pollutions.

A sustainable plan must anticipate these future developments and provide adequate solutions to overcome the problems. Simply increasing road capacities is definitely not sustainable, since air pollution, noise and emission of greenhouse gas will increase, as well as the number of traffic accidents. In addition, broad roads and motorways that are necessary to carry the increased traffic volumes will have an immense separation effect, dividing communities and making living in the city less attractive. This corresponds also with the idea of the green economy issued by the Ministry of Environment and Tourism.

Safety is not only an important feature of sustainability, but as well a major topic in Windhoek's newspapers and transport discussions. Half of all traffic accidents in Namibia take place in Khomas Region. This is as well a social issue, since another half of these are pedestrians, usually low income traffic participants. Main causes are missing road crossings, walk- and cycle-ways, unregulated taxi services with poor safety performance, engineering flaws, little account of safety issues in traffic and town planning, little awareness building and school safety training and poor law enforcement.

Economic and Financial Sustainability:

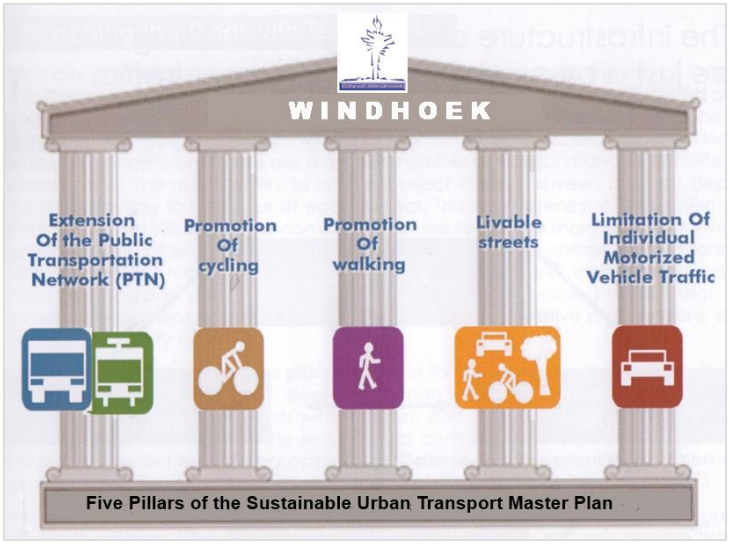
Without sound economic principles, the sustainability of transport systems and projects is endangered. These relate for example to appropriate budgeting, cost-recovery, prioritisation according to costs and benefits or rates of return, public expenditure tracking. A negative example is the regular financial deficit of Windhoek's Public Transport operator as well as of the rail operator TransNamib. Both are causing major subsidies which endanger long-term financial sustainability. An improvement of operations and management could entail major revenue increases and thus release funds for investments and service improvement.

Another issue is related to external costs in transport. Those costs are environmental and accident costs that are generated by individual users, but are paid by the whole society. External costs are calculated and included in the SUTMP multi-criteria assessment.

Pillars of sustainable urban transport

The pathway towards sustainability may be adapted from Freiburg, which is one of the leading sustainable cities in Germany. Five pillars constitute the transport policy, namely extension of public transport, promotion of cycling and walking, liveable streets and limitation of car traffic. A combination of these pillars will have positive impacts on Windhoek as well as it had in many cities of the world. Reduced congestion, emissions, accidents combined with increased social equity, a liveable urban environment, more healthy population and improved accessibility for all.

Figure 3-2: Main features of sustainable transport in Windhoek



World-wide a multitude of best practice examples exist that show how these five pillars may be built.

In Curitiba, a Brazilian town with 1.7 m inhabitants, a Bus Rapid Transit (BRT) system serves the city with a fast, comfortable, reliable and safe public transport system at costs of 10 N$/trip, that is sufficient to cover operational costs.

In Bogotá, Colombia, bicycle tracks are separated from the fast moving traffic allowing high travel speeds for the cyclists and a good safety record.

In Panama City beautiful walkways have been constructed and in Germany many pedestrian zones have been established in the past 50 years and now the "Shared Space" concept is implemented in many towns. Of course, these measures are combined with a multitude of institutional, organisational and legal reforms, with tendering of transport services and independent agencies being the most important ones.

The GIZ Sustainable Transport Sourcebooks for Policy Makers give many more lessons learnt and best practice examples for different topics such as Land-use planning, Managing Transport, BRT, Institutional Development, et al. Below are some illustrations of best practice examples envisaged also as adaptable for the Namibian context.

Figure 3-3: Examples of best practice PT measures:

Beijing BRT, Curitiba BRT System, Zuric PT interchange at the Limmatbridge

Figure 3-4: Examples of best practice NMT measures:

Segregated bicycle tracks in Bogotá, pedestrian walkway in Panama City, Shared Space in Germany

Source: Lloyd Wright, Gtz Transport Photo CD, GIZ Beijing project, own picture

Pathway towards sustainability

The situation in the above cities has not always been as it is today. Often errors of the past had to be removed, alternative approaches tested and new policies implemented. The public transport networks were developed step by step and gradually expanded over time. Since this was not possible without the resistance by beneficiaries of the old system, the new approach needed political commitment and determination. If this commitment is provided by Windhoek's decision makers and strongly supported by the Namibian Government, the city can choose to acquire a modern approach towards sustainability in transport and thus might develop a role model for Namibia and Southern Africa.

The project team faced mostly very positive reactions in the entire stakeholder engagement process. Even in the taxi industry besides some general concerns there is the feeling that the SUTMP will also entail chances and not only risks for this industry. Nevertheless, the advantages of sustainable transportation need to be clearly communicated via different media for different audiences. Such promotional activities are included as accompanying "soft" measures also in the SUTMP as described more detailed in the next chapters.

4 Institutional and Legislative Framework

Th Chapter 4 describes briefly the institutional and legal framework conditions, their strengths and weaknesses and outlines the principle best practice institutional set-up for SUTMP implementation and recommends the way forward to achieve this revised legal, institutional and policy environment mandated by the strategic directions given.

4.1. Existing Institutional Setting

Several institutions play a role in the land use and urban transport system of Windhoek, including Rehoboth, Okahandja and Hosea Kutako International Airport. The key players are the Ministry Works and Transport (MWT) and the City of Windhoek (CoW), Rehoboth Town Council, the Municipality of Okahandja and Khomas Regional Council. MWT is responsible for sectoral policy and regulation, and has a mandate to ensure infrastructure development and maintenance. The ministry has three departments, the Department of Transport (DoT), the Department of Works and the Department of Administration. The DoT is responsible for policy and regulatory functions of the transport sector, which is separate from implementation functions. As will become clear further on, the regulatory function is critical to the successful implementation of the proposed measures. Equally important is the role of various service providers or operators. Proper definition and assignment of these functions between different actors in terms of "who does what" is critical to the success the SUTMP. Other important players include State Owned Enterprises (SOEs), such as the Roads Authority (RA), TransNamib Holdings Limited, Motor Vehicle Accident Fund (MVA Fund), Namibia Airports Company (NAC), Road Contractor Company (RCC) and Namport are responsible for carrying out implementation or operational functions. Other actors in the transport sector include the National Road Safety Council, Transport Advisory Board and the Engineering Council of Namibia.

Directorate of Transport Policy and Regulation

Transportation Policy and Regulation is one of the directorates in the DoT. In it are five divisions (ie, Transportation Policy, Transportation Legislation, Transportation Regulations, Traffic Safety Secretariat and Auxiliary Support Services). The Division of Transport Policy is mandated to formulate policy and advise the Minister concerning policy and implementation issues. Headed by a Deputy Director, the division has the responsibility to coordinate and ensure implementation of economic regulatory policy in all modes of transport. The function of the Division of Transport Regulation include ensuring qualitative, efficient and equitable regulation of the operation of transport services, ensuring industry adherence to regulatory provisions, and facilitating the harmonisation of rules, regulations and technical standards applicable to services, equipment and infrastructure.

Road safety policy is handled by the Division of Traffic Safety Secretariat while the National Road Safety Council (NRSC) is responsible for implementation aspects. Last, but by no means least, the Division of Transportation Legislation is mandated to ensure the promulgation of legislation considered important for the creation of a conducive environment for transport; serve as a catalyst for socio-economic development; ensure the proper interpretation of legislation; and guide implementation by agencies in the execution of their transport powers and functions in an efficient and effective manner. The functions that these agencies perform is critical to the implementation of the SUTMP (please refer also to chapter 4.5) and therefore their capacity and efficaciousness must be maintained, extended and strengthened in tandem with the demands of a modern public and non-motorised transport system.

Directorate of Transport Infrastructure

The Directorate of Transportation Infrastructure has two divisions – Transportation Infrastructure Planning and Transportation Infrastructure Management. The overall objective of the directorate is (1) to ensure the development of modern transport infrastructure for roads, aerodromes, harbours and waterways, (2) to ensure optimal utilisation of management of transport infrastructure projects assigned to the directorate, (3) to ensure integrated sectoral planning, and 4) to advise the Minister on all transport infrastructure planning matters. Three SoEs – RA, RFA and RCC – are responsible for implementation of the transport infrastructure mandate. It is envisaged that these mandates and responsibilities will be in greater demand during implementation of the SUTMP and therefore the performance of these agencies, particularly those that are responsible for infrastructure planning and management, will be of critical importance to the successful the SUTMP implementation process. This issue is discussed in greater detail in Chapter 4.

Directorate of Railway Affairs

The objective of the Directorate of Railways Affairs objective is to plan, design, construct, maintain, manage and control the railway infrastructure (both civil and rolling stock) in the country as well as to ensure the provision of railway services, and compliance with the National Transport Services Holding Company Act (Act No. 28 of 1998). There is one division in the directorate (ie, Project Management). Meanwhile, TransNamib is via a performance agreement with the MWT-Directorate of Railway Affairs responsible for the entire maintenance of the rail infrastructure, including all safety related aspects - determining standards such as inspecting and licensing rolling stock and rail infrastructure, accident investigation and presentation of improvement measures and other service obligations for customer protection.

City of Windhoek

City of Windhoek is primarily responsible for ensuring that municipal services are rendered efficiently and effectively to the entire city population. The following five are particularly critical for delivering transport infrastructure and services: Community Services, Urban Planning and Property Management, Infrastructure Water and Technical Services, City Police and, Economic Development and Environment. The Department of Community Services has the five following divisions – Community Development, Public Transport, Sustainable Management, Emergency Management and Disaster Management. The Public Transport Division currently operates the City Bus Service. Planning, Design and Traffic Flow, Land Delivery and Urban Planning are three divisions under the Department of Urban Planning and Property Management that are vital for the success of the SUTMP. Several other divisions (eg, Procurement and Creditors in Department of Finance and Traffic Management in Department of City Police) are also important for the successful implementation of the SUTMP.

Khomas Regional Council

Khomas Regional Council is a Regional Government structure empowered in law (Chapter 12 of the Constitution of the Republic of Namibia and Part IV of the Regional Councils Act, Act No 22 of 1992) to undertake the planning of the region to which the SUTMP applies. To the extent that the Government policy is to decentralise functions (Decentralisation Enabling Act, No. 33 of 2000) to institutions such as Regional Councils, the Khomas Regional Council and other lower level jurisdictions are relevant and enjoined to the agenda of developing an integrated land use and sustainable urban transport systems in the region.

Rehoboth Town Council and Okahandja Municipality

These are two additional local authorities in the study area with statutory powers, duties and functions, under the Local Authorities Act, No. 23 of 1992. Town Planning Ordinance 11 of 1954, and Townships and Division of Land Ordinance 18 of 1937, such as to construct and maintain

streets and public spaces, to establish, carry on and maintain a public transport service, to establish and maintain parking garages and to designate areas for the parking of vehicles, and to construct, acquire and maintain railway sidings, among other transport related functions. Considering that the two towns are satellites of Windhoek with direct road and rail links to the latter, their future growth will to a degree be influenced through the implementation of the SUTMP in particular, and the growth of the City of Windhoek in general. Improvement of PT links between these urban centres will no doubt have a direct bearing on the level and intensity of interaction between them.

The following Figure provides a summary of the main institutions, both state and non-state, with most relevance to the SUTMP, and their respective functions. Some institutions carry more responsibilities than others. For example, the City of Windhoek performs all five functions – planning/policy, regulation, implementation, monitoring and evaluation.

Figure 4-1: Summary of SUTMP related institutions

Institution	Function				
	Policy/Planning	Regulation	Implementation	Monitoring	Enforcement
Central Government Ministries					
Ministry of Works and Transport	✔	✔	✘	✔	✘
Ministry of Regional and Local Government, Housing and Rural Development	✔	✔	✔	✘	✘
Regional and Local Government					
City of Windhoek	✔	✔	✔	✔	✔
Okahandja Municipal Council	✔	✔	✔	✔	✔
Rehoboth Town Council	✔	✔	✔	✔	✔
Khomas Regional Council	✔	✔	✘	✔	✘
Statutory Bodies (i.e. Commissions, Councils and Boards)					
Road Transport Board	✔	✔	✘	✔	✘
Road Transport Commission	✔		✘	✔	✘
National Planning Commission	✔	✔	✘	✔	✘
Namibia Planning Advisory Board	✔	✘	✘	✔	✘
Namibia Planning Advisory Board	✔	✘	✘	✔	✘
The Namibian Council of Town and Regional Planners	✔	✔	✘	✔	✘
Namibia Institute of Architects	✔	✔	✘	✔	✘
Institute of Namibian Quantity Surveyors	✔	✔	✘	✔	✘
Association of Consulting Engineers of Namibia (yet to be established)	✔	✔	✘	✔	✔

Institution	Function				
	Policy/Planning	Regulation	Implementation	Monitoring	Enforcement
Namibian Planning and Construction Council	✔	✔	✘	✔	✘
Namibian Competition Commission	✔	✔	✔	✔	✔
State-owned Enterprises Governance Council	✔	✔	✘	✔	✘
National Housing Advisory Committee	✔	✔	✘	✔	✘
Sustainable Development Advisory Council	✔	✘	✘	✔	✘
State-Owned Enterprises and Executive Agencies					
Namibia Airport Company	✘	✘	✔	✔	✘
TransNamib	✘	✔	✔	✔	✘
Motor Vehicle Accident Fund	✔	✔	✔	✔	✘
Roads Authority	✔	✔	No, unless directed by the Minister in accordance with Section 16(4)	✔	✔
Roads Contractor Company	✘	✘	✔	✘	✘
Road Fund Administration	✔	✔	✔	✔	✘
Private Sector Actors / Intermediate Institutions					
Namibian Manufacturers Association	✔	✘	✔	✔	✘
Namibian Bus and Taxi Association (NABTA), Namibia Transport and Taxi Drivers Union (NTTU) and Namibia Public Passenger Transport Association (NPPTA)	✘	✘	✔	✔	✘
Private Sector Road Safety Forum	✘	✘	✔	✔	✔
Namibian Employer Federation	✔	✘	✔	✔	✘
Non-State Actors					
Bicycle Empowerment Network	✘	✘	✔	✔	✘
Physically Active Youth	✘	✘	✔	✔	✘
Namibia Cargo Bicycle	✘	✘	✔	✔	✘
Rock and Rut Mountainbike Club	✘	✘	✔	✔	✘

Further information about stakeholders and their roles and capacities can be found in the stakeholder analysis report incl. its addendum, September 2012, available with the GIZ. Recommended measures for capacity strengthening and for creating an SUTMP enabling institutional framework are given in chapter 4.5 ff.

4.2. Legislative and Regulative Basis

The success of the SUTMP will depend on the extent to which the legislative and regulatory regime is aligned with the sustainable transport agenda. There is a well-established legal framework in Namibia for administering the land use (e.g., Article 129 of the Constitution, Local Government Act, Regional Councils Act, etc.) and the transport sectors (e.g., Road Traffic and Transport Act 22 of 1999, Road Traffic Ordinance 30, Road Authority Act 17 of 1999, etc.).

However, review of existing laws and, if circumstance so determine, legislating new ones, will be necessary not only to increase their efficaciousness in the context of the SUTMP, but also to minimise encumbrances during the implementation of all proposed measures, and to ensure that the legal framework contributes positively to the desired outcomes of the NDP IV and Vision 2030.

Some of this work may well be covered under the "Legislative and Institutional Reform of Road Safety Management in Namibia", a project supported by GIZ. What remains will require a similar exercise but with a greater focus on the SUTMP (please refer also to the implementation plan in chapter 10).

To provide a clearer view of the legislative and regulative drivers of the SUTMP, the main relevant legislations in transport and land use planning are listed in the table below. In the near future, those laws and especially the relevant parts given in column 2 of the table need to be discussed in the light of SUTMP realisation on a policy making level (see also chapter 4.5) in order to achieve faster and better expected SUTMP impacts.

Figure 4-2: List of laws in the field of transport and land use planning

Law	SUTMP-relevant Parts, Chapters, Sections & Articles	Comment
National Transport Services Holding Company Act, No. 28 of 1998, as amended by Act 2 of 2006	• Section 1 – Definitions • Section 2 – Incorporation of Holding Company • Section 4 – Objects of Holding Company • Section 8 – Power of Minister to issue directions to Holding Company • Section 14 – Transfer of assets to Holding Company	Provides for the incorporation of a holding company to undertake, either by itself or through any subsidiary company, transport services in Namibia or elsewhere; and provide matters incidental thereto.
Road Traffic and Transport Act, No. 22 of 1999 (Amended by the Road Traffic and Transport Act, No. 6 of 2008).	• Chapter 1 – Transportation Commission of Namibia (Sec • Chapter 7 – Road Traffic Signs and Speed Limit (Sec 73, 74, & 76) • Chapter 11 – Regulations (Sec 91, 92 & 93)	Foundational for governing road traffic in the country. For example, Section 92 defines the power of Local Authority Councils and Regional Councils to make regulations and Section 93 - power of the Minister to make standard regulations)
National Road Safety	• Section 5 – Object and	Provides for the appointment of the National

Law	SUTMP-relevant Parts, Chapters, Sections & Articles	Comment
Act, No. 9 of 1972 (as amended in South Africa prior to Namibian independence)	Execution • Section 6 – Functions of Director-General (DG) • Section 7 – Powers of the DG	Road Safety Council to, inter alia, assist the Minister in the co-ordination and activation of road accident combating measures, including provisions intended to promote road safety
Roads Contractor Company Act, No. 14 of 1999 (as amended by the Roads Contractor Company Amendment Act, No 11 of 2002, and the State-owned Enterprises Governance Act, No. 2 of 2006)	• Section 1 - Definitions • Section 4 – Object of RCC • Section 5 – Powers and duties of RCC • Section 7 – Performance agreement	Provides for the incorporation of a company to undertake the construction and maintenance of roads and other construction works; and to provide for matters incidental thereto.
Roads Authority Act, No. 17 of 1999 (as amended by Roads Authority Amendment Act, No. 20 of 2004, and the State-owned Enterprises Governance Act, No. 2 of 2006)	• Part II (Sec. 3 – Objects of the Authority, Sec. 13 & Sec. 15 – Functions of the Authority) • Part III – Management of Road Network • Part IV – Financial and General Provisions	Establishes a Roads Authority to manage the national road network in accordance with Section 16 with a view to achieving a safe and efficient road sector; and to provide for matters incidental thereto
Road Fund Administration Act, No. 18 of 1999 (as amended by the State-owned Enterprises Governance Act, No. 2 of 2006)	• Part I – Preliminary Provisions • Part II (Sec. 3 – Objects of the Administration & Sec. 15 – Functions of the Administration) • Part III – The Road User Charging System	Establishes the Road Fund Administration to manage a road user charging system; to establish a Road Fund; and to provide for matters incidental thereto
Motor Vehicle Accident Fund Act, No. 10 of 2007	• Part I – Preliminary Provisions • Part II (Sec. 3 – Establishment, purpose and functions of the Fund, Sec. 3 Powers of Fund & Sec. 4 – Moneys of Fund • Part III – Administration of Fund • Part IV – Accident response • Part VI – Benefits • Part VII – Exclusions & limitations • Part VIII – Claim procedure • Part IX – Investigation &	Provides for the establishment, administration and management of the Motor Vehicle Accident Fund as an administrative body to provide assistance and benefits to persons injured in motor vehicle accidents and to dependents of persons killed in such accidents; and to provide for incidental matters

Law	SUTMP-relevant Parts, Chapters, Sections & Articles	Comment
	furnishing of information • Part X – Rights, legal remedies and prescriptions • Part XI – General provisions	
Town Planning Ordinance, No. 18 of 1954, as amended by Ordinance 13 of 1970; Ordinance 11 of 1973; Act 27 of 1993; Act 15 of 2000.	• Section 9-14 (establishment of the Namibian Planning Advisory Board), • Section 16&17 (Procedures for obtaining permission to prepare a town planning scheme) • Section 20-28 (approval process for town planning schemes) • Section 29-38: purchase, expropriation, conformation and compensation issues • First Schedule – nature and content of pre-planning surveys	Makes provision for the preparation and carrying out of town planning schemes and for matters incidental thereto and to provide a framework for Planners within which such schemes are to be prepared
Townships and Division of Land Ordinance, No. 11 of 1963, as amended by Ordinance 36 of 1967; Ordinance 10 of 1973; Act 28 of 1992; Act 21 of 1998; and Act 11 of 2000	• Section 2&3: Establishment of Township Boards • Section 24-26: deproclamation of approved townships, their re-vesting and transfer of public places and reserved land in deproclaimed townships and the cancellation of general plan for such townships • Section 31-33: variation, cancellation and enforcement of conditions imposed in terms of the Ordinance	Provides for consolidation and amendment of laws relating to the establishment of townships and to provide for the regulation and control of the development and subdivision of land and for matters related thereto.
Local Authorities Act, No 23 of 1992, as amended by Act 3 of 1997; Act 14 of 1997; Act 24 of 2000; Act 17 of 2002; Act 14 of 2004; and Act 2 of 2009	• Section 50: Sets out procedures to be followed for the closing of public places	Provides for the establishment of an ordered system of management for the affairs of cities, towns and villages. It seeks to establish the rules, procedures and tasks of the Local Authorities which must be performed to ensure the highest possible level of harmony where many people live together.
Regional Councils Act, No. 22 of 1992, as amended by Act 17 of 1997, Act 12 of 2002; Act 12 and Act 16 of	• Part VI – Section 28-30: powers, duties, functions, rights and obligations of Regional Councils • Section 32: management and	Provides for establish of Regional Councils in regions determined in accordance with article 103 of the Namibian Constitution; to provide for the election by Regional Councils of members of the National Council; and to

Law	SUTMP-relevant Parts, Chapters, Sections & Articles	Comment
2010	control of settlement areas • Part IX – General provisions, including Sec. 41: Public meetings	define the rights, powers, duties and functions of such regional councils; and to provide for related matters.
Townships and Division of Land Ordinance, No.11 of 1963, as amended by Act 28 of 1992	• Section 1 – Definitions • Section 14 – Vesting of public places in Local Authority or Minister • Section 15 – Transfer to State or Local Authority of reserved land • Section 19 – Subdivision of erven • Section 36 – Regulations • First Schedule	To consolidate and amend the laws relating to the establishment of townships and to provide for the regulation and control of the development of land and for matters incidental thereto
Town and Regional Planners Act, No. 9 of 1996, as amended by Act 32 of 1998	• Section 2 – Establishment of Namibian Council for Town and Regional Planners • Section 9 – Powers of Council • Section 20 – Prohibition of unregistered persons to perform certain kinds of work • Section 25 - Regulations	Provide for the registration of Town and Regional Planners and Town and Regional Planners in training; and to provide for matters connected therewith
Architectural and Quantity Surveying Professionals Bill, No. 18 of 2010	• Part 1 – Preliminary • Part 2 – Namibia Council for Architectural and Quantity Surveying Professions • Part 3 – Reservation of Work for and Registration of Architects and Quantity Surveyors and Architects and Quantity Surveying Professionals • Part 4 – Disciplinary matters • Part 5 – Boards of control • Part 6 – General	To provide for the continued existence of the Namibia Council for Architects and Quantity Surveyors under the name Namibia Council for Architectural and Quantity Surveying Professions; to provide for the registration of architects and quantity surveyors, architects in training and quantity surveyors in training, and other architectural and quantity surveying professionals; to provide for the reservation of certain kinds of work to architects and quantity surveyors and architectural and quantity surveying professionals; to provide for the establishment of boards of control for architectural and quantity surveying professionals; and to provide for incidental matters.
Namibian Planning and Construction Council Bill, No. 7 of 2010	• Section 1 – Definitions • Section 2 – Establishment of Council • Section 29 – Prohibition of carrying on business	Provide for the establishment of the Namibian Planning and Construction Council and for its powers and functions; to provide for the registration of persons engaged in the construction industry and to provide for

Law	SUTMP-relevant Parts, Chapters, Sections & Articles	Comment
	• Section 21 – Qualification for registration • Section 27 – Offences • Section 28 - Regulations	incidental matters
State-owned Enterprises Governance Act, No. 2 of 2006, as amended Act 2 of 2008	• Part III – Procedure for appointment of board members and obligations of SoEs • Part VI – Restructuring of SoEs • Part VII – General (Section 42: Communication to be notified to portfolio Minister and Section 43: Regulations)	Provides for the efficient governance of State-owned enterprises and the monitoring of their performance; restructuring of SoEs; establishment of the SoE Governance Council and define its powers, duties and functions; and make provision for incidental matters
Competition Act, No. 2 of 2003	• Chapter 1 – Preliminary provisions • Chapter 2- Namibian competition Commission • Chapter 3 – Restrictive business practices • Chapter 8 – Application of this Act and other legislation relating to competition	An act to safeguard and promote competition in the Namibian market; to establish the Namibian Competition Commission and make provision for its powers, duties and functions; and to provide for incidental matters
National Planning Commission Act, No 15 of 1994	• Section 1: Members of the Commission • Section 3: Functions of the Commission	Provides for the membership, powers, functions and personnel of the Commission and matters incidental thereto
National Housing Enterprise Act, Not 5 of 1993, as amended by Act 32 of 2000	• Section 3: Objects of NHE • Section 4: Powers of NHE • Section 22: Exercise of powers by NHE and submission of powers by board to Minister • Section 23: Regulations	Provides for the continued existence of a body corporate fir the purpose of providing for the housing needs of the inhabitants of Namibia..., and to provide for its powers, duties and functions, and matters connected therewith
National Housing Development Act, No. 28 of 2000	• Section 5: Functions of Advisory Committee • Part III (Section 8&9): Regional and Local Housing Revolving Fund • Part IV (Section 10&11): Allocation of moneys from Trust Fund to Housing Revolving Funds and utilisation of such moneys • Part VI – Decentralised Build	Provides for the establishment of a National Housing Advisory Committee and defines the powers, duties and functions of that Committee; provide for the establishment of Housing Revolving Funds by Local Authority Councils and Regional Councils; to regulate the allocation of moneys to, and the administration of Housing Revolving Funds; to provide for the establishment of Decentralise Build Together Committees and

Law	SUTMP-relevant Parts, Chapters, Sections & Articles	Comment
	Together Committees • Part VII – General (Section 31: Appeals and Section 32: Regulations)	to define the powers, duties and functions thereof; and to provide for matters incidental thereto
Environmental Management Act, No. 7 of 2007	• Section 2 – objects of the act • Section 3 – principles of environmental management • Part IV: Sustainable Development Advisory Council	Promotes the sustainable management of the environment and the use of natural resources by establishing principles for decision making on matters affecting the environment; to establish the Sustainable Development Advisory Council; to provide for the appointment of the Environmental Commissioner and environmental officers; to provide for a process of assessment and control of activities which may have significant effects on the environment; and to provide for incidental matters.
Decentralisation Enabling Act, No. 33 of 2000	• Section 2 – decentralisation of functions • Section 3 – effects of delegation of functions • Section 7 – use of budgeted funds paid to Regional Councils or Local Authority Councils	Provides for and regulates decentralisation to Regional Councils and Local Authority Councils of functions vesting in line ministries; and to provide for incidental matters

4.3. General Policies in the Transport Sector

As briefly discussed in Chapter 3.2 several policies guide the transport sector administration. In addition to the legal, regulatory as well as policy instruments listed and or discussed before, below are additional policy and strategy documents pertaining to the transport sector in general and the road sub-sector in particular that were referred to during the preparation of this SUTMP. The title, author (or responsible agency), date of publication and a synopsis of the documents are presented in the following Table. The same is valid as said already for the legal list in the chapter before: a couple of those policy papers ought to be discussed and possibly revised in the light of this Master plan for smooth implementation of recommended measures. This is especially true for the White Paper.

Figure 4-3: List of policy documents in the field of transport

Title	Author	Date of Publication	Summary
White Paper on Transport Policy Currently under review	Department of Transport of the Ministry of Works and Transport (MWT)	23 June 1995	To propose policies for the transport sector in line with the basic objectives of the GRN. To revive and sustain economic growth, create employment opportunities, alleviate poverty, reduce inequalities in incomes, promote an

Title	Author	Date of Publication	Summary
			efficient use of scarce resources. To ensure safe, effective & efficient transport services on all modes of transport.
White Paper on Labour Based Works Policy (LBW)	MWT	April 1999	The LBW represents an important step forward in the struggle to combat poverty and unemployment in Namibia. It is aimed at equipping the various economic sectors with guidelines for meaningfully increased utilization of Namibias abundant human resources.. It might be relevant also for urban roads when thinking on some of the envisaged measures in the field of NMT and residential street reshaping.
SADC Protocol on Transport, Communications and Meteorology	GRN	Signed August 1996	Based on articles 22 and 23 of the SADC Treaty in order to expand and deepen the cooperation of the SADC-States in the areas of infrastructure and services to establish viable and sustainable transport, communications and meteorology systems. The scope is to tune up all policy: Legal, regulatory, institutional, operational, logistical, technical, commercial, administrative, financial, human resources and other issues.
NDP 4 2012/13 – 2016/17	National Planning Commission	July 2012	Objectives of NDP 4: The overarching goals of NDP 4 are: high and sustained economic growth, employment creation and increased income equality. The thrust of NDP IV is to provide direction as regards high-level national priorities, desired outcomes and strategic initiatives. The three priority areas are: **Basic Enablers** – ie, the essential albeit not sufficient conditions for economic. These are (1) the institutional environment (2)education and skills (3) health (4) reduction of extreme poverty, and (5) public infrastructure. **Economic Priorities** – these are logistics, tourism, manufacturing and agriculture. **Execution, Monitoring and Evaluation, and Progress Reporting** Under the enabler "public infrastructure", the relevant outcome for transport infrastructure is as follows: By 2017, Namibia shall have well-functioning, high quality transport infrastructure. This is already envisaged in the 5 year realization plan of the Ministry of Works and Transport.

Title	Author	Date of Publication	Summary
Medium to Long Term Roads Master Plan (MLTRMP) Revision Draft Report	Roads Authority	February 2012	The objective of this Roads Master Plan is the revision of the MLTRMP 2003 and to update the road development and preservation programmes or the medium and long-term. The planning horizon for the revised MLTRMP is 20 years split into two periods – 2011-2015 (ie, short and medium-term) and 2016-2030 (ie, long-term). This is relevant as
Transformation Strategy for Motor Vehicle Accident Fund 2004 – 2006	MVA	August 2004	The implementation framework for this Transformation Plan to achieve two objectives: Transform the Funds's functional and operational mode from those of legal and legalistic entity to those of an administrative body. ▪ Ensure financial Sustainability. ▪ Build a Management Team for delivering the Fund's mandate. ▪ Establish operational efficiency ▪ Improve customer services
Draft Consultation Report on the Merging of the MVAF and the NRSC	MWT + KFW - Consultant	2006	Look into the merging aspects
Vision 2030 (page 67 – 96)	GRN / OPM	September 2003	Policy Framework for Long Term National Development: ▪ Expansion and maintenance of road infrastructure network to uncovered places in rural areas and others ▪ Adequate maintenance of existing road network ▪ Provision of road linkages to neighbouring countries
Draft Bill: National Construction Industry Council of Namibia	MWT / GTZ	Dec 2006 Ongoing process	To provide for the establishment of the National Construction Industry Council of Namibia for the promotion, regulation and development of the construction industry, for the registration of persons engaged in the construction industry and general for matters incidental thereto or connected there with.
German – Namibian Development Co-operation Priority Area: Transport Strategy Paper. Note: a new	Simana / Oel	2006 / 2010	Based on the general principles as elaborated in this strategy paper as well as the on-going policy dialogue on transport related issues, it is intended to implement measures and activities under financial and technical cooperation, deploy integrated expertise and run training programmes.

Title	Author	Date of Publication	Summary
German-Namibia Development Cooperation Framework is up for discussions in the first quarter of 2013			
Climate Change Strategy and Action Plan (Proposed)	Ministry of Environment and Tourism	October 2009	The document is intended to *inter alia* mainstream climate change adaptation and mitigation in the medium- to long-term nationaldevelopment goals. With reference to transport, the following is proposed: • Promote the development of alternative modes of service delivery that will reduce carbon emissions • Promote development of climate change resilient transport infrastructure • Diversify transport energy sources • Improve motor vehicle fuel efficiency • Promote use of public transport

4.4. Conflicts of Interest and Deficiencies

Successful implementation of the SUTMP will require competing interests to be judiciously reconciled and deficiencies addressed. While it is inevitable that implementation of the proposals contained in this Master Plan will unrattle certain vested interests, on the whole this SUTMP is designed to serve the greater public good. To achieve such a broad-based and sustainable goal reflective of the public good requires reconciling differences and competing interests and deficiencies, which arise primarily from the existing transport system and characteristics as described in Section 2.

The gap between the current state of the transport system in the City of Windhoek, including Rehoboth, Okahandja and Hosea Kutako Airport on the one hand, and the desired state, on the other, represents certain deficiencies that are attributable to human, technical, financial, and institutional constraints as aptly discussed throughout this SUTMP. Highlighting these deficiencies (e.g. weak legislative and regulatory frameworks, low implementation capacities, etc. discussed below), as well as recommending measures to address them is tacit support for change towards a more sustainable urban transport system. Therefore, the necessary adjustment to accommodate a more inclusive transport system will require both patience and skillful engagement with all stakeholders. The active involvement of stakeholders has been on-going since the start of the master planning process (see Section 1.3). These efforts should be continued and even intensified during implementation all the way to the evaluation phase.

4.4.1 Weak legislative and regulatory frameworks

Reference has been made in Section 4.2 to the key legislative and regulatory frameworks in the transport and land use sectors. The legislative and regulatory framework is "weak" in the context of SUTMP realisation. This is underpinned by the principle that a supportive institutional and legal framework is a prerequisite for the successful implementation of the SUT. As noted in that Section,

alignment between the objectives of the Master Plan and the legislative and regulatory frameworks is pivotal to the successful implementation of the SUT. This applies to all strategic areas of the MP including:

(a) Land use Planning
(b) Public Transport
(c) Non-motorised Transport
(d) Traffic Management, and
(e) Financing.

An exhaustive review of all relevant legal and policy frameworks (e.g., Local Authorities Act, Police Act, Road Traffic and Transport Act, Roads Authority Act, National Transport Services Holding Company Act, etc.) shows that they are in reasonable alignment with the Sustainable Urban Transport Master Plan's strategic objectives. Therefore, implementation of the SUTMP is not conditional to conducting a comprehensive regulatory and institutional review/reform of the existing legal framework. For example, a new BRT company could be either established as municipal division, as national transport service holding company or as a private company. However, again in the light of best practices world-wide, strategic directions given and SUTMP recommendations, the following immediate measures are proposed:

(a) Land use planning

- Revise existing planning laws and guidelines in the Town Planning Ordinance of 1954 and the Townships and Division of Lands Ordinance 11 of 1963 and the Local Authorities Act 23 of 1992 as amended with a view to ensure that PT and NMT considerations are better reflected in land use planning such as densification, mixed land-use, land developments such as new shopping malls with inherent traffic plans.

(b) Public transport

- Make legal provision (e.g., in the National Transport Services Holding Company Act, No. 28 of 1998, Road Traffic and Transport Act No. 22 of 1999, Local Authorities Act, No. 23 of 1992, State-owned Enterprises Governance Act No. 2 of 2006 – all as amended, and any other relevant laws, for the establishment of a Transport Agency (at national and or city level) that is/are sufficiently autonomous and independent to sustain the implementation of a modern state of the art public transport for the City of Windhoek.

(c) Non-motorised transport

- Provide adequate mechanisms for implementing all NMT proposals in an equitable and transparent manner consistent with the goals of increasing the modal share of NMT and reducing the number of cyclists and pedestrians killed or injured in traffic crashes. Some of the legal levers include (but not limited to) the Road Traffic and Transport Act of 1999 as amended, National Road Safety Act No. 9 of 1972 as amended, Roads Authority Act 17 of 1999 as amended, etc.

(d) Traffic management

- Codify and apply Transport Demand Management principles within, for example, the Roads Authority Act as amended, Road Traffic and Transport Act as amended, the Local Government Act as amended, etc., as well as in statutory agencies such as the City of Windhoek Traffic Management Division, Public Transport Division, and the City Policy.

(e) Financing

- Alignment between all relevant financing and legal instruments and procedures (e.g., State Finance Act No. 31 of 1991 as amended, Anti-Corruption Act No. 8 of 2003, Competition Act No. 2 of 2003, etc.) and the SUT proposals.

4.4.2 Low implementation capacity

The ability to execute proposed measures depends on stakeholders' material resources and skills endowment. The supply of basic competencies as well as access to or control of resources determines the individual's or organisation's capacity to implement the various measures proposed in the SUTMP. Considering the existing planning and implementation capacity and coordination capabilities, accompanying capacity building measures have been proposed for all interventions (please refer also to chapter 10 – implementation plan) to ensure that the desired quantity and quality of service is achieved.

4.4.3 Poor quality public service delivery

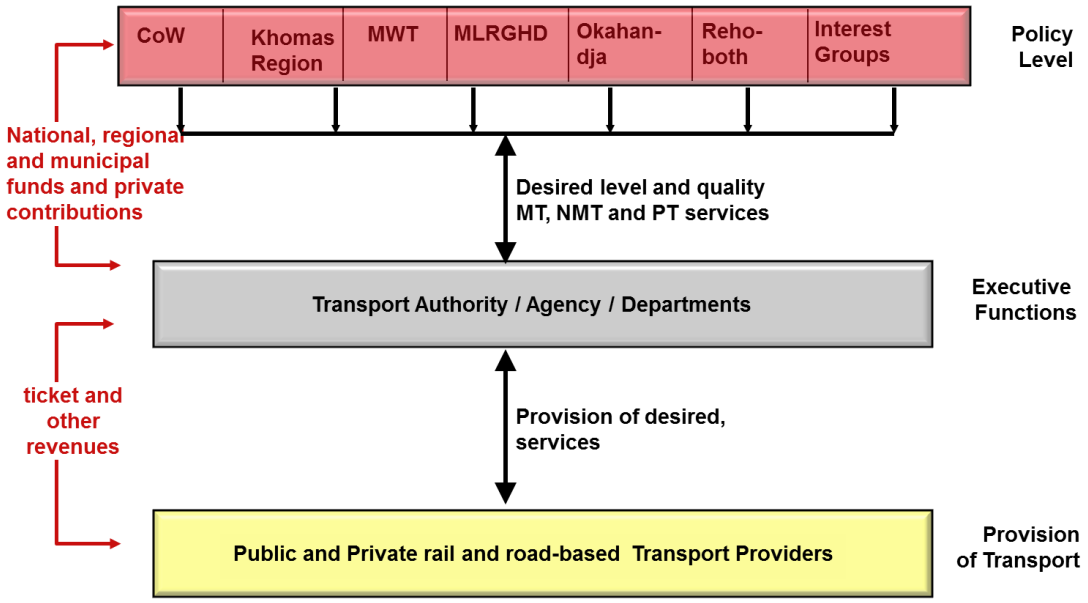
Enhancing the quality of transport services is an integral part of the SUTMP. The problem of poor quality of service offered by some transport service providers was exhaustively identified as early as 1995 in the White Paper on Transport Policy. For example, passenger safety is often compromised by private taxi operators who tend to make their livelihood by adopting aggressive forms of competitive behaviour on the road. Poor maintenance of publicly operated buses also contributes to low level of service (e.g. level of breakdowns and pollution generation) aside from the limited service hours, routings stemming still from before Namibia becoming independent and weak customer service and information. Specific to cycling, an on-site check undertaken by the project team of the available quality and quantity of bicycle infrastructure Windhoek (including Rehoboth and Okahandja) shows negative line-of-sights (LOS) on nearly all typical traffic and infrastructure characteristics (e.g. motorised traffic speeds, land width, conflict level, riding surface, etc.). Walking conditions along most urban roads is not any better. These are set to change under the proposed road reclassification scheme described below and other NMT measures.

4.5 Institutional Development

If there is the political will to achieve a major paradigm shift towards a more sustainable transport system in the SUTMP proposed pace, the existing institutional, legal and financial framework needs to be strengthened.

The principle state-of-the-art transport sector organisation comprises of three levels, i.e. the policy level, the executive/administrative level and the service provision. The following figure shows the relations between those three levels in the urban transport sector of the study area.

Figure 4-4: Principle organisation and relations of the institutional, legal and financial framework in urban transportation



For all those relations (black and red arrows) as well as for the executive functions for public transportation, the institutional, legal and financial set-up has to be reviewed and optimised towards the new paradigm for sustainable urban transportation. This is also true for the relations between the policy level institutions, e.g. which policy level is responsible for financing which parts of the SUTMP measures.

The presently existing framework has to be reviewed against the targeted measures for achieving sustainable transportation and has to be adapted accordingly. The following text for the strategic directions was agreed upon with wide consensus by all key stakeholders and paves the way forward.

Strategic Directions for the Institutional, Legal and Financial Framework

Excerpt of the Memorandum of Understanding for the Institutional, Legal and Financial Framework:

Having considered the various strategic options for the institutional set-up of efficient sustainable modes, namely strengthening of existing institutional set-up, establishing a Transport Agency, privatisation of existing operational PT services, and Public Private Partnership for complete renewal of Public Transport system;

And taking into account the financial constraints of the City of Windhoek;

And taking into account that the operational costs of Public Transport systems need to be covered by efficient Public Transport operations;

And taking into account uneven investments of the Central Government for different modes of transport;

It is agreed that:

a. commercialisation of public transport has to go along with secure financing;
b. there is a need for a strong regulatory entity and ensuring that Public Transport operation is tendered for competitively;
c. Road Fund Administration can take over part of the investment costs, if overall life cycle costs are reduced e.g. by low cost design standards;
d. the potential for increasing fuel levy in order to finance Public Transport and Non-motorised Transport needs to be investigated;
e. the regulation and administrative functions for Public Transport ought to be taken over by a national transport agency;
f. the coverage of investment costs is not a challenge as long as it follows certain principles such as user chooses his/her services, Public Service Obligations are addressed and the Government does not limit service provision;
g. coverage of public service obligations is not a challenge if it goes along with efficient service provision;
h. the process of legal reforms should be supported;
i. to form an interagency/intergovernmental Committee aiming at further elaboration of institutional, legal and funding implications of Public Transport and Non-motorised Transport measures after SUTMP submission.

From an institutional point of view there are three strategic directions agreed upon which were followed-up by the project team and which are further outlined in the next sub-chapters.

a) Interagency/intergovernmental Committee (chapter 4.5.1)

b) Commercialisation of Public Transportation (chapter 4.5.2)

c) National Transport Agency (chapter 4.5.3)

In view of the major changes proposed in the field of NMT, PT and TM, and in addition to the establishment of new entities, existing entities and capacities need to be considerably strengthened and the existing staff trained accordingly. This topic will be dealt with in more detail in chapter 4.5.4.

Whereas in NMT and in TM, the new measures can be introduced to a great extent within existing institutional structures and mainly require some capacity strengthening and training measures combined with up-dates in design standards and financial support systems, the organisation of future public transportation is by far more complex. Thus, the following chapter concentrates on public transportation and just if there are explicit NMT and TM functions concerned an excursus is made.

Some positive measures have already started being implemented in the transport sector. One of these is the introduction and enforcement of performance management in the City of Windhoek. Following a review of its management system and practices, the CEO announced a new management structure in October 2012 to ensure delivery on its key strategic objectives of improved

customer and stakeholder value, improved internal efficiency and effectiveness, good corporate governance in all business practices, increased capability and well-being of human capital, increased organisational capability, and maximisation of all revenue-generating opportunities. Examples of other on-going initiatives include:

- NDP4 execution plans.
- Exploration by the Directorate of Transport Policy and Regulations of suitable options to engage the Taxi Industry much more meaningfully.
- On-going review of planning standards by a Ministry of Regional and Local Government, Housing and Rural Development appointed Committee.
- The imminent review of Structure Plan for the City of Windhoek
- Legislative and Institutional Reform of Road Safety Management in Namibia.

All the above initiatives represent opportunities to anchor this Master Plan and make SUT a reality. Other suggestions for institution building already on the table include (1) increasing revenue collection and review of tax regime, (2) promotion of public-private partnerships, (3) improving indicators for doing business in Namibia, (4) improve and implement policy and legislative frameworks, and (5) increase public access to environmental information. The measures proposed by this Master Plan are in alignment with most of these propositions and their implementation will contribute to the overall economic and social objectives of the Government of Namibia.

An efficient and effective urban transport system is a powerful tool for improving the efficiency and accessibility of the labour market, and providing better access to education and health services. Thus, implementing measures intended to increase supply of PT and NMT infrastructure and services such as is proposed under the polycentric land use scenario will increase access to pre-primary and primary education facilities, directly contributing to one of the desired outcomes in education and skills under NDP4. The same is true, for example, with increasing access to health facilities. This required a coordinated approach with the Ministry of Education, Ministry of Health and Social Services, Ministry of Gender Equality and Child Welfare, as well as other primary stakeholders and responsible entities. Providing efficient and affordable PT will also directly contribute to poverty alleviation by increase their access for the extremely poor and vulnerable to quality public services.

4.5.1 Intergovernmental Special Commission for Sustainable Transportation

Urban Transportation has many players on various governmental levels (City, Region, and Nation), involving various ministries (e.g. MWT, MRLGHRD, MoF) and other statal and parastatal entities such as the National Planning Commission, TransNamib, the taxi industry and the municipal and private sector bus services to name just a few acting within a given legal and financial framework, within formalised and informal interrelations and within given capacities.

In order to effectively accompany, guide and enable the intended sustainable transport development in Windhoek and towards Okahandja, Rehoboth and Hosea Kutako International Airport, the need for establishing an Intergovernmental Special Commission (ISC) was recognised and is part of the MoU.

It is recommended that this Special Commission on Sustainable Transport (SCST) should have the following powers and working procedures:

- Constitutes mid 2013 latest;
- Composed of delegates of the relevant key Government entities;
- Fixed meeting schedules preferably once a month;
- Empowered to
    - elaborate and issue draft laws, rules and regulations,
    - suggest and request changes in administrative procedures and organisational set-ups,

- draft respectively revise the statutes and rules of procedures for new and existing governmental agencies, companies and divisions;
- guide the capacity building measures for existing and eventually newly established entities;
- tackle related budgetary issues such as PSOs, financing support from international donors; budget provisions in existing budget lines to name just a view of them.

- A Secretariat for managing the agenda of the SCST, taking minutes of meetings and follow-up and coordination of actions decided upon in the meetings;
- Take over tasks of a project implementation unit mainly with regard to monitoring and evaluation of SUTMP implementation plan;
- Preferably reports directly to the Cabinet minimum on a half year basis;
- Established minimum for the duration of three to five years;
- As it deals mainly with the enabling transport sector institutional, legal and financial framework it should be chaired by the MWT on the highest possible level.

The Special Commission itself causes no additional costs as it consists of delegates from existing government organisations. However, in order to make the commission's work effective, the Secretariat should be adequately equipped and staffed. It is proposed that the SCST Secretariat is headed by a Namibian transport professional with stated project management experience, assisted by a project secretary. The Secretariat should also be able to rely on a pool of international and national consultants (land-use and town planners, lawyers, economists and transport engineers) to be drawn on short notice in case of highly specialised expertise required which is not readily available in the involved organisations.

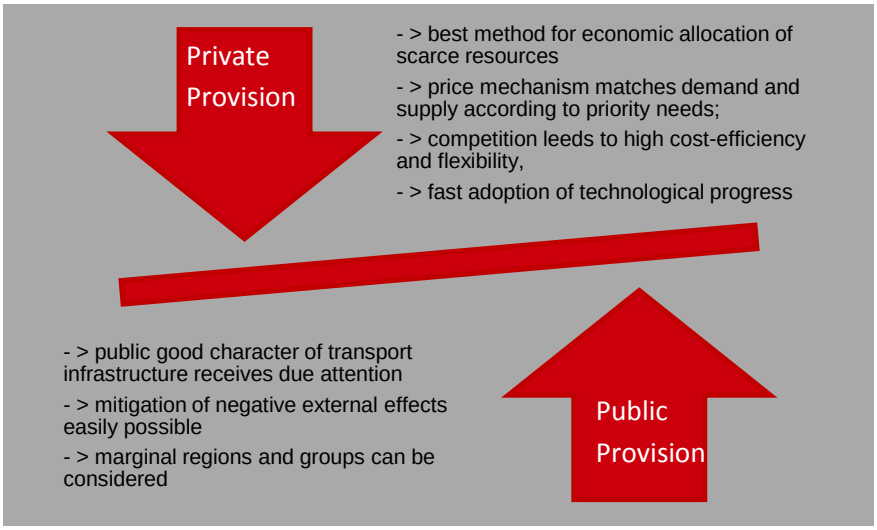
So the costs for such a secretariat is roughly estimated to be 1 million N$ per year and the cost for the expert pool is estimated for the 1st year with 4 million N$ and for the 2nd and 3rd year with 1 million N$ each.

In its constituting session, clear targets and outcomes should be set on the basis of the SUTMP implementation plan which is aligned with the targets of NDP4 and the Vision 2030.

4.5.2 Commercialisation of Public Transportation

The majority of transport politicians and professionals worldwide promote meanwhile state-regulated private provision of transport services as best option, because it can combine the advantages and strengths of both – the private and the state sector as the following graph indicates.

Figure 4-5: Advantages of private and advantages of public provision of transport services



The introduction of an integrated public transportation system which delivers services for all parts of the population, which is highly accessible as it comprises all living, industrial and business areas within the city, which is also affordable and offers a reasonable level of services concerning service times and quality of service, needs to be efficiently regulated[18].

As already outlined in chapter 2, public transportation in Windhoek is presently determined by both ends of the scale, i.e. public and private service provision each with certain advantages and deficiencies.

However, world-wide experience shows that free, unregulated competition in public transport markets leads to reduced service and accessibility levels providing services only for a few or it leads to the so-called raisin picking. "Raisin picking" means that small private service providers are using the infrastructure and the service schedules on major public transport routes – and only on those major routes - ahead of the scheduled services in order to capture passengers. For the scheduled service providers, this raisin picking behaviour results in leaving them with fewer passengers, with less frequented marginal routes and with off peak services and thus reducing their potential for recovering operational and capital costs. Also higher safety and security risks as well as environmental problems can be observed.

A regulated public transport market aims:

- To maximise the efficiency of the overall integrated public transport system;
- to organise a competition for the market[19];
- to assign each market player a role according to its strengths;
- to introduce, target and manage public service obligations[20] in a way that the overall burden for Government budgets is kept to a minimum.

This regulation allows to start with the co-existence of both systems - public and private service providers, or with other words, the municipal bus division, the TransNamib, the taxi industry and private bus operators and it allows for step-wise adaptations and alterations in the medium and medium to long run, in case of need. Furthermore, this state-regulated public transportation allows easily accommodating and step-wise adjusting the system towards an integrated public transport system best serving the needs of the population of Windhoek.

BRT, BHLS and commuter rail systems require major engineering and operational but also managerial know-how not existing yet in Namibia. They also require capital investments which could be made fast and competent available when allowing foreign players to step into the market. This is also especially true for the rail sector as TransNamib presently hardly deliver any regular passenger services and none at all for commuters.

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[18] Some examples for institutional set-ups enabling are given in Reducing Carbon Emissions through Transport Demand Management Strategies, A review of international examples: http://www.tdm-beijing.org/files/International_Review.pdf

[19] Definition:

- Competition in the Market, i.e. private and/or statal enterprises offer services on routes and according to standards which seem to be most profitable for them.
- Competition for the market, i.e. the Government or his Agency or a Municipality determines routes, vehicle standards, frequencies and other operational details, tenders these conditions and awards the contract in form of a concession to the bidder which requires the least subsidy.

[20] Definition Public Service Obligation: PSO is an arrangement in which a governing body or other authority offers an auction for subsidies, permit the winning company a monopoly to operate a specified service of public transport for a specified period of time for the given subsidy. This is done in cases where there is not enough revenue for routes to be profitable in a free market, but where there is a socially desirable advantage in this transport being available.

Thus, a separate entity using the Government owned right-of-way for the railway and share the rail infrastructure with TransNamib against fees is the way forward. This is to avoid cross-subsidisation and to have decentralised and thus closer to the people decisions on service levels and supplies.

Steps to be taken for Windhoek:

- Outsource municipal Bus Company as a company under private Law;
- Increase capital basis of the bus company through private investors;
- Assign new routes, the performance and service qualities and public service obligations on those routes and issue operator licenses for each route;
- Include other private bus operators / minibuses / taxis via tender and incentive schemes;
- Separation of land-based rail infrastructure from rail operation and concessioning commuter rail companies for delivering the required services.

The optimal form and sequencing ought to be subject to further elaborations in the feasibility phase of the integrated public transportation network.

4.5.3 National Transport Agency

The role of a transport agency varies under three regulatory models as defined in the following:

- **No competition:** Ensure that certain general standards of service coverage, performance and quality are met but no effective recourse if standards are not met and mutual blaming for this, combined with a need to cover ever increasing operating deficits.
- **Controlled competition:** Planning of transport infrastructure and technical systems (such as infromation and tiketing systems); defining each route in the network and specifying the service parameters, procuring services through tendering and contrating and the management of those contracts, resolving coordination issues between the operators; Monitoring the compliance of each route contract; monitoring the overall network against demand, fare setting; advising the government on public transport policy and recommend service standards
- **Open market:** setting minimum safety and operational standards, procuring any services that the market is unwilling to provide through tendering and contracting; monitor the industry to ensure that competition remains effective and that operators or illicit organisationa are not controlling or restricting entry to market or access to passengers.

In the previous chapter based on the strategic directions and based on the existing situation in the capital and beyond its borders, it was already outlined that controlled competition is the way forward. As also correctly pointed out in the MoU there is a need for a strong regulatory entity and ensuring that Public Transport operation is tendered for competitively and it was decided that such an entity ought to be on the national level.

Having such an entity on a national level instead of a decentralised level has several advantages:

- ✓ It can attract rarely available skilled staff from all over the country;
- ✓ PT sector in overall Namibia is run according to the same standards;
- ✓ Economies of scale are achievable;
- ✓ It allows easily for all operational and funding options and thus for inclusion of vested interests of the main stakeholders into the integrated transport system;
- ✓ Integration of central road and rail access regulatory functions are easily possible;

- ✓ Most efficient advisory service and competence centre for the national policy level but also for the municipal and regional level;
- ✓ Could easily accommodate the regulation of TransNamib so that it is not self-regulating any more

General tasks to be carried out either on the policy or the agency level are given in the following textbox.

General tasks of urban transportation

1. **Integrated strategic transport planning and land use planning**
2. **Transport infrastructure (MT / NMT / PT) planning and programming**
3. **Push and Pull measure planning and implementation**
4. **Separating social and commercial tasks of PT**
5. **Set fair competition rules for the PT market**
6. **Internalise external costs and apply the user-pay-principle**
7. **Set safety, security, environmental and design standards**

In public transportation there are many further tasks to be cared for partly on an executive agency level but some of them might also remain on the municipal level.

Main urban transport tasks for the executive level

PT Infrastructure

1. PT design
2. PT tendering
3. PT construction
4. Management or monitoring the management of PT networks (bus and rail)

PT Services

1. PT planning (routes, service levels, marketing, fare structure and collection system, bus/rail/taxi integration)
2. Determining and managing public service obligations (PSOs)
3. Eventually revenue collection in case of fare integration between modes
4. PT regulating (licensing taxis operators and drivers, bus operators and drivers, PT vehicles)
5. Monitoring the use of PT infrastructure and vehicles and ensuring safety determining standards
6. PT infrastructure and operators accident investigation and presentation of improvement measures
7. PT contracting and contract monitoring or alternatively PT operation (in case government responsibility extends to operations)

In case more than one operator is permitted on existing PT infrastructure:

- Executing and monitoring access regulations
- Advising on and monitoring implementation of access charges on an equitable basis
- Arbitrating between users and infrastructure providers

Last but not least other urban motorised and non-motorised transportation including traffic management needs to be tackled. This is especially true for all cases where urban road space is shared between public, motorised and non-motorised users.

MT, NMT and TM tasks on the executive level

1. **Integrated strategic transport planning and land use planning**
2. **Transport infrastructure (MT / NMT / PT) planning and programming**
3. **Push and Pull measure planning and implementation**
4. **Separating social and commercial tasks of PT**
5. **Set fair competition rules for the PT market**
6. **Internalise external costs and apply the user-pay-principle**
7. **Set safety, security, environmental and design standards**

It goes without saying that the overall rules of the game, i.e. the legal framework are to be established by the policy level, i.e. the MWT and the MRLGHRD, urban planning functions need to be still in the hands of the City and the execution and administration is subject to the transport agency recommended to be established.

However, it is not the task of this SUTMP to anticipate decisions to be taken by the Namibian politicians and to be prepared by the Special Commission on Sustainable Transport (SCST). Of course the detailed design, statutes, organisational structures, staffing requirements and others is one of the major tasks of the Special Commission on Sustainable Transportation.

Nevertheless some ideas and considerations are given and a rough estimation of the costs and revenues of the establishment of a national agency is carried out. Special attention is also laid on the potential for integration of the taxi industry (see next paras) and other private bus operators and for creating an enabling environment for stepwise implementation and extension as well as for viable, innovative, effective and efficient financing schemes of the overall integrated PT System (see also chapter 10).

In principal MT, NMT and PT infrastructure and service planning should be on a decentralised level in order to get closer to the people planning and decisions. This principal requirement has to be aligned with the advantages of a National Agency for PT Planning and Operations in view of the limited size of Namibian cities. An intensive coordination between the central agency level and the municipal level can be achieved on various ways, e.g.:

a) the Management Board of the National Agency can comprise representatives from Municipalites and other statal and private stakeholders.

b) the National Agency is organised with branches similar to the NaTIS branches or even by extending the tasks of the NaTIS.

c) the City delegates staff members to the regional branches

d) an effective coordination among different government levels, e.g. via common approval procedures for PT planning, marketing, fare setting, implementation oversight and monitoring.

In any case, the National Agency ought to start with general divisions for the tasks given in the textboxes above and a municipal branch for the City of Windhoek. This organisational structure will also ease cascading the improvement of PT to other regions and cities within Namibia.

The integration of the taxi industry is a critical point for the success of the envisaged integrated public transportation system and a political arbitration process has to show the optimum way. This discussion was started by the project team and was taken over by the administrative and political level. From the SUTMP point of view, a way forward is sketched in the next paragraphs.

The taxi industry can be sub-divided into two categories:

- Taxis which deliver door-to-door service on request (radio taxis). This service is profitable and will face increasing demand from tourists but also from the local business and private persons such as elderly people.
- Taxis which deliver public transport services in certain zones and on certain routes from certain taxi ranks.

When talking about integrating the taxi industry into an overall public transport system it refers only to the latter part of the industry. In addition the approach for incorporating the taxi industry in the overall PT scheme has to distinguish between the owners of the taxi and the drivers of the taxis.

Medium Term Options for addressing the interest of the taxi owners might be:

- Incentive Schemes, e.g. special credit schemes to replace taxi cars with bigger vehicles (minibuses and buses) and deliver services within the integrated PT system, e.g. as feeder services
- Tendering feeder lines for the exclusive servicing by a specific taxi owner or a group of taxi owners
- Selling shares of newly established PT service companies to the taxi industry
- Enabling participation in bus leasing schemes for intercity and innercity operations

Medium Term Options for addressing the interest of a part of the taxi drivers might be:

- Offer prioritised employment opportunities in the integrated PT system.
- Incentive schemes for becoming owner drivers and transforming their business in door-to-door services or integrated in the overall PT system.

Short term options in the overall interest of the society:

- Revision of the admission standards, i.e. professionalising the industry and combining the renewal of licenses with specific training measures.

Medium term options in the overall interest of the society:

- Introduction of taximeters for the door-to-door services increases transparency of taxi for the users and allows a clear distinction between PT services on fixed routes and taxi services.
- Inclusion of Taxis which are officially integrated into the overall public transport scheme in the fare integration, ticketing and revenue distribution schemes.

An indirect but most welcome side effect of any of above options would be reducing the safety hazards stemming from the present taxi system.

It is obvious that the role of the taxi industry will change (see also chapter 5.5). Whatever institutional, organisational or financial options from above outline is taken, the important role of the taxi industry it plays nowadays and it has to play in the future needs to be officially addressed and negotiated, starting as soon as possible.

Overall, it is important to note that the proposed system of assigning certain PT-routes (inner-city and intercity) to different public and private players via tendering procedures allows for assigning market shares to all interest groups (public and private). In addition it allows for the influx of additional financial resources and know-how and it allows for a stepwise introduction and extension of the integrated PT-system.

4.5.4 Capacity Strengthening of Relevant Existing Entities

As already stated before, within the existing capacities a major shift towards more sustainable transport provision is not possible and business as usual will prevail. Another major point of

concern is the low implementation capacity perceived in the master planning process, a fact which can only be encountered in the medium and long term via a comprehensive capacity strengthening effort.

This chapter deals with the additional capacity and training needs within the existing key stakeholders. Mainly there are five fields of competencies to be addressed:

a) SUTMP planning and up-dating of the master plan.

   This refers mainly to such topics as regular up-date of traffic counts, traffic surveys, traffic modelling and forecasting, urban design, transport and land-use planning, organising and implementing public hearings and stakeholder participation; coordination and mediation of key stakeholders, data analysis and monitoring as well as evaluation of existing situation, but also skills given in b) and c).

b) PT Planning and Operations

   This refers mainly to such topics as route and frequency planning and design, marketing, customer information and ticketing systems, responsiveness to changing needs of users, procurement, vehicle and driver disposition, maintenance planning, financial management, and others. A most important aspect is the competency of PT-drivers who ought to be able to preserve vehicles as assets, drive safely and defensively, are punctual and reliable and respect their customers.

c) NMT and TM Planning and Implementation

   This refers mainly to such topics as optimum design of pedestrian walkways, bicycle lanes and storage, safe intersection design, traffic micro-simulation, road design, maintenance, construction and project management, parking management and last but not least road safety[21].

d) Public Transport Regulation

   This refers mainly to such topics as vehicle, driver and operator licensing, monitoring and evaluation, tendering of public transport services, Public Service Obligations, ticket and revenue sharing systems, transport laws and regulations.

e) General Management and Team Building Skills

   This refers mainly to the cross-cutting issues aiming to improve the level of performance. Examples are general business principles, transport economics, financial management and accounting, management of teams within an organisation / business unit; identifying and taking into account external (environmental) factors that influence the workings and success of the team; coaching individuals in a business environment in order to meet a team´s required service levels, project management, customer relations to name just a view.

On the basis of a training-needs-analysis, an intensive skills enhancement programme ought to be conducted in the short run, i.e. within the next five years. It is suggested to have a mixture of components such as on-the-job training, internships, seminars and study tours for existing and additional staff, but it should also comprise longer-term train-the-trainer concepts based on existing and newly established transport training institutes and curricula. The initial costs are estimated to be

SUTMP Implementation requires three more important accompanying capacity enhancing measures:

f) The SUTMP implementation will reshape the face of the City of Windhoek and will considerably affect the daily life of its inhabitants. Thus, there is a strong need for intensified

[21] Within this SUTMP road safety deals only with all urban infrastructures related safety aspects and counts for road safety impacts of PT and NMT measures. All other road safety aspects such as accident statistics and enforcement are dealt with by the NRSC supported by GIZ road transport project.

stakeholder engagement in the phase of detailed SUTMP planning. Thereafter, the normal schedule of yearly CoW public hearings appears to be sufficient for addressing future up-coming concerns and ideas of the public concerned.

g) It is estimated, that in order to have a quick and smooth start of project implementation there is a need for permanent additional 5 staff members, thereof 3 in the CoW and 2 in the MWT assigned for the SUTMP implementation for a period of three years. Thereafter they might be transferred to the national transport agency going to be established from year three and four of implementation start.

h) Accompanying consultancy for smooth start of SUTMP implementation, in order to use momentum until capacity strengthening measures are realised and working. It is proposed that minimum one long-term expert and a pool of short term experts are accompanying overall SUTMP action plan realisation.

A rough cost and time estimate of the proposed measures a) – g) is given in the respective figures of chapter 10.

4.6 Law Enforcement

Traffic police enforcement is and stays crucial for the achievement of a more sustainable transportation. This is especially true for

a) Traffic regulations with regard to the safety perspective

In this respect, the on-going efforts for decriminalisation of traffic offenses and the fine system has to be further tackled. Also important is to seek for solutions for the overlapping responsibility between Namibian Police and the City Police. These efforts ought to be addressed and monitored by the SCST described in the previous chapter. Furthermore, on-going projects of the Municipal Traffic Police supported by the GIZ address already some main capacity strengthening issues. Beyond this involvement, there are no further short or medium term measures envisaged in the SUTMP.

b) Traffic regulation with regard to protect the dedicated public transport infrastructure as well as the NMT infrastructure from misuse.

This topic relates mainly to private cars or unlicensed, informal and illegal PT operators using the PT and NMT infrastructure for parking or for operational purposes. There is a need to establish a fine system.

c) Ensuring security along and within PT and NMT facilities

There will be an increased need for observing public transport infrastructure mainly remote bus stations as well as NMT infrastructure and bicycle storage facilities, e.g. when they are along riverbeds and remote roads or off-peak with regard to the safe and secure usage. Experience shows that those places and off-peak times are prone for mugging and thefts. Additional crime prevention measures are necessary and need to be addressed by the municipal city police.

d) Controlling of ticket offenses by PT users

A new field for enforcement is the fare avoidance by PT users. There is a need to assign and regulate competences for ticket inspectors, their administrative anchorage, their controlling competences as well as fines for offenders.

Overall, it is strongly suggested to re-channel the fines towards the provider of the enforcement service and the provider of the traffic infrastructure and systems instead of channelling it towards the general state budget or to dedicated funds like parking management fees.

4.7 Development of Legislation and Regulation

In line with NDP 4 proposed strategy to speed up the review of outdated legislation pertaining to land delivery and registration so that the procedures will allow for speedy acquisition and ownership of land for business and housing development, there is need to align land and planning laws to produce the desired outcome of an integrated land use and transport system as described under the polycentric scenario. In particular, it is necessary to create incentives for densification. Consideration should be given to the following;

Within the context of a revised spatial structure plan for the City of Windhoek,

- a new zoning scheme
- incentives for high rise developments
- a preference for mixed-use development

Some initiatives already on-going in this area include the Legislative and Institutional Reform of Road Safety Management in Namibia Study whose aim is to review and restructure the management of Road Safety in Namibia through legislative and structural reforms in response to the aspirations of Pillar 1 of the Namibian Chapter of the Decade of Action 2011-2020 and the 2012-2013 Consolidated Annual Plan. There is also a call for Expression of Interest to provide services for an Urban Design for an Integral Urban Master Design Improvement Plan that was issued by the Urban Planning and Property Management Department in December 2012. Meanwhile, the Structure Plan for the City of Windhoek is due for revision and there is strong indication that this will be implemented during 2013. One of the key considerations during the revision will be to bring the new structure plan into alignment the SUTMP.

In addition, there are other equally important processes involving, for example, amendment to the National Planning Commission Act, No. 15 of 1994 intended to give NPC legal mandate to monitor and evaluate implementation of sector projects and programmes. This will have relevance to the transport sector where a number of PT and NMT projects are envisaged under the SUTMP. Similarly, the finalisation of the Public-Private Partnerships Act under the Ministry of Trade and Industry is likely to provide the legal framework for the accompanying measures discussed under the Financial and Implementation Plan (Chapter 10), and without which it be relatively difficult to gain traction with PPP projects since one of the attractions for investments is a stable and predictable environment embedded in a legal and policy framework.

As already mentioned, these efforts can at best complement the SUTMP. However, additional reviews and capacity building work will be necessary, on an on-going basis as part of the implementation process, to identify elements that should be maintained and refined, and changes needed to lend clarity and make the legal and regulatory framework more workable.

5 Public Transport

In this chapter 5 the principle strategies, the process of elaboration and the main recommendations, technical features, pricing and marketing for the future integrated public transport system is described and the steps towards this integrated systems are given. The proposed system is rooted on international best practice but already strongly targeted towards applicability in Windhoek and the rest of the study area.

5.1. Strategy

The main core objective of the strategy is the implementation of real modern state of the art and highly integrated Public Transport System that is aligned to the predicted mobility demands and implementable in the local context. This means:

- implementation of Mass Transit System (MRT) lines;
- development of a graduated PT network with mainly fixed lines;
- operation during the whole day;
- serving all types of central and sub-urban, residential and industrial areas;
- service with different types of rolling stock (e.g. Buses, minibuses, taxis) adopted to the individual needs,
- efficient interchanges;
- priority installations for public transport at junctions;
- integrated tariff and ticketing system;
- adequate passenger information systems.

All those requirements profiles are further outlined in the following sub-chapters.

In the textbox below, the excerpt of the Memorandum of Understanding is given stating additional requirements, options and investigations meanwhile undertaken as mandated. The strategic directions were the basis for further investigations, calculations and translation of the strategy into a manageable and cost-efficient public transport system.

Excerpt of the Memorandum of Understanding for Public Transportation:

Bearing in mind the need to modernise public transport in Windhoek and surrounding region;

And having considered the various strategic options for modernising public transport, namely normal bus, bus on dedicated marked bus lane, bus rapid transit (Bus Rapid Transit), light rail transit (Light Rail Transit), minibus and taxi distributor service, and commuter rail as well as integrated approaches comprising several of the Public Transport options;

And based on the land-use scenario C;

And aiming at providing affordable transport for all residents in the project region;

It is agreed that:

a. a highly integrated system of Public Transport is required in Windhoek;
b. Bus Rapid Transit and Light Rail Transit options will be further investigated (costs, required capacities according to forecasted passenger volumes) for high frequency transit corridors;
c. the Public Transport system requires space which needs to be secured either from existing road space in high frequency (transit) corridors; or within railway servitudes; or acquisition of additional land.
d. in further land developments there need to be reservations for rail right of-way and bus lanes and stations;
e. the Public Transport system needs to have priority at intersections;
f. the Public Transport system needs to be implemented stepwise and gradually extended according to actual demands;
g. within existing railway servitudes, options for commuter trains integrated with improved inner city options for urban transport will be further investigated;
h. easy access for mobility restricted persons;
i. The taxi industry is to be integrated in the overall public transportation scheme.

5.2. Recommended Innovations

5.2.1 General notes

While the land use scenario C (polycentric development) was selected as the designated solution, the public transport should be organized and aligned to this development in the Windhoek agglomeration.

The existing transportation system and characteristics have been described in chapter 2.2. The existing bus network (chapter 2.2, Figure 5) leads to the misimpression that the City of Windhoek is covered by a suitable bus service. But in reality, on most lines only few buses are operating (in some cases only one single bus) in the early morning and in the late afternoon (bus to and from work places) as inherited from pre-independence times.

Thus, the biggest improvement for the future public transport in Windhoek will be the whole day service and a short frequency during peak hours (see chapter 5.2.2 for more detail). This improvement should be accompanied by several other measures.

The implementation of the graduated Public Transport network should bring several other innovations:

- stops and stations with regular service and maintenance
- stops and stations with state of the art service equipment, such as:

- sun- / rain-protection shelters (vandalism resistant)
- seats
- wastepaper baskets
- timetables
- information about travel conditions, etc.
- everything vandalism secure
- dynamic passenger information systems (at important stations)
- if applicable: fencing or other physical separation from the surrounding
- ticket vending machines (not necessary from the start of operation of the new system (please refer also to chapter 5.9.1)

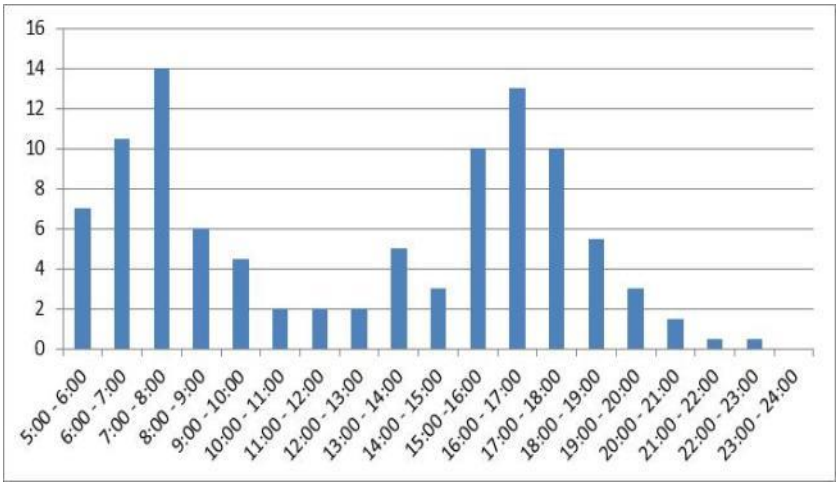
- segregation of right of way (ROW) (in case of high PT demand and high volume of individual transit in the concerned corridor)
- Integrated ticketing system
- Intermodal Transport Control System (ITCS) ITCS includes:
  - Automatic Vehicle Location (AVLS[22])
  - communication from Central Control Centre (CCC) to drivers, passengers inside vehicles, passengers at stations
  - providing data for the dynamic passenger information system, etc.

The sum of the proposed innovations will bring more safety, security, reliability and other amenities to the passengers and are further outlined in the next sub-chapters.

5.2.2 Graduated network with mainly fixed lines

While Windhoek is a capital City with high transport demand during peak hours, it needs a Mass Rapid Transit (MRT) system for the efficient movement of passengers, i.e. all kinds of modern PT systems which are quick, can operate with short intervals and have high passenger transport capacities. However, the distribution of passengers over the day reveals that 75 % of the demand is generated during the morning and afternoon peak times. As an example, the case of Independence Avenue is given in the following two figures (see Figure 5-1 and 5-2).

Figure 5-1: Distribution of passengers demand over the day, example Independence Avenue (in %)



[22] For this topic, currently there is a joined pilot project of the CoW bus company and the PoN planned in order to test and develop custom made software and mobile data collection "blue boxes" to be installed on all buses of the city network.

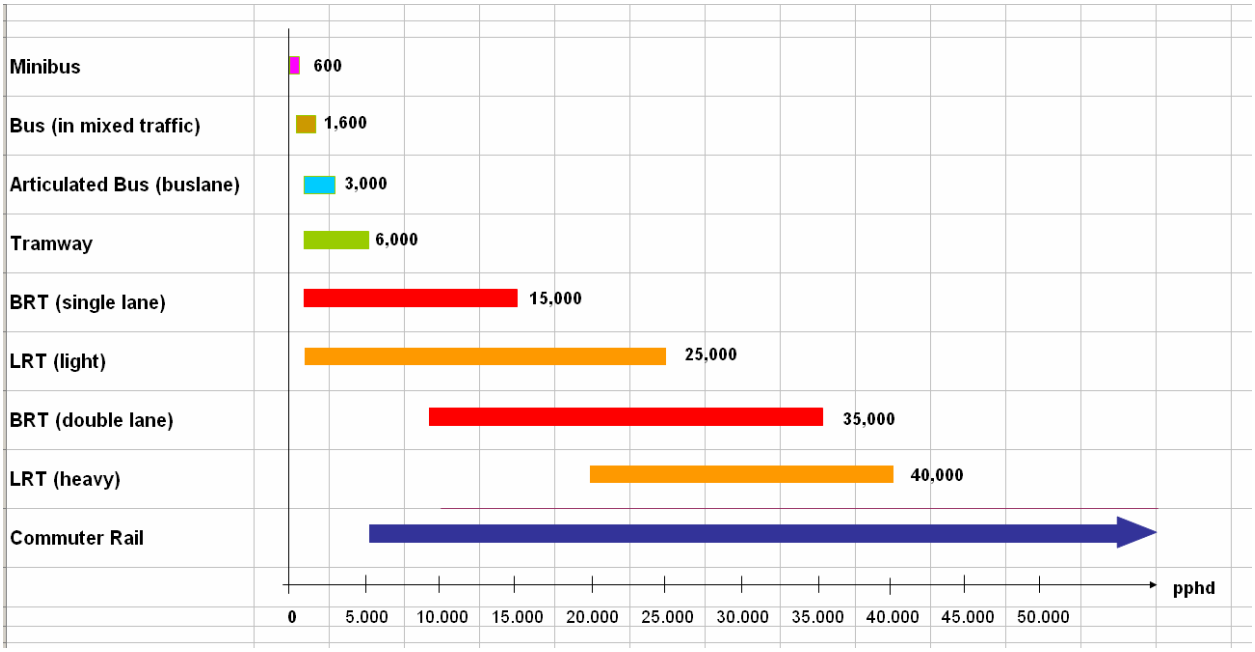
Figure 5-2: Distribution of passengers over the day, example Independence Av. (diagram)

clock	% / h	% / time	time period	pass. / h	passing buses / h
5:00 - 6:00	7			1.500	9
6:00 - 7:00	10,5			2.250	14
7:00 - 8:00	14		**14**	3.000	19
8:00 - 9:00	6	37,5	37,5	1.286	8
9:00 - 10:00	4,5			964	6
10:00 - 11:00	2			429	3
11:00 - 12:00	2			429	3
12:00 - 13:00	2			429	3
13:00 - 14:00	5			1.071	7
14:00 - 15:00	3	18,5	18,5	643	4
15:00 -16:00	10			2.143	13
16:00 - 17:00	13		**13**	2.786	17
17:00 - 18:00	10			2.143	13
18:00 - 19:00	5,5	38,5	38,5	1.179	7
19:00 - 20:00	3	3	3	643	4
20:00 - 21:00	1,5			321	2
21:00 - 22:00	0,5			107	1
22:00 - 23:00	0,5	2,5	2,5	107	1
sum				**21.429**	
peak	76	%			
peak of peak	27	%			
off peak	21,5	%			
low demand	2,5	%			

The demand for all lines is given in the Technical Annex Report, Annex G, in form of maps for the years 2012, 2017 and 2032. Those present and forecasted PT demands were the basis for outlining the principle network and pre-selection of PT - systems suitable to meet the calculated demands. Or with other words: how many buses/rail cars are needed to transport all the people willing to use public transportation. This depends not only on the absolute demand (in case of Independence Avenue the absolute demand was calculated by the traffic model to be 21429 passengers), but by the distribution of the demand over the day.

Considering the principal capacities, it is worth recalling the following picture which was part of the strategic directions workshop presentation and which is also attached in the Technical Annex Report, Annex E.

Figure 58: Capacities of Public Transport Modes



Accordingly, in view of the demands in Windhoek, it would be possible to establish a heavy MRT-System or a rail bound system. However, this would lead to very low intervals during off peak times or empty low occupancy vehicles in short intervals. In addition, a rail bound system needs very high investment in the infrastructure. This could only be justified in case of a very high demand all over the day or in mixed traffic rail routes combining long distance freight and passenger traffic on the same commuter rail route. Therefore, from a capacity point of view, a rail bound system, such as Light Rail Transit (LRT), Tramway or Metro is presently not the right choice for Windhoek.

However, the rail option is further discussed in chapter 5.3.

One important reason for the suitability of a BRT-System for Windhoek is the cost benefit advantage (please refer also to chapter 9.4 Financial and Economic Analysis were amongst others costs and benefits of different system scenarios are given). Bus Rapid Transit systems generally have lower capital costs per km than Light Rail Transit systems. In countries without developed railway industry and with low labour cost, the BRT operation cost will also be lower than for LRT systems. And last but not least, the hilly landscape in Windhoek leads to high investments for LRT infrastructure, while the climbing performance of railcars is less than for buses.

For the two main axis of highest demand the LRT option was investigated but the cost coverage ratio calculated (please refer also to chapter 9.4) did clearly not suggest to follow this option for the time being.

The right conclusion to fit all perceived needs of PT in the City of Windhoek is a graduated holistic PT-Network with 2 Bus Rapid Transit Lines as backbone along the two trunk roads to Katutura and Wanaheda (Independence and Monte Cristo) and several High Quality Bus lines. These lines are operated by so called BHLS Buses (Bus System with High Level of Service) but with lower infrastructure necessities and thus lower investment costs (For futher system comparison and examples, please refer also to the PT presentation at the Strategic Directions workhop, Technical Annex Report Annex E)

However, for the connection to the new development area of Brakwater with a potential of 250.000 inhabitants towards the end of the planning horizon, a commuter railway is proposed as a backbone system to be operational from the year 2032 onwards. The existing railway right of way (ROW) is adequate for additional tracks and on this ROW are no strong inclines. Thus, the investment costs on that stretch are moderate. Furthermore the track layout with no level crossings in the innercity and the station spacing envisaged would allow high speeds and also political and economic aspects such as time savings, are high on this corridor.

All bus lines should operate more or less from the CBD to the neighbourhoods. The dispersion of passengers from the bus stations in trunk roads to the small roads in the residential zones, industrial zones or within the CBD should be covered by a minibus system, which must be integrated into the PT ticketing and tariff system.

At the latest stage, the graduated public transport network will consist of the graduation as given in the following Figure.

Figure 5-3: Graduated PT Systems with example pictures

Commuter Railway Option	 	For the connection from the suburban municipalities to the city centre and other important locations inside the COW
BRT	 	For the service in very important corridors with very high transit volume
BHLS	 	For the service in important corridors with high transit volumes
Minibuses / Taxis	 	For the service in the neighbourhoods for the spread distribution

The final stage in 2032 of the proposed integrated PT network is shown on the following page, Figure 5-5. This network is optimised according to the forecasted traffic demand and findings of the multi-criteria analysis and was determined in an iterative process comprising several steps. But the final alignment might vary in the immediate vicinity of the proposed network. This ought to be finally determined in the feasibility investigations which need to follow this strategic master planning.

However, road reserve to accommodate the proposed bus systems is on most parts of the proposed alignment not a problem at all as the two pictures below indicate. Only on some short stretches and junctions some widening need to be envisaged.

Figure 5-4: Example road reserve for the Line 1 and 2

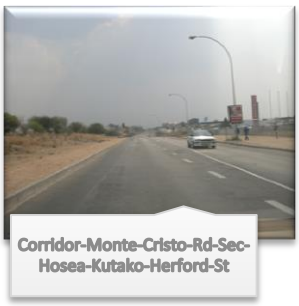
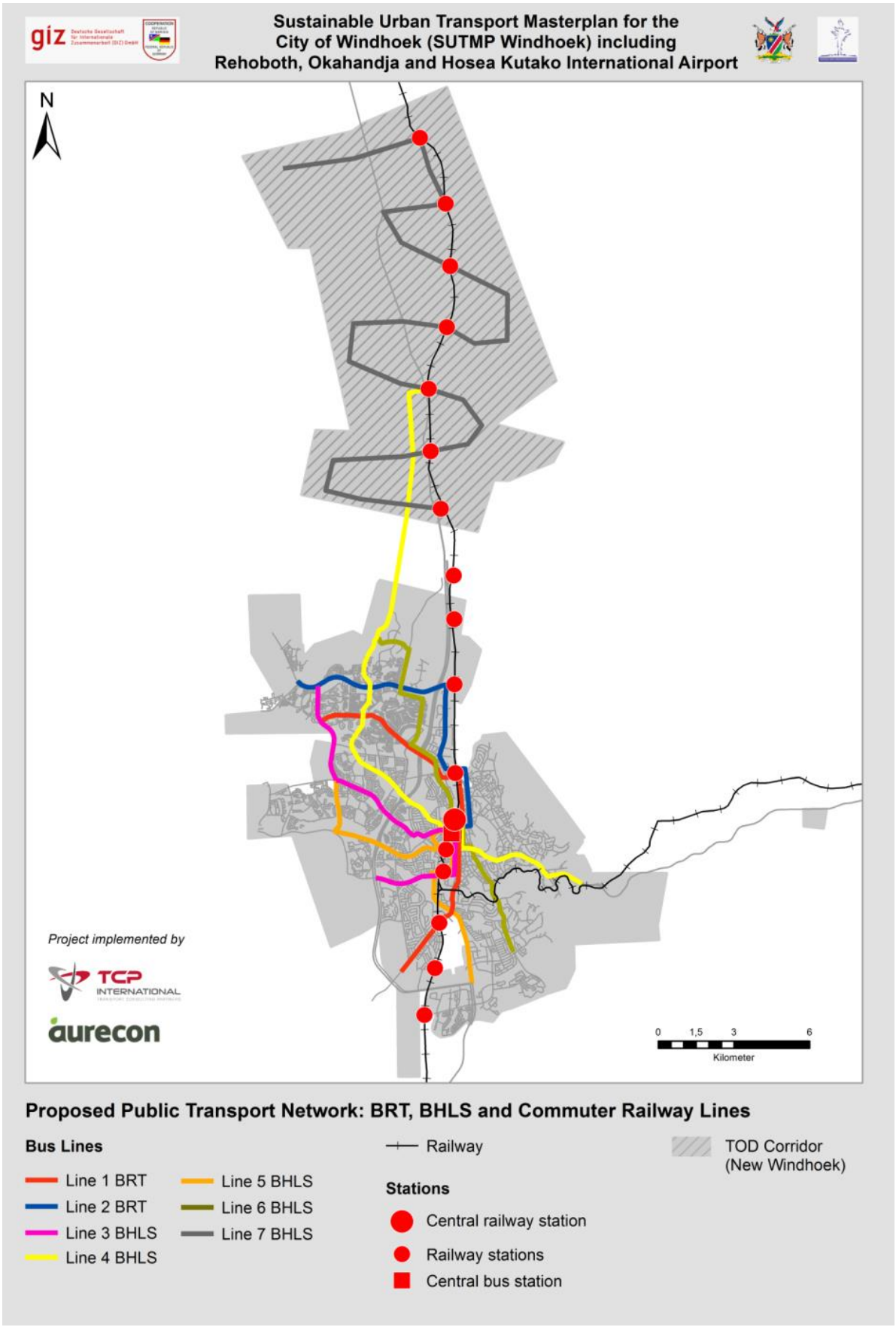
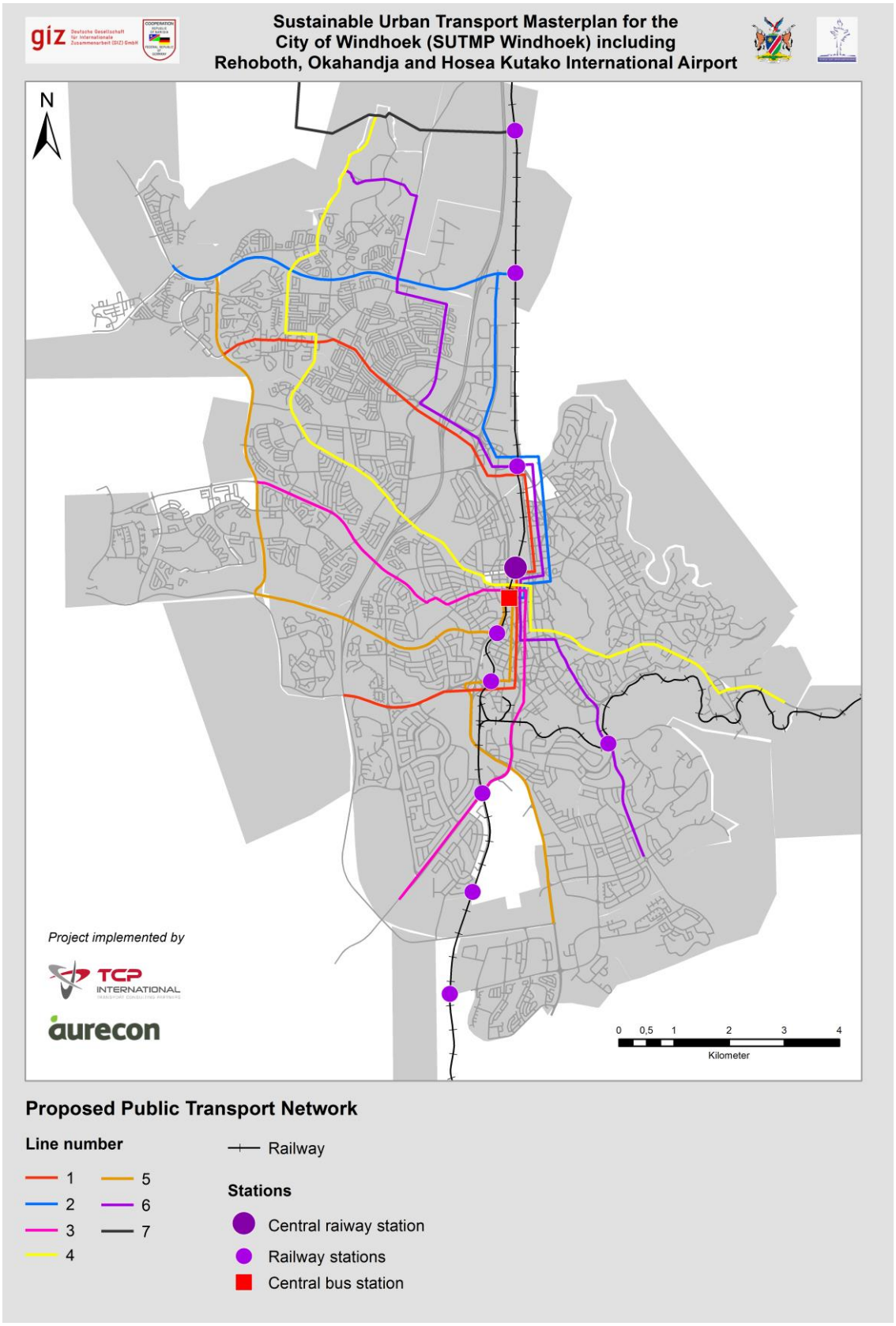


Figure 5-5: Graduated PT network with BRT, BHLS and Commuter Railway lines in 2032



This graduated network relates to the high demand corridors identified in the traffic modelling system. Below in the next table an excerpt of this map without the new development areas is given.

Figure 5-6: Graduated PT network with BRT, BHLS and Commuter Railway lines in 2032



It has to be noted that the alignment is stylised and optimum design and alignment parameters in a smaller scale have to be determined in the feasibility stage of the PT project.

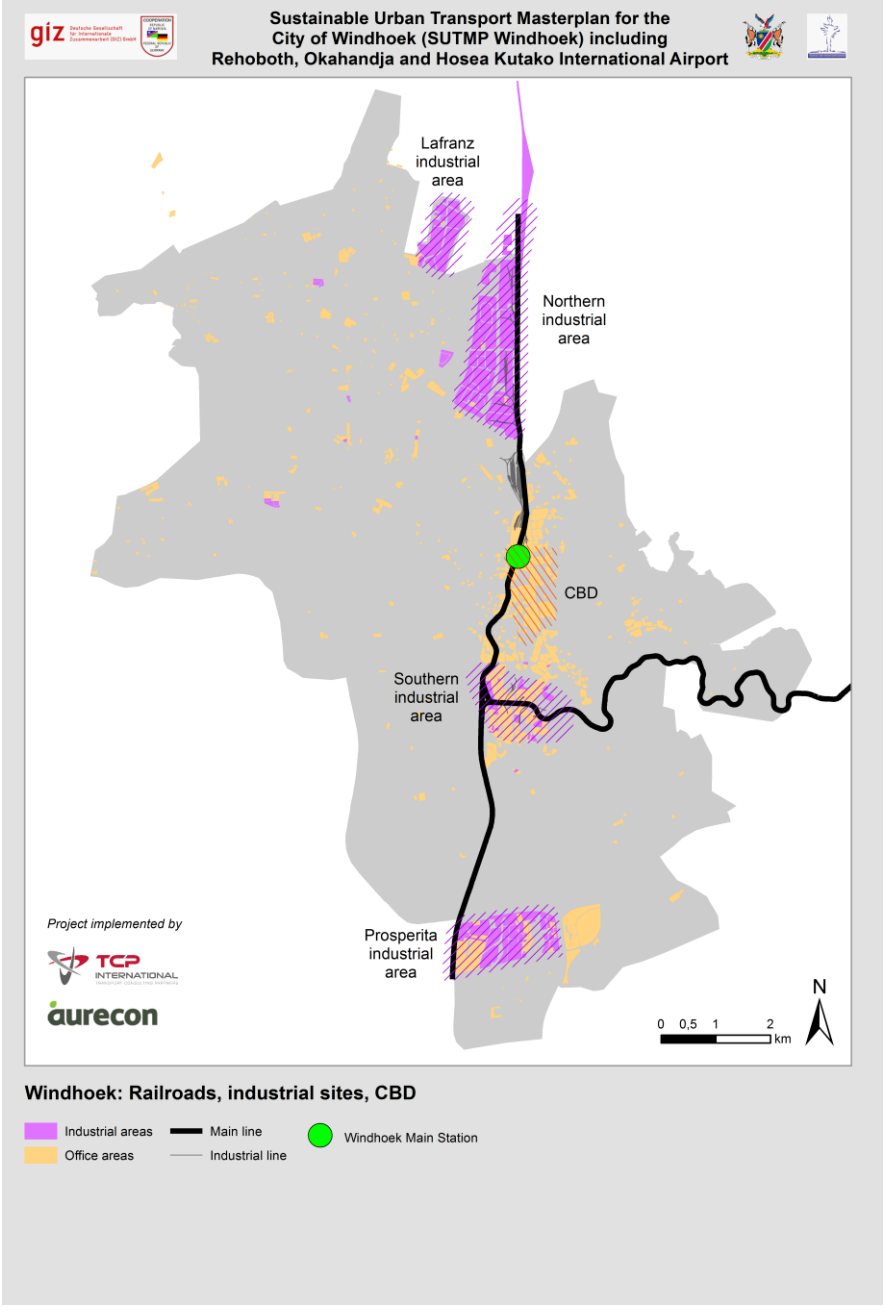
5.3. Options for rail for meeting transport requirements

5.3.1. General remarks and condition of railway infrastructure

The existing railway infrastructure passes through the City from north to south. It goes through the two industrial zones with many workplaces. The existing Railway Station is located close to the CBD. A third direction in which the railway runs is eastbound.

The following map shows the rail alignment and the location of the major job opportunites in the city.

Figure 5-7: Railway Lines and location of major job opportunities in the City of Windhoek



The three stretches have presently the following characteristics:

1. **Northern line – direction Okahandja**
   - tracks in fair condition
   - speed limit is approx. 60 km/h
   - speed advancement is not very expensive
   - actually, tracks are used for operations only during the night (very few exceptions)
   - single track on broad ROW
   - tracks without strong curves
   - there is possibility for adding one or two tracks on the sides
   - track touches three times the proposed bus network (transfer station)
   - track passes the Northern Industrial area
   - track passes the new development area of Brakwater with high estimated population

2. **Southern line – direction Rehoboth**
   - tracks in fair condition
   - speed limit approx. 60 km/h
   - speed advancement not very expensive
   - actually, tracks are used for operations only during the night (very few exceptions)
   - single track on broad ROW
   - tracks inside Windhoek without strong curves
   - tracks outside Windhoek partly with stronger curves
   - possibility for adding one or two tracks beside is given
   - track touches three times the proposed bus network (transfer station)
   - track passes the Southern Industrial area

3. **Eastern line – direction Hosea Kutako International Airport**
   - tracks in poor condition
   - speed limit partly below 30 km/h
   - speed advancement very expensive
   - actually, tracks are used for operations only during the night (very few exceptions)
   - single track on broad ROW
   - tracks generally curvaceous
   - tracks outside Windhoek partly with stronger curves
   - adding one or two tracks beside is very complex
   - no additional transfer station on this line
   - track passes the Southern Industrial area
   - track passes the new development area of Brakwater with high estimated population

5.3.2. Railway option to the neighboring cities

The future Bus System proposed is adequate for the service within the City of Windhoek.

To the existing neighbouring cities particularly Okahandja and Rehoboth, it is necessary to establish a regular, frequent and also reliable type of public transport.

During the next approx. 20 years the PT demand to Okahandja and Rehoboth is relatively low, as the following figures and tables indicate. Those figures were based on the regular traffic counts at the robots as well as on the OD surveys carried out in September 2012 by the project team.

Table 5-8: Peak hour demand between Windhoek and Okahandja

Okahandja Data - BAU Scenario				
	AM Peak Hour PT passengers from	AM Peak hour PT passengers to	AM Peak hour Car veh from	AM Peak Hour Car veh to
2012	137	50	158	60
2032	179	72	207	83

A total of approximately 1400 passengers travelling between Rehoboth and Windhoek every day can be attracted for the commuter train at the end of the planning horizon. However, this figure is on the lower side, because census figures and projected and agreed upon official population growth rates appear to be underestimated and there could also some induced traffic be expected because, the attractiveness of affordable living places outside Windhoek will increase.

Figure 5-9: PT demand Windhoek - Okahandja, distribution of passengers over the day[23]

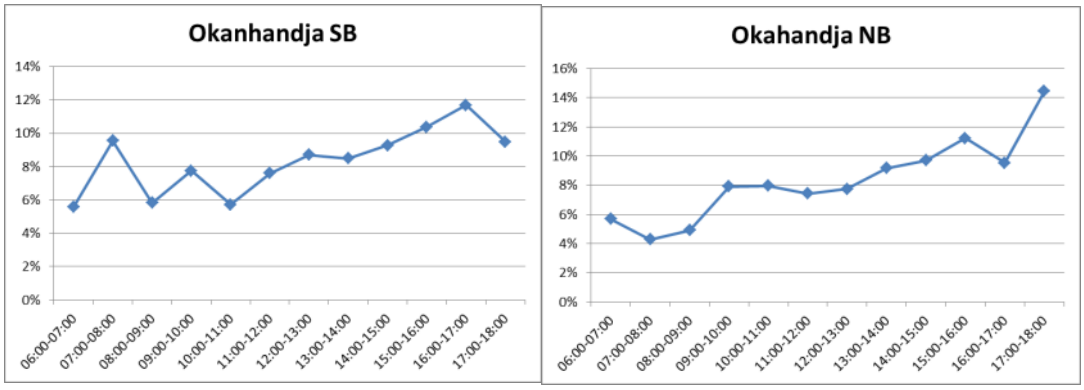


Figure 36 and Figure 5-11: show similar facts for the transport demand to Rehoboth. However, the distribution of traffic over the day distinguishes significantly with a high morning peak towards Windhoek and a high evening peak towards Rehoboth, indicating a high degree of daily commuters.

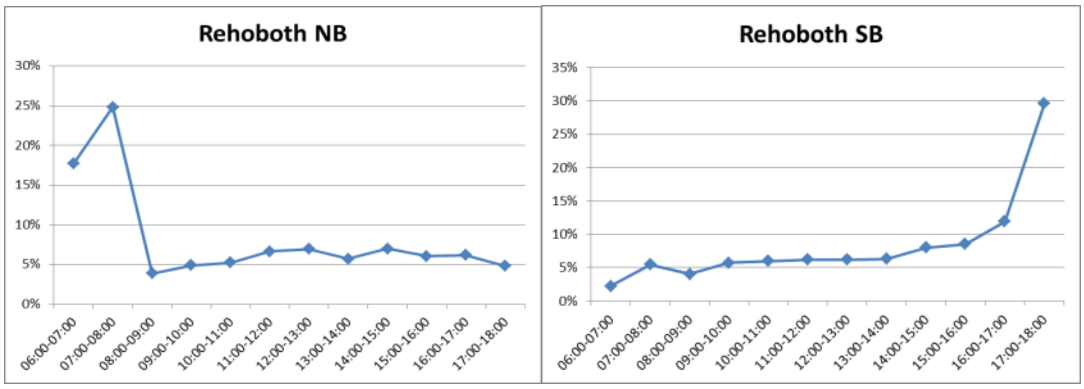
Figure 5-10: Peak hour PT demand between Windhoek and Rehoboth

Rehoboth Data - BAU Scenario				
	AM Peak Hour PT passengers from	AM Peak hour PT passengers to	AM Peak hour Car veh from	AM Peak Hour Car veh to
2012	224	80	257	92
2032	314	118	360	136

[23] SB and NB meaning southbound and northbound

With other words, approximately 900 pass. / day are estimated to travel by public transportation between Rehoboth and Windhoek.

Figure 5-11: PT demand Windhoek - Rehoboth, distribution of passengers over the day



The demand to Rehoboth is round about 900 and to Okahandja 1.400 passengers/day. In any case, costs for the implementation of a separate ROW of a BRT or even a rail bound system cannot be justified for that low numbers of passengers.

Therefore it is generally proposed to connect these cities with Windhoek via a regular bus line in the short and medium term.

Somer further information on those aspects is given in chapter 8 Intercity Transportation.

5.3.3. Railway option for commuter trains in Windhoek and the new development area of Brakwater

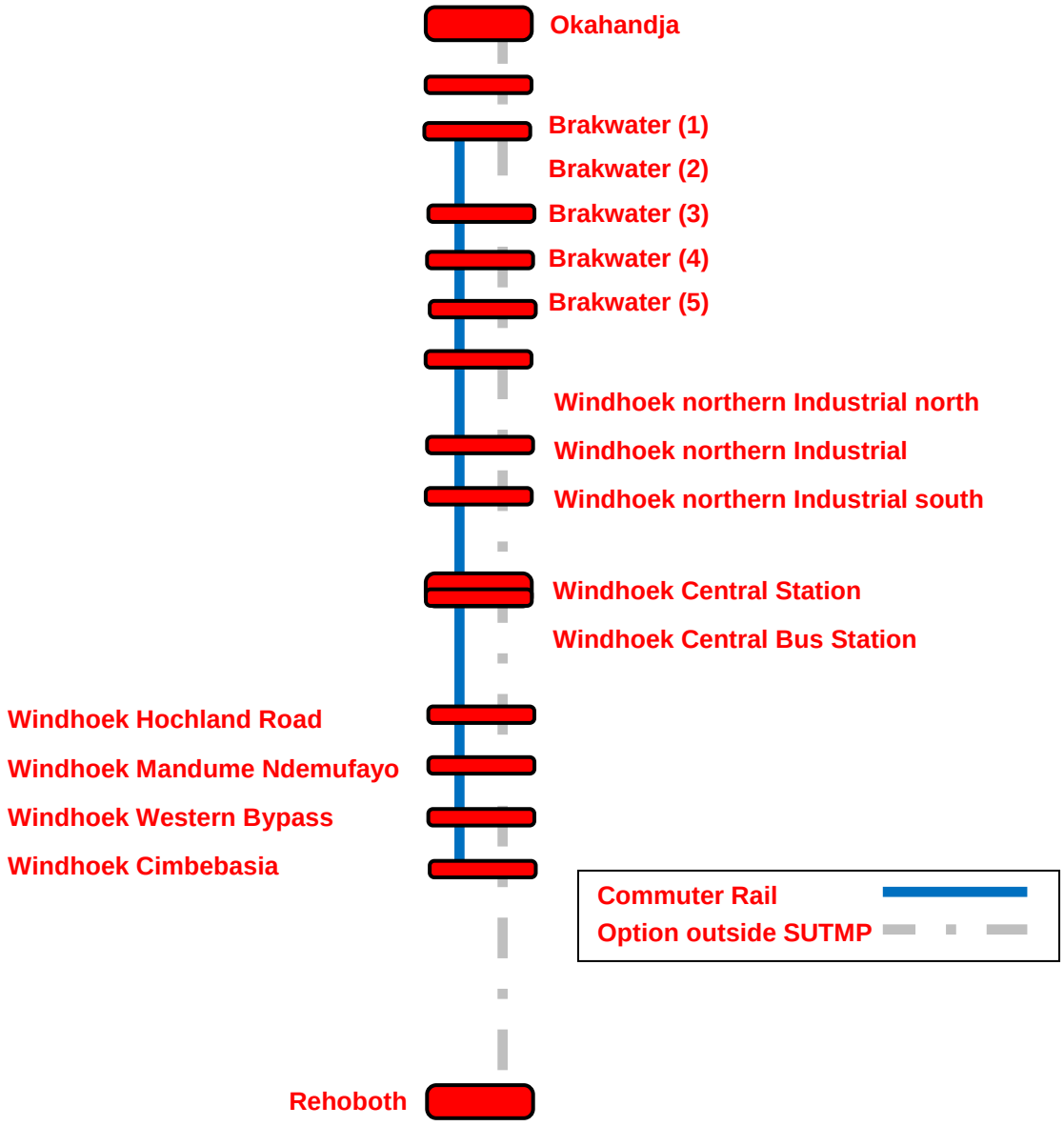
Considering that the railway passes the CBD, the planned new Central Bus Station, the new development area of Brakwater (250.000 inhibitors estimated for 2032) and the two industrial zones of Windhoek (with many work places), the conclusion is to use the railway corridor for PT within the Windhoek agglomeration (Windhoek and Northern Corridor).

Positive factors are:

- the ROW allows a relative easy and economic extension of tracks,
- small inclines on the stretch,
- connection from industrial zones to CBD, central bus station, other bus lines to the new development area of Brakwater and vice versa,
- high riding comfort,
- higher average speeds, and
- bus lines cross the tracks approx. 10 times (each time with interchange).

The corresponding proposed railway network is shown in Figure 5-12: This network is proposed to start in the year 2032. The blue line is part of the SUTMP. The grey one is an option apart of the SUTMP. A separate, detailed study with cost benefit analyses can confirm, if commuter rails to the cities of Okahandja and Rehoboth are reasonable.

Figure 5-12: Proposed Commuter Railway Network (CRN) to be operational in 2032



Consequences for the "railway option" Windhoek South to Brakwater:

- acquisition of several light diesel rail cars (DMU= Diesel Multiple Unit)
- implementation of a control center with a management system
- Implementation of a own platform for the commuter trains at the existing railway stations Windhoek
- implementation of additional railway stops (2 platform tracks at each station)
- implementation of separate tracks for the commuter rail (independent but parallel to existing TransNamib tracks), 100 km / h as design speed
- integration to the PT ticketing system

5.3.4. Railway Option to Okahandja and Rehoboth

While there is the existing right of way of the TransNamib, the opportunity for the use of infrastructure and land for the creation of a suburban Railway Network is obvious.

A relatively economic option is the use of existing tracks with its existing speed limits during the day time, when the regular trains service from TransNamib is not using the relevant tracks (taking into account that actual rail services are only running during the night, the tracks are generally available for commuter rail operation with low frequency during the day). In this case, the upgrading and the minimized need of adoptions of the railway infrastructure is not extremely cost extensive.

Consequences for this light "railway option":

- acquisition of several light diesel rail cars,
- implementation of a small control center with a simple management system
- small preparations at the existing railway stations (Windhoek, Okahandja, Rehoboth),
- implementation of additional simple railway stops,
- implementation of switches for passing tracks,
- small advancements to the existing rail track infrastructure (speed advancement, etc.), and
- integration to the PT ticketing system

In case of increasing demand during the day and a rising demand during early morning and late evening hours, additionally tracks must be constructed for independent operations (avoiding conflicts with other TransNamib railway operations). In that case the total railway infrastructure between Okahandja Windhoek and Rehoboth must be advanced.

Consequences for the advanced "railway option":

- acquisition of several light diesel rail cars (DMU),
- implementation of a small control center with a simple management system,
- Implementation of a own platform for the commuter trains at the existing railway stations (Windhoek, Okahandja, Rehoboth),
- implementation of additional railway stops (2 platform tracks at each station),
- implementation of separate tracks for the commuter rail (independent but parallel to the existing TransNamib tracks), 120 km / h as design speed, and
- integration to the PT ticketing system.

These options are presently not envisaged in the SUTMP as the traffic volume does not justify major investments in the rail system just for passenger services (for cost and revenue calculations please refer to chapter 9.2 and 9.3). However, the National Transport Master Plan[24] foresees the up-grading of the core railway network mainly for national and international freight rail services within the SADC. Priority lines are outside the Windhoek area, within Windhoek, specifications are yet unclear. However, the rail option should be reinvestigated and eventually envisaged earlier in the framework of the regular up-date of the SUTMP.

[24] In parallel with the development of the SUTMP, a National Transport Master Plan tackling all modes of transport is developed, supported by the EIB.

5.4. Integration of Taxi Services

Presently, taxis operate as part of the PT, which is a mix between international known radio taxi (call a taxi) and minibus service but with low occupancy vehicles (please refer also to chapter 2).

It is proposed to change the actual taxi system into two different parts:

- classic radio taxi system (one can call a taxi or stop the taxi in the street and get door to door service e.g. with distance based fares measured by taximeters)
- minibus system (for further description of operational requirements and recommendations please refer to the chapter below).

For more details on the institutional and financial integration of the taxi industry see chapter 4.5.3 last paragraphs and the recommendations made over there and chapter 5.5 for the conversion of parts of the taxi industry into the regulated overall PT minibus/taxi scheme.

5.5. Integration of Minibus Services

As described in chapter 5.4, the existing taxi service should change to classic radio taxis and to a minibus service for the distribution of passengers from the bus lines in trunk roads to their places of interest (households, work places, etc.).

The Minibus service must be integrated into the ticketing system of the PT network, so that passengers can use the minibuses as well as any other PT system in Windhoek with the same ticket or smart card.

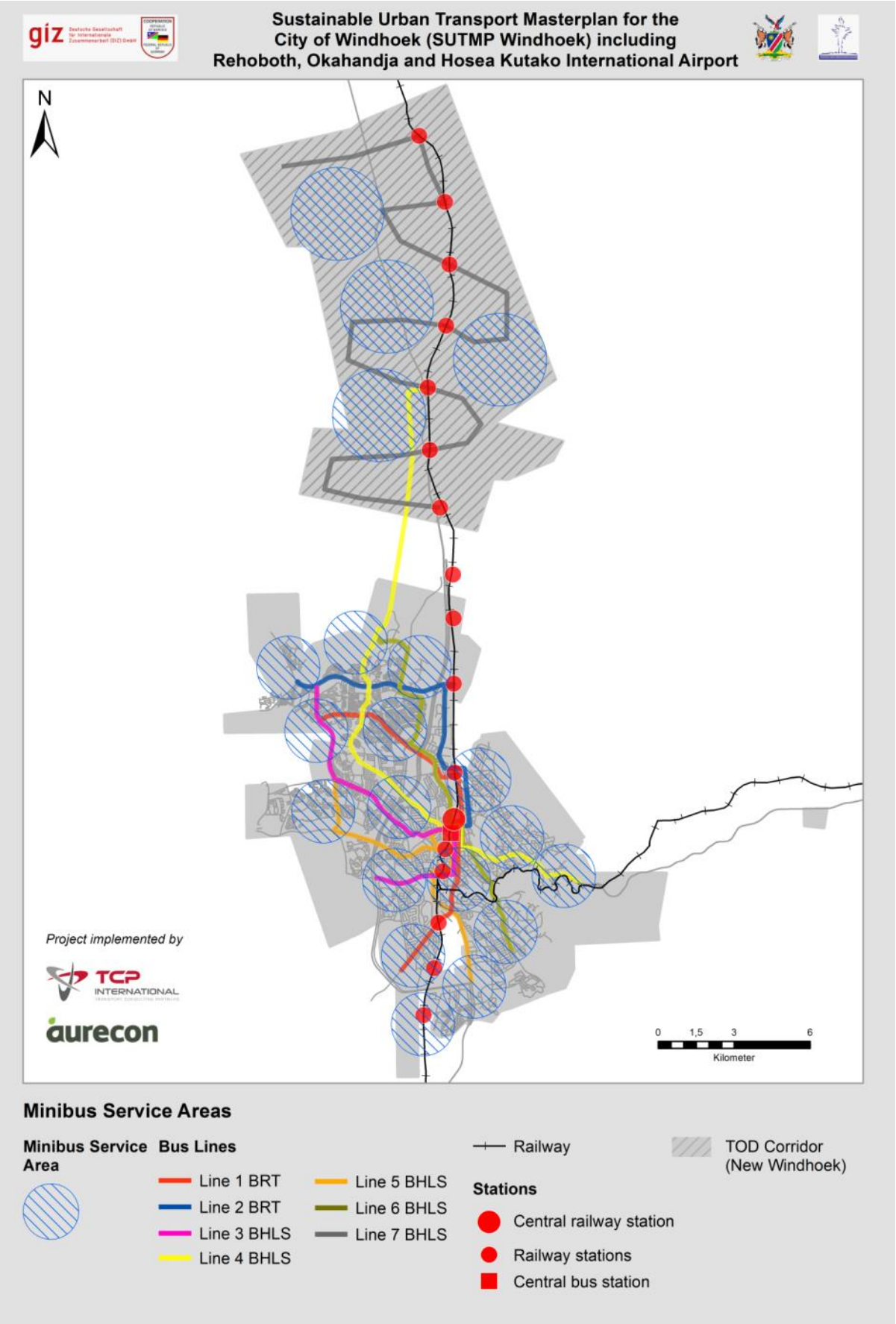
At this stage, the City of Windhoek was divided into 20 regions for minibus services (see Figure 5-13). For further calculations, each region will be equipped with 7 mini buses.

The service in these regions can be tendered to private operators. Such operators could be former taxi owners experienced in delivering PT services and also familiar with requirements of a zoning system which exists right now for taxis in Windhoek anyhow. It is possible to combine the tender of these services with the maintenance of the auxiliary infrastructure in these regions (bus bulbs, passenger information, etc.). The winner of the tender process must guarantee a safe, secure and reliable service while using the mandatory ticketing system (see chapter 5.9).

How this integration could be done from an organisational, institutional and legal point of view was already outlined in chapter 4.5.

That is why the project team proposes rather small to medium sized minibus/taxi areas in order to enable as many operators as possible to step into this new market. During the feasibility stage of the envisaged PT system, the stakeholder engagement with the taxi industry and the subsequent mediation process this minibus / taxi feeder system zoning need to be fine-tuned. It might also turn out in the mediation process that several operators together bid and serve for a larger / combined zone.

Figure 5-13: Windhoek's 20 Minibus Service Areas



5.6. Network Aspects

One of the main aspects for the network of the future PT system is the integrated and holistic characteristic. The project team strongly suggests a central bus station (CBS) planned to be planned and build right from the beginning of SUTMP implementation and to be located in the CBD. The CBS is the central point, where all bus lines and the railway line are coming together, allowing passengers the interchange between the bus lines and other transit modes. It is proposed to build the CBS at a free space next to the Wernhill Shopping Mall. BRT and BHLS lines are meeting each other. Also the new planned regional Minibuses and the new to be introduced radio taxis will have an area for their services in the CBS. Generally PT lines leave the CBS in an astral form, so that the whole city area is accessed via trunk roads. Additionally, the railway passes the CBS. Platforms from the railway will have direct access to the CBS. Last but not least, there should be reserved a part inside the CBS for intercity bus services.

The railway is the future transversal backbone system towards the end of the planning horizon. It will run from the south of Windhoek to the north and then further to the new development area of Brakwater. So it runs middle through the area with actual 250.000 inhibitors and then through the area, where another 250.000 inhibitors will live in the future.

There are two main reasons for the stepwise development of the holistic system. One is the constricted possibility to do many works at the same time. The other is the adaptation of implementation steps to the city development and derived transport demands.

Therefore the development is divided into 4 main phases. During the later real implementation, each phase must be divided into several sub steps.

Since most PT demand is generated in the northern neighborhoods of Windhoek, such as Katutura, Wanaheda, Goreangab, etc., the first two lines (Line 1 and 2) are proposed from the CBS to that part of Windhoek (see Figure 5-14:). Because of the high demand, these two lines are proposed as BRT lines (for characteristics see chapter 5.7 PT infrastructure). This first implementation phase can start operation earliest in 2017, assuming that planning procedures can start in the near future after delivering the SUTMP.

Two further lines are proposed to be built during the second phase. Line 3 and 4 and all other lines are having a little less demand than line 1 and 2. Therefore the characteristics of those lines are a little lighter so that these lines will be built as BHLS lines (differences between BRT and BHLS see chapter 5.7).

The line 3 of this phase makes amongst others Khomasdal and Rocky Crest accessible. Line 4 connects the Avis district with the CBD and goes farther in the northern direction. It is one of two later connections to the new development area of Brakwater.

This phase can possibly start in 2022.

During the third Phase, the bus network will be completed.

The BRT Line 1 will be extended to the UNAM (University of Namibia). The two other BHLS Lines 5 and 6 are connecting the remaining (till now not accessed) neighborhoods (see Figure 5-16:). This phase can possibly start in 2027.

During the last phase 4, the railway (commuter rail service, CRS) implementation is proposed. The Railway than is the backbone PT system which runs in the center corridor from the most southern point of settlement to the opposite end of future settlement in Brakwater. This phase can possibly be operational in 2032.

Please find in chapter 10 the implementation plan for an overview of the sequencing scheduled above.

Figure 5-14: New PT System, phase 1; BRT lines on trunk roads to the northern region of Windhoek (2017)

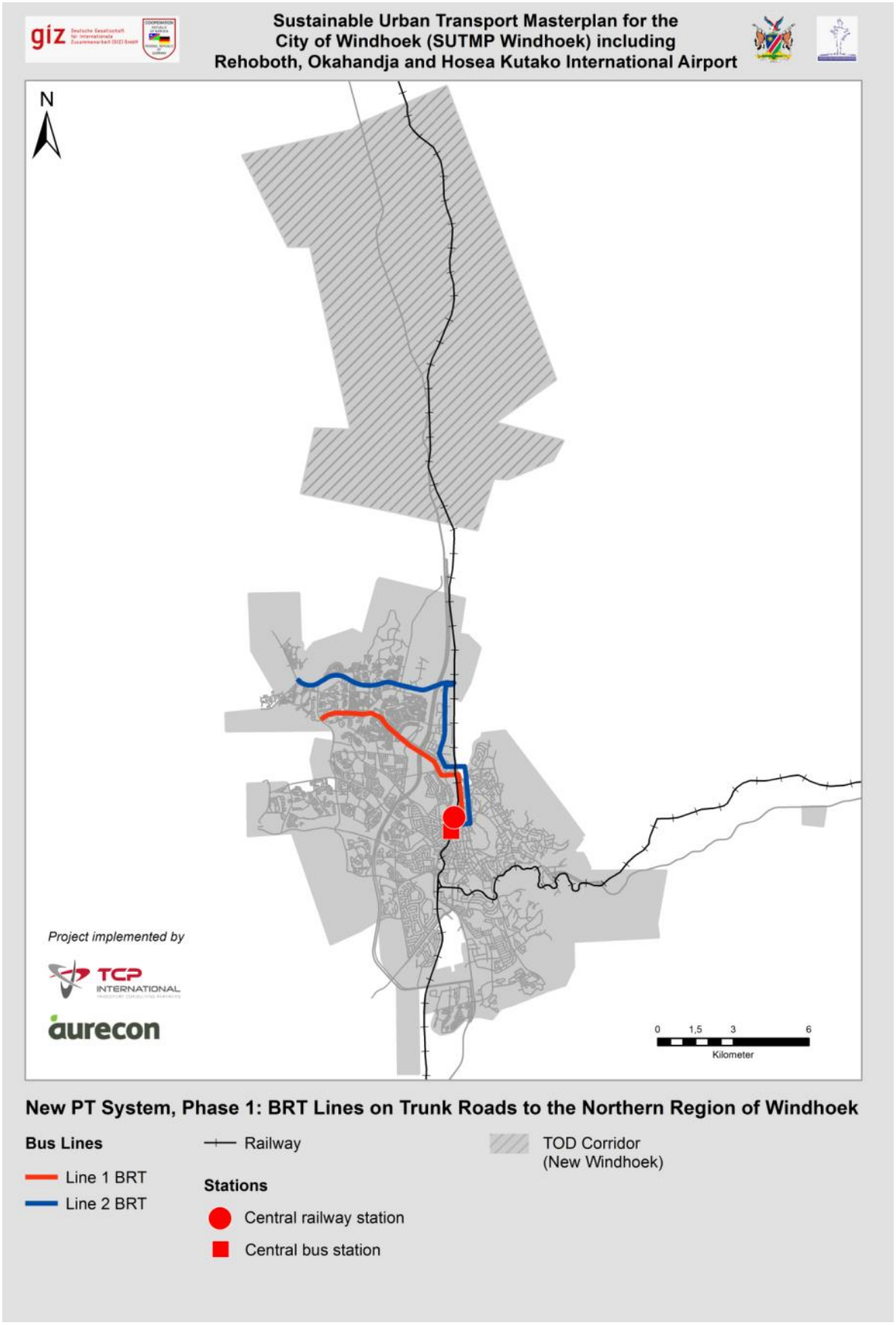


Figure 5-15: New PT System, phase 2; Prolonged BRT line and additional BHLS lines (2022)

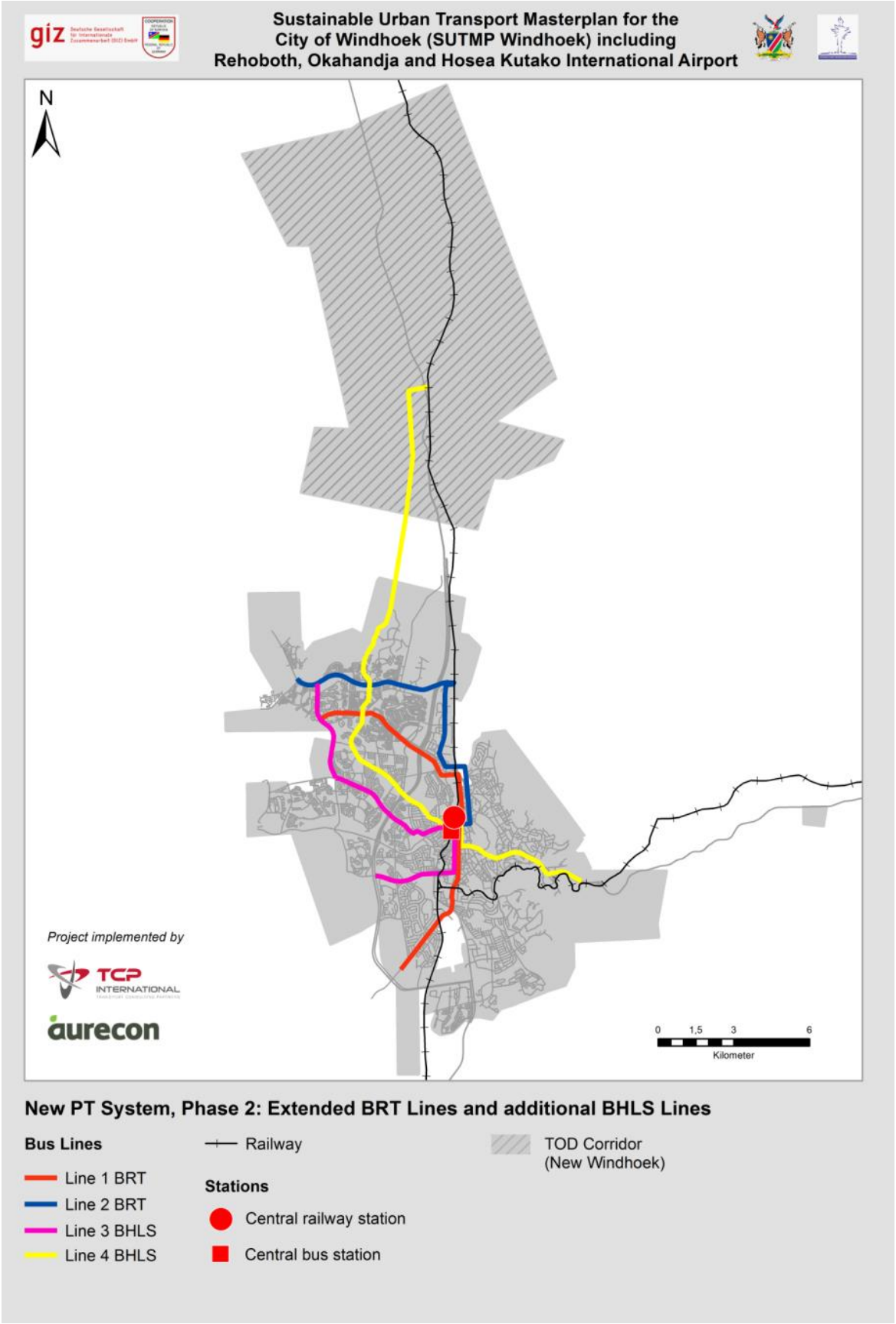


Figure 5-16: New PT System, phase 3: BRT and BHLS lines in most trunk roads serving most Windhoek city regions (2027)

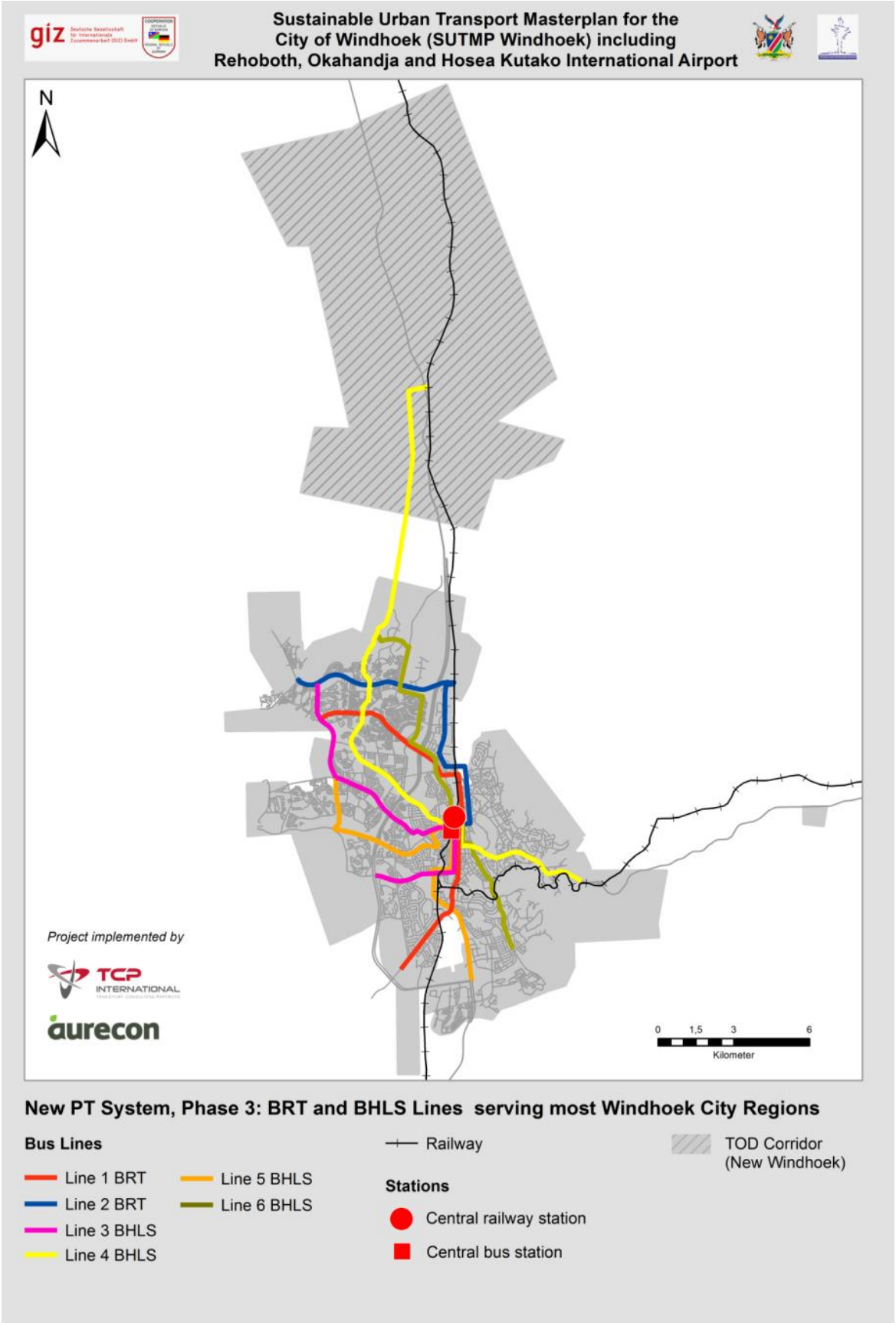
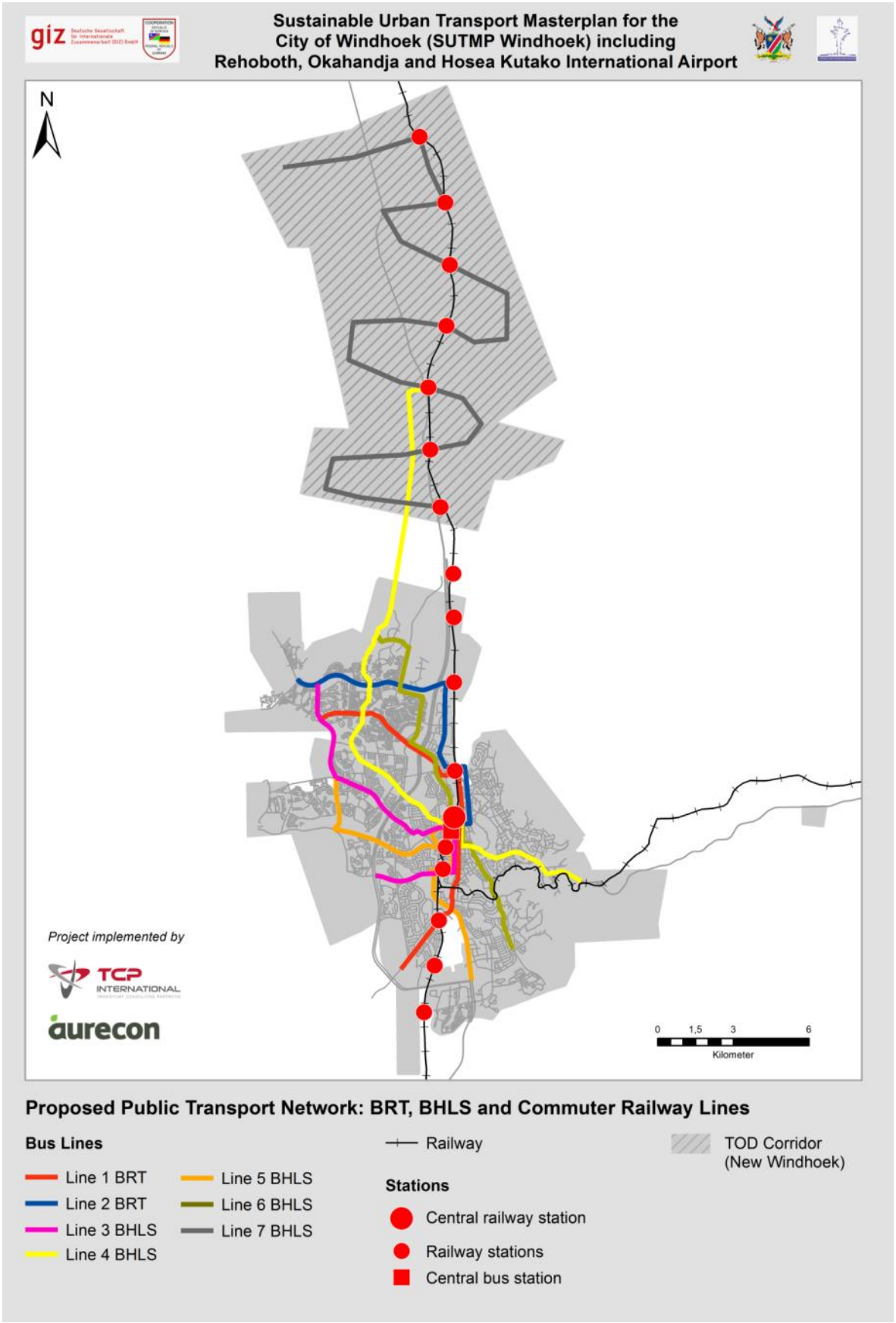


Figure 5-17: Graduated PT network with BRT, BHLS and Commuter Railway lines



While the planning for Brakwater region does not exist till now, it is not possible to define the exact alignment of the BHLS Line 4 to or Line 7 within Brakwater. During later planning procedures, the length of lines and the need of infrastructure and rolling stock can vary according to the detailed planning. But generally this requirement is valid for all other lines, because the type of city development and type of land use in different corridors has a strong influence to many details in PT. Therefore all described steps, alignments and calculations based on that background are generally to be seen as guideline.

5.7. Public Transport Infrastructure

5.7.1. Commuter Railway (CRS)

The implementation of railway infrastructure for the commuter railway is foreseen for the latest implementation phase 4 up to 2032.

While the interval during peak time is very short (5 min headway), the railway needs one track in each direction, independent from the existing railway tracks. The existing railway corridor allows in most cases the relative easy adoption of further tracks (clearing of ROW to left and/or right side of existing track).

Stations with platforms on each side of the tracks are needed (examples see Figure 5-18)

Figure 5-18: Station Example 1 and 2, Regiobahn line Mettmann – Dusseldorf - Karst

Depot and Workshop

The necessary railway depot and workshop can be kept rather small and could be located along the tracks close to the existing maintenance facilities or in the new development area Brakwater.

Furthermore there is a need of a sort of managing and signaling system with a control center.

The railway control centre can be integrated into the same building. Otherwise there is the possibility to integrate the control centre for the CRS into the proposed CCC of the bus system.

Figure 5-19: Example: Depot and Workshop area for 14 DMU's, REGIOBAHN Dusseldorf, Germany (approx. 550 m * 25 m)

Rolling Stock

The market offers a wide range of diesel rail cars for commuter services. Most DMU's comes from Europe, Asia, and Northern America. The capacity of an approx. 40 m unit for example is about 120 seats and 120 standees (variable, according to needs of customers, width between 2,5 and 3 m). Figure 5-1: shows a typical DMU for commuter rail application.

Coupling of multiple units during peak hour service is possible. In case of two coupled units for example, the capacity or the interval is double. In case of double interval one need half amount of drivers for the movement of the same quantity of passengers. That can reduce the operating costs (because of the conservative calculations in this SUTMP report, this advantage was not taken into account).

Figure 5-20: Example: DMU of Regiobahn, Germany

The calculated investment costs for the Computer Rail System CRS are listed in the figure on the next page. Basis for the calculation were unit costs from MWT rail construction projects and international prices in case of necessary imports.

Figure 5-21: Investment cost for the CRS Windhoek Brakwater

Windhoek South - Brackwater	units		single cost		sum	
New double Track	20	km	14.000.000	N$	282.800.000	N$
electric controlled switches	12	pc.	450.000	N$	5.400.000	N$
land acuasition (9 m strip)	20	km	300	N$	54.540.000	N$
control centre incl line equipment	1	pc.	50.000.000	N$	50.000.000	N$
depot and workshop	1	pc.	100.000.000	N$	100.000.000	N$
stations with two platforms	14	pc.	20.000.000	N$	280.000.000	N$
25 % supplement for the unforeseen					193.185.000	N$
trains (DMU)	14	pc.	40.000.000	N$	560.000.000	N$
					1.525.925.000	N$

5.7.2. Bus System

The implementation of BRT infrastructure starts in the first phase. The lines should be opened in 2017.

While the interval during peak time is very short (3 minutes headway), the BRT system needs segregated ROW in each direction, independent from individual transport (see examples Figure 5-22 and 5-23).

Figure 5-22: BRT ROW Example 1 Quito

Figure 5-23: BRT ROW Example 2 Quito

In Windhoek, analogue to the BRT system in Quito, physical separating structures ought to be very "light" but nevertheless completely segregated. Strengthening the road bed and surface is only calculated for a small portion of the overall BRT alignment with very short headways, e.g. in the case of two lines approaching the CBS on the same route.

Stations with platforms for easy and quick access on each side of the ROW are needed (examples see Figures 5-24 until 5-27).

Figure 5-24: Example 1 Station BRT Quito Quito

Figure 5-25: Example 2 Station BRT

Figure 5-26: Example 3 Station BRT Curitiba Station,

Figure 5-27: Example 4 Access Control Curitiba

Furthermore there is a need of a sort of managing and signaling system with a control center and other facilities like ticketing system, access control, etc. The BRT stations are generally housed, so that people can only enter at the entrance and leave at the exit. This leads to a quick access and leaving to and from the buses, in addition to the pre-boarding the passengers. That means that only passengers with valid tickets can get access to the platforms.

Further information can be found in the GIZ BRT planning guidelines.

During the next implementation phases 2 to 4, the so called BHLS lines will be constructed.

The BHLS lines are mostly running like the BRT lines on separated ROW. But in BHLS lines the separation is often lighter than in case of BRT. Partly the separation is only a painted line on the pavement and sometimes (when the other traffic allows it or if there is no need or implementation costs are too high) the buses use the normal road infrastructure. Only in problematic sections or at points where other traffic is heavy, a stronger segregation is needed. This must be studied in detail during the later planning phase for those lines. In this report, the need of strong and light segregations is estimated according to the site visits and international experiences.

Stations for the BHLS system are less complex, so that investment costs are lower than for BRT stations.

The following figures 5-28 until 5-30 show examples for BHLS right of way (ROW) and stations. A similar standard was the basis for cost calculations with Namibian construction unit prices.

Figure 5-28: Example 1 BHLS Station, Hamburg, Germany

Figure 5-29: Example BHLS ROW Hamburg

Figure 5-30: Example 2 BHLS Station Hamburg

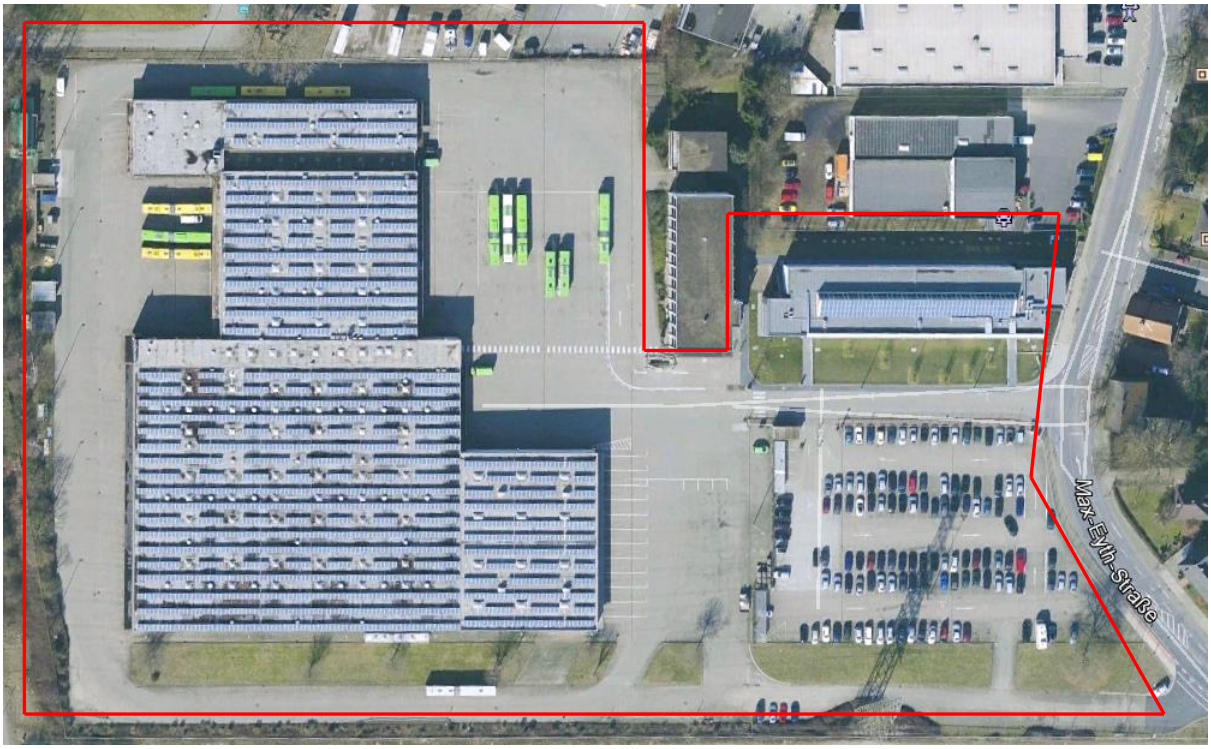
Depots and Workshops

During the first phase there is a need of maintenance facilities for approx. 40 buses. At the latest phase 4 the workshop must be able to maintain approx. 120 or more buses. For the easier distribution of buses it is useful to have 2 depot areas.

The new state of the art buses need modern and efficient new depot and workshop facilities, but it is sufficient to concentrate the maintenance at one point. Presently, there exist already two depots for the municipal buses. However, the one in the southern industrial is anyhow envisaged to be closed due to space requirements for new property developments in this area, the one in the northern industrial need to be investigatd but appears to be too small to accommodate requirements of the ew PT system..

Therefore a new depot with maintenance facilities is proposed on the green field north of Windhoek at the beginning of Brakwater region. A second depot with light maintenance infrastructure (only for cleaning and refreshing) should be located in southern Windhoek. The investment cost for the depot with central maintenance facilities is estimated with **65.000.000 N$**. The second depot with light maintenance facilities and less capacity is estimated with **30.000.000 N$.** Exact prices are strongly varying, because of unknown land prices and in-house production depth of maintenance.

Figure 5-31: Example: Bus depot and workshops for 120 buses, Oberhausen Germany (approx. 250 m * 170 m)



Rolling Stock

The market offers a wide range of buses for BRT services. Most buses come from South America, Europe, Asia, and Northern America. For Mass Transit applications the most common bus type is an articulated bus.

The capacity of an approx. 18 m unit for example is about 80 seats and 70 standees (variable, according to needs of customers, width approx. 2.5 m).

Figure 5-32: Example: Articulated Bus for BHLS lines in Zurich, Swiss

The calculated investment costs for the BRT and BHLS systems are listed in the following figures and were given per implementation stage shown in the consecutive maps in chapter 5.6.

First PT implementation phase (up to 2017)

Figure 5-33: Investment cost for the BRT Line 1 Independence first Phase

line 1 Independence				
type	BRT			
length of line	9 km			
average distance between stations	640 m			
average speed	29,7 km/h			
minimum round trip time	48 min			
minimum headway	3 min			
max. pass. / h / dir during peak hour	3.000 pass./h/dir.	km	N$ / km	N$
number of stations	15 stations		4.000.000	60.000.000
number of buses neded	16 buses		3.500.000	56.000.000
complex additional traffic lane	Otjumuise Road - Abraham Mashego	1,5	14.000.000	21.000.000
complex reserve of one existing trafficlane	Abraham Mashego - Hosea Kutako Dr.	3,5	3.000.000	10.500.000
complex additional traffic lane	Hosea Kutako Dr. - WCB	3,5	14.000.000	49.000.000
infrastructure sum		8,5		80.500.000
supplement CCC				5.000.000
supplement depot and workshops				20.000.000
supplement for reconstructions works				60.000.000
all sub-totals				281.500.000
25 % supplement for the unforeseen				70.375.000
total system cost for the line				384.000.000

Figure 5-34: Investment cost for the BRT Line 2 Monte Cristo, first Phase

Line 2: Monte Cristo				
type	BRT			
length of line	12,1 km			
average distance between stations	670 m			
average speed	30,0 km/h			
minimum round trip time	60 min			
max. pass. / h / dir during peak hour	3.000 pass./h/dir.	km	N$ / km or unit	N$
number of stations (aditional to line 1)	19 stations		4.000.000	76.000.000
number of buses neded	20 buses		3.500.000	70.000.000
complex additional traffic lane	Otjumuise Road - Abraham Mashego	9	14.000.000	126.000.000
rest of line follows line 1 in Independence				
infrastructure sum		9		126.000.000
supplement CCC				5.000.000
supplement depot and workshops				20.000.000
supplement for reconstructions works				55.000.000
all sub-totals				352.000.000
25 % supplement for the unforeseen				88.000.000
total system cost for the line				440.000.000

The total investment for rolling stock and infrastructure for the first implementation phase is **824.000.000 N$**.

Second PT implementation phase up to 2022

Figure 5-35: Investment cost for the BRT Line 1 Independence Avenue second Phase

line 1 Independence				
type	BRT			
length of line	15 km			
average distance between stations	600 m			
average speed	28,1 km/h			
minimum round trip time	75 min			
minimum headway	3 min			
max. pass. / h / dir during peak hour	3.000 pass./h/dir.	km	N$ / km	N$
number of stations	26 stations		4.000.000	104.000.000
number of buses neded	25 buses		3.500.000	87.500.000
complex additional traffic lane	Otjumuise Road - Abraham Mashego	1,5	14.000.000	21.000.000
complex reserve of one existing trafficlane	Abraham Mashego - Hosea Kutako Dr.	3,5	3.000.000	10.500.000
complex additional traffic lane	Hosea Kutako Dr. - WCB	3,5	14.000.000	49.000.000
complex reserve of one existing trafficlane	WCB - UNAM	6,5	3.000.000	19.500.000
infrastructure sum		15		100.000.000
supplement CCC				5.000.000
supplement depot and workshops				20.000.000
supplement for reconstructions works				80.000.000
all sub-totals				396.500.000
25 % supplement for the unforeseen				99.125.000
total system cost for the line				495.625.000
minus investment for the first pahase section (because this is a calculation for the whole phase 2 line 1				384.000.000
additional investment cost for phase 2 of line 1				111.625.000

Figure 5-36: Investment cost for the BHLS Line 2 Rocky Crest second Phase

Line 3: Rocky Crest				
type	BHLS			
length of line	16,4 km			
average distance between stations	630 m			
average speed	27,3 km/h			
minimum round trip time	85 min			
minimum headway	5 min			
max. pass. / h / dir during peak hour	1.800 pass./h/dir.	km	N$ / km or unit	N$
number of stations	26 stations		1.600.000	41.600.000
number of buses neded	17 buses		2.500.000	42.500.000
simple additional traffic lane (30%)	Monte Cr-WCB + Hendrik Witbooi-Rocky Crest	12	10.000.000	36.000.000
complex reserve of one existing trafficlane	Hochland Rd + CBD	3,5	3.000.000	10.500.000
toghether with line 1 and 2		1	0	0
infrastructure sum		16,5		46.500.000
supplement CCC				3.000.000
supplement depot and workshops				15.000.000
supplement for reconstructions works				60.000.000
all sub-totals				208.600.000
25 % supplement for the unforeseen				52.150.000
total system cost for the line				260.750.000

Figure 5-37: Investment cost for the BHLS Line 4 Florence Nightingale second Phase

Line 4: Florence Nightingale				
type	BHLS			
length of line	19,2 km			
average distance between stations	600 m			
average speed	20,0 km/h			
minimum round trip time	100 min			
minimum headway	5 min			
max. pass. / h / dir during peak hour	1.800 pass./h/dir.	km	N$ / km or unit	N$
number of stations	33 stations		1.600.000	52.800.000
number of buses neded	20 buses		2.500.000	50.000.000
simple additional traffic lane (30%)	Omuvapu Str. - Hosea Kutako Dr.	13	10.000.000	39.000.000
complex reserve of one existing trafficlane	CBD - AVIS	1,5	3.000.000	4.500.000
simple reserve of existing traffic lane		1	1.200.000	1.200.000
toghether with line 1 and 2		1	0	0
infrastructure sum		16,5		44.700.000
supplement CCC				3.000.000
supplement depot and workshops				15.000.000
supplement for reconstructions works				80.000.000
all sub-totals				245.500.000
25 % supplement for the unforeseen				61.375.000
total system cost for the line				306.875.000

The total investment for the second implementation phase is **679.250.000 N$.**

Third PT Implementation phase

Figure 5-38: Investment cost for the BHLS Line 4 third Phase

Line 5: Eros Airport				
type	BHLS			
length of line	17,05 km			
average distance between stations	550 m			
average speed	25,8 km/h			
minimum round trip time	90 min			
minimum headway	7,5 min			
max. pass. / h / dir during peak hour	1.200 pass./h/dir.	km	N$ / km or unit	N$
number of stations	32 stations		1.600.000	51.200.000
number of buses neded	12 buses		2.500.000	30.000.000
simple additional traffic lane (30%)	Otjomuise - Sam Nujoma Dr. Mandume Ndemufayo	6,5	10.000.000	19.500.000
complex reserve of one existing trafficlane	Otjomuise St.- Hosea Kutako Dr.	5,5	3.000.000	16.500.000
simple reserve of existing traffic lane	in Hosea Kutako	2	1.200.000	2.400.000
toghether with line 1 ,2 and 3		3	0	0
infrastructure sum		17		38.400.000
supplement CCC				3.000.000
supplement depot and workshops				15.000.000
supplement for reconstructions works				80.000.000
all sub-totals				217.600.000
25 % supplement for the unforeseen				54.400.000
total system cost for the line				272.000.000

Figure 5-39: Investment cost for the BHLS Line 5 third Phase

Line 6: Hosea Kotako				
type	BHLS			
length of line	18,15 km			
average distance between stations	550 m			
average speed	25,7 km/h			
minimum round trip time	97,5 min			
minimum headway	7,5 min			
max. pass. / h / dir during peak hour	1.200 pass./h/dir.	km	N$ / km or unit	N$
number of stations	32 stations		1.600.000	51.200.000
number of buses neded	20 buses		2.500.000	50.000.000
simple additional traffic lane (30%)	Maxuilili - Independence Rd. + Jan Jonker St. + RobMu	8	10.000.000	24.000.000
complex reserve of one existing trafficlane	Independence - WCB	7	3.000.000	21.000.000
simple reserve of existing traffic lane	in Robert Mugabe	1	1.200.000	1.200.000
toghether with line 1 ,2 and 3		1	0	0
infrastructure sum		17		46.200.000
supplement CCC				3.000.000
supplement depot and workshops				15.000.000
supplement for reconstructions works				80.000.000
all sub-totals				245.400.000
25 % supplement for the unforeseen				61.350.000
total system cost for the line				306.750.000

The total investment for rolling stock and infrastructure for the first implementation phase is **578.750.000 N$.**

Fourth PT implementation phase

It is proposed to connect the new development area of Brakwater during the fourth implementation phase with the commuter rail service. But inside the huge new development area, it is necessary to connect the urban districts with buses. While the new development zone is not planned yet, the amount for investment costs for a BHLS system is estimated with the following figure.

Figure 5-40: Investment cost for the BHLS Line 7 fourth Phase

Line 7: Brackwater				
type	BHLS			
length of line	16400 km			
average distance between stations	631 m			
average speed	27,3 km/h			
minimum round trip time	85 min			
minimum headway	5 min			
max. pass. / h / dir during peak hour	1.800 pass./h/dir.	km	N$ / km or unit	N$
number of stations	27 stations		1.600.000	43.200.000
number of buses neded	17 buses		2.500.000	42.500.000
simple additional traffic lane (30%)		8	10.000.000	24.000.000
complex reserve of one existing trafficlane		7	3.000.000	21.000.000
simple reserve of existing traffic lane		1	1.200.000	1.200.000
infrastructure sum		16		46.200.000
supplement CCC				3.000.000
supplement depot and workshops				15.000.000
supplement for reconstructions works				80.000.000
all sub-totals				229.900.000
25 % supplement for the unforeseen				57.475.000
total system cost for the line				287.375.000

The total investment for rolling stock and infrastructure for the service within Brakwater is estimated with **287.375.000 N$.**

5.7.3. Mini bus system

During all phases, the minibus service network should grow according to the bus corridor development.

The mini bus regions are distributed along the bus lines around or beside the trunk roads.

Each time, when a new line will be build, the corresponding region for mini bus service must be integrated to the project step.

Therefore it is useful to tender those regions, which touches a new constructed bus line during their implementation.

While the road network for the new development areas inside and outside Windhoek is not known yet, estimates of the implementation cost of the mini bus system are relatively sketchy (see figure 5-41).

Because of the private ownership of minibus fleets and the standard design of minibuses which is clearly similar to private vans, it is not necessary to build an own maintenance facility for minibuses. The minibuses can be maintained in normal car workshops.

Figure 5-41: Investment cost estimation for the mini bus services

cost / bus		800.000	N$
mini bus regions	20		
mini buses / region	7	5.600.000	N$
minibuses total	140	112.000.000	N$
infrastructure cost per region		1.500.000	N$
infrastructure cost total		30.000.000	N$
Windhoek: mini bus regions	16		
Windhoek: minibuses total	112	89.600.000	N$
Windhoek: mini bus infrastructure		24.000.000	N$
Brackwater: mini bus regions	4		
Brackwater: minibuses total	28	22.400.000	N$
Brackwater: mini bus infrastructure		6.000.000	N$

5.8. Operational Concept

The operational concept for the whole system is based on the investigations in Windhoek, such as:

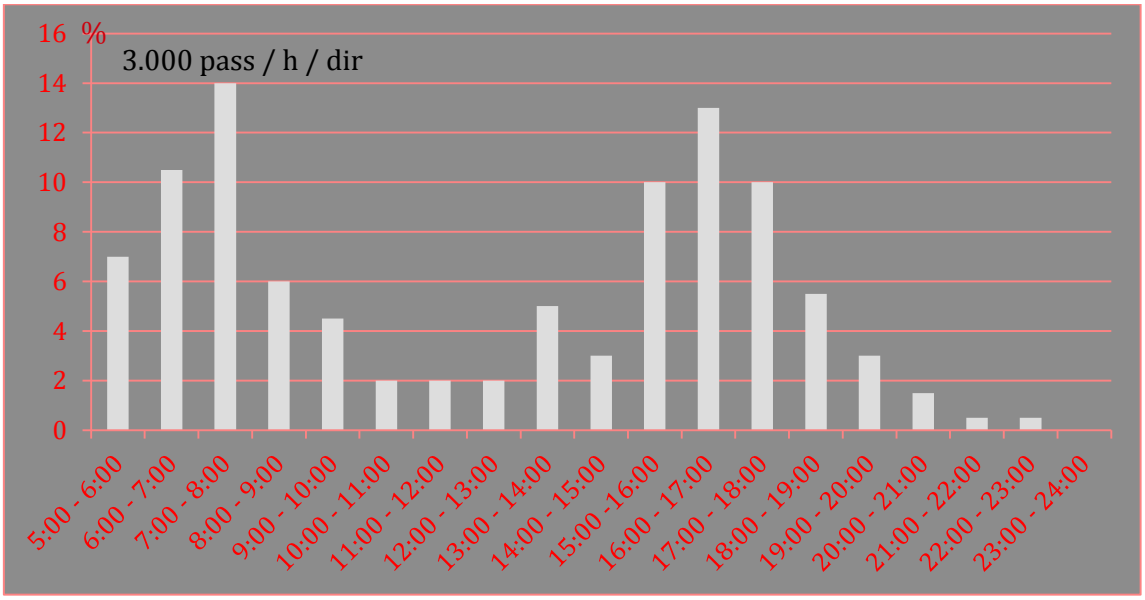
- Traffic counts
- Site inspections
- Calculations and simulations

The traffic counts have been the basis for the modelling of PT infrastructure. It would be interminable to describe each detail of the iterative process comprising several loops e.g. involving also different supply parameters in the traffic forecasting modell for optimisation of system choice system design and system costs. Thus, as an example, the dimensioning of Line 1 in Independence Avenue will be described in the following section.

In independence road, the demand of PT is round about 3.000 passengers per hour and direction during peak hour (see Annex F). This is the highest demand in Windhoek. This demand can be served by 20 Buses with 150 passengers (articulated bus) per hour (3 min headway).

The calculation for the quantity of buses required must be done on the basis of the peak hour. It is to consider, that the distribution of passengers over the day will vary, when PT service is offered during the whole day. The percentage of users during peak of peak will go down and the percentage of users during standard peak and off peak time will increase. An example for the expected distribution of passengers over the time is shown in Figure 5-42:

Figure 5-42: Expected distribution of passengers over time along Independence corridor



While the highest peak with 3.000 passengers in the corridor is 14 % of the whole traffic volume. The whole traffic volume on this corridor can be estimated at approx. 20.000 passengers per day. There are PT-lines in the world, where most passengers travel for example from one end to the half and the second most from the half to the other end. In that case the number of travellers on that line is the double amount. To work out this variation, a traffic model program was used. All further calculations have been executed on the conservative side.

Further details of the distribution of passengers and the need of busses are shown in the following Figure 5-43.

Figure 5-43: Percentage of passengers during the day hours

clock	% / h	% / time	time period	pass. / h	passing buses / h
5:00 - 6:00	7			1.500	9
6:00 - 7:00	10,5			2.250	14
7:00 - 8:00	14		**14**	3.000	19
8:00 - 9:00	6	37,5	37,5	1.286	8
9:00 - 10:00	4,5			964	6
10:00 - 11:00	2			429	3
11:00 - 12:00	2			429	3
12:00 - 13:00	2			429	3
13:00 - 14:00	5			1.071	7
14:00 - 15:00	3	18,5	18,5	643	4
15:00 -16:00	10			2.143	13
16:00 - 17:00	13		**13**	2.786	17
17:00 - 18:00	10			2.143	13
18:00 - 19:00	5,5	38,5	38,5	1.179	7
19:00 - 20:00	3	3	3	643	4
20:00 - 21:00	1,5			321	2
21:00 - 22:00	0,5			107	1
22:00 - 23:00	0,5	2,5	2,5	107	1
sum				**21.429**	
peak	76	%			
peak of peak	27	%			
off peak	21,5	%			
low demand	2,5	%			

The quantity of buses needed was done with an operation simulation tool. The simulation run for the first phase of Line 1 is shown in Figure 71.

Figure 5-44: Simulation run for first phase line 1 BRT

Input Data	**Line 1: Independence (phase 1)**	
max speed	50	km/h
average accelertion	1	m/s^2
braking	1	m/s^3
time reserve	5	%
headway	3	min

Output Data	
average speed	8,2
average speed	**29,7**
minimum round trip time:	48,0
need of buses	**16**

section from [km]	from Name		section to [km]	to Name		distance [m]	v_{max} [km/h]	v_{max} [m/s]	stop time [s]
0+000	Independence	Otjomuise	0+700	Independence	Omongo	700	60	16,7	0
0+700	Independence	Omongo	1+200	Independence	Caesar	500	60	16,7	20
1+200	Independence	Caesar	1+650	Independence	Soweto Market	450	60	16,7	20
1+650	Independence	Soweto Market	2+230	Independence	Clemence Kapuuo	580	60	16,7	20
2+230	Independence	Clemence Kapuuo	2+780	Independence	Shanghai	550	60	16,7	20
2+780	Independence	Shanghai	3+280	Independence	Wilibald Kaouenene	500	60	16,7	20
3+280	Independence	Wilibald Kaouenene	4+030	Independence	Hans Dietrich Genscher	750	60	16,7	20
4+030	Independence	Hans Dietrich Genscher	5+230	Independence	Husea Kutako	1.200	60	16,7	20
5+230	Independence	Husea Kutako	6+830	Independence	Eros	1.600	60	16,7	20
6+830	Independence	Eros	7+330	Independence	Nelson Mandela	500	60	16,7	20
7+330	Independence	Nelson Mandela	7+730	Independence	Uhland	400	60	16,7	20
7+730	Independence	Uhland	8+230	Independence	Banhofstr.	500	60	16,7	20
8+230	Independence	Banhofstr.	8+530	Railwaystation		300	60	16,7	20
8+530	Railwaystation		8+930	Mandume Ndemufayo	Central Bus Station	400	60	16,7	20
sum						8.930			
average						638			20

[m/s]					price / bus	3.500.000 $
[km/h]	places / bus (seated)	80	turn time	Independence Otjomuise	5 min	
	places / bus (standees)	70	turn time	Mandume Ndem Central Bus St	5 min	
[min]	places / bus (totl)	150	time reserve at terminus station		2 min	
buses	**pass / h / dir**	**3.000**			**all buses**	**56.000.000 $**

time of			ditance		travel time				travel time	average
acceleration	continous v_{max}	braking	from t1+t3	from t2	without	with	with	with	accumulated	speed incl.
t1	t2	t3	s1+s3	s2	anything	timereserve	stop time	stop time		everything
[s]	[s]	[s]	[m]	[m]	[s]	[s]	[s]	[min]		[km/h]
16,7	26,6	16,7	277,8	422,2	59,9	62,9	62,9	1,0	1,0	40,0
16,7	14,0	16,7	277,8	222,2	47,3	49,7	69,7	1,2	2,2	25,8
16,7	10,9	16,7	277,8	172,2	44,2	46,4	66,4	1,1	3,3	24,4
16,7	19,0	16,7	277,8	302,2	52,4	55,0	75,0	1,2	4,6	27,8
16,7	17,2	16,7	277,8	272,2	50,5	53,0	73,0	1,2	5,8	27,1
16,7	14,0	16,7	277,8	222,2	47,3	49,7	69,7	1,2	6,9	25,8
16,7	29,8	16,7	277,8	472,2	63,1	66,2	86,2	1,4	8,4	31,3
16,7	58,1	16,7	277,8	922,2	91,4	96,0	116,0	1,9	10,3	37,2
16,7	83,3	16,7	277,8	1.322,2	116,6	122,5	142,5	2,4	12,7	40,4
16,7	14,0	16,7	277,8	222,2	47,3	49,7	69,7	1,2	13,9	25,8
16,7	7,7	16,7	277,8	122,2	41,0	43,1	63,1	1,1	14,9	22,8
16,7	14,0	16,7	277,8	222,2	47,3	49,7	69,7	1,2	16,1	25,8
16,7	1,4	16,7	277,8	22,2	34,7	36,5	56,5	0,9	17,0	19,1
16,7	7,7	16,7	277,8	122,2	41,0	43,1	63,1	1,1	18,1	22,8
233,3	317,6	233,3	3.888,9	5.041,1	784,3	823,5	1.083,5	18,1		29,7

The main issues and results are:

Length:	8,9 km
Average speed	29,7 km/h
Capacity	3.000 pas/h/dir
Buses needed	16
Total travel time	18 min

The same calculations have been done for the other steps and lines with the same simulation tool. All results are shown in Annex G.

Further guidelines for the dimensioning of the bus fleet and the distribution of intervals during the day are:

Peak hour (morning):	05:00 to 09:00
Off peak hour:	09:00 to 15:00
Peak hour (evening):	15:00 to 19:00
Hour of low demand:	20:00 to 23:00

Shortest interval in general:	3 min
Appropriate interval during the day:	7.5 min
Longest interval during low demand:	30 min

The adjustment of the intervals of corresponding lines in terminus stations is not necessary during intervals between 3 to max. 10 min. During times with longer intervals than 10 min, the timetables of corresponding lines should be adjusted to avoid long and unattractive waiting times for the customers.

5.9. Tariff and Customer Information Concept and Technology

5.9.1. Ticketing and Fare System

While the actual ticketing system (smartcard system) is new and state to the art, it is proposed to use it further on. For the future more and more integrated bus system it is necessary to adopt and advance the existing system. While the smartcard system it is a modular system, the upgrade is easy and all modern possibilities are given.

It is strongly recommended to implement the so called pre-boarding system on the BRT-line-stations and in the railway-stations. That means that people must have a ticket before entering the platform of a station. The station can be entered by passing for example a rotary cross which gives permission during passing with a valid smart card or any other valid ticket. In case of Smartcard, the debit of charged money or ticket data must be done automatically.

It is to discuss, if the BHLS lines are fitted with the same pre-board facilities or a similar but lighter system or not. Similar considerations must be given to the minibus / taxi feeder system. Those details are to be verified during a later feasibility study.

But in any case the ticket system should be an integrated system, used for BRT, BHLS, commuter railway, minibuses and all other potential transport modes in Windhoek.

The offering of different types of tickets is recommended. These tickets can be:

- single
- quadruple
- day
- week
- month
- yearly subscription
- etc.

All tickets should be offered to different persons at different prices:

- adults
- children
- pensioners
- unemployed
- scholars/students
- other

The average ticket price is estimated with 7 N$ for the year 2017.

The reasoning is as follows:

- Marketing considerations: the price is slightly higher as the present value (5 N$ with smart card, 6 without) but lower then the present taxi system with 9 N$
- Macro-economic considerations: in 5 years time an increase of fares is assumed due to higher average income (GDP growth) and some inflationary tendencies
- Higher price for better service than the presently existing system, but still affordable for the poorer part of the population.
- A flat fare is recommended as it has the following advantages compared with the frequently applied distance based fares:
    - Easy to understand and to collect
    - Fare evasion both intentional and unintentional is lowered as passengers need not to warry about paying for the correct numer of sections or zones
    - the poorer part of the population living in remote suburbs is specifically encourarged to use the PT-system.
    - It attempts to attract choice riders, i.e. as flat fares are more attractive to long-distance riders - the kind of riders whom normally would have taken that long-distance trip by automobile.

However, the smart card system easily allows also switching to a distance based system, which might nevertheless be envisaged if the integrated system is established and mature.

5.9.2. Passenger Information System

Passenger information is necessary before entering the system such as sales points for tickets, tourist offices, university black boards and inside the system, i.e. buses and stations. Passengers should find information about:

- tariff information
- ticket types
- ticket prices
- ticket sales offices / customer care centres
- line maps
- timetables
- special offers
- etc.

and:

- sales points
- customer care centres
- shopping centres
- museums
- restaurants, cinemas, libraries etc.
- internet
- mobile phone
- convenience shops and other ticket distributors
- etc.

Inside the systems, at each stop and on each platform and possibly in each bus, passengers need minimum information about:

- lines and stops
- timetables

This information can be started via printed signs and at a later and more advanced stage, customer information could also be automated. As an immediate measure, it is strongly advised to considerably increase the number of sales points for the smart cards as soon as possible. This could be done via sales partners similar to the MTC airtimes sales system.

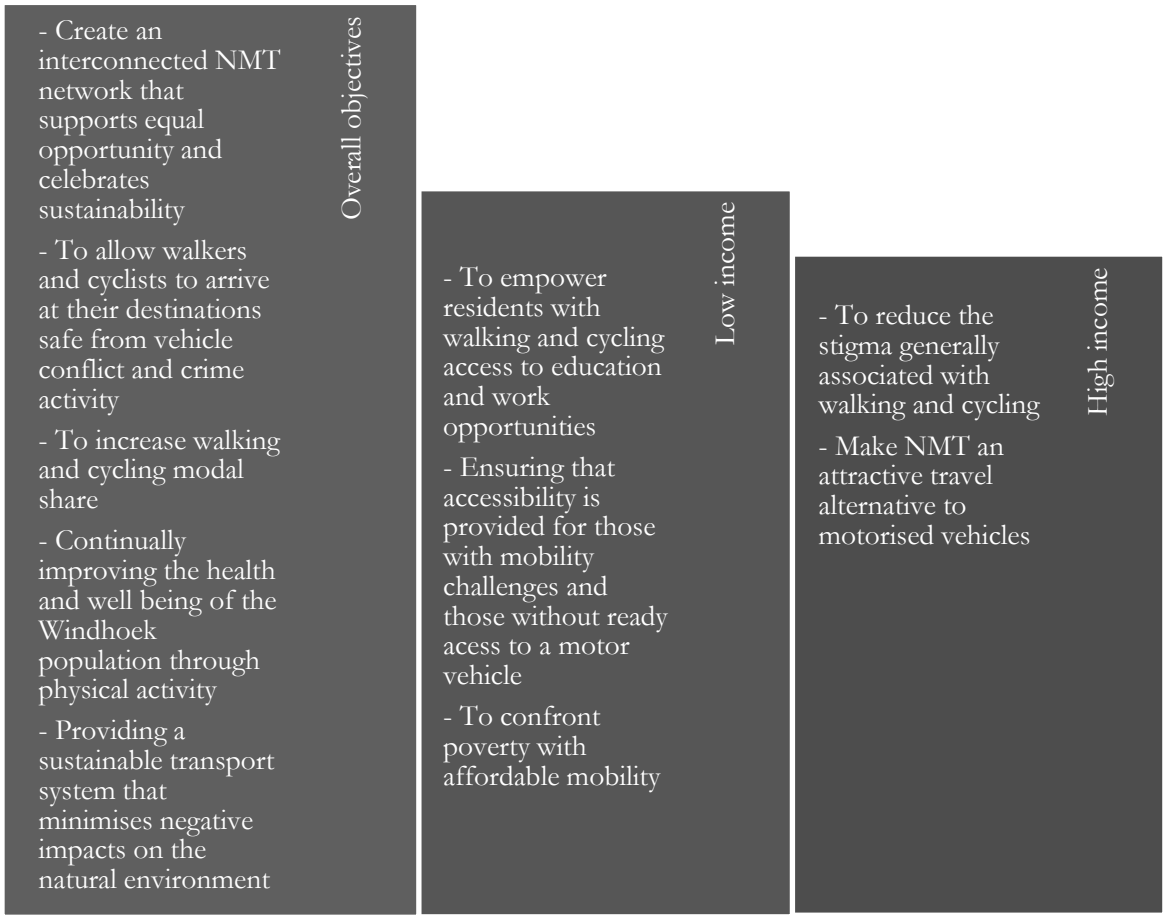
6 Non-motorised Transport

In this chapter 6 the principle strategies, the process of elaboration and the main recommendations and technical features for an improved NMT system is described. In addition, prioritization and stepwise implementation of recommended measures is given. Again it can be stated that the proposed system is rooted on international best practice but strongly targeted towards applicability in Windhoek and the rest of the study area.

6.1. Strategy

The goals and objectives tabled below were formulated based on the current urban and economic situation that the city is faced with. The NMT strategy's goals and objectives were derived to address the city as a whole, thus "overall' objectives were established, as well as addressing the duality that the city is faced with in terms of its urban form and economy. Hence, 'low income and high income' goals were formulated that will produce an efficient and targeted strategy to implement NMT infrastructure and initiatives for each group. These goals and objectives complement the strategic direction that was agreed upon with wide consensus by all key stakeholders, as shown in the below textbox.

Figure 6-1: NMT goals and objectives



Strategic Directions for Non-motorised Transport

Excerpt of the Memorandum of Understanding for Non-motorised Transportation:

Bearing in mind that the majority of trips generated are by pedestrians and walking and cycling as affordable, efficient, environmental friendly, healthy modes;

And considering that improved, safe and secure facilities for walking and cycling will considerably contribute to liveable cities;

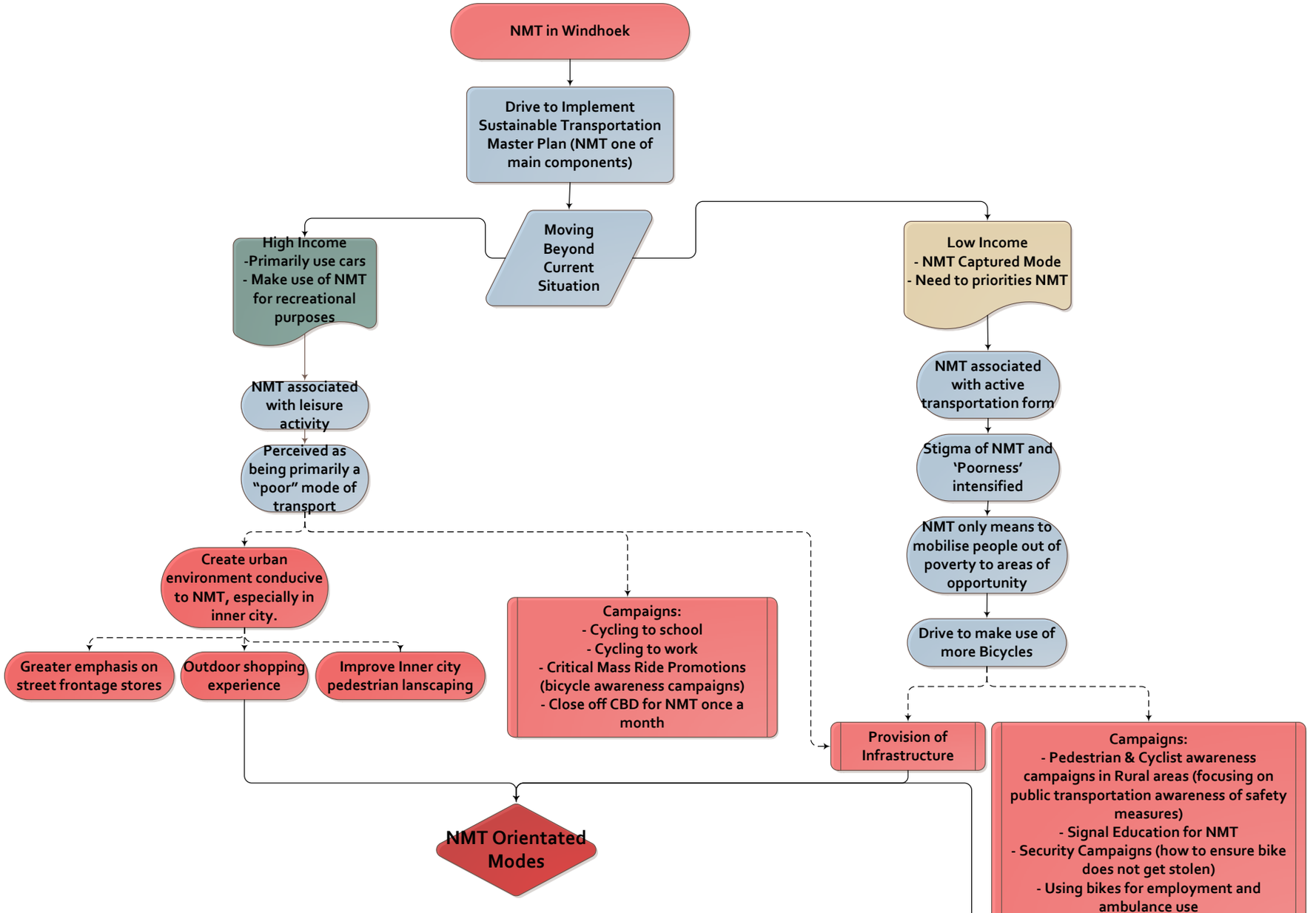
And having considered the options for core and secondary Non-motorised Transport networks;

And being of the opinion that only continuous networks will have the desired effects;

It is therefore agreed that:

a. the core network and the links for Non-motorised Transport is a good basis for further SUTMP elaborations;
b. within the core network there is need for optimisation and extended coverage towards the following areas, for example routes to Otjomuise, the riverbed tracks from Avis dam to Eros and northerly expansion to Okuryangava;
c. the yellow route (strategic links to various employment and social opportunities in the north), the red route (CBD and further north) and the pink route (north-western Windhoek along two hospitals and linked with Red Route) should be developed in parallel as priority;
d. the Western Bypass is a barrier to Non-motorised Transport and appropriate grade separated crossings are a necessity;
e. the network coverage for educational facilities needs to be further investigated and prioritised (precedence needs to be given to school precincts);
f. to convert portion(s) of Independence Avenue to pedestrianised zones, sequenced with suitable public transport alternatives;
g. non-motorised Transport campaigns are critical to the successful implementation of Non-motorised Transport networks and facilities;
h. there is a need to provide also for adequate Non-motorised Transport facilities such as bicycle storage, lockers, and safe interchange with Public Transport;
i. security issues are to be addressed when developing Non-motorised Transport networks and facilities;
j. easy access for mobility restricted persons.

It is evident from the NMT objectives and memorandum of understanding that there is a definite need to implement NMT facilities. However, it is also evident that a dual implementation strategy will be required to ensure the success of the NMT facilities; due to the distinct segregation between low-income earners to the north-western part of the city and the high-income earners to the south-eastern part of the city. Based on this situational characteristic of the city, the proposed methods of intervention can be summarised in the red boxes below. As shown, there is a distinct approach in terms of soft measures (such as campaigning) that need to be addressed in terms of low-income areas and higher income areas. In order for the proposed NMT routes to be implemented successfully and sustainably (thus used when implemented) it is vital that both hard and soft issues are targeted simultaneously.


NMT in Windhoek
Drive to Implement Sustainable Transportation Master Plan (NMT one of main components)
Moving Beyond Current Situation
High Income
-Primarily use cars
- Make use of NMT for recreational purposes
Low Income
- NMT Captured Mode
- Need to priorities NMT
NMT associated with leisure activity
Perceived as being primarily a "poor" mode of transport
NMT associated with active transportation form
Stigma of NMT and 'Poorness' intensified
NMT only means to mobilise people out of poverty to areas of opportunity
Drive to make use of more Bicycles
Create urban environment conducive to NMT, especially in inner city.
Greater emphasis on street frontage stores
Outdoor shopping experience
Improve Inner city pedestrian lanscaping
Campaigns:
- Cycling to school
- Cycling to work
- Critical Mass Ride Promotions (bicycle awareness campaigns)
- Close off CBD for NMT once a month
Provision of Infrastructure
Campaigns:
- Pedestrian & Cyclist awareness campaigns in Rural areas (focusing on public transportation awareness of safety measures)
- Signal Education for NMT
- Security Campaigns (how to ensure bike does not get stolen)
- Using bikes for employment and ambulance use
- Bicycle funding campaings
NMT Orientated Modes

6.2. Pedestrian and cycling infrastructure improvements

The following factors were considered to determine a proposed NMT network within Windhoek:

Figure 6-2: Factors considered in determining NMT network

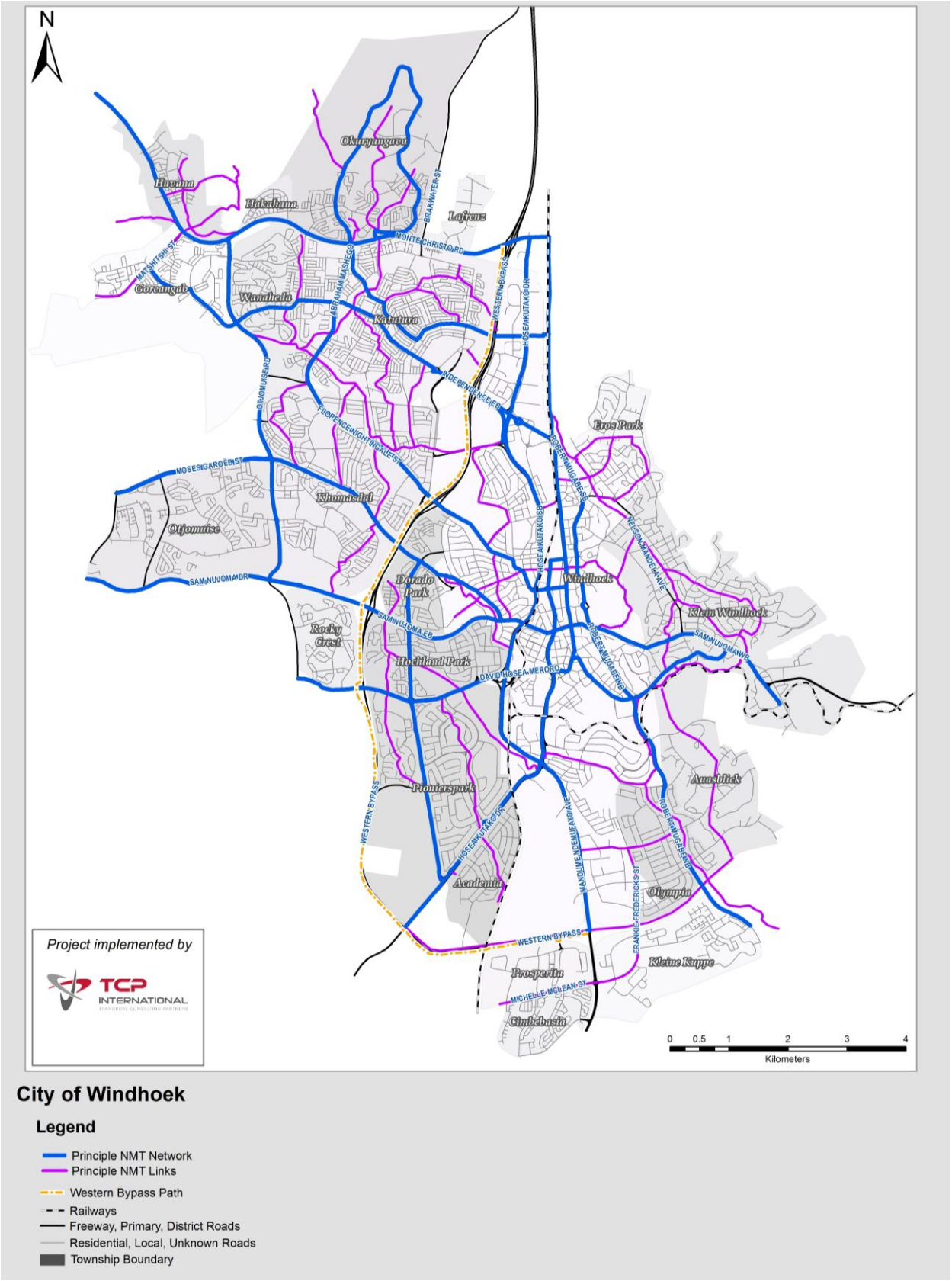
Factor	Description
Likely pedestrian and cyclist origins and destinations based on existing and proposed land uses	Between residential areas and the CBD, University, retail areas and significant employment zones such as industrial or mixed used areas
Analysis of aerial maps showing naturalised walking paths (i.e. faded patches of grass or worn pavement etc.) or available open spaces	Indicated where there is a need for formal infrastructure or feasible locations where open spaces can be developed to form part of the NMT network
Modal splits, economic and demographic statistics	Identified locations where walking and cycling are most common which did not correlate to where existing NMT infrastructure is provided. Areas where the populace are less economically advantaged were taken into especial consideration, as NMT infrastructure is critical for this demographic.
Existing gaps in NMT infrastructure	As shown in Section 2.3 in Figure 2-13 no continuous NMT facilities are provided.
Available crash information	As discussed before, the crash data shows that pedestrians are most at risk within Katutura and the CBD
Site and road user characteristics	Site visits were undertaken in and around Windhoek. Data was captured using SmartyCam technology driving along higher class roads. SmartyCam records video footage with GPS and real time data. This allowed footage to be interrogated and assessed in fuller detail at a later stage. Topography, available space and vehicle speed or behaviour was taken into consideration

Based on the above, the following NMT network is proposed.

A link to the new development areas towards Brakwater is presently not envisaged as distances are quite demanding for NMT users. However, it is to be expected that planning standards towards the end of the time horizon are as such that the NMT option is always to be taken into account.

It has also to be stated that site investigations were made for the entire principal NMT network and only partly for the link network, too. However, in the design phase of the NMT project, alignments ought to be optimized with a view to the specific landscapes (green spaces, river beds, road reserves, etc.) and in order to minimize costs.

Figure 6-3: Proposed NMT Network



As shown, there are three levels of NMT network proposed:

- **Principle NMT Network** acts as the 'core' or primary routes within Windhoek. These routes were identified to have the greatest potential to distribute people effectively and efficiently.
- **Western Bypass** – a national highway which is designed and allowed for fast motorised transport but which is separating several important Windhoek areas. Requested through stakeholder consultation it should serve mainly recreational and long distance riding purposes
- **NMT Links** are informal or feeder routes for the principle NMT network through river beds or open spaces. It is vital that these routes be formalised as they will ultimately increase the accessibility of Windhoek.[25]

As part of the principle NMT network, key north-south and east-west routes were formulated to ensure adequate distribution of pedestrians and cyclists.

The proposed principle NMT network routes from north to south are:

- Hosea Kutako Drive;
- Robert Mugabe; and
- Otjomuise Road

The proposed principle NMT network routes from east to west are:

- Sam Nujoma Drive;
- Moses Garoeb Street;
- David Hosea
- Independence;
- Monte Christo; and
- Florence Nightingale

In Annex D, maps are provided which show the relationship of the above network and various land uses. Within this Annexure 'buffer' maps are included that show the extensive coverage that is provided by the proposed NMT network.

Figure 6-4: NMT map description

Map	Title	Description
Map 9.1	Principal NMT network (see also figure 6-3 above)	As shown in blue the principle NMT network acts as the 'core' or primary routes within Windhoek. It is intended that these routes be developed first, and the NMT 'Link' routes be developed progressively to build upon and extend this network. In addition to the principle NMT network, a Western Bypass path has been requested through stakeholder consultation.
Map 9.2	Principal NMT network and land uses	This map shows how the principle NMT network relates to existing land uses and future institutional uses. The proposed NMT Network is situated on major roads as most of

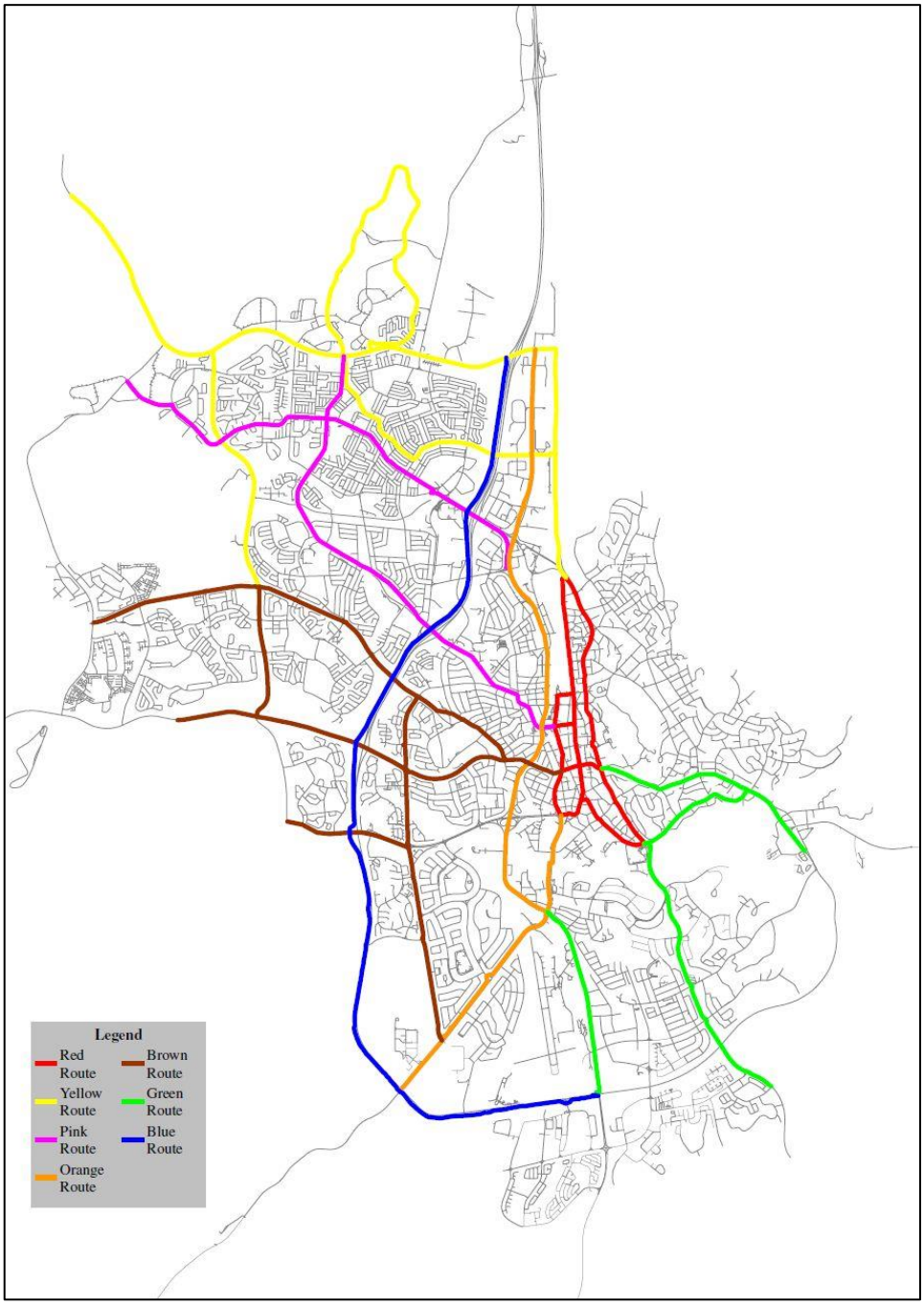
[25] There is a private initiative for reshaping the rivieres as attractive urban spaces. A first pilot is proposed to be in Klein-Windhoek riviere in order to increase attractiveness of this area for its residents and for the many tourist facilities in that area. This might serve as an example to be extended also to other "poorer" areas in Windhoek, as well.

Map	Title	Description
		these land uses are accessed from these roads.
Map 9.3	Principal NMT Network and NMT Links	The NMT links are informal or feeder routes for the principle NMT network through river beds or open spaces; it is vital that these routes be formalised as they will ultimately increase the accessibility of Windhoek.
Map 9.4	Principal NMT Network, NMT Links and land uses	There is a strong correlation between all the proposed routes and land uses. The routes provide adequate access to all main land uses.
Map 9.5	Pre-Primary School (500m buffer)	Maximum capture distance = 500m. Pre-primary school children cannot travel vast distances.
Map 9.6	Primary Schools (1 km buffer)	Maximum capture distance = 1km. This is considered an acceptable distance to walk or cycle to school for children between the ages of 6 and 12.
Map 9.7	Secondary Schools (2km buffer)	Maximum capture distance = 2km. It is considered that young adults between the ages of 13 and 18 can travel larger distances to access educational facilities. Thus 2km can be seen as an acceptable capture zone.
Map 9.8	Tertiary Institution (5km buffer)	Maximum capture distance = 5km. Adults from the age of 18 attend these institutions. Due to the lack of options in terms of tertiary institutions the willingness to travel is bigger, thus capture zones are larger.
Map 9.9	Speciality Institutions (500 m buffer)	Maximum capture distance = 500 m. These are a variety of institutions that cater for either disabled children or provide other specialised services. The distance of 1km was seen as a realistic walking or cycling capture zone; as people may not have the capabilities to walk or cycle to these institutions.
Map 9.10	Other Training Institutions (1 km buffer)	Maximum capture distance = 1km. Institutions that provide skills development such as artisan skills, etc. Due to the nature of these training facilities and the fact that specialised tools may be needed to attend these institutions, 1km was seen as a reasonable distance to travel.
Map 9.11	Hospital and Clinics (8km and 3km buffer respectively)	Maximum capture distance = 8km hospital, 3km clinic Clinics generally act as a neighbourhood facility and thus the capture site is not as extensive as is the case for Hospitals. The proposed capture zone for hospitals is estimated to be 8km; as hospitals will ultimately cater for a greater region.
Map 9.12	Regional and Local Shopping Centres (3-5km and 1km buffer respectively)	Maximum capture distance = 3-5km regional, 1km local The difference between regional and local shopping centres is the level of goods and service that can be delivered. In regional shopping centres a variety of stores are available, providing the consumer with a greater choice in terms of goods and services, however in local shopping centres choice is limited; in many instances one can only find essential goods and services. The buffer around the Regional shopping centre is 3-5km; as people will travel further for more specialise products. The buffer around the local shopping centre is 1km; as it will generally cater for basic needs in a

Map	Title	Description
		specific area.
Map 9.13	NMT principal and link network coverage of existing bus stops and taxi ranks	This map shows how the principle NMT network relates to existing bus stops and taxi ranks.
Map 9.14	NMT principal and link network coverage of shopping centres	This map shows how the NMT network relates to existing shopping centres. It shows that it provides access to the majority of those centres.

For the purposes of this report and potentially for future mapping or way finding references, the Principle NMT Network has been grouped into areas identified by colour.

Figure 6-5: Priority of implementation



The Primary NMT routes are described as follows:

Red Route: Major CBD route, through Independence Avenue and will potentially form part of the future pedestrianised zone.

Yellow Route: Low-income residential hub circulation route. There is no existing formal pedestrian and cycling infrastructure within these areas. It is evident that there is a great need to provide infrastructure to the population in these areas, as they generally cannot afford private vehicles and primarily make use of NMT for commuting.

Pink Route: Emergency routes which provide quick and effective accessibility to Hospitals, especially for family and relatives of hospitalised persons

and for hospital employers, as well as linking the Windhoek North-West to the CBD. These two routes consist of a section of Independence Avenue and Florence Nightingale Road.

Light Red Route: Inner-city routes, encouraging the CBD to move towards a pedestrian and cyclist friendly environment.

Orange Routes: North-South corridor, which will ultimately link up to all the other proposed routes.

Brown Route: Connects Windhoek South-East to the CBD and links through to the University.

Green Route: Generally the lowest priority routes with some existing pedestrian infrastructure present on these routes. Thus, they do not require a high level of investment at this stage to make them NMT friendly.

Blue Route: Western Bypass Path as requested through stakeholder consultation to serve recreational and long distance riding purposes. This route is seen as the primary recreational route that will provide adequate cycling facilities next to the highway for recreational cycling groups in Windhoek but also for commuters living west of the Bypass or heading towards Prosperita. However, it should be noted that the Consultant advises that the following points be taken into consideration:

- As the speed limit of the bypass ranges from 80km/h to 120km/hr, it is recommended that the proposed bike path be set back by at least 9 to 13m (depending on projected annual volumes and any lane duplications) from the road carriageway in accordance with standard road clear zone widths
- This distance can be reduced if appropriate concrete barriers are implemented (not included in the indicative costs) along the length of the path

Section 6.5 discusses the prioritisation and implementation strategy of these various routes.

6.3. Pedestrian and cycling facilities

Levels of NMT facilities to be provided are dependent on:

- Road classification (traffic volume and speed): these two factors directly correlate to the potential severity of any collisions between vehicles and NMT user. Also affects the comfort of NMT infrastructure use – the higher the volume and speed of vehicles the more space between pedestrians/cyclists is required (please refer also to chapter 7.4)
- NMT route classification: Path hierarchy and importance in overall NMT network for Windhoek such as principal or link network first, second or third priority introduction.
- Expected type / age / vulnerable NMT user such as NMT facilities around primary schools or tertiary institutions.

The following types of trip attractors will be examined in closer detail and the basic expectations of NMT for each will be explored.

- Education facilities
- Significant employment zones
- Significant retail and hospitality zones
- Major public transport stops and interchanges

Presently there are no standards for NMT infrastructure given in the legal framework which stems mainly from pre-independent times. Thus, a new urban road reclassification should have inherent also the design parameters for NMT but also for PT infrastructure facilities within the road reserve.

6.3.1 NMT hierarchy

Depending on the trip type, NMT users have differing needs. Examples of NMT path types include:

- Footpath
- Shared user path
- Off road cycle path
- Separated on road cycle lane
- On road cycle lane
- Wide kerbside traffic / transit / bus lane which can accommodate cyclists
- No formal space provision for cyclists, however route advisory signage provided

As a minimum, a pedestrian path should be provided on at least one side of the road carriageway. The type of cycling facilities to be provided is based on road speed and daily volumes (refer Figure 6-13 in Section 6.3.2).

The following NMT hierarchy is adopted for the purposes of the SUTMP, with examples of each class shown in the following figures.

Figure 6-6: NMT hierarchy

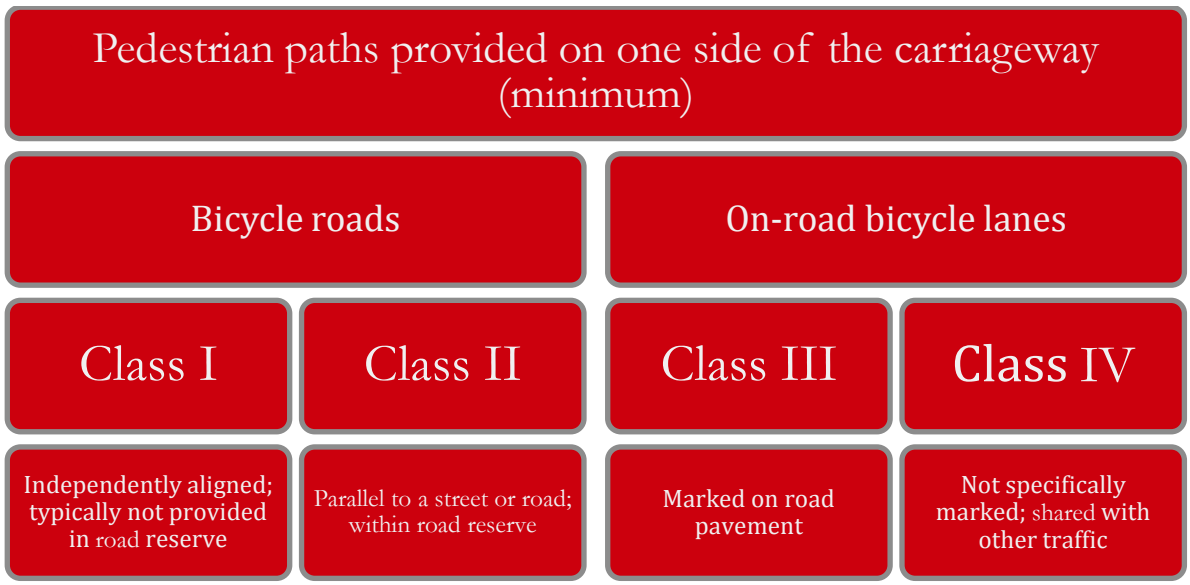


Figure 6-7: Class I: Shared Use Paths, Away from Road Side Environment

Figure 6-8: Class II: Shared Use Paths, Dedicated Cycle Lane and Pedestrian Path, Parallel to the Road on one or both sides

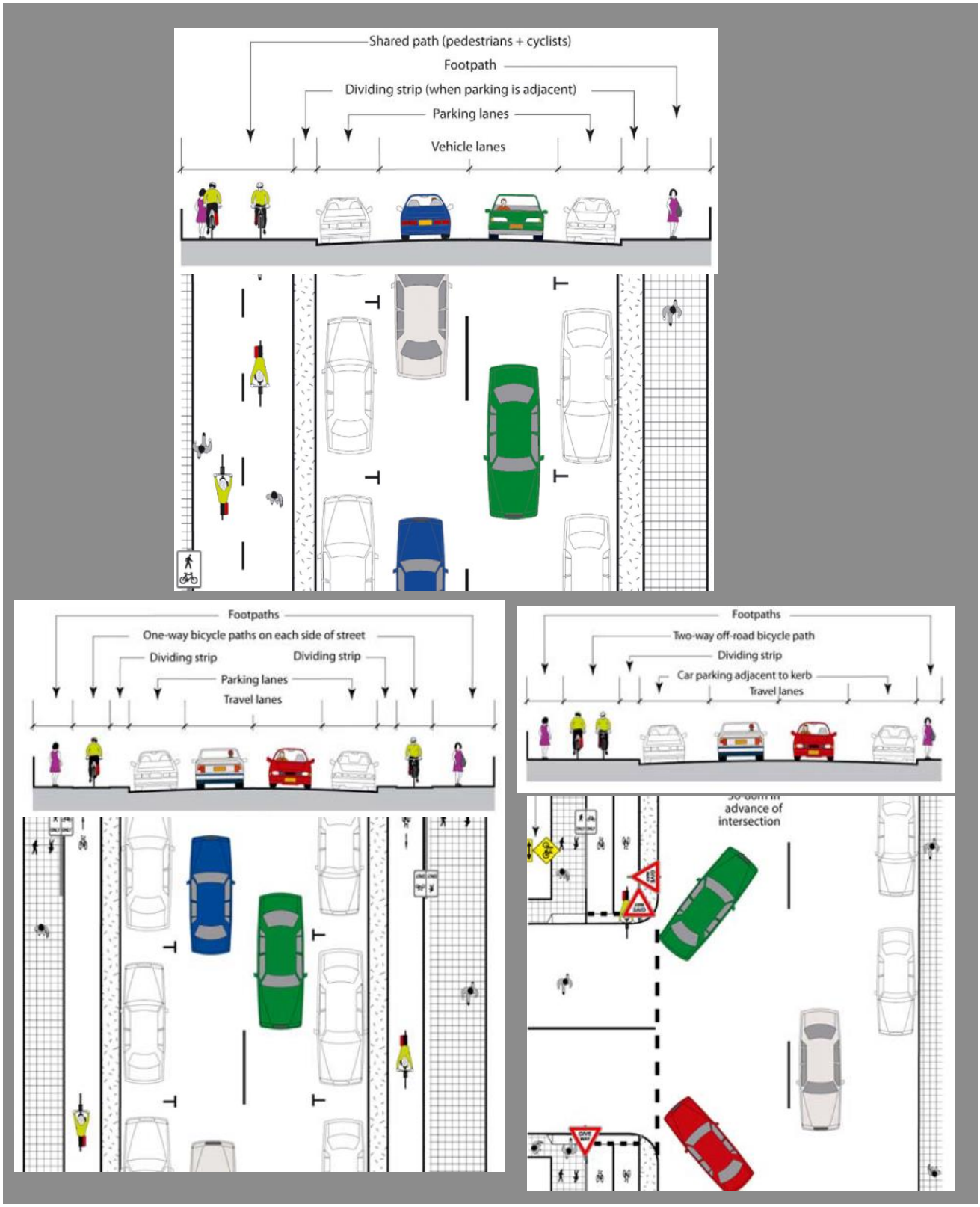


Figure 6-9: Class III: Copenhagen Style Paths, Physical Separation (Painted or Kerbs), on Road Markings

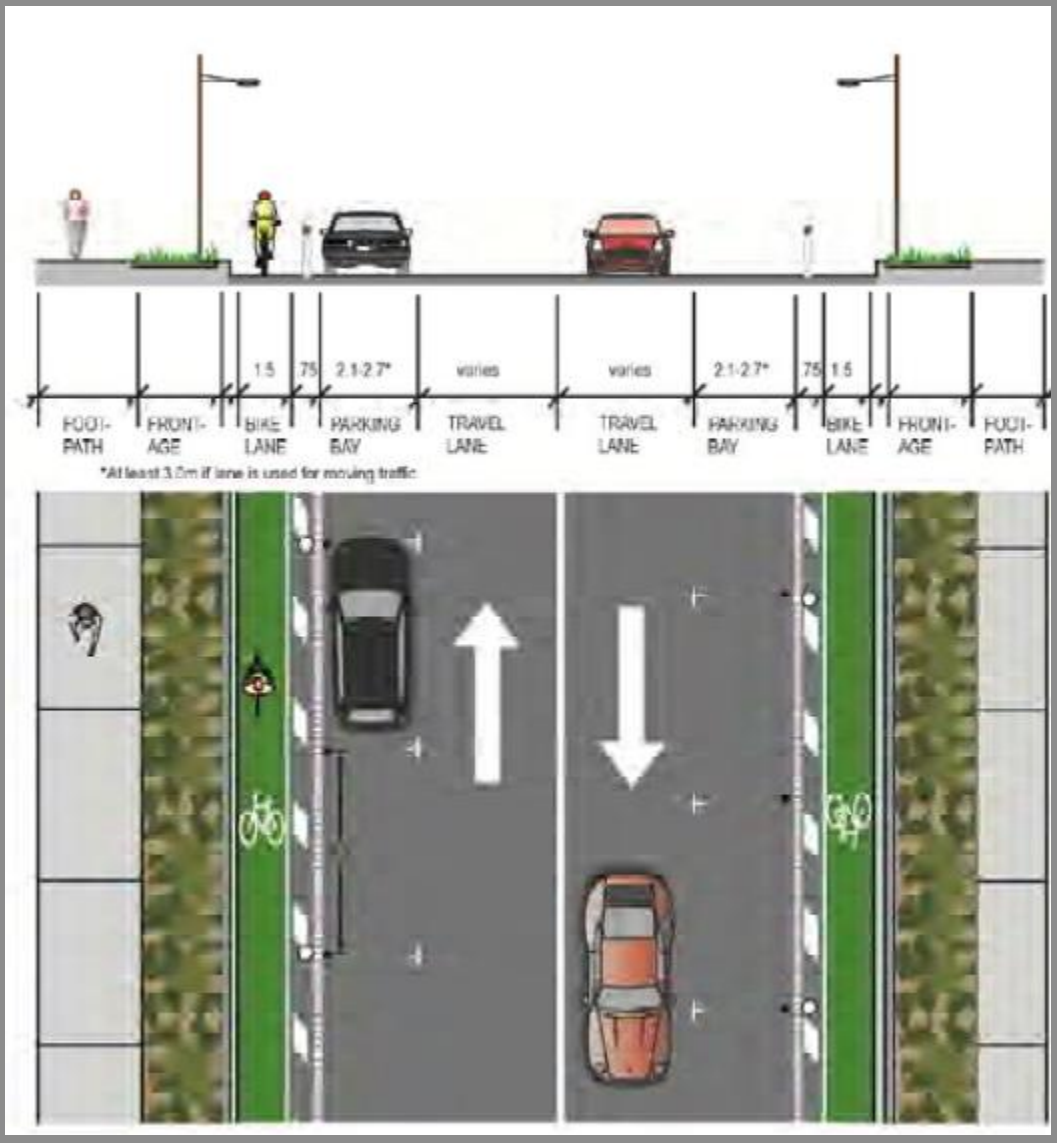


Figure 6-10: Class III: On road marked bicycle path

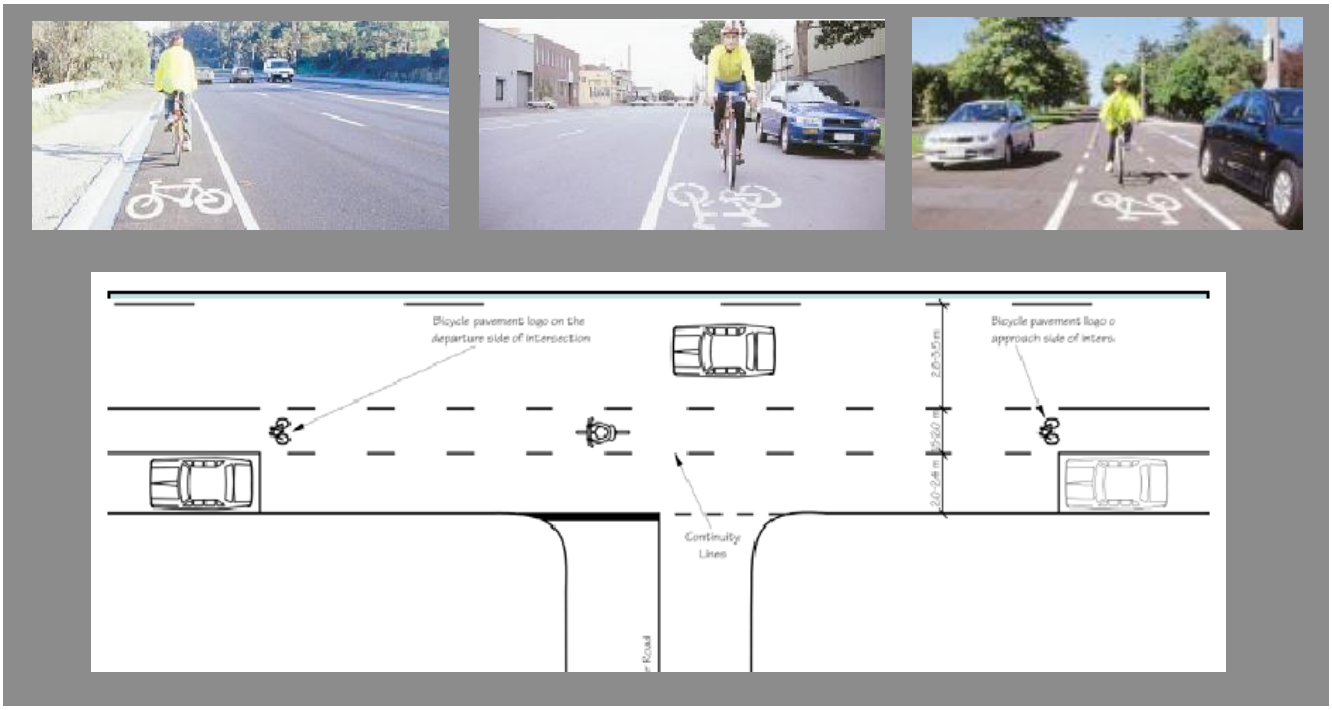
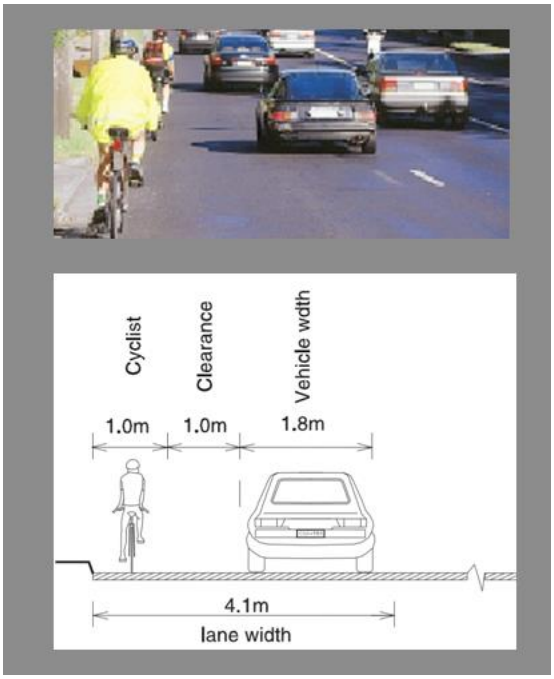


Figure 6-11: Class IV: Wide Kerbside Lanes, Potential for Sharing Bus or Transit Lanes- More Suited for Low Volume Residential Streets



As a minimum, the following configuration should be adopted for each of the NMT classes:

Figure 6-12: NMT Hierarchy minimum requirements

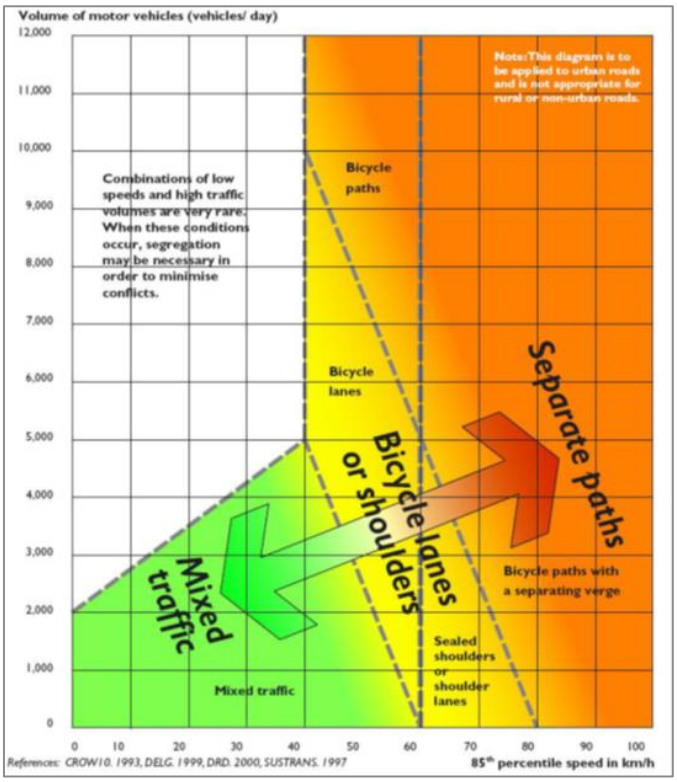
	Class I	Class II	Class III	Class IV
Pedestrian path width	Minimum 1.8m wide path provided on one side.			
Cycle path width, one way	Minimum 2.0m			Wide kerbside traffic lanes, no marked facilities required.
Cycle path width, two way	Minimum 4.0m			n/a
Separation width between cyclists and motorised traffic	Path should be independently aligned away from the road way.	Minimum 0.75m	n/a	

Wider facilities should be adopted where pedestrian or cyclist volumes warrant it.

6.3.2 Road classification and speed

Whether a bicycle facility should be segregated from vehicular traffic or not is dependent on the speed of the motorised traffic, as shown in the following figure.

Figure 6-13: Speed and level of separation required[26]



[26] Reference for this graph is Delg 1999, DRD 2000, Sustrans 1997

Figure 6-13 shows the relationship between road speed and the recommended bicycle facility. As a rough guide:

- **Class I:** Speeds over 80-90km/hr and over 5000 vehicles per day
- **Class II:** Speeds under 90km/hr and below 5000 vehicles per day
- **Class III:** Speeds between 40 and 60km/hr and between 5000 and 9000 vehicles per day
- **Class IV:** Speeds lower than 60km/hr and below 5000 vehicles per day

However, Figure 6-13 should still be referred to for particular speed and volume combinations.

6.3.3 Education facilities

The type of NMT infrastructure will be dependent on the general expected age group of those attending the school.

The expected acceptable walking and cycling distances will vary according to age. However, it is recognised that children with a lower socio economic background will be forced to have no option but to walk to school, despite significant distances. As such, it is vital to provide NMT infrastructure that will enable students to walk or cycle safely to and from school.

It is reasonable to expect that younger children will not be fully capable of processing the overall roadside environment and accordingly, will not be aware of any potential dangers. Furthermore, motorists are required to understand that children are relatively unpredictable and due to their size, are difficult to see. As such, it is necessary to design a forgiving NMT network in the vicinity of this vulnerable user group, to accommodate safe travel to and from school. This will include facilitating physical separation from moving traffic where possible and crossing priority over vehicles.

Research indicates that lowering the speed of vehicles enables drivers to avoid collisions or reduce the severity of crashes. As such, the following traffic management / calming methods can be employed to both lower the speed of vehicles and enable drivers to be aware that they are entering an environment with children:

- Time based speed reductions (i.e. at school start and end times)
- Speed humps
- Children warning signs

As the age of students increase through high school and tertiary education facilities, it is reasonable to assume that these NMT users will have a greater awareness of the roadside environment and as such, are more responsible in interactions with motorised vehicles. As such, although physical separation from motorised traffic is still desirable, adequately designed on road cycle facilities will be acceptable.

Figure 6-14: Matrix of NMT facilities to be provided at educational institutions

	Primary school	High school	Tertiary
NMT required radius	500m walking and cycling	1km walking, 2km cycling	2km walking, 5km cycling
Pedestrian path	Continuous path on one side (min.)	Continuous path on one side (min.)	Continuous path on one side (min.)
Minimum cycle path provision	Class I or II	Class I or II	Class II or III
On premises	Secure bicycle storage, drinking fountains	Secure bicycle storage, drinking fountains, showers	Secure bicycle storage, drinking fountains, showers

6.3.4 Significant employment zones

It is understood that the predominant method of travel to and from work is by car at approximately 40%.

However, it recognised that by providing a more comprehensive NMT network will allow current employees greater flexibility in choice and time management in their travel arrangements, as well as enabling those without the means to travel by motorised travel to access work opportunities.

Further, providing a safe and efficient NMT network will encourage those who generally drive to work to consider an alternative method of transport. This will not only provide health benefits to those who walk or cycle to work but assist in alleviating traffic congestion on the road network.

To support the NMT infrastructure, facilities such as secure bicycle parking, showers and change room facilities will further encourage travel through non-motorised means.

6.3.5 Retail and hospitality zones

Research indicates that pedestrian thoroughfare has a positive correlation to business income. As such, it is in the best interests of local economy to facilitate and advocate better NMT infrastructure to and from significant retail and hospitality zones.

Pedestrian malls are defined by streets which are closed to vehicular traffic (or allow deliveries to be made at certain times) and are lined with retail or hospitality frontages.

However, for pedestrian malls to reach their full potential, several factors must be considered:

- Community willingness to embrace the mall
- Active street fronts with a symbiotic mixture of amenities and retail, including dining and entertainment
- An attractive built environment that encourages social interaction

However, it is recognised that pedestrian malls are not built overnight and are often a result of organic retail and hospitality growth. As such, as a minimum, NMT infrastructure should be in place which will allow a convenient, easy and safe connection to these retail and hospitality zones.

For all new retail and hospitality zones there is a strong need for incorporating NMT but also PT from the beginning (please refer also to chapter 4.4.1 recommending immediate legal revisions).

Figure 6-15: Matrix of NMT facilities to be provided at retail and major employment zones

	CBD	Major employment zones	Shops
NMT required radius	500m walking, 2km cycling	1km walking, 2km cycling	1km walking, 5km cycling
Pedestrian path	Continuous path on one side (min.)	Continuous path on one side (min.)	Continuous path on one side (min.)
Minimum cycle path provision	Class I or II	Class II or III	Class II to III
On premises	Secure bicycle storage, drinking fountains	Secure bicycle storage, drinking fountains, showers	Secure bicycle storage, drinking fountains

6.3.6 Major public transport stops and interchanges

Whilst in an ideal world, everyone would walk and cycle to their destinations. However, due to distance, fitness levels or time constraints this is not possible. As such, patronage of public transport should be encouraged through supporting the public transport network with excellent NMT infrastructure.

Whilst pedestrian and cycle paths to public transport stops are a necessity, the amenities and facilities at the waiting area are just as important as these and play a significant contributing factor to the general NMT environment. These include:

- Seating
- Rubbish bins
- Shelter
- Lighting
- Quality of environment

6.4. Walking and cycling promotion

There are a variety of factors that need to be taken into consideration to ensure the successful implementation of NMT networks in terms of user preference and attitude change towards NMT. Though the benefits of NMT are clear, people in general are increasingly car dependent.

In accordance to CIVITAS (City-VITAlity-Sustainability), it is important that there is a new "mobility culture" that is established in cities through promotional, educational and marketing campaigns.

As discussed in Section 6.1 and shown in the objectives within Figure 6-1, it is important to recognise that different approaches must be taken to address high and low income populations.

6.4.1 Necessary measures required to move towards an NMT culture

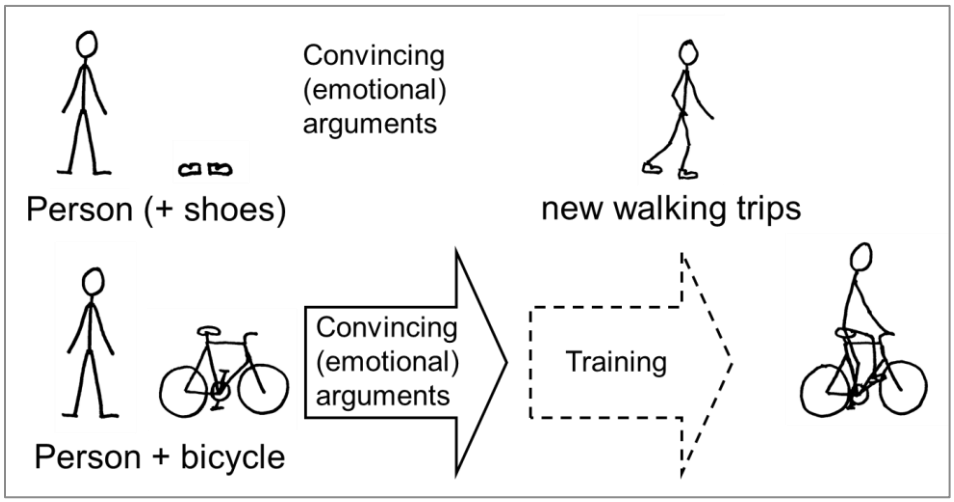
Krag (2012) states the factors that affect NMT usage are classified as either hard measures (infrastructure) or soft measures (information, communication and marketing).

In the developed world the soft measures are generally perceived as more influential. In developing countries, hard measures may be lacking or entirely absent and will therefore have to be implemented, yet the cultural attitude towards NMT use is already present. It is clear that the mentality of 'NMT is only for the poor' needs to be changed. Therefore, it is important that hard and soft measures be addressed simultaneously in developing countries.

Figure 52, shows the various basic tasks and activities that need to happen for people to switch from motorised transport to NMT use.

As all trips already involve an element of walking, it is comparatively easy for a person to make the personal decision to walk the entire trip. With cycling, capital expenditure is required to purchase a bicycle. A personal decision then needs to be made to use the bicycle as a means of transportation and basic training is required to undertake a variety of trip distances.

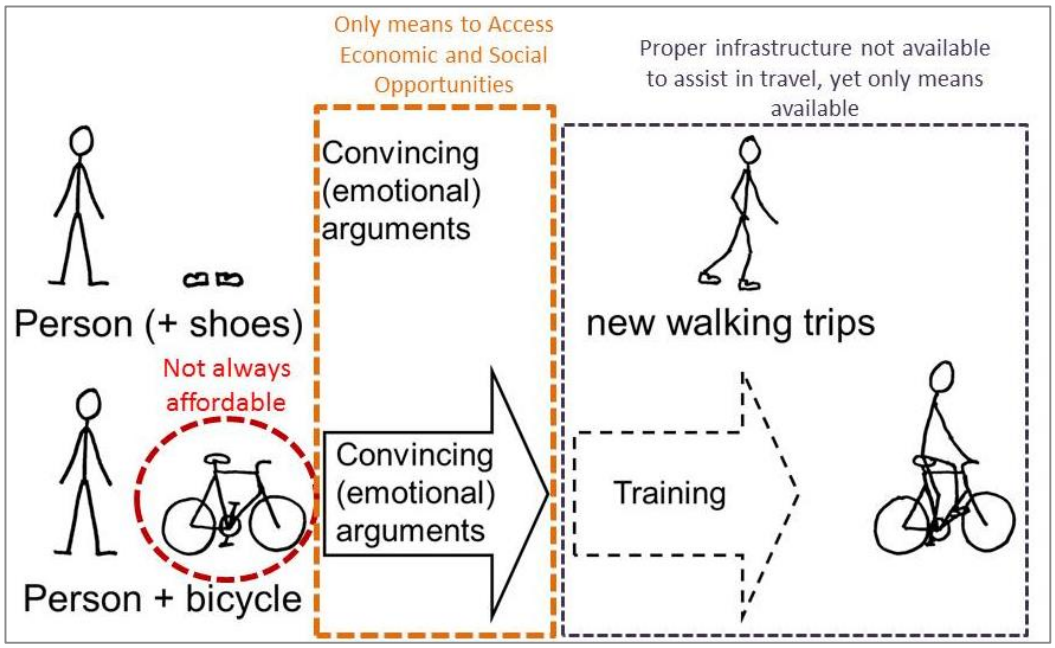
Figure 6-16: Tasks to make use of NMT (Krag, 2012)



Applying Figure 6-16 to the context of a low income population, it must be understood that trips are made through NMT due to financial constraints or a lack of accessibility to any other transport modes. Due to cost and average household incomes, bicycles are seen as a luxury. As mentioned previously NMT infrastructure provisions are inadequate in developing countries, thus trips are not secure and generally NMT users are forced to make use of the road.

Thus, it is increasingly important that campaigns in developing countries focus on the hard and soft measures simultaneously, in which improved NMT facilities are provided concurrently with campaigns to change the perception of NMT modes and users being inferior.

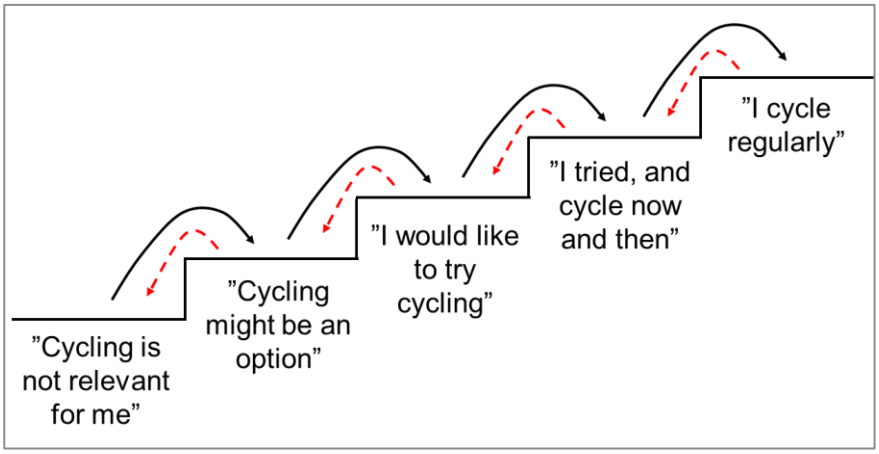
Figure 6-17: Tasks to undertake NMT in developing countries (adapted from Krag, 2012)



6.4.2 Stages of change required to use NMT modes

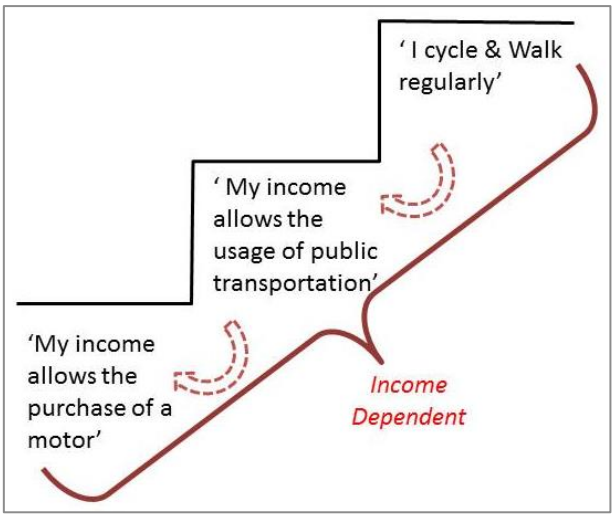
According to Krag (2012), the "changes of stage model" is used to determine what the behavioural patterns people require to shift to NMT modes. As shown in the figure 6-18, there are various stages in terms of decision that people go through to achieve to a stage of 'regular cycling'. Thus, NMT should aim to promote the upward movement of individuals on the steps and prevent them from moving back down.

Figure 6-18: General changes of stage model (Krag, 2012)



The above model is generally applicable to those who have ready access to other viable transportation methods and are not financially captured or restricted to NMT usage. Thus, in the context of low income households the step model for NMT usage will take on the form shown in Figure 6-19, where income dictates transport mode.

Figure 6-19: Stages of change model for low income (Krag, 2012)



It is important to recognize the differences between these two stages of change models when producing promotional, educational and marketing campaigns, to prevent people moving down the 'steps'.

6.4.5 Potential campaign initiatives

The following are examples of campaigns that have been used to promote the usage of NMT in both developed and developing countries.

Figure 6-20: NMT Campaign Examples

Figure 6-21: NMT Campaign examples description

Bike to Work & School Day or Week

- Allows the community and businesses to collectively promote NMT use. Prior to this event, basic bike education (road rules, rider courtesy, bicycle maintenance) work shops are generally held. Work places should provide bicycle parking, showers and change room facilities to encourage cycling.

Walking or riding school buses

- Similar to a conventional school bus service, a route is established. The walking or cycling adult supervisor or parent, picks up or drops off children at designated stops or houses and the 'bus' walks or cycles to and from school together. This allows children to learn basic NMT skills under supervision in real life situations.

Car free days

- Mainly inspired by Bogotà Columbia; the city closes off approximately 43 km of its road network to cars every Sunday from 7 am to 2 pm, in an attempt to create a more conducive environment for NMT usage. This "encourages residents to think differently about their city streets, to improve physical activity, to reduce obesity rates, or even just to highlight the cultural and physical amenities of the city" (walkinginfo.org).

Bicycle Mobs

- The programme initiated and proposed by BEN (Bicycle Empowerment Namibia) will address the barrier of affordability of bicycles for low income earners by working directly with employers to facilitate workplace purchase programmes. Employers will purchase bicycles and deduct the repayments from their employees' pay over a series of months. In the case of students, bicycles will be made available at low or no cost, with alternative forms of 'social capital' repayments being facilitated. For instance, students may be requested to plant 50 indigenous trees in exchange for a bicycle, or spend a number of days in a riverbed cleanup programme to earn a bicycle.

Figure 6-22: NMT groups and organisations

Bicycle User Groups (BUG)

- Advocacy bicycle group established within an employment zone (such as Toronto, Melbourne) which exists to encourage and support cyclists who wish to improve conditions for cycling in their workplace, neighbourhood, community, or school. Some BUGs form in order to further specific goals such as acquiring secure bike parking, while others simply wish to come together for casual group rides or group commutes to work.

Bicycling Empowerment Network (BEN)

- Established in Cape Town South Africa and is active in Namibia. The purpose of BEN is to economically empower individuals in the country through the provision of bicycles. BEN enables the poor to access economic, social and educational opportunities, opportunities. In an African context HIV/Aids is prevalent in rural areas, and bicycles enable home-based care takers to access health centres more readily.

Cycling out of Poverty (COOP)

- Established in the Netherlands, but primarily active in Africa. COOP's aim is to increase bicycle ownership in countries, especially through micro-credit initiatives. It supports rural area access to educational, health and economic facilities via bicycles. COOP also produces bicycle ambulances and bicycle transport as modes to move people / goods / services to enable trade.

First African Bicycle Information Organisation (FABIO)

- Fabio was established in Uganda. The Mission statement of FABIO is as follows: "FABIO aspires to help build the capacity of these groups to improve their own lives. These issues are addressed through FABIO's bicycle-related programs that aim to help make non-motorized forms of transportation more readily available to marginalized communities". FABIO is broken down into; cycle to school, bicycle rentals, healthcare projects, bicycle for peace and capacity building.

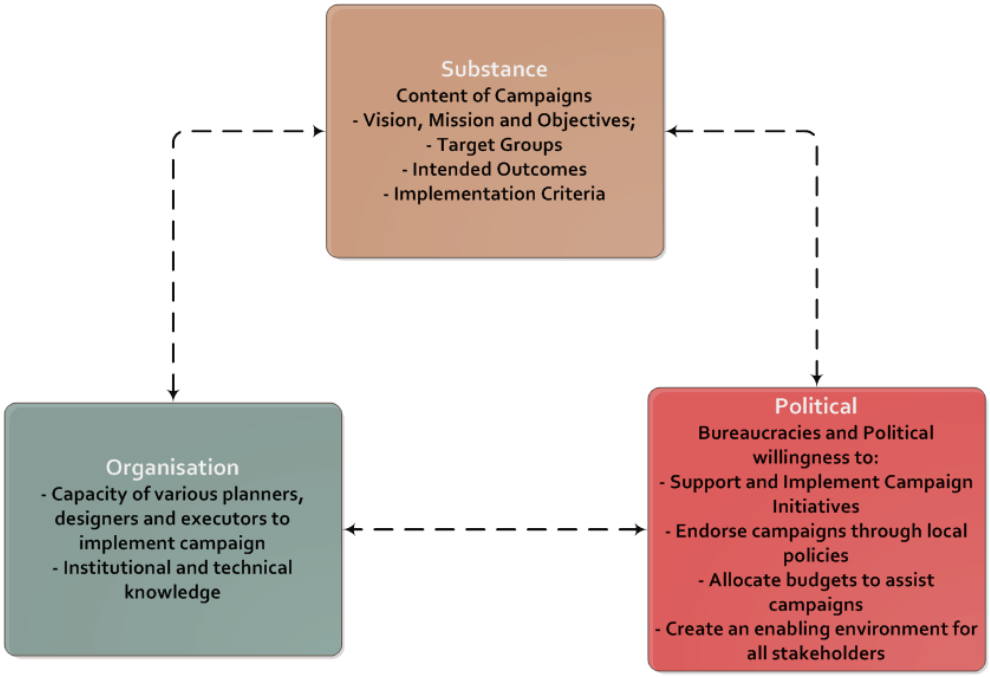
6.4.6 Conditions for sustainable implementation of NMT campaigns

The following model adopted from I-ce (2000) shows conditions that are necessary to implement sustainable NMT campaigns. This includes the following dimensions:

- **Substance:** NMT campaign plans and strategies; it will also address the implementation criteria and provide the basis from which work will be done.
- **Organisation:** Capacity of the implementing agencies as well as their technical knowledge of NMT as well as institutional knowledge. It is vital that the implementing agencies have the capacity to manage these campaigns thus ensuring their overall success.
- **Political:** Will ultimately determine if the overall sustainability of NMT campaigns. Most campaigns such as car free days will require strong political incentives so as to ensure that these initiatives are taken seriously and that all stakeholders become more involved.

Thus, conditions for sustainable implementation of NMT campaigns can be summarised as indicated in the following figure.

Figure 6-23: NMT groups and organisations



There are various barriers that need to be taken into consideration when undertaking NMT campaigns in developing countries. In studies that were carried out in India the following were seen as main promotional barriers that need to be taken into consideration:

- **Social barriers:** The attitude that motorist and law enforcers such as police have towards NMT, which is not perceived as being a formal mode of transportation.
- **Financial barriers:** Affordability of various modes.
- **Infrastructure barrier:** Lack of Infrastructure.
- **Institutional barriers:** No institutional arrangement present to support and integrate NMT in local planning or in higher level master plans.
- **Administrative barriers:** No regulations are present to ensure that the rights of NMT users are taken into consideration, no legal arrangement for the traffic management of NMT.

In short in order for a campaign to succeed in a developing world context the following factors needs to be taken into consideration.

Figure 6-24: Successful campaigning

In order for the proposed NMT routes to be implemented successfully and sustainably (thus used when implemented) it is vital that both hard and soft issues are targeted simultaneously.

An exciting and feasible campaign strategy that should be strongly considered is the proposed ***Bike Mobs: Making cycling safer, more visible and more socially acceptable in Windhoek*** strategy currently proposed by BEN. This campaign can definitely assist in creating the necessary NMT culture that will be required to ensure the successful implementation of the proposed NMT network. The purpose of the NMT network is to ensure that the future transportation system of Windhoek will be sustainable; however, if the overall consumer preference remains in favour of private vehicle usage, the proposed infrastructure investment will not have the desired effect.

As a first attractive measure, the Consultant proposes to start with a pilot project which could make the advantages immediately visible. The pilot ought to be carefully selected, i.e. being in line with the rest of the proposed NMT infrastructure measures. Most promising would be to start with areas

around a school. A lump sum for planning, construction, cycle storage facilities and awareness creation measures was applied. It is highly recommended to start the pilot this year and inaugurate next year in order to not lose momentum now created with the development of the master plan and to show the broader public: yes we care about the safety of our children.

Other measures proposed and included in the total cost of SUTMP are:

- Green travel plans
- Way finding, place setting and aesthetics
- Promotional activities such as a car free day which should also start with
- Other awareness creation activities such as traffic signs for attention of walkers and cyclists crossing the road and awareness creation for the vulnerability of NMT users
- Children traffic and cycling education, e.g. in combination with the establishment of a Velodrom as presently planned by some private initiators.
- Promotion of increased bicycle ownership

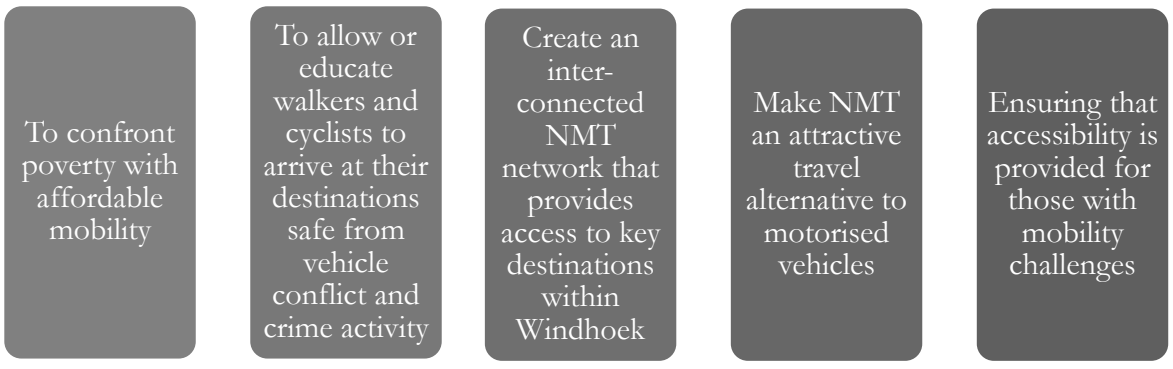
Many of those events can be realised together with private sponsors or even relate to already existing events such as the cycle races presently conducted in the CoW by private sponsors. Some of those events might need a popular person in front who could inspire and promote most efficiently the use of non-motorised modes and fun, health and commuter mode of transport.

6.5. Prioritisation of NMT measures

The following section provides an indicative cost of the proposed NMT measures that have to be implemented. Although these costs are primarily focussed on NMT facilities, they should not be assessed in isolation but should be taken into consideration with the public transportation measures and traffic demand management (TDM) measures that have been proposed. In order for the proposed Master Plan to be sustainable a holistic view as to be taken when considering all the various components throughout the report, especially where costing such as indicated below is involved. Special attention has also to be given to the sequencing in order to avoid doubling of works e.g. when it comes to construction on the same route for NMT, PT and road reclassification safety and TDM measures. Thus, there is the need for a strong SUTMP implementation management throughout implementation process in order not to waste scarce resources.

For NMT prioritisation of recommended measures, a score was allocated based on the below objectives or goals, taken from Section 6.1.

Figure 6-25: Action plan scoring system



Based on how each of the recommendations achieved these goals, a low, medium, high or crucial level of importance was allocated.

Taking this into consideration, together with the relative ease and likely planning/investigation time required for implementation; and budget or cost constraints, the following timeframes were allocated:

Figure 6-26: Action timeframe

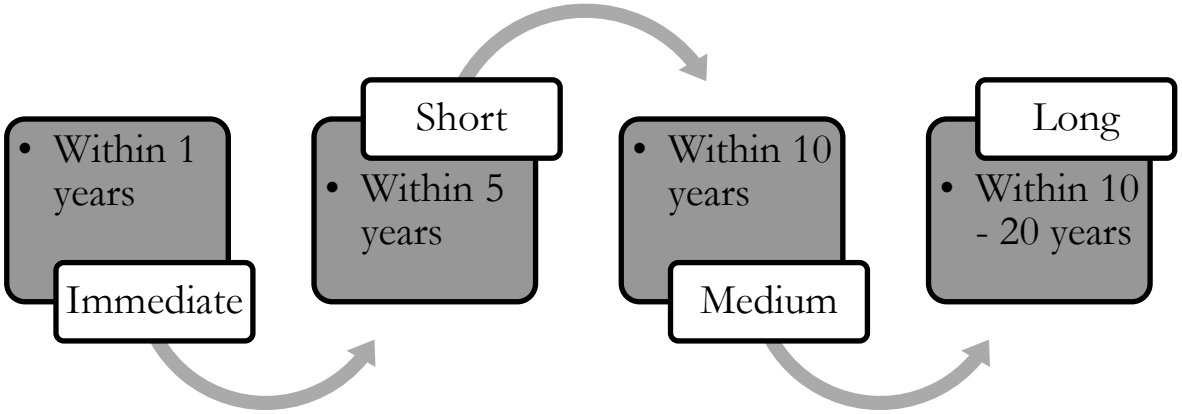


Figure 6-27 displays the results of this process.

The costs shown are indicative only and are based on high level assessment based on unit costs from latest construction projects in Windhoek. The costs are subject to inflation and detailed review.

It should be noted that in-line with the below mentioned Red Route Costing, provisional CBD pedestrianisation costs were also allocated. The following activities listed below have been budgeted for in terms of the first year's budget that was already forwarded to the relevant Government entities for financing.

- Architectural design competition for Closure of parts of the Independence Avenue (1.25 million N$)
- Pedestrianisation of CBD (24 million N$ conservative estimation depending on selected design standards applied

The above mentioned costs will have a strong impact on the TDM component as well, as mentioned previously, thus the following has also been budgeted to ensure that the TDM component is also taken into consideration:

- Planning of accompanying road traffic management for closure of CBD and introduction of segregated NMT and PT (3.5 million N$)

Figure 6-27: NMT Action Plan

Theme	Action	Location	Priority	Timeframe	Approx. cost	Tasks
Principle NMT network	**Red routes**	**Investigate and plan exact alignment and type of NMT facility. Detailed design and construction required for:**				
		Robert Mugabe, between Independence to Jan Jonker	**Crucial**	Immediate	**NAD 13.8M**	• Class II facilities on both sides of the carriageway (approximately 5.0km)
		Independence, between Robert Mugabe and Bahnhof	**Crucial**	Immediate	**NAD 8.0M**	• Class II facilities on both sides of the carriageway (approximately 2.9km)
		'Loop' of Bahnhof, Independence, Reheboother, Hochland and Mandume Ndemufayo	**Crucial**	Immediate	**NAD 12.4M**	• Class II facilities on both sides of the carriageway (approximately 4.5km)
		Remainder of red route	**Crucial**	Immediate	**NAD 4.7M**	• Class II facilities on both sides of the carriageway (approximately 1.7km)

Theme	Action	Location	Priority	Timeframe	Approx. cost	Tasks
Principle NMT network	**Pink routes**	**Investigate and plan exact alignment and type of NMT facility. Detailed design and construction required for:**				
		Green Mountain Dam, Eveline to Independence, west of Abraham Mashego	**Crucial**	Immediate	**NAD 6.0M**	• Class II facilities on one side of the carriageway (approximately 3.7km)
		Independence, between Abraham Masego and Mahatma Ghandi	**Crucial**	Immediate	**NAD 6.7M**	• Class II facilities on both sides of the carriageway (approximately 4.1km)
		Abraham Mashego to Florence Nightingale, between Monte Christo and Western Bypass	**Crucial**	Immediate	**NAD 8.9M**	• Class II facilities on both sides of the carriageway (approximately 5.4km)
		Florence Nightingale to Frans Indongo, between Western Bypass and Mandume Ndemufayo	**Crucial**	Immediate	**NAD 4.4M**	• Class II facilities on both sides of the carriageway (approximately 2.7km)

Theme	Action	Location	Priority	Timeframe	Approx. cost	Tasks
Principle NMT network	**Yellow routes**	**Investigate and plan exact alignment and type of NMT facility. Detailed design and construction required for:**				
		Monte Christo, west of Abraham Mashego	**Crucial**	Immediate	**NAD 9.8M**	• Class II facilities on one side of the carriageway (approximately 6.0km)
		Monte Christo, between Abraham Mashego and Railway line	**Crucial**	Immediate	**NAD 5.7M**	• Class II facilities on one side of the carriageway (approximately 3.5km)
		Monte Christoto Okuyangava	**Crucial**	Immediate	**NAD 12.1M**	• Class II facilities on one side of the carriageway (approximately 7.4km)
		From Monte Christo, rivew path throuugh to Dortmund	**Crucial**	Immediate	**NAD 7.5M**	• Class II facilities on one side of the carriageway (approximately 4.6km)
		Otjomuise, between Monte Christo and Moses Garoeb	**Crucial**	Immediate	**NAD 6.6M**	• Class II facilities on one side of the carriageway (approximately 4.0km)

Theme	Action	Location	Priority	Timeframe	Approx. cost	Tasks
Principle NMT network	**Orange routes**	**Investigate and plan exact alignment and type of NMT facility. Detailed design and construction required for:**				
		Hosea Kutako, between Monte Christo and Frans Indongo	**High**	Short	**NAD 9.7M**	• Class II facilities on one side of the carriageway (approximately 5.9km)
		Hosea Kutaka, between Frans Indongo and Mandume Ndemufayo	**High**	Short	**NAD 5.0M**	• Class II facilities on one side of the carriageway (approximately 3.1km)
		Mandume Ndemufayo, between Hochland and Hosea Kutako	**High**	Short	**NAD 2.5M**	• Class II facilities on one side of the carriageway (approximately 1.5km)
		Mandume Ndemufayo, between Hosea Kutako and Western Bypass	**High**	Short	**NAD 6.0M**	• Class II facilities on one side of the carriageway (approximately 3.7km)

Theme	Action	Location	Priority	Timeframe	Approx. cost	Tasks
Principle NMT network	**Blue route**	**Investigate and plan exact alignment and type of NMT facility. Detailed design and construction required for:**				
		Western Bypass, between Monte Christo and Florence Nightingale	**High**	Short	**NAD 55M**	• Class I facilities on one side of the carriageway (approximately 4.7km)
		Western Bypass, between Florence Nightingale and Hochland	**High**	Short	**NAD 75M**	• Class I facilities on one side of the carriageway (approximately 3.7km)
		Western Bypass, between Hochland and Auas	**High**	Short	**NAD 55M**	• Class I facilities on one side of the carriageway (approximately 8.0km)
	As this path is a Class I facility, the path will be independently aligned from the road. However, it will follow the alignment of the Western Bypass where practicable and safe.					

Theme	Action	Location	Priority	Timeframe	Approx. cost	Tasks
Principle NMT network	**Brown routes**	**Investigate and plan exact alignment and type of NMT facility. Detailed design and construction required for:**				
		Moses Garoeb, between Matshitshi and Western Bypass	**High**	Short	**NAD 8.7M**	• Class II facilities on one side of the carriageway (approximately 5.3km)
		Moses Garoeb to Bach, between Western Bypass and Sam Nujoma	**High**	Short	**NAD 3.8M**	• Class II facilities on one side of the carriageway (approximately 2.3km)
		Otjomuise, between Moses Garoeb and Sam Nujoma	**High**	Short	**NAD 3.6M**	• Class II facilities on one side of the carriageway (approximately 2.2km)
		Sam Nujoma, west of Western Bypass	**High**	Short	**NAD 5.0M**	• Class II facilities on one side of the carriageway (approximately 3.1km)
		Sam Nujoma, bewteen Western bypass and Mandume Ndemufayo	**High**	Short	**NAD 5.9M**	• Class II facilities on one side of the carriageway (approximately 3.6km)
		Hochland, west of Hendrik Witbooi	**High**	Short	**NAD 5.7M**	• Class II facilities on one side of the carriageway (approximately 3.5km)

Theme	Action	Location	Priority	Timeframe	Approx. cost	Tasks
Principle NMT network	**Green routes**	**Investigate and plan exact alignment and type of NMT facility. Detailed design and construction required for:**				
		Auas, between Mandume Ndemufayo and Western Bypass	**High**	Short	**NAD 4.8M**	• Class II facilities on one side of the carriageway (approximately 2.9km)
		Robert Mugabe, south of Jan Jonker	**High**	Short	**NAD 7.2M**	• Class II facilities on one side of the carriageway (approximately 4.4km)
		Jan Jonker to Sam Nujoma, east of Robert Mugabe	**High**	Short	**NAD 4.6M**	• Class II facilities on one side of the carriageway (approximately 2.8km)
		Sam Nujoma, between Robert Mugabe and Jan Jonker	**High**	Short	**NAD 3.4M**	• Class II facilities on one side of the carriageway (approximately 2.1km)

Theme	Action	Priority	Timeframe	Approx. cost	Tasks
NMT Link network	Yellow area	**Crucial**	Immediate	**NAD 53.6M**	Investigate and plan exact alignment and type of NMT facility ranging from Class III and IV.
	Brown area	**High**	Short	**NAD 21.7M**	
	Green area	**High**	Short	**NAD 40.1M**	
Land use based infrastructure	Education	**Crucial**	Immediate	Pre-school and primary: **NAD 30K** Secondary: **NAD 40K** Tertiary: **NAD 70K**	• Required radius: 500m-2km walking, 2km-5km cycling; depending on age of scholars • Identify education facilities in particular need of NMT infrastructure based on vulnerability of scholars and adjacent road classifications (Class II to IV) • Secure bicycle storage, drinking fountains on premises *Costs may be reduced due to walking/ cycling radius overlap with proposed NMT network*
	CBD and regional shops	**Crucial**	Immediate	**n/a**	• Required radius: 1km walking and 2km cycling • Provide one continuous foot path on one side (min.) and Class II or III bicycle facilities • Secure bicycle storage, drinking fountains through CBD and at regional centre *Costs need to be calculated due to walking/ cycling radius overlap with proposed NMT network*

Theme	Action	Priority	Timeframe	Approx. cost	Tasks
Land use based infrastructure ***(continued)***	Major public transport stops or interchanges	**Crucial**	Immediate	**n/a**	• Required radius: 1km walking and 2km cycling • Provide one continuous foot path on one side (min.) and Class II or III bicycle facilities • Secure bicycle storage, drinking fountains through CBD and at regional centre *Costs need to be calculated due to walking/cycling radius overlap with proposed NMT network*
	Major employment zones	**High**	Short	**NAD 70K**	• Required radius: 5km walking and 5km cycling • Provide one continuous foot path on one side (min.) and Class II or III bicycle facilities • Secure bicycle storage, showers/changing facilities, drinking fountains on premises *Costs need to be calculated due to walking/cycling radius overlap with proposed NMT network*
Land use based initiatives	Education	**High**	Immediate	**NAD 2M**	• Green travel plan • Initiatives such as: walking/cycling school buses, walk/cycle safe education, cycle classes, road user behaviour skills

Theme	Action	Priority	Timeframe	Approx. cost	Tasks
	CBD and retail	**Medium**	Immediate	**NAD 500K**	• Green travel plan • Initiatives such as: Reduction of parking,
Land use based initiatives ***(continued)***	Employment	**Medium**	Immediate	**NAD 250K**	• Green travel plan • Initiatives such as: Cycle/walk to work day, reduction of parking, commute type based rewards/bonuses,
Community and promotion	Promotion	**Medium**	Immediate	**NAD 1.5M**	• Examples: Public workshops, community based bicycle repair shops,
	Events	**Medium**	Immediate	**NAD 750K**	• Car free day, walking / cycling events
Way finding, place setting and aesthetics	Way finding strategy	**Medium**	Short	**n/a**	• Can be implemented once a reasonable proportion of NMT infrastructure is in place • Involves implementing pedestrian and cyclist specific directional and information signage, as well as map displays
	Place setting and 'gating'	**Medium**	Medium	**n/a**	• Can be implemented once a reasonable proportion of NMT infrastructure is in place
	Landscaping	**Medium**	Long	**n/a**	• It is necessary to implement paths first before considering these items. However, can be done progressively as paths are built
	Shelter provision	**Medium**	Long	**n/a**	
	Seating provision	**Medium**	Long	**n/a**	
	Public spaces	**Medium**	Long	**n/a**	

6.6. Pedestrianisation of the CBD

Pedestrian zones (also known as **auto-free zones** and **car-free zones**) are areas of a city or town reserved for pedestrian only use and in which only some specific (PT, delivery services) might be allowed. The main benefits found for car-free developments and expected also to be realisable for Windhoek CBD:

- Revival of CBD also during weekends,
- Improved retail business,
- Increased attractiveness for tourists,
- More squaremetres available for green or social space,
- Low atmospheric emissions,
- Low road accident rates,
- Better built environment conditions,
- Encouragement of activo modes,
- very low levels of car use, resulting in much less traffic on surrounding roads,
- high rates of walking and cycling,
- more independent movement and active play amongst children,
- less land taken for parking and roads.

Pedestrian zones are instituted by communities who feel that it is desirable to have pedestrian-only areas. In the City of Windhoek there are strong tendencies to use this instrument to make the City more attractive and to revitalize the city center by the retail business and urban planners encouraged by the City Administration and Council. The process is supposed to start in Independence Avenue between Fidel Castro and John Meinert Street.

Figure 6-28: proposed pedestrian Zone in Independence Avenue

This move is strongly supported by the SUTMP team and taken up as an important measure which could considerably contribute to achieve SUTMP objectives. The pedestrianisation could already be established until 2017.

The CBD is any city's showpiece. That is why the project team recommends not just closing the road, but to tender an "architectural design competition" and budget this event (please refer also to chapter 10) which we expect will give some attractive ideas shaping the cities future face.

In general, the main problems are related to parking management and this is also valid for Windhoek. The closure has to go hand in hand with traffic planning and parking management around the CBD which could also result in an ease of the traffic flow situation around the CBD, if carefully surveyed and targeted[27]. Also it has to be taken into account that some private parking places have access from Independence Road. This traffic flow improvement measure is also budgeted for as an accompanying measure to be started in parallel with the architectural design competition already in this year (please refer also to chapter 10 implementation and financing plan).

Costs are heavily depending on the selected design standards applied. We estimated based on some unit costs for NMT and PT lines and with a lump sum for deconstruction of existing structures with 24 mio. N$ which is very conservative. Further parts of the CBD could be pedestrianised within the time horizon of the master plan. A lump sum was also given to this extension of the pedestrian zone before 2032.

[27] Please refer also to "Reducing Carbon Emissions through Transport Demand Strategies – A review of international examples, GIZ / Beijing Transport Research Board - http://tdm-beijing.org/files/International_Review.pdf for examples of pedestrianisation and other transport demand management measures outlined in the next chapter 7.

7 Managing Transportation

This chapter 7 relates to the transport management intending to make better use of existing capacities, strengthen the avoid-shift-improve measures and last but not least contribute to a considerable reduction in the terrifying road safety situation starting with the City of Windhoek, where 50% of all accidents happen.

7.1. Strategy

Travel Demand Management (TDM) refers to various transport strategies that encourage efficient and sustainable transport. The aim of TDM is to reduce the number of vehicle trips and trip times, while still supporting the person trip demand, i.e. the personel mobility needs. TDM strategies give priority to the non-motorised transport and the use of public transport, while simultaneously applying constraints on the use of private vehicles.

The benefits of TDM include reduced congestion on roads and a reduction of the environmental impact of transport activities through the decrease in fossil fuel usage and consequently vehicle emissions. Additionally, because TDM reduces private vehicle trip demand on particular routes at certain times, traffic volume decreases and expensive infrastructure upgrades to increase the physical capacity of highways can be postponed or negated.

Additional TDM benefits and advantages include:

Figure 7-1: Benefits of TDM Measures

Cost efficiency

- TDM strategies are often the most cost effective way to improve transportation. TDM can defer and reduce the need to expand roads and parking facilities, and provide other benefits such as reduced traffic accidents, energy conservation, and improved mobility for non-drivers.

Flexibility

- TDM can provide flexible responses to many types of transportation problems, including those that are urgent, temporary, variable or unpredictable. TDM programs can be implemented quickly, and tailored to a particular situation and user group. TDM avoids the risk that a major capital investmnt will prove wasteful due to unforeseen changes in transportation needs.

Consumer benefits

- Many TDM strategies use positive incentives, they improve transportation options and provide financial rewards, and consumers benefit from reduced traffic congestion, parking problems, crash risk and pollution emissions.

Equity

- TDM can result in a fairer allocation of resources between different demographic and geographic groups. Many strategies directly benefit people who are economically, physically or socially disadvantaged by improving transportation options available to non-drivers.

Sustainable transportation

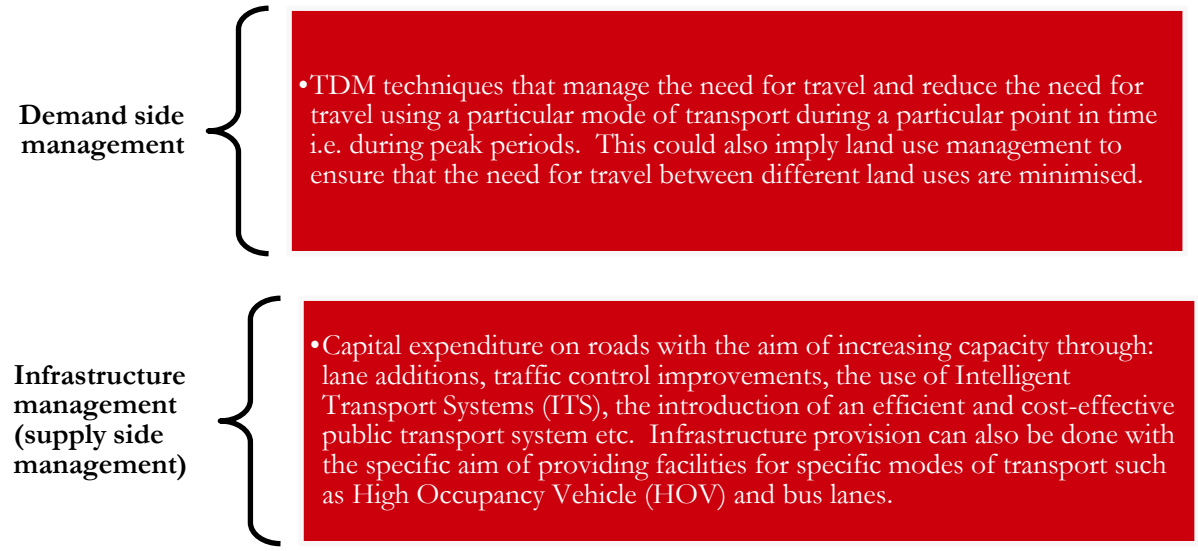
- TDM can encourage the use of sustainable transportation. TDM reflects sustainability principles of efficiency and integration. It can help achieve and build towards resource conservation, equity, environmental protection, efficient land use, and public involvement.

TDM Measures

A number of TDM measures have been implemented both domestically and internationally, some of which with more success than others. Currently, TDM measures are at the forefront of traffic planning and management and as such research initiatives to expand the body of knowledge and the field of expertise is on-going. Therefore, no single list of TDM measures can ever be exhaustive as new TDM measures are being researched, developed, piloted and implemented constantly.

TDM measures can typically be addressed by two strategies, namely:

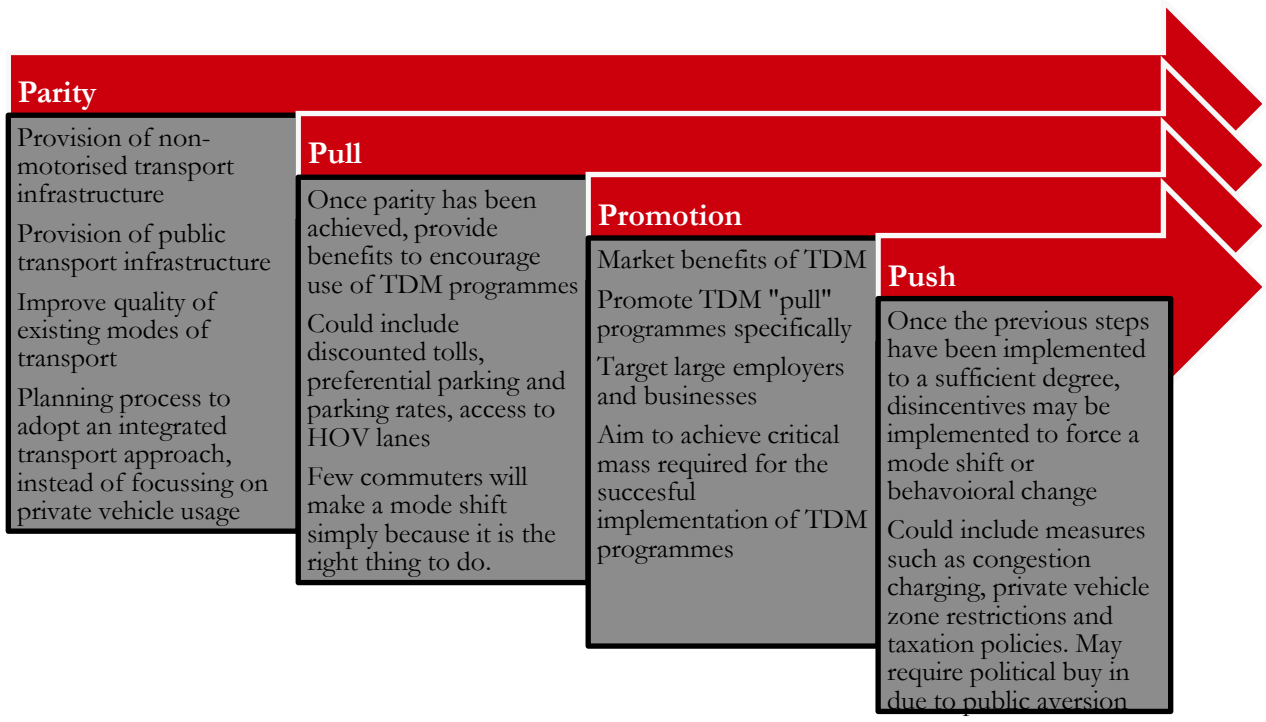
Figure 7-2: Demand side vs. Supply side management



TDM Implementation Stages

The effective implementation of TDM typically includes four stages as shown in the figure below.

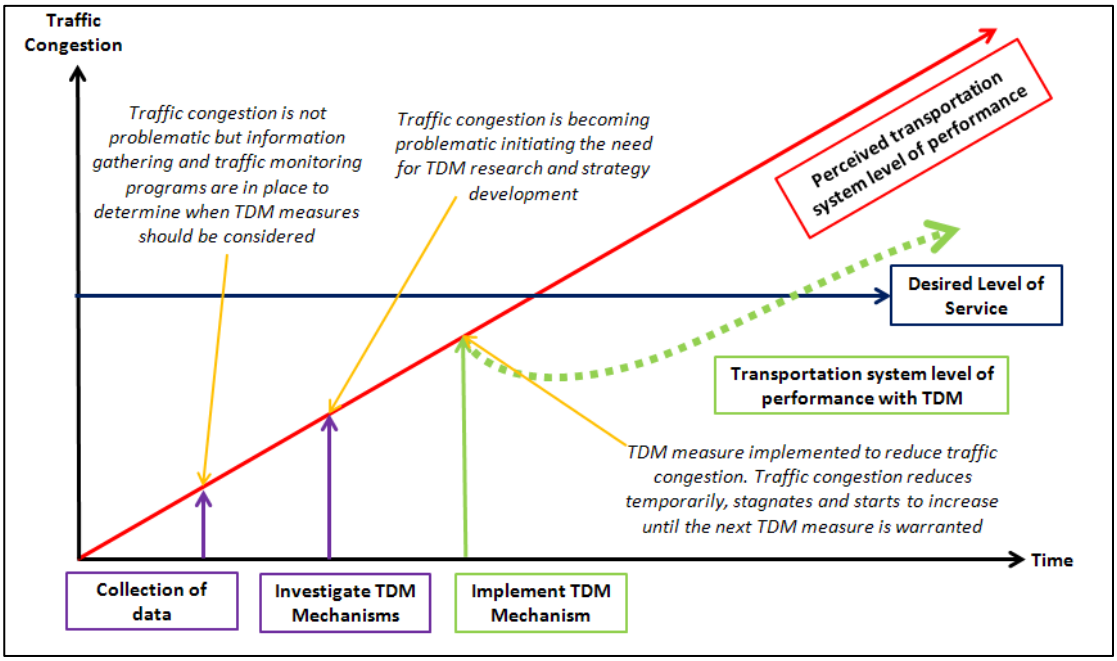
Figure 7-3: TDM Implementation Stages



The success of any TDM strategy depends on the stages roll-out of measures. It is important that parity between different modes should be established first, in order for pull and push strategies to be effective.

As shown in Figure 7-4 below, the above implementation strategy requires time for implementation.

Figure 7-4: TDM Implementation Methodology



Ideally, TDM measures will be planned so that they can be implemented at the time when it is required and when it will have the desired impact. In the long run any specific TDM measure is unlikely to result in an indefinite improvement in the performance of the transportation system on its own. The performance of the system will deteriorate with time as the demand for travel increases at which point additional TDM measures need to be implemented to achieve the desired improvement in the network operational performance.

Figure 7-5: Demand Side Management Measures - Examples

Demand side measures	Stage	Description and objective
Land use / Zoning policies	Parity	Should enable the provision of sustainable public transport, as well as opportunities for effective non-motorised transport. Mixed land use might reduce the need for travel between different land uses and high density development ensures sufficient demand for travel required for a sustainable high service level public transport system. ***Reduce the number of trips and reduce the travel distances of users.***
Work schedules	Pull	Flexi-time and alternative working times will allow for off-peak travel. Compressed working hours allow employees to work the required number of hour in fewer days, thereby reducing the demand for travel. ***Reduce the number of trips and travel demand.***

Demand side measures	Stage	Description and objective
Ride-share programmes	Pull	Also referred to as carpooling, where commuters travel together often sharing vehicles on alternate days (it should be noted that in South Africa carpooling schemes where only one vehicle is used and the owner is compensated by other occupants is in conflict with legislation and therefore illegal). ***Reduce the number of trips and travel demand by using one vehicle for multiple users.***
Parking management	Push	Management of the need for parking by adjusting the cost of parking. Some schemes even compensate employees if they wave their allocated parking bays, or allocate parking to car pool vehicles at a lower cost. Preferential parking can also be provided to off-peak travellers. This may include implementing or increasing parking charges for CBD areas. ***Reduce the number of required parking bays and promote carpooling.***
Tele-commuting, conferencing and education	Pull	Telecommunication infrastructure is used to ensure that work, shopping and education is done at the place of residence or in some cases as the place of employment to prevent travel to a different location to participate in one of these activities. ***Reduce the total usage and demand for travel buy utilising the internet.***
Public transport subsidies	Promotion	For companies or developments which actively support public transport usage. ***Reduce usage of private vehicles and promote the usage of Public Transportation.***
Pre-Trip Travel Information	Promotion	To be provided with travel information, ride-share information, public transport information, congested route information before travel. The information is provided in attempt to influence mode choice as well as the time of travel to avoid congested roads or peak period. ***Reduce unnecessary trips and consequently reducing unnecessary congestion.***
Improved walking, cycling and public transport image	Promotion	Make walking; cycling and public transport an attractive, safe, and accessible service in order to be able to encourage a mode shift to sustainable transport. ***Encourage walking, cycling and the use of public transport by making it a viable transport option.***
Private vehicle restriction zones	Push	Prohibition of access to specific zones for private vehicles to encourage the use of public transport. ***Reduce the number of trips and usage of private vehicles.***
Taxation policy	Push	Can be used to discourage private vehicle subsidies and for tax rebates where public transport is actively promoted. ***Reduce usage of private vehicles.***

Demand side measures	Stage	Description and objective
Shadow tolling	Push	Land owners or businesses pay toll to the road infrastructure implementation agency for the use of the infrastructure on behalf of the patrons of that specific development. Although it could be seen as a supply side TDM measure to recover the cost of infrastructure, it could be used as a demand side measure if the shadow toll is related to the degree to which public transport is promoted by a specific development. I.e. if no public transport plan is actively promoted, shadow tolls will be higher. The inverse, i.e. lower shadow tolls, if the development actively promotes public transport and limits the extent to which private vehicle trips are generated by the development. ***Business users are encouraged to provide public transport infrastructure in order to promote public transport usage rather than private vehicle usage.***

Figure 7-6: Supply Side Management Measures Examples

Supply side measures	Stage	Description and objective
Non-Motorised Transport facilities	Parity	The provision of cycle lanes and safe pedestrian walkways to ensure that these modes of transport are accommodated safely within the road reserve to minimise the risk of accidents and injury. ***Protect vulnerable non-motorised road users and increase accessibility.***
Freeway Ramp Control	Parity	Traffic signals controlling the flow of vehicles onto a freeway, thereby ensuring that the traffic flow on the main road is maintained at an optimum level. It can also be used to give preference to specific vehicle types such as public transport or HOV vehicles. ***Reduce bottle necks and unnecessary congestion on freeways and bridges.***
Traffic signal settings	Parity	Can be adjusted to favour certain movements if used by public transport, or pre-emption by public transport vehicles (e.g. bus/taxi priority systems). The provision of advanced traffic signal control systems can also optimise the flow of traffic and minimise lost time, thereby maximising the capacity of a section of road. ***Reduce congestion and optimise the flow of traffic and minimise lost time, thereby maximising the capacity of a section of road.***
Network TDM capacity improvements	Parity	Increase or decrease in network capacity can be done to the advantage of public transport specifically. ***Increase or decrease in network capacity***
HOV Lanes	Parity	Dedicated lanes for public transport and / or high occupancy vehicles (HOV). Such lanes can also be tolled in which case it is referred to High Occupancy Toll Lanes (HOT). ***Reduce the amount of trips buy promoting carpooling and use of public transportation.***
Park-and-Ride	Parity	For private vehicles to access a public transport hub easily via accessible routes, park their cars and use HOV / small busses / taxis to travel to high congested areas. ***Reduce private vehicle trips as well as urban (CBD) congestion.***

Supply side measures	Stage	Description and objective
Connector / Feeder Services	Parity	Connecting to or feeding a high capacity public transport services such as BRT, rail and light rail. It implies the provision a frequent, reliable connector / circulation bus / mini-bus service to reduce private traffic to the congested areas - may be integrated with a park and ride facility. ***Reduce private vehicle traffic to the congested areas.***
In-vehicle Travel Information	Promotion	Provides travel information or congested route information in the vehicle while travelling e.g. traffic reports. This is a management technique which attempts to route vehicles to uncongested routes, thereby using available infrastructure optimally. ***Informs road users about accident and congestion hot spots as well reduce travel time.***
On-road Travel Information	Promotion	To be provided with travel information along-side the road via fixed or variable message signs providing information on public transport, ride-sharing, alternative routes, toll or parking information. ***Provide users with relevant information to make choices on appropriate means and times to travel.***
Parking Supply Limitations	Push	Parking provision requirements can be reduced during the development stages of development to encourage the use of public transport. However, such strategies are only effective where alternative modes of transport are available. ***Reduce usage of private vehicles and promote the usage of public transportation and non-motorised transport***
Congestion pricing	Push	Generally associated with higher or variable toll during peak periods or on very congested roads to influence travel and mode choice patterns. ***Reduce usage of private vehicles, trips and promote other means of travel.***

The implementation of TDM strategies is primarily reliant on accurate, robust and current traffic information. The process of determining the need for TDM implementation is highlighted as follows:

- Understand the local transportation context and determine the true nature and severity of identified problems.
- Assess where current transportation plans are likely to lead to resolving the identified problems and identify shortfalls where TDM strategies could provide a solution.
- Use available domestic and international best practice, explore a range of TDM options available and assess the impact these will have on the municipal transportation problems.
- Analyse the trade-offs among the different alternative approaches regarding cost, timing, impact and other criteria important to local decision makers and culminate the analysis in a decision or recommendation of which TDM measures would be most effective to implement.
- Decide what mechanisms are required to implement the chosen solution.

Having this in mind, the Consultant proposed from the entire available instruments the most suitable ones for the City of Windhoek's present and expected situation. In the strategic direction meetings those options were discussed and the Key Stakeholders together with the Consulting Team agreed on the principle strategic direction as given in the textbox below. This was further outlined, elaborated and assigned with costs and capacities as given in the following sub-chapters.

Strategic Directions for Traffic Management Measures

Excerpt of the Memorandum of Understanding for Transport Management:

Bearing in mind that there is a need to accompany the objectives for a modal shift and improvement of sustainable modes of transport;

And bearing in mind that efficient, reliable, affordable, safe, secure, integrated, convenient Public Transport and Non-motorised Transport contribute to sustainability;

And having considered the wide variety of possible transport demand measures;

It is agreed:

a. to reclassify the urban road network, e.g. in arterial roads, collector roads, residential access roads, residential street and pedestrian area, and attribute different speed limits combined with modern, low cost design standards;

b. that the reclassification ought to be done in close consultation with residents, stakeholders and partners, tested via pilot schemes;

c. that the reclassification should also incorporate Non-motorised Transport and Public Transport infrastructure provisions;

d. that the taxi industry has to be incorporated in all relevant transport demand management measures;

e. that parking management is important but parking restrictions should not be implemented before viable Public Transport and Non-motorised Transport Alternatives are provided;

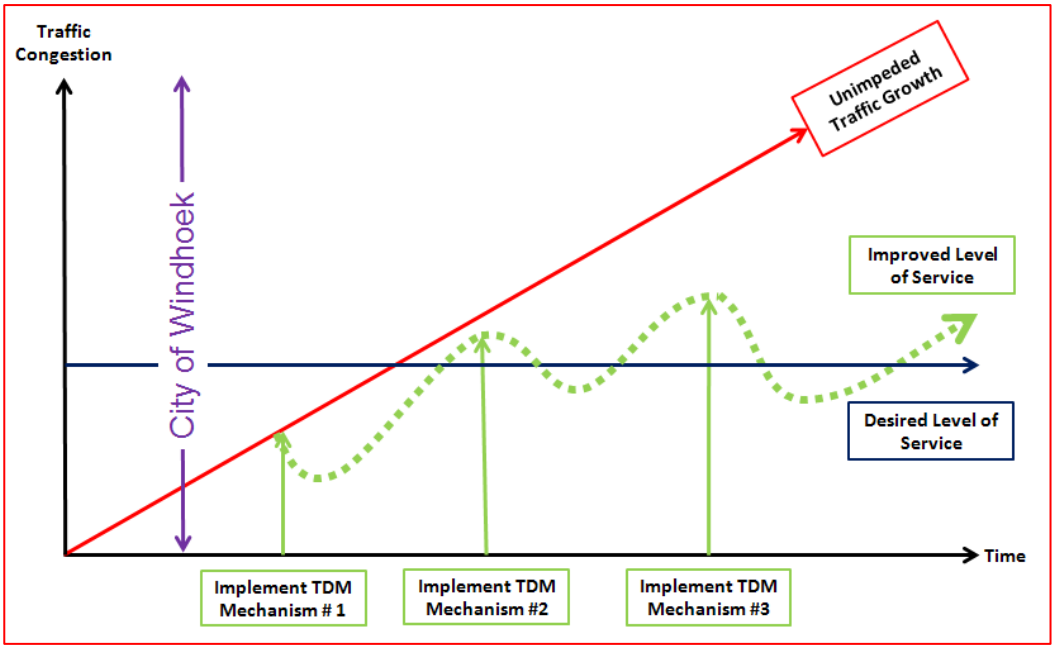
f. that education and awareness measures are essential for achieving sustainable urban transport objectives through Transport Demand Management measures.

g. that all SUTMP measures should take road safety impacts into account within the entire life cycle of the measures.

7.2. Transportation Demand Management (TDM) in Windhoek

Using the basic stages of TDM as described in the previous section, the status or current position of the City of Windhoek is estimated and shown in the following figure.

Figure 7-7: City of Windhoek TDM Status



The City of Windhoek is considered to be at the early stages of TDM. More emphasis should be placed on achieving parity between all modes of transport within the City (refer to Figure 7-7). Further, traffic data should be more extensively collected, managed and analysed in order to develop detailed TDM measures and strategies in the future.

The priority for the City of Windhoek is to achieve parity amongst all modes of transport in order to develop TDM strategies, specifically:

- Non-motorised transport infrastructure and facilities needs to be in place in order to provide a viable and formal means of transport for those who do not have access to a private vehicle and to protect vulnerable road users.
- Implement a cohesive public transport network with non-motorised transport links.
- Traffic data should be more extensively collected, managed and analysed in order to develop detailed TDM measures and strategies in the future

At present, the majority of TDM instruments discussed in the previous chapter are unsuitable for short term implementation, due to current insufficient parity amongst transport modes. However, it is foreseen that the following TDM measures can be implemented on a short term basis (i.e. within 5 years), together with improving non-motorised and public transport infrastructure:

Demand side measures

- Improved walking, cycling and public transport image
- Parking management
- Land-use policies

Supply side measures

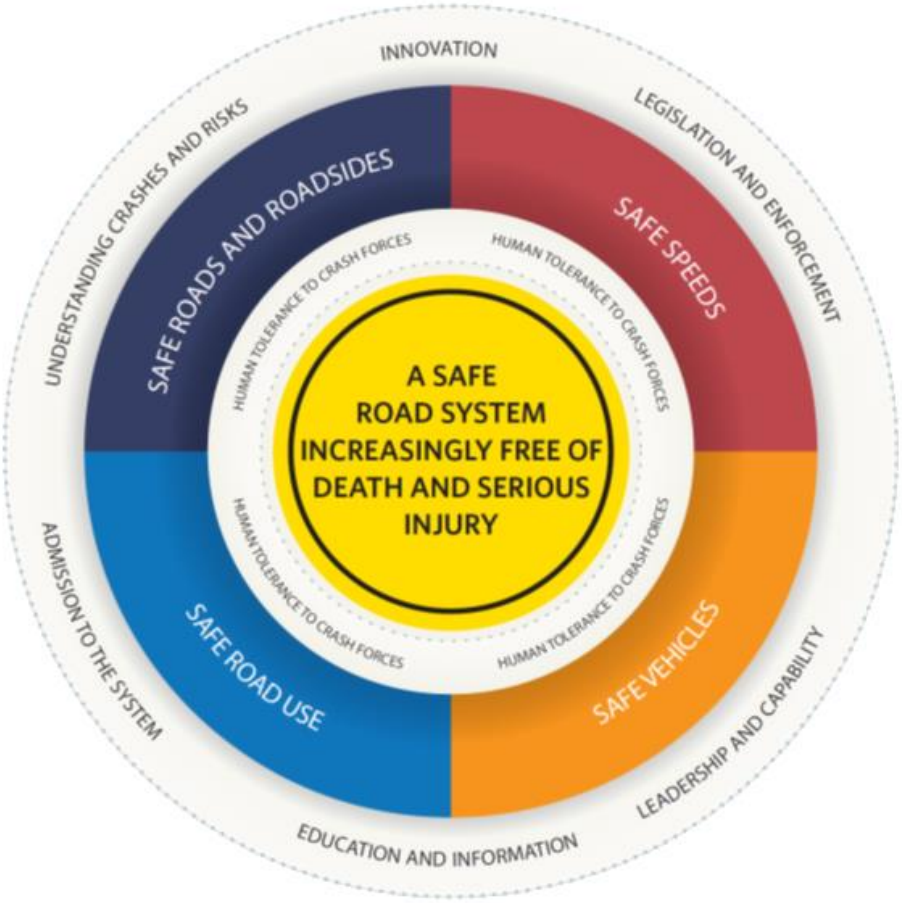
- Pedestrian and Cycle facilities
- Parking supply limitations
- Traffic signal settings
- HOV or Dedicated Public Transport Lanes

The proposed sequencing and costing of above measures is given in chapter 10, implementation and financing plan. Impacts of these measures will need to be monitored and reviewed through analysis of traffic data and efficient project management ensuring timely realisation of proposed supply side measures. Accordingly, there is a need to up-date respectively fine-tune the implementation plan and determine the appropriate range and timing of the TDM strategy.

7.3. Road Safety

Road Safety is not a separate entity but should be automatically embedded within other elements that contribute to building a safe road system as illustrated in the following figure.

Figure 7-8: Safe Road System[28]



Taking these principles into consideration, the following elements will assist in improving the level of road safety within Windhoek.

Road classification and speed limits

The current road classification (please refer also to chapter 2.2) needs to be reviewed and modern design features applied accordingly throughout the Windhoek road network to support the road classification.

[28] Source: Safe System, NZ Transport Agency 2012

Strategically allocating roads to a lower order classification indicates that the corresponding speed limits will need to reduce. Ensuring that the road design and environment discourages speeding and supports speed reduction is integral to the driver identifying lower order road classifications and driving appropriately.

This is particularly important when considering incorporating walking and bicycle lanes within the road carriageway. Segregated walking and bicycle facilities are required when the vehicle travel speed is high; however bicycle lanes can be integrated on road at lower vehicle speeds.

Traffic calming measures are a variety of road design features that are applied with the intention of speed reduction. Examples of traffic calming measures are shown below.

Figure 7-9: Traffic calming measure examples

Traffic calming measure examples	Description
Mini-circle	Mini-circles are raised circular islands constructed in the centre of residential street intersections. They reduce vehicle speeds by forcing motorists to manoeuvre around them and are sometimes used instead of stop signs.
Chicane	 Slows traffic down through horizontal deflection and road narrowing.
Choker	 A choker slow vehicles down through horizontal deflection. The configuration only allows one vehicle to pass at a time.
Speed humps	 A speed hump slows traffic down through vertical deflection.
Raised pedestrian crossing	 A pedestrian crossing painted on a speed hump with a flatter and wider profile.

Traffic calming measure examples	Description
Reducing lane widths	Vehicles are inclined to travel at a faster speed on wider lanes (greater than 3.3m) such as found on a freeway. Reducing lane widths to less than 3.3m (3.1m minimum) potentially through painted edge lines alerts the driver of a lower speed environment.
COSBI (Control of Speed by Optical Illusion) Line	COSBI lines are on road painted strips. Through varying the width and spacing of the lines, drivers perceive that they are travelling faster; as a result drivers slow down.

Presently in Windhoek mainly speed humps and raised pedestrian crossings are to be found and the city does not yet make full use of available methods to make its roads safer. More detailed recommendations are to be found in chapter 7.4.

7.3.1 Improved Non-Motorised Transport provision

As shown in Section 2.8, the number of fatalities per suburb correlates with the suburbs where the highest number of pedestrians can be expected. As identified within Section 6, various actions are proposed to improve NMT provision within Windhoek. Particular focus has been applied in prioritising NMT provision in areas of economic need and the CBD, aligning pedestrian crash prone areas with improved facilities.

Further, various classes of bicycle infrastructure and facilities are proposed that are appropriate for the road area, in terms of level of segregation and vehicle speeds.

This will improve the safety of pedestrians and cyclists as the ultimate NMT network aims to be interconnected and continuous, increasing both the quantity and quality of provision such that pedestrians, cyclists and drivers can interact in a safe manner.

7.3.2 Sustainable transport modal shift

By providing more and better NMT and public transport facilities, sustainable transport will be made to appear an attractive and viable alternative means of travel. The following figure shows the absolute advantage in terms of pkm between individual and public transportation derived from international research. Those ratios were applied in order to derive the road safety impacts of the project:

Figure 7-10: Road Safety Ratios Private / Public Transportation

Transport Mode	Casualties per billion pers. km	Fatal casualties per billion pers.km
(I) Private Traffic	3000	40
(II) Public Transportation	90	0.7
(II) / (I)	1/33	1/57
Percentage (II) / (I)	3%	2%

It can be clearly stated that the level of safety on the road is reduced as more trips are made on safe walking and cycling paths as well as via public transportation.

Implementing strategies, promotional and educational campaigns reinforce the benefits of public transportation, further encouraging a shift towards this safer and thus more sustainable mode.

7.3.3 Taxi driver professionalisation program

Approximately 5% of the vehicle population comprise of taxis. Providing the necessary tools to enable taxi drivers to adhere to road rules and drive safely will make a significant contribution to improving driving behaviour in general. This can be achieved through professionalization of the taxi industry e.g. via special public transport licenses or via education programs to be linked to taxi permit or license provision.

7.3.4 Vehicle inspections

Vehicles are a pillar in providing a safe road system. Ensuring that vehicles are road worthy through regular inspections will considerably contribute to safety enhancement, especially when it comes to items such as the tyres, braking system and steering. The ongoing programme of the RA together with the NaTis is the way forward and ought to be followed-up, strengthened and continued.

7.4. Optimising the Road Network – Infrastructure and Traffic

The current road network within the City of Windhoek has developed over time and as such has been influenced by town planning and road planning strategies at the time when the road network was developed mainly based on South African road design standards which are still valid. The development of the city is also influenced by socio economic and political factors. The net result is that the road network layout (in terms of no of lanes, lane widths, NMT facilities, intersection control etc.) does not necessarily reflect the current land use, the ever increasing traffic and latest research.

Thus, it was proposed and adopted during the strategic direction workshop reclassified to determine the required road hierarchy to promote sustainable transport. Besides the positive effects this measure will have on traffic flow and safety, it will also considerably contribute to make the City of Windhoek an attractive place for the people.

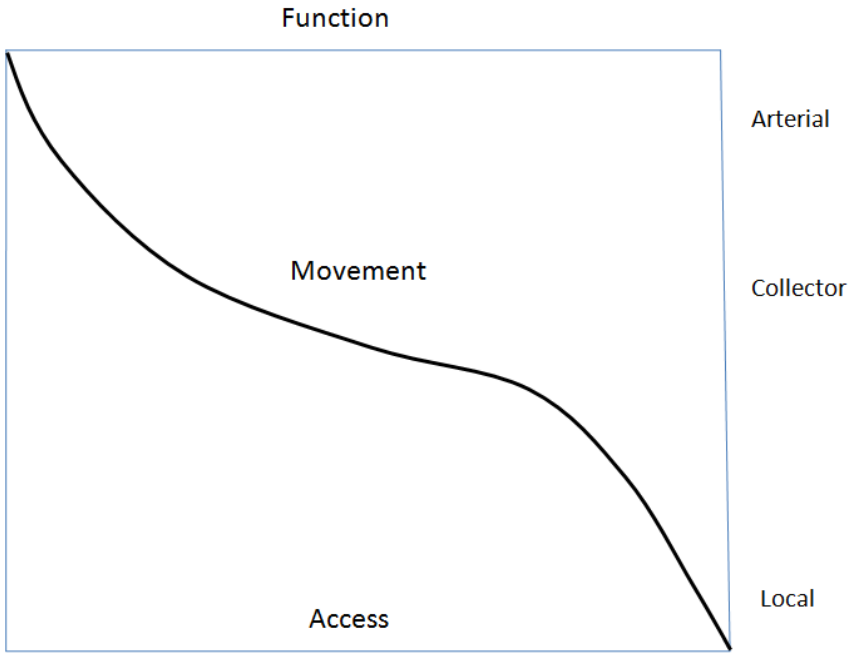
7.4.1 Road network reclassification

For the majority of the recommended investment measures the road space is affected, but not for all urban roads. The project team together with the key stakeholders during the strategic direction workshops decided it is high time to have a general new approach on this matter.

When considering the road network classification, it is important to consider the movement (mobility) vs. access function of roads. Higher order roads have an important mobility function. On these roads ease of movement is important, traffic therefore needs to be able to flow at a reasonably high speed with limited interruptions. Lower order roads have an important access function. Mobility is less important and the road environment needs to be adapted to ensure that traffic operate at a lower speeds. Public transport corridors are often associated with higher order roads as these roads allows for high operating speed and minimal interruption of the service.

The relationship between access and movement is shown graphically in the following figure where *Arterial* refers to higher order roads and *local* refers to lower order roads

Figure 7-11: The relationship between movement, access and road class[29]



Basic Functional Classes (Stover 2002)

In urban areas, roads generally comprise the most important part of the transport infrastructure system. Roads have two key functions which may not be compatible with each other. Firstly to enhance mobility for vehicles and users and secondly, to increase accessibility to locations people want to travel to and from. Thus, fast roads have fewer entry / exit points so that vehicles can better maintain their higher speeds whilst local roads have many points of access to residences, business and intersections which means that traffic should move more slowly. Presently there is a lack of a clearly-agreed classification system for urban roads not only in Namibia but also e.g. in most other Eastern African countries.

It is proposed to have at minimum four levels /orders of urban road classes,

- **main arterial roads / urban corridors**
- **feeder roads**
- **residential access roads**
- **residential living streets**

and, to apply different design standards and specifications and maybe also different financing schemes.

The specification should form the basis for a revised legal framework in this respect and should comprise:

- Roadway designs that reduce traffic speeds (different design speeds for different road categories)
- Segregated sidewalks bicycle lanes when car traffic has high speeds
- Integrated walking and bicycle lanes where vehicles travel at low speeds

[29] Please refer to Vergil G. Stover, Frank J. Koepke. 2002. Transportation and Land Development. Institute of Transport Engineers

- Speed limits according to road classes

Consequently, it is recommended that the most appropriate urban road classification scheme needs to be identified in the form of an urban road reclassification study covering the following:

- Elaboration and confirmation of an appropriate urban road classification system based on international best practice examples.
- Determination of (low-cost) design standards per class/order.
- Determination of intersection standards per road class/order.
    - Required road reserve width;
    - Road design standards, including cross section, lane widths, shoulder widths, requirements for median islands, requirements for public transport lanes, on-street parking, NMT facility requirements, provision for public utilities within the road reserve;
    - Preferred vehicle operating speeds and therefore road design speed, road design elements which needs to be introduced to enforce the preferred operating speed.
- Identification and determination of all class 1 – nn roads, starting with the mobility routes and thereafter with the classification of collector and access roads in the City of Windhoek
- Costing and staggered implementation plan.

During the reclassification process careful attention to the Windhoek CBD needs to be applied, given that whilst it is important to have arterial routes to ensure mobility within the CBD, the primary role of roads within the CBD is access to properties. The needs of NMT users as well as the future planning in terms of public transport provision are also important in the CBD and should be taken into account during this stage.

The product of the reclassification process will be a road hierarchy definition as well as road hierarchy plan for the greater Windhoek area and also a revision / amendment of the Red Book should be targeted and a solution for the Western Bypass categorisation.

Figure 7-12: Examples for urban road and design standards with priority for pedestrians and Public Transportation

(shared space in Havelland, Signalisation for residential street, urban space with PT and NMT priority in Zurich / Switzerland)

The reclassification requires physical intervention to ensure that traffic operations on the road network are in line with the functional classification. The plan will to some extent represent an idealistic view as and the planned class of a specific road and its current function might not be

aligned immediately. In such cases the traffic operations along the road needs to be managed through appropriate traffic management and enforcement techniques.

The new road hierarchy is best to be tested in a pilot case eventually starting with traffic-calmed play streets where children are allowed to play respectively with space open to children. Private stakeholders and public hearings should accompany the pilot project.

The costs for the proposed road reclassification measures (Study Phase, Pilot Phase and Implementation phase) are altogether estimated to roughly 100 mio. N$ to be verified in the study phase.

7.4.2 Traffic management

The combined impact of the road network reclassification as well as the proposed public transport and NMT strategies will require geometric and regulatory interventions to ensure that the road network classification and its function in terms of private vehicle movement/access, public transport requirement and NMT operations are all aligned. As part of the network reclassification project the following additional tasks need to be completed:

Road access management

A road access management policy is important to ensure that the functional requirements of the road classification system are achieved. The policy needs to address access standards to properties taking into account the requirements for movement and access, whilst ensuring that road safety is not compromised.

Traffic flow and capacity studies

The introduction of pedestrian right of ways in the Windhoek CBD, combined with the introduction of public transport systems will restrict the movement of private and delivery vehicles within the CBD. A dedicated traffic management plan to address traffic flow around Independence Avenue will be required. Given the interaction of pedestrians, private vehicles, delivery vehicles as well as the different public transport modes in the area it is envisaged that micro-simulation of the CBD will be required. The study needs to address the anticipated redistribution of traffic in the CBD with a special focus on the intersections and with regard to existing and planned signal control systems.

Appropriate micro-simulation software such as PTV Vissim, Aimsun, Paramics or similar must be used to conduct this study. It is important that the model used must allow for dynamics assignment of traffic on the network. This study must provide an integrated approach to address the following:

- Traffic flow within the CBD (all vehicle modes);
- Public transport within the CBD, ensuring that these vehicles have right of way without impacting to the need for private and delivery vehicles to have access to businesses in the CBD;
- Parking provision in the CBD;
- A detailed pedestrian and NMT movement plan, ensuring that universal access principles are applied.
- Emergency service movement/access strategy to the CBD.

The outcome of this study needs to be a traffic management plan for Windhoek CBD, with a detailed action and implementation plan, including cost estimates.

7.5. Introduction of Environment Friendly Technology

First of all it has to be emphasised, that from the environmental point of view, public transport is much more favourable than individual cars. In Europe and America and in many other parts of the world stricter emission regulations was the trigger to technology changes that entailed tremendous improvements of air quality. In Namibia such regulations are presently not in place. Possible measures are related to national laws and thus not within the scope of the Urban Master Plan. However, a conceivable option would be to allow only low emission vehicles into the City of Windhoek as it is practiced in many European towns in order to reduce particulate emissions[30]. Nevertheless, this practice is criticised by environmentalist as entailing only minor effects. This option should be only pursued if particulate concentrations are frequently measured in the framework of vehicle inspections. As long as such a national legal obligation does not exist, the introduction of such schemes is not possible.

While for car emissions the scope of action of the city is relatively low, a number of technological options for public transport systems exist that could further improve environmental performance of public transportation. These relate to

- Gas fuelled buses
- Usage of biofuels
- Hybrid technologies
- Renewal of the vehicle fleet

Gas fuelled buses

Generally for buses the following alternative fuels may be used:

- Liquefied Natural Gas (LNG)
- Compressed Natural Gas (CNG)
- Liquefied Petroleum Gas (LPG)

Impacts of these technologies are mainly related to pollutant emissions, with a CO reduction of 60-80%, NO_x of 50-80% and non-methane organic gas up to 87% (SUTP Sourcebook Module 4d, p. 13). An additional environmental impact is the reduction of noise emissions 3-5 db(A) (SUTP Sourcebook 4a, p12). However, the effect of well to wheel CO_2 emissions is either negative or neutral (Kadijk 2008, Kroon 2009).

The LNG technology may be regarded as a niche market that may not be recommended for developing countries (McPherson 1999). Investment costs for CNG buses are 8-16% higher, compared to standard diesel buses and LNG buses cost 39 to 52.000 US$ more (SUTP Sourcebook 4a, p12). These increases in investment costs have to be balanced against possible reductions of operation costs through reduced fuel consumptions and lower gas prices. Additionally, the availability of CNG and LNG has to be assessed. Both should be done within a feasibility study.

Usage of biofuels

The usage of biofuels is generally considered as positive regarding climate change. However, the effect is very much determined by the production process. If agricultural production uses large quantities of inputs, such as fuel, fertiliser or water, the sustainability is endangered. This is as well the case, if bio fuels push aside natural rain forests, e.g. through palm oil plantations. However,

[30] For Germany this concept is widely used. For further information on the application, please refer to www.umwelt-plakete.de. This website contains also Danish cities.

latest research reveals, that extremely high impacts on the climate may be achieved through the usage of methane gas derived from waste deposits. If these natural emissions of landfill sites are taped, the climate effect has double impact. A study by KfW (2012) shows that in South Africa up to five fold the CO_2 equivalents (well to wheel emissions) of a diesel bus may be saved through this technology. The study shows as well, that in South Africa about 14% of the national bus fleet may be fuelled through biogas from waste deposits. Here a similar study for Namibia may be recommended or might be included as additional task in the feasibility study.

Hybrid technologies

Hybrid technology is considered as an efficient environmental measure for buses, which has its impacts through improved energy efficiency. The usage of electric engines combined with the recycling of braking energy is adequate especially for buses with large number of acceleration and stopping procedures. Dependant on the urban traffic conditions, hybrid buses may save 23 to 43% of CO_2 emissions and 18-39% of NO_x emissions (Chandler /Walkowics 2006).

The costs of hybrid buses may be 30% higher than a conventional bus (Chandler/Walkowics 2006). Since the operational costs are 15% lower, costs for urban transport may be saved on the long run. However, it has to be emphasised that this technology is cutting edge: In Germany only 204 Hybrid buses are in operation and in developing countries they are only operating in test services (Peterson/ Hook /Fritsche 2008). Therefore hybrid buses are only recommended as test vehicles in Windhoek.

Renewal of the vehicle fleet

The energy efficiency of buses may be improved considerably through the optimisation of the powertrain. Research in USA reveals a 20% reduction of energy consumption through new powertrain technologies. However, not only new technologies may be considered. Windhoek's bus fleet is old, with many vehicles being more than 20 years in use. If the technological development in Germany during the last 16 years is analysed, the fuel consumption of buses decreased by 6% (Kuhnert Radke 2011). Thus, a renewal of the bus fleet would reduce fuel consumption and thus vehicle emission by this factor. The impact can be enhanced if latest filter technologies are applied that add their impacts on air quality.

The same idea might apply for the taxi vehicle fleet with the additional effect of enhancing the road worthiness / safety of the taxi fleet. Furthermore, such a renewal scheme would ease the task of integrating the taxi industry into the overall regulated public transport scheme.

In the course of the urban public transport feasibility study, but much more important in the tender specification for the new public transport scheme, alternative technologies and systems ought to be specifically encouraged.

8 Intercity Transportation

This Chapter 8 makes a brief excursion to relevant intercity transportation amending what has already been outlined in chapter 5 for the future PT links within the study area, i.e. towards Okahandja, Rehoboth and Hosea Kutako International Airport.

8.1. Intercity Transportation Demand

8.1.1 Current Intercity Transportation Demand

Origin-destination surveys, accompanied by link counts were conducted (as described in chapter 2.4.1.3) to gain a better understanding of the intercity transportation demand. The counts show that relatively high volumes are currently experienced to & from Rehoboth, Okahandja & Hosea Kutako per day (refer to Figure 8-1).

Figure 8-1: Vehicle volumes (06:00 to 18:00) at origin-destination survey locations

Link	Light Vehicle	Taxi	Mini-bus taxi	Heavy vehicle	Bus
Okahandja to Windhoek	1,709	0	156	333	43
Windhoek to Okahandja	1,647	1	187	312	62
Hosea Kutako to Windhoek	1,562	1	156	185	36
Windhoek to Hosea Kutako	1,677	5	175	210	34
Rehoboth to Windhoek	1,328	0	117	236	24
Windhoek to Rehoboth	1,333	5	133	208	19

The origin destination survey revealed the following in terms of intercity travel behaviour:

- The estimated number of daily public transport passengers from Okahandja & Rehoboth to Windhoek is 1,400 and 900 respectively
- Trips from Okahandja to Windhoek is spread throughout the day, only around 10% of trips from Okahandja to Windhoek occurs during the morning peak hour
- The traffic volume from Hosea Kutako to Windhoek has a peak in the morning and again in the afternoon. About 14% of trips from Hosea Kutako to Windhoek occur in the morning peak hour
- The majority of trips from Rehoboth to Windhoek is in the morning peak with 25% of trips being in the morning peak hour
- The main trip purpose for persons interviewed travelling from Okahandja to Windhoek is 'To work' (34%) followed by other trips (31%) which comprise mainly of return trips to home and visiting trips
- The dominant trip purpose for persons interviewed travelling from Rehoboth to Windhoek is 'To work' with 71%.

- 67% of persons interviewed travelling from Hosea Kutako Airport to Windhoek is 'From airport' consisting of tourists, persons returning home and persons dropping off others.
- Only 10% of persons interviewed were through traffic i.e. not starting or ending their trip in Windhoek
- 18% of persons interviewed travelling to Windhoek had other origins than Okahandja, Rehoboth & Hosea Kutako Airport. The other main origins include Swakopmund, Gobabis, Otjiwarongo, Walvisbay, Okapuka and Oshakati
- 29% of persons interviewed travelling from Windhoek had other destinations than Okahandja, Rehoboth & Hosea Kutako Airport. The other main destinations include Mariental, Omeya, Aris, Groot Aub, Keetmanshoop, Gobabis, Swakopmund and Walvisbay.

8.1.2 Future Intercity Transportation Demand

Future intercity transportation demand is based on several factors:

- Population growth in Okahandja, Rehoboth & developments around Hosea Kutako Airport would result in growth in travel demand towards Windhoek. Okanhandja is expected to grow from 22,500 inhabitants to 31,000 inhabitants by 2032 and Rehoboth is expected to grow from 28,800 inhabitants to 40,000 inhabitants by 2032. Those numbers were confirmed on the third steering committee meeting as well as on the strategic directions workshop (see Technical Annex Report, Annexes B and E) but are rather cautiously estimated.
- Economic growth resulting in new job opportunities within Okahandja, Rehoboth & developments around Hosea Kutako Airport would in turn reduce the need to travel to Windhoek for employment. Almost 2,000 and 1,500 jobs are expected to be created in Okahandja and Rehoboth respectively by 2032.
- The improvement of intercity public transport as proposed in this document as well as the National Public Transport Master Plan suggesting some improvements on the Okahandja – Windhoek link but does not envisage major capacity increases on the Rehoboth – Windhoek link.

Results for future public transportation demand:

- It is projected that the public transport passengers per day from Okahandja to Windhoek will increase from 1,400 in 2012 to 1,800 in 2032
- It is projected that the public transport passengers per day from Rehoboth to Windhoek will increase from 900 in 2012 to 1,300 in 2032
- An annual growth rate of 5% was assumed for airport traffic. It is projected that in 2032 around 1.2 million passengers will arrive at Hosea Kutako International Airport.

It is important to note that on the political and personnel level high travel activities at certain times on the north- and southbound road links from and to Windhoek were perceived and than above figures appear to be rather low. However, as already stated in previous chapters (e.g. chapter 2.4.1.5 and 2.5.1), investigations revealed that only a portion of this traffic is originating and ending in the study area and that from this portion only a certain percentage will shift towards public transportation.

Thus, the operational concept for the intercity buses at the beginning is quite unpretentious and easy to achieve on short notice. In order to offer a customer friendly service during the whole day, buses must run minimum once an hour, better every 30 minutes. While the highest demand is during peak hours, the frequency was shortened in peak time according to the necessity.

For the cost calculation we assumed for all of the three directions (Okahandja, Rehoboth and Airport) an hourly service as an absolutely minimum and in each case adopted higher intervals during peak hours. Also all buses were assumd to have in-between up to three stops and at the final destination up to three stops. The incorporation of the bus service in the Windhoek innercity PT is dealt with in the next chapter.

However, the database for the distribution of passengers over the time during the day is very limited. This must be analyzed in more detail during the feasibility stage of this project.

8.2. Integration of Intercity Public Transport

It is highly recommended that the intercity public transportation is integrated in the intracity PT interchange stations. First of all there need to be a dedicated part for intercity buses within the envisaged central bus station. In the long run the same applies for integration with the commuter train stations.

Two to three further interchange stations depending on the direction intercity passengers (northbound, eastbound or southbound) intend to travel, ought to be envisaged for convenience of the travellers.

Altogether the linkage of intercity and intracity services allows easy transfer of those passengers and especially Rehoboth and Okahandja commuters but also tourists and air travellers will have a considerable advantage in terms of convenience and travel times.

If both systems are more advanced, in the medium term there is also a time schedule integration to be envisaged between inter- and intracity traffic. For more information on proposed intercity transportation please refer back to chapter 5.

9 Financial and Economic Analysis

The evaluation of all of the proposed measures is given in chapter 9, starting with a description of the applied evaluation methodologies in chapter 9.1, with summarising investment and operational costs and with applying the methodology on proposed measures and giving the results and findings.

9.1. Evaluation Methodology

The Sustainable Urban Transport Master Plan takes a comprehensive multi-criteria approach to evaluate the impacts of the various transport measures. Comprehensive implies that not only costs and benefits are taken into account in the scenario evaluation, but as well safety, environment and social aspects.

The evaluation methodology has the following main features:

- Scenario development and definition measures to be assessed,
- economic assessment of investments,
- multi-criteria assessment of the above mentioned impacts, and
- a system dynamics model for macro-economic assessment.

9.1.1 Scenarios and definition of measures

Two types of scenarios have to be distinguished: land-use and transport scenarios. The steering committee's decision was to calculate the transport scenarios on the basis of the land-use scenario 'Polycentric Development' (see as well Chapter 2.1). Two scenarios have been developed to assess the impacts of the transport interventions:

- **Business As Usual for the year 2032 (BAU 2032):**
  This scenario assumes a continuation of the present policies with no major improvement of roads, public or non-motorised transport. It includes all measures already planned today. The BAU 2032 is used to assess the impacts of ST 2032.
- **Sustainable Transport for the year 2032 (ST 2032):**
  This scenario assumes major improvement of the transport system as described in the previous chapters.

Both scenarios will include projects in construction, planned and foreseen in 2012. All assessments are done by comparing BAU 2032 with Sustainable Transport 2032. Since a large number of interventions have been planned, it is impossible to assess all of them separately. In the contrary, it would contradict the aim of this strategic study. Assessments of single interventions have to be done on the level of feasibility studies that are laid down in the action plan.

Derived from the above chapters, seven bundles of interventions have been developed that are listed in Figure 9-1: , henceforth called measures. For some of the measures, it makes sense to compare variants. When adding three land-use and two transport scenarios, seven measures and four variants up, this study deals with 16 planning options. However, in order not to confuse the reader, a stepwise approach is taken to assess these options. Next to the selection of the land-use scenario described above, variants for some measures are assessed using a business economic approach. Only for the more favourable variant the multi-criteria assessment is conducted.

Figure 9-1: Measures and variants to be assessed

	Measure	Variants	Remarks
1	Public Transport in Windhoek	a. BRT/Bus b. LRT/BRT/Bus	Old parts of Windhoek as in 2012
2	Public Transport in the Northern Corridor	a. Commuter Rail + Feeder Buses b. BRT + Feeder Buses	New urban developments towards Okahandja including Brakwater
3	Public Transport in the Southern Corridor	Express Bus Service	New urban developments towards Rehoboth including Groot Aub
4	Public Transport in the Eastern Corridor	Express Bus Service	New urban developments towards Hosea Kutako including Finkenstein
5	NMT Network including pedestrian zones	No variants	
6	Road Reclassification	No variants	
7	Accompanying measures	Institutional & legal Transport Management Public Awareness	Impacts of measures are not assessed

Accompanying measures are very important for the success of most interventions, but they do not directly generate impacts or its effects are difficult to assess. For example, public awareness campaigns are very important for the acceptance of NMT, but their impacts may hardly be assessed. Therefore, accompanying measures are regarded as additional measures that improve the performance or acceptance of the above infrastructure investment measures.

9.1.2 Financial assessment of investments

Without economic sustainability, the proposed measures may not be recommended. It has to be emphasised that no single interventions are assessed which would be rather the scope of a feasibility study assessing macroeconomic costs and benefits. This study assesses the four variants by using a business economic approach that estimates the performance from the view of the public transport provider. Important criteria are, (i) which of the variants produces higher net profits, and (ii) if the revenues cover operational costs. Variants will be compared by calculating the Net Present Value of investments, operating costs, maintenance costs, and revenues. Financing costs are not regarded on this stage of pre-feasibility.

9.1.3 Multi-criteria assessment

The assessment criteria are derived from Namibia's Vision 2030. The assessment of the scenarios and measures will take up the goals and 'basic enabling areas'. The main goal is a "high and sustained economic growth". This shall be achieved through basic enablers, of which "public infrastructure", "reducing extreme poverty", "health" and "institutional environment" are relevant for the SUTMP. These enablers are specified by a number of variables as listed in Figure 9-2:

Figure 9-2: Goals and indicators for multi-criteria assessment

Topic	Variable	Unit	Explanation
High and sustained economic growth			
Cost Utility	Net Present Value	N$	All costs (infrastructure, operating) and revenues, no other benefits
Accessibility	Trip duration	Min/trip	Average travel time per trip
Impact on GDP	GDP/Capita	N$	Output of a system model
Impact on employment	employment ratio	%	Output of a system model
Public infrastructure and NMT			
Total investment costs	Costs for roads, public transport infrastructure and vehicles	N$	Expert calculation
Public transport usage	Modal split of public transport	%	Model output
Balanced mode choice	Modal split of NMT (walking&cycling combined)	%	Model output
Congestion	Travel Time in Congested Situations	hours/year	Level of service cogestion: Usage is bigger than 80% of road capacity
Cycle lanes & walkways	Length of cycles lanes	km	Expert calculation
Institutional sustainability			
Enabling legislative framework	Laws, by-laws and regulations related to sustainability	Marks 1-5	Expert judgement
Institutional capacities	Coordination, financing, participative planning, administrative procedures, etc.	Marks 1-5	Expert judgement
Reducing extreme poverty			
Transport cost for low income households	Transport costs per household	N$/trip	Only lowest income group
	Share transport costs of disposable income	%	
Average travel time	According to modes	min/trip	
Walking and cycling	Duration of daily travel per household	minutes/day	
Access to Public Transport Stops	Share of population with less than 15 minutes access to next public transport stop	%	
Health/Environment			
Road accidents	Road fatalities, injuries	Number p.a	Expert assessment
Local air pollution	NOx, CO,SO2, NO2 emissions	Tons p.a.	Model output
Climate Change	Carbon dioxide emissions	Tons p.a	Model output
External Costs	Climate Change, air pollution and accidents	N$ per year	Calculation of above

9.1.4 System dynamics model

The rapid growth of population and economic activity creates a challenge for urban development planning in the sense that following past trends will lead to unsustainable living conditions in the area, with detrimental impacts on environmental quality, attractiveness of city areas and economic potential of the city. A change of trends will be necessary in particular with respect to the management of transport flows. It will be necessary to divert substantial parts of the future traffic growth to public transport because otherwise congestion will no longer be manageable as well as the further external diseconomies of transport.

The project team intended to evaluate their concept of land use and transport planning for the city of Windhoek in economic terms. This implies that the concept should be tested with respect to its impacts on leading economic indicators such as GDP or employment. This is a challenge insofar as tested models for the impacts of transport infrastructure (or accessibility) on macro-economic indicators are only existing on the national and aggregate regional level worldwide. In the case of Namibia only a macro-econometric model exists without any regional disaggregation (van Frausum, 2012). Therefore it will be necessary to zoom to the regional and urban levels through using a flexible model approach which allows for an easy adjustment of model relationships with regional and urban benchmark data. Following a rich experience with different kinds of modelling it has been decided to use a System Dynamics Model (SDM) for the present purpose.

9.1.4.1 Outline of the System Dynamics Model

In order to assess the economic impacts of the traffic system of both developed scenarios 2032 on the economic performance in Windhoek, an appropriate System Dynamics Model (SDM) was developed. Taking into account the fast population growth and the expected rapid economic development and structural change in several regions of Namibia, in particular the Khomas Region, an SDM is the preferred approach to estimate the long run impacts. SDM combines a philosophy and a methodology[31]:

a) Basic philosophy is to model the feedbacks in a system as completely as possible for the given purpose, i.e. not to restrain to partial aspects or selected points of time of the future, as CBA or MCA approaches do.[32] As far as possible scientifically (e.g. econometrically) well-tested inputs are used. Other inputs can be generated by expert ratings.

b) Although the system may be highly complex, consisting of many non-linear dynamic equations, the numerical solution methodology cuts this complex structure down into a sequence of small and easy to calculate sub-problems. This allows for constructing large models (the largest European SDM ASTRA includes more than 200,000 dynamic variables).

The system to be constructed for the evaluation of economic impacts from transport policy in the Windhoek area includes three levels:

(1) The macro level of Namibia.

(2) The regional level, disaggregating Namibia to 3 macro regions.

(3) The urban level, disaggregating Windhoek to 6 urban districts.

Macro level: The population sub-module models the development of population, (natural), employment potential and education level (secondary and tertiary). The economics sub-module includes the variables of national account on the macro-level (GDP, employment, investment, consumption, exports, imports, government expenditure).

Regional level: Functional relationships[33] are established between gross value added (GVA) and potential factors, in this case measured by education level and quantity/quality of transport infrastructure (or accessibility indicators). These potential factors complement the effects of capital and labour input on GVA.

Urban level: Regional results are broken down to city districts.

[31] The methodology has been developed by Forrester (1968): Principles of Systems. Cambridge Univ. Press. Cambridge. Mass.
[32] CBA: cost-benefit analysis; MCA: multi-criteria analysis
[33] so-called quasi-production functions

The impact modelling for Windhoek transport investments then follows the feedback chain:

- transport improvement →
- Δ urban development potential →
- Δ regional GVA potential, employment →
- harmonisation with national accounts.

This type of approach helps to measure the impacts on all levels while at the same time avoiding double counting.

9.1.4.2 Structure of the model and data input

The model consists of 6 modules:

(1) National: GDP and production potential: Modelling aggregate supply and demand for Namibia in real terms. Indicators of national accounts. Without financial sector.

(2) National: Population and labour force: Development of population and employment for Namibia.

(3) Regional: Macro region North: Caprivi, Oshana, Kunene, Omusati, Ohangwena, Oshikoto, Kagango, Otjozondjupa. Population, production potential, labour force.

(4) Regional: Macro region South: Karas, Hardap, Erongo, Omaheke. Population, production potential, labour force.

(5) Regional: Khomas. Population, production potential, labour force.

(6) Urban: Windhoek, 6 districts. Breakdown of Khomas regional data.

Time horizon is 2011 – 2035. Time unit of simulation is a quarter of a year, i.e. the model computes 100 time periods. The model is started 5 periods before 2011 to smoothen initial fluctuations.

Data inputs are taken from:

- National Accounts 2001-2011; Namibia Statistics Agency.
- Namibia 2011 Population and Housing Census. Namibia National Planning Commission. 2012.
- Namibia Household Income & Expenditure Survey 2009/2010. Namibia Statistics Agency, 2012.
- Namibia Labour Force Survey 2008. Namibia Ministry of Labour and Social Welfare.
- Supply Driven Growth Model for Namibia. Presentation. Y. G. van Frausum for the National Planning Commission. 2012.
- TCP International / Aurecon. Sustainable Urban Transport Master Plan. Presentation. Methodology and Basic Input Data.
- TCP International / Aurecon. Interim Results on Land Use and Transport Planning for Windhoek.
- European Investment Bank. Technical Assistance for Namibia Integrated Transport Master Plan. Namibia Ministry of Works and Transport. 2012.

- European Investment Bank. Technical Assistance for Namibia Integrated Transport Master Plan. Socio-economic Drivers of the Transport Demand (Regional). Namibia Ministry of Works and Transport. 2012.

Missing elasticities are complemented by default values from European economic and transport modelling, adjusted by Namibia benchmark data. This means that the input data set is formally complete (this is a basic requirement of SDM modelling) while a part of the data inputs is not empirically tested for Namibia and its regions. This is important for interpreting the results which are mathematically accurate while they only can indicate rough orders of magnitude in the application context.

9.1.4.3 Scenarios and impact analysis

The project team has developed two scenarios for the transport development in the Windhoek area:

(1) Business as usual: Motorization follows past trends, no extension of transport infrastructure capacity. Rapid growth of population.

(2) Sustainable Urban Transport Master Plan (SUTMP): Public transport is substantially improved to accommodate future transport demand growth.

The interim results for transport time used in business traffic and commuting for the two scenarios serve as inputs for the SDM model calculations. Roughly speaking, the transport times double in the BAU scenario versus the present situation which corresponds to reducing the quality parameters for the transport infrastructure in the SDM accordingly. In the SUTMP scenario the average travel times almost remain constant compared with the present situation, which seems a considerable achievement regarding the expected doubling of population in the time horizon. The systems dynamics feedback mechanism induced by this change triggers the productivity of production processes in the first round of adjustment. In a second round also the influence of good education (secondary and tertiary) is reduced, because high qualified workers and employees loose a lot of productive time and will find the Windhoek region less attractive. This triggers the productivity of production again and reduces production efficiency, growth and employment.

All measures proposed are implemented in 5-year time steps (please refer also the implementation and financing plan in chapter 10). However, the benefits can only be assessed by taking into account all synergies generated by the combined measures through the synergies they generate. Also behavioral changes only occure in the medium to long run. Therefore, overall benefits were assessed for the year 2032. It has to be noted that of course most of the positive impacts are to be expected much earlier. The Sustainable Transport Scenario (2032) has the following results (please refer also to the performance figures given in 2-31 in chapter 2.6):

- Increased public transport share as a result of:
  - Improved access to the public transport system
  - Improved public transport travel times as a result of separated right of way
  - Improvement in quality of service
  - Improved perception about public transport
- Increased use of bicycles as a result of:
  - Improved cycling network
  - Improved safety for cyclists
  - Higher bicycle ownership
- A decrease in car usage as a result of a better public transport service
- A decrease in pedestrian trips as a result of the shift from walking to cycling and public transport

9.2. Capital Costs

The basis for the calculation of investment was shown in the chapter "5.7 Public Transport Infrastructure". In the following figures an overview about the investment during the different phases and for different corridors is summarised.

The following figure shows the investment costs for each implementation phase of the PT system including the necessary number of buses, trains and employees for the operation phase of the system.

Figure 9-3: Investment cost per phases for the overall system including other numbers

		BRT line km	BHLS line km	railway line km	PT network line km	vehicle km / day	buses / trains	passengers / day	employees	investment cost
2017	phase 1	21			21	11.623	36	36.000	219	824.000.000
2022	phase 2	27	36		63	34.493	80	67.000	424	679.250.000
2027	phase 3	27	71		98	53.809	103	94.000	543	578.750.000
2032	phase 4	27	87		114	62.639	120	121.000	609	287.375.000
2032	phase 4 rail			20		6.561	14	35.000	48	1.525.925.000
2032	phase 4 total	27	87	20	134	69.200	134	156.000	657	1.813.300.000

In Figure 9-4: the investment cost for Windhoek city without the PT lines on the northern corridor is shown.

Figure 9-4: Investment cost / system cost for Windhoek without lines to and within Brakwater

Windhoek	infrastructure	rolling stock	sum
line 1 BRT	408.125.000	87.500.000	495.625.000
line 2 BRT	335.000.000	70.000.000	405.000.000
line 3 BHLS	218.250.000	42.500.000	260.750.000
line 5 BHLS	242.000.000	30.000.000	272.000.000
line 6 BHLS	256.750.000	50.000.000	306.750.000
sum	**1.460.125.000**	**280.000.000**	**1.740.125.000**
16 minibus regions	24.000.000	89.600.000	113.600.000
total sum	**1.484.125.000**	**369.600.000**	**1.853.725.000**

The additional costs for the northern corridor are given in the following figure.

Figure 9-5: Investment cost / system cost for lines to and within Brakwater

northern corridor	infrastructure	rolling stock	sum
line 4 BHLS	256.875.000	50.000.000	306.875.000
line 7 BHLS	244.875.000	42.500.000	287.375.000
4 minibus regions	6.000.000	22.400.000	28.400.000
express bus	1.600.000	10.500.000	12.100.000
railway	965.925.000	560.000.000	1.525.925.000
sum	**1.475.275.000**	**685.400.000**	**2.160.675.000**

The investment cost for the Central Bus Station (CBS) with approx. 14 bus bulbs for BRT and BHLS buses and approx. 6 bulbs for intercity services plus some bulbs in reserve and space for mini buses and taxis is estimated with approx. 50.000.000 N$. This price can vary extremely according to the development state and the prestigious design of the station. Furthermore, experience shows that it is possible to cover the whole Central Bus Station (CBS) station e.g. via combining it with the development of a business centre or other facilities on top of the CBS. Therefore it was not included in the evaluated system cost but in accompanying measures.

Additionally there are investment costs for the implementation of a regular service to Okahandja, Rehoboth and the Airport Hosea Kutako. The whole costs for all services are listed in Figure 9-6:

Figure 9-6: Total investment cost / system cost for the whole examination area except CBS and mini buses

Cumulated Investments in Scenario ST 2032	Public Transport		
	Infrastructure	Rolling Stock	Total
Unit	N$	N$	N$
Windhoek	**1.484.125.000**	**369.600.000**	**1.853.725.000**
Northern Corridor	**1.475.275.000**	**685.400.000**	**2.160.675.000**
Southern Corridor	**1.600.000**	**14.000.000**	**15.600.000**
Eastern Corridor	**1.300.000**	**7.000.000**	**8.300.000**
Whole Scenario	**2.962.300.000**	**1.076.000.000**	**4.038.300.000**

Concerning NMT, the following figure summarises the cost items of all measures described in chapter 6.2

Figure 9-7: Summary of route lengths and total costs for sidewalks and cycle lanes

Route	Length of Route	One / both sides	Investment Costs
Red Route	13.7	2	37'812'000
Pink Route	15.9	1	21'445'200
Orange Route	13.5	1	22'123'125
Yellow Route	19.7	1	32'283'375

Route	Length of Route	One / both sides	Investment Costs
Brown Route	25.6	1	32'678'400
Green Route	14.9	1	19'019'850
Yellow Link Network	42.0	1	53'613'000
Brown Link Network	17.0	1	21'700'500
Green Link Network	32.0	1	40'848'000
NMT around Schools, Shopping, Industries etc.	lump-sum		300'000
Pedestrianisation CBD	lump-sum		48'000'000
Western Bypass (accompanying measure)	20.0	1	185'000'000
Total NMT Network	**194.3**		**514'823'450**

Overall SUTMP implementation costs within the time horizon of 20 years, for PT infrastructure and vehicles + NMT infrastructure and facilities + CBD pedestrianisation and Western Bypass NMT structure and all accompanying measures, i.e. planning, awareness and promotion campaigns and capacity building measures are given in the figure below.

Figure 9-8: Total Costs of SUTMP implementation

Overall SUTMP Implementation Costs	Investment	Accompanying Measures	Total
Cross-Cutting Issues	0	87	87
Public Transportation	4'038	63	4'101
Non-motorised Transport	329	226	555
Transport Demand Managem.	95	9	104
Total	4'462	384	4'846

9.3. Operating Costs

The operating cost calculations for the public transportation system are given in the following figures 120-123. They were calculated on the basis of an operational system model developed and successfully applied in many countries and cities by OSK Consult and adapted to the Namibian circumstances and reference system.

Figure 9-9: Operating costs and revenue during first implementation phase

Construction phase 1 (2017)					vehicles		pas. / day	pas / year
line 1 phase 1	9	km	5.000	km / day	16	buses	18.000	5.190.000
line 2 phase 1	12	km	6.623	km / day	20	buses	18.000	5.190.000
total network	**21,0**	**km**	**11.623**	**km / day**	**36**	buses	average price for a ticket	
total network			**3.351.196**	**km / year**			7	N$
maintenance and operation cost	9	N$ / km			30.160.763	N$ / year		
bus drivers	1,6	dr. / bus	58	drivers	13.824.000	N$ / year		
other administrative employees	0,3	pers/bus	11	pers.	3.888.000	N$ / year		
station masters BRT	4	pers/stat.	136	pers.	29.376.000	N$ / year		
station Masters BHLS	1	pers/stat.						
other operational employees	0,4	pers/bus	14	pers.	3.024.000	N$ / year	revenue	
			219	**pers.**	**80.272.763**	**N$ / year**	**72.660.000**	**N$ / year**

Figure 9-10: Operating costs and revenue during second implementation phase

Construction phase 2 (2022)				vehicles		pas. / day	pas / year
line 1 phase 2	15 km	8.278 km / day		25 buses		20.000	5.766.667
line 2 phase 2	12 km	6.623 km / day		16 buses		20.000	5.766.667
line 3 phase 2	17 km	9.106 km / day		17 buses		15.000	4.325.000
line 4 phase 2	19 km	10.486 km / day		22 buses		12.000	3.460.000
total network	**62,5 km**	**34.493 km / day**		**80**		average price for a ticket	
total network		**9.945.465 km / year**				7 N$	
maintenance and operation cost LRT	9 N$ / km			89.509.183 N$ / year			
drivers	1,6 dr. / veh	128 drivers		30.700.476 N$ / year			
other administrative employees	0,3 pers/veh	24 pers.		719.542 N$ / year			
station masters LRT	4 pers/stat.	180 pers.		3.240.000 N$ / year			
station Masters BHLS	1 pers/stat.	60 pers.		1.080.000 N$ / year			
other operational employees	0,4 pers/veh	32 pers.		576.000 N$ / year		revenue	
		424 pers.		**125.825.201 N$ / year**		**135.228.333 N$ / year**	

Figure 9-11: Operating costs and revenue during third implementation phase

Construction phase 3 (2027)				vehicles		pas. / day	pas / year
line 2 phase 1	12 km	6.623 km / day		16 buses		20.000	5.766.667
line 1 phase 2	15 km	8.278 km / day		25 buses		20.000	5.766.667
line 3 phase 2	17 km	9.106 km / day		17 buses		16.000	4.613.333
line 4 phase 2	19 km	10.486 km / day		20 buses		18.000	5.190.000
line 5 phase 3	17 km	9.382 km / day		12 buses		8.000	2.306.667
line 6 phase 3	18 km	9.934 km / day		13 buses		12.000	3.460.000
total network	**97,5 km**	**53.809 km / day**		**103**		average price for a ticket	
total network		**15.514.925 km / year**				7 N$	
maintenance and operation cost	9 N$ / km			139.634.325 N$ / year			
bus drivers	1,6 dr. / bus	165 drivers		39.552.000 N$ / year			
other administrative employees	0,3 pers/bus	31 pers.		927.000 N$ / year			
station masters BRT	4 pers/stat.	180 pers.		3.240.000 N$ / year			
station Masters BHLS	1 pers/stat.	126 pers.		2.268.000 N$ / year			
other operational employees	0,4 pers/bus	41 pers.		738.000 N$ / year		revenue	
		543 pers.		**186.359.325 N$ / year**		**189.723.333 N$ / year**	

Figure 9-12: Operating costs and revenue during fourth implementation phase (without railway)

Construction phase 4 (2032)					vehicles		pas. / day	pas / year
line 2 phase 1	12	km	6.623	km / day	16	buses	20.000	5.766.667
line 1 phase 2	15	km	8.278	km / day	25	buses	20.000	5.766.667
line 3 phase 2	17	km	9.106	km / day	17	buses	18.000	5.190.000
line 4 phase 2	19	km	10.486	km / day	20	buses	20.000	5.766.667
line 5 phase 3	17	km	9.382	km / day	12	buses	10.000	2.883.333
line 6 phase 3	18	km	9.934	km / day	13	buses	14.000	4.036.667
line 7 phase 4	16	km	8.830	km / day	17	buses	19.000	5.478.333
total network	**113,5**	**km**	**62.639**	**km / day**	**120**		average price for a ticket	
total network			**18.060.964**	**km / year**			7	N$
maintenance and operation cost	9	N$ / km			162.548.676	N$ / year		
bus drivers	1,6	dr. / bus	192	drivers	46.080.000	N$ / year		
other administrative employees	0,3	pers/bus	36	pers.	1.080.000	N$ / year		
station masters BRT	4	pers/stat.	180	pers.	3.240.000	N$ / year		
station Masters BHLS	1	pers/stat.	153		2.754.000			
other operational employees	0,4	pers/bus	48	pers.	864.000		revenue	
			609	**pers.**	**216.566.676**	**N$ / year**	**244.218.333**	**N$ / year**

Figure 9-13: Operating costs and revenue during fourth implementation phase (railway)

Construction phase 1 (2017)					vehicles		pas. / day	pas / year
commuter railway line	20,2	km	6.561	km / day	[m/s]	buses	35.000	10.091.667
total network	**20,2**	**km**	**6.561**	**km / day**	**0**	buses	average price for a ticket	
total network			**1.891.665**	**km / year**			7	N$
maintenance and operation cost	21	N$ / km			39.724.965	N$ / year		
bus drivers	1,6	dr. / train	22	drivers	8.601.600	N$ / year		
other administrative employees	0,4	pers/ train	6	pers.	806.400	N$ / year		
station masters	3	pers/stat.	14	pers.	9.072.000	N$ / year		
other operational employees	0,4	pers/ train	6	pers.	483.840	N$ / year	revenue	
			48	**pers.**	**58.688.805**	**N$ / year**	**70.641.667**	**N$ / year**

Figure 9-14: Operating costs and revenue per phases for the overall system

		BRT line km	BHLS line km	railway line km	PT network line km	vehicle km / day	buses / trains	passengers / day	employees	investment cost	operating costs N$ / year	revenues N$ / year
2017	phase 1	21			21	11.623	36	36.000	219	824.000.000	80.272.763	72.660.000
2022	phase 2	27	36		63	34.493	80	67.000	424	679.250.000	125.825.201	135.228.333
2027	phase 3	27	71		98	53.809	103	94.000	543	578.750.000	186.359.325	189.723.333
2032	phase 4	27	87		114	62.639	120	121.000	609	287.375.000	216.566.676	244.218.333
2032	phase 4 rail			20		6.561	14	35.000	48	1.525.925.000	58.688.805	70.641.667
2032	phase 4 total	27	87	20	134	69.200	134	156.000	657	1.813.300.000	275.255.481	314.860.000

In all cases of the construction phases, the revenues can reach or lightly exceed the operation costs. Only during the first phase, the operation costs are lightly higher than the revenues.

Of course, more detailed calculations for the real cash flow, i.e. investments, operational costs and revenues are to be undertaken during the next phase of project implementation, i.e. the feasibility study and the later detailed design. However, the conclusion for the time being is quite clear:

In average the operational costs can be covered by the revenues from ticket sales

Also very encouraging is the figure of 219 in the first phase up to 2017 and 657 permanent employed citizens (bus drivers, station masters and other administrative and operational staff) employed at the end of the given period just for the operation of the system without regard to other supporting functions. As a comparison, presently are ca. 90 permanent employed staff members.

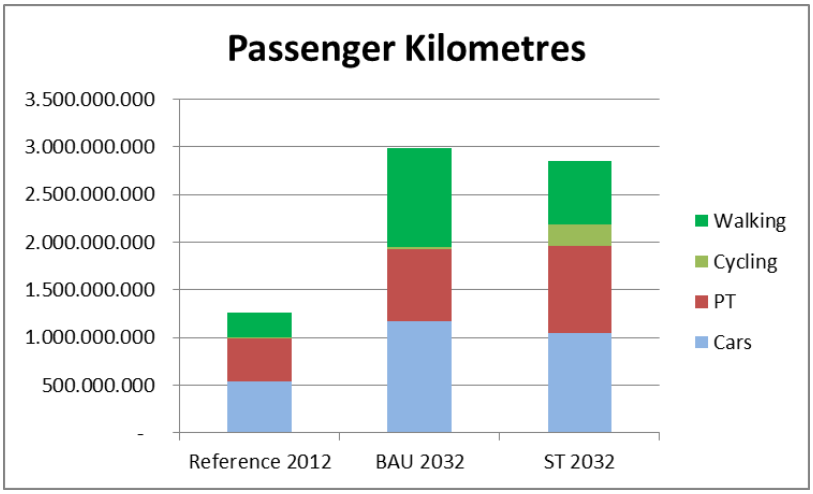
9.4. Multi-Criteria Analysis

The impacts of the planned measures are assessed using the goals laid down in the Vision 2030 for Namibia. However, before that a short overview on the transport impacts will be given.

9.4.1 Transport Development

The scenario calculations revealed a tremendous growth in transport volume in 2032 compared to 2012 (Figure 9-15). This mainly due to the large number of in migrating inhabitants combined with a per capita economic growth. Total Passenger kilometres increase by more than 130%. It has to be mentioned that this increase would have been even higher if not transport avoiding measures were implemented through poly centric and dense settlement structures (Chapter 2.5.3). Especially in Brakwater, places of employment and residential areas will be located close to each other and thus reduce trip length in such a manner, that many working trips can be done using non-motorised means of transport.

Figure 9-15: Transport volumes in the scenarios

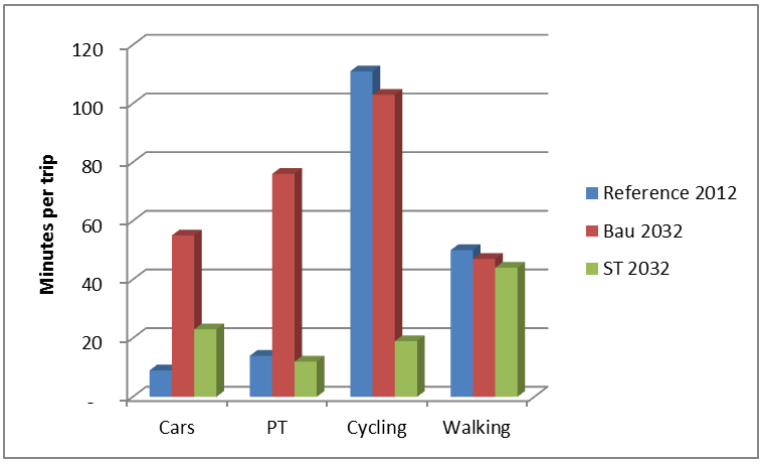


The second most important output of the scenarios is the development of travel times. Since for BAU2032 no major investments in road infrastructures have been assumed, the overall travel time increases enormously (Figure 9-16) as roads in Windhoek will be congested. While in 2012 people spend less than 10 Minutes in their car on average, in BAU2032 they will need nearly one hour for their trip. Since buses are caught up in the jam as well, travel time for bus passengers increases by more than one hour in 2032.

A strategy of simply extending road capacities will not solve the problem, since congestion would occur at places where roads cannot be widened. Additionally negative effects, such as separation, noise- and pollutant emissions, climate change and accidents would deteriorate. A sustainable solution is extension of public transport services and improvement of facilities for non-motorised transport. And the good news is, not only public transport passengers will save one hour travel, but

as well car users, that benefit with more than half an hour in the ST2032 Scenario. The trip duration in cycling can be explained by the fact that nowadays only enthusiasts cycle, but in ST2032 cycling has been made so attractive, that many people use their bikes for normal distances.

Figure 9-16: Average travel time in the Scenarios



To conclude:

the main impacts of the Sustainable Transport compared to BAU are a shift to more efficient and environmental friendly modes and higher speeds for all users.

9.4.2 High and sustained economic growth

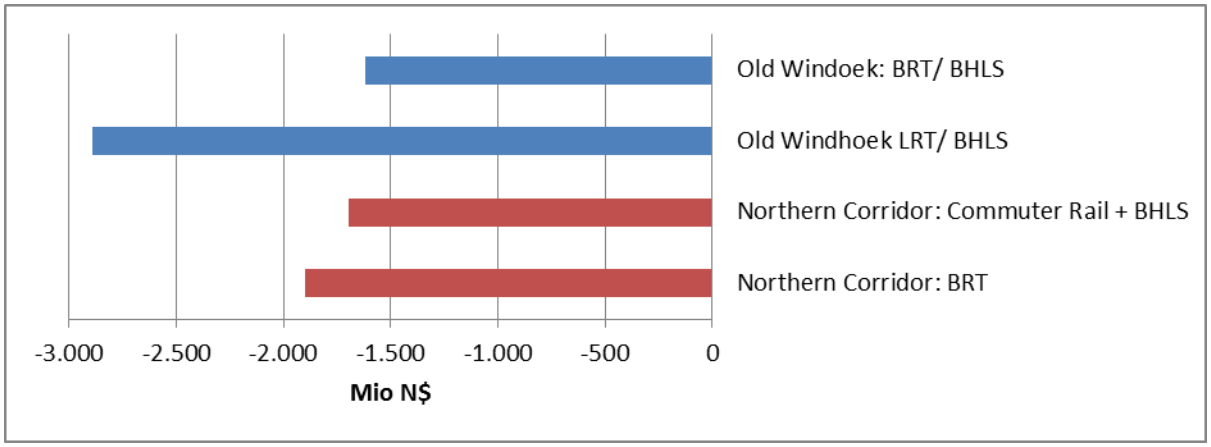
Economic growth is the most important goal of Vision 2030 and transport is an important enabling factor. Good access to places of production, services and employment is a precondition for high economic growth rates. The system dynamics model, described in Chapter 9.5, shows that due to major congestion in the BAU2032 Scenario, the economic development will be hampered considerably. The loss of production potential for Khomas is estimated 3 bn N$ or in a range of 5-6%. The reduction of employment is estimated about 12,000 work places in the Khomas region, i.e. predominantly for the urban area of Windhoek or in a range of 6-8 %. This is the output of the system dynamic modell which is explaned in chapter 9.5. The measures developed in ST2032 will overcome these constraints and thus be a precondition of strong economic growth.

As already described above, ST2032 has very positive effects on travel time and thus accessibility. Figure 9-16 shows that most measures reduce travel time considerably, not only for the improved Public Transport but as well for cars. The strongest impacts may be expected in the northern corridor where major congestion occurs in BAU2032. Without improvements, people have to walk long distances, while in ST2032 they take the bus to work. Old Windhoek and the Southern Corridor benefit as well from major travel time improvements. Only the road reclassification has minor negative impacts on travel times, since the maximum allowable speed is reduced. However, the slight travel time increase is more than compensated by the other measures in a manner that the overall accessibility is improving tremendously. This shows clearly, that measures to improve Public Transport accelerate overall speeds in Windhoek's entire transport system.

Figure 9-17: Impacts of ST2032 on accessibility

Improvement of travel time per trip [min/trip]	Impacts of ST2032 on Accessibility			
	Cars	PT	Cycling	Walking
PT Windhoek	-15	-19	0	0
PT Northern Corridor	-296	-232	0	-109
PT Southern Corridor	-23	-24	0	0
PT Eastern Corridor	-10	-7	0	0
NMT Network	0	0	-85	0
Road Reclassification	8	11	0	0
Whole Scenario	-32	-64	-84	-3

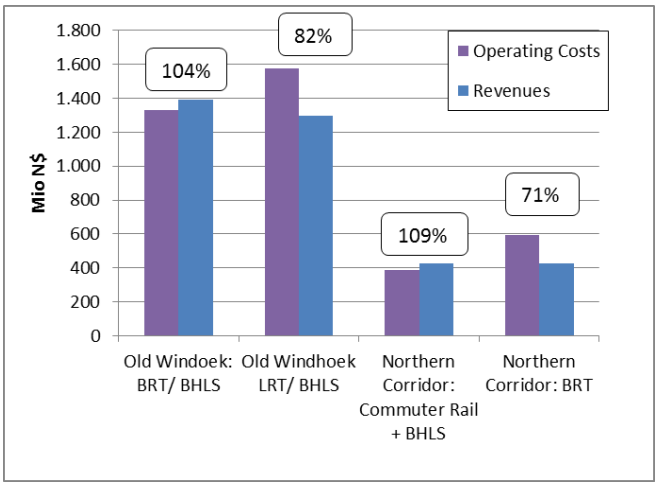
Figure 9-18: Net Present Value of investments[34]



Another important criterion is a comparison of recurrent costs and revenues. Figure 9-19 shows the Net Present Value of investment and operating costs and fare revenues over a period of 20 years. The highest cost coverage is achieved on the commuter rail in the northern corridor, followed by BRT in Old Windhoek. For both variants revenues exceed costs. Cost coverage for the alternative variants is not achieved.

[34] The net present value method means that each cash inflow/outflow is discounted back to its present value (PV). Then they are summed. Therefore NPV is the sum of all terms, $\frac{R_t}{(1+i)^t}$ where t - the time of the cash flow, i - the discount rate (the rate of return that could be earned on an investment in the financial markets with similar risk.); the opportunity cost of capital, R_t- the net cash flow i.e. cash inflow – cash outflow, at time t . For educational purposes, $R_0$is commonly placed to the left of the sum to emphasize its role as (minus) the investment. Given the (period, cash flow) pairs (t, R_t) where N is the total number of periods, the net present value (NPV) is given by: $\mathrm{NPV}(i,N) = \sum_{t=0}^{N} \frac{R_t}{(1+i)^t}$

Figure 9-19: NPV of annual costs and revenues and cost coverage ratio



To conclude, the variants BRT/BHLS in Windhoek and the Commuter Rail + BHLS in the Northern Corridor are the most favourable options regarding investment costs and coverage of operational expenditure.

9.4.3 Public infrastructure and NMT

For the development of the Sustainable Transport Scenario, considerable investment into infrastructure and rolling stock have to be undertaken that amount to the order of 4.5 bn N$ up to 2032. The largest share is spent on public transport improvements and is confined to Old Windhoek and the new town quarters in Brakwater. Redesign cost for roads only occur in Old Windhoek, but the new design will be applied in Brakwater as well without extra costs.

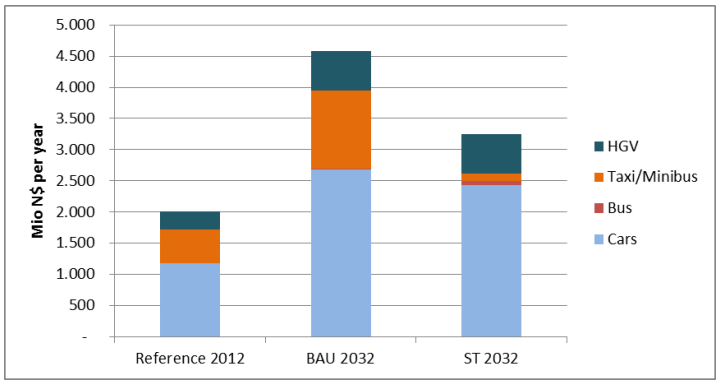
Figure 9-20: Cumulated Investments in Scenario ST 2032

Mio N$	Public Transport			NMT	Roads	Total Investments
	Infrastructure	Rolling Stock	Total	Infrastructure	Infrastructure	
PT Windhoek	1.484	370	1.854	299	95	2247
PT Northern Corridor	1.475	685	2.161	11	0	2172
PT Southern Corridor	2	14	16	11	0	27
PT Eastern Corridor	1	7	8	8	0	16
Whole Scenario	**2.962**	**1.076**	**4.038**	**329**	**95**	**4.462**

The amount of investments sounds rather large, but two issues have to be taken into account. Firstly, the expenditures will be stretched over a period of 20 years and secondly, the investments have to be counter balanced by macro-economic savings. Windhoek's population is benefitting through (i) reduced vehicle operating and (ii) congestion costs, as well as (iii) decreased environmental and accident costs (external costs).

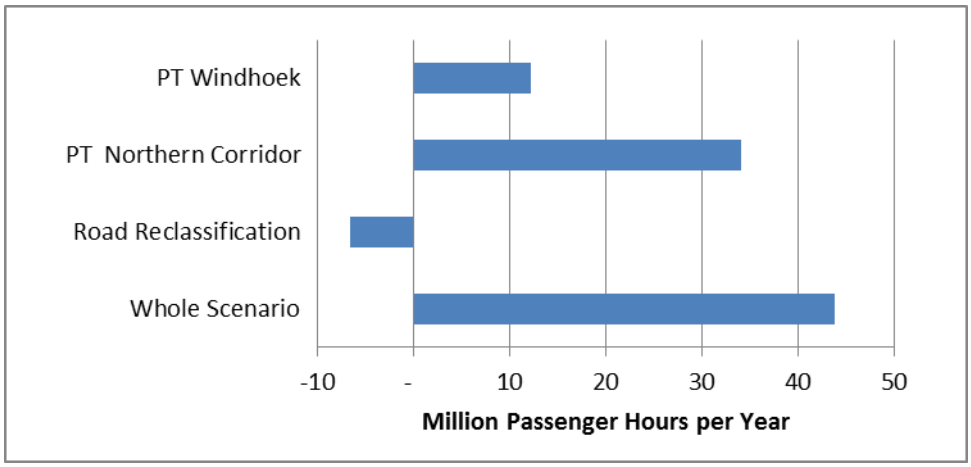
Vehicle Operating Costs (VOC) are carried by private and public entities (Figure 9-21). VOCs are assessed by applying specific cost data which EGIS 2013 used for the Namibian National Transport Master Plan originating from Road Authority HDM 4 System. Compared to 2012 VOC will increase in BAU 2032 by nearly 130%, but the measures planned in ST2032 will reduce the costs again by 29%. This is caused by the conversion of taxis into mini buses and the reduction of the kilometrage of private vehicles. The figure shows as well that vehicle operating cost of buses make up only a small share of total VOC. Thus, the investments into public transport will entail net cost savings of annually 1.3 billion N$.

Figure 9-21: Vehicle Operating Costs in the Scenarios



In Scenario BAU2032 Windhoek's passengers will spend annually more than 50 million hours in congested traffic situations[35]. The measures planned in ST2032 will save annually 44 million hours as depicted in Figure 9-22. The slight increase of congestion on reclassified roads is more than compensated by the other measures. If the saved time is valued according to World Bank rules[36], annually 2.2 bn N$ will be saved by Windhoek's population. The figure shows as well that congestion will be reduced mainly on the Northern Corridor.

Figure 9-22: Reduction of travel time in congestion in ST2032



The benefits of ST2032, comprising reduced VOC, congestion and external costs, amount to annual benefits of 4.3 bn N$. This may be compared to total investment costs of 4.5 bn N$ paid over a period of 20 years. Clearly, there may be huge macro-economic benefits expected. The population of Windhoek will benefit from the investments which the state has to pay. But the state will profit as well through tax revenues by increased growth (5-6%) and employment (7-8%). Therefore it is most probable that the city of Windhoek and the state of Namibia will improve the balance of their households by ST2032.

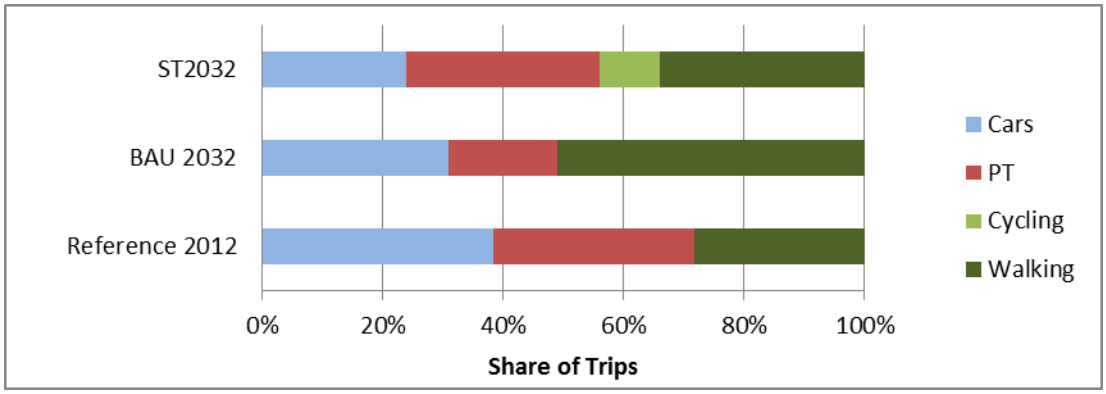
[35] Definition of congestion: level of service more than 80%
[36] World Bank Guideline: Value of time equals 50% of average wages

Figure 9-23: Comparison of Investments and Benefits in ST2032

Million N$	Period	Investments	Benefits
Investments PT, NMT, Road Design	20 years	4,462	
Reduction Vehicle Operating Costs	p.a.		-1,324
Reduction Congestion Costs(Time Savings)	p.a.		-2,183
Reduction External Costs	p.a.		-783
Total	**p.a.**	**223**	**-4,290**

The above investments into transport infrastructures have induced a modal shift towards more efficient and environmentally friendly transport means (Figure 9-24). While in 2012 about 38% of trips are driven with a car, this share decreases to 31% in BAU2032. This shift is the result of the transport avoiding urban planning measures that generate shorter trips that are undertaken mainly by walking. Another shift from away from cars is induced in Scenario ST2032 through the investments in Public Transport that reduce car trips to 24%. The improved public transport services entail that people are no longer forced to walk long distances. Since they use the bus instead, the number of walking trips decreases. The measures for bicycle improvement increase modal share to 10%.

Figure 9-24: Modal Split in the Scenarios

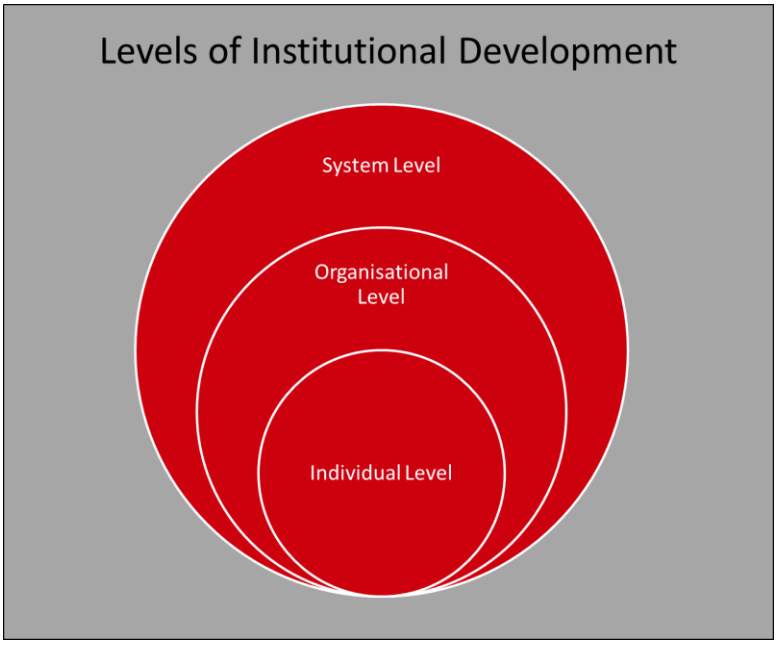


The overall assessment for public infrastructure reveals that costs may be easily recovered through alleviation of traffic jams, reduction of vehicle operating and external costs. These effects dominate in the whole study area, but the Northern and Southern Corridor have higher cost efficiencies. The construction of the NMT network has positive impacts on modal split, while the reclassification of the road network has major impacts through improved quality of urban life.

9.4.4 Institutional sustainability

Institutional Sustainability is frequently defined as the process by which individuals, organisations and social systems (see Figure 9-26 below) increase their capacities and performance in relation to goals, resources and environment.

Figure 9-25: Levels of Institutional Development[37]



At the **individual level** we find people and actors, including small networks and groups - participants in and managers of projects. They are the smallest and often most basic building blocks serving the requirements for individual competence, and representing conditions for any project or organisation to function efficiently and effectively.
The **organisational level** might be a government entity, a private sector firm or a community-based organisation. Relevant is the organisation's strategy, management, finances, administration, culture, workflow procedures etc.
The **system level** is the level extending beyond the organisation. System-level aspects include overall policies, laws, rules and norms governing the mandates, priorities, modes of operation, etc. within and across the respective sectors.
All levels and dimensions of institutional development (sometimes also referred to as capacity development) are to be addressed, in order to realise the potential of sustainability to its fullest extent.

This general concept **fits with the fourth National Development Plan** which addresses the institutional environment as a basic enabler. In this respect, the NDP4 requires amongst others an improved public service delivery and improved public private sector coordination.

In the multi-criteria assessment methodology there are two indicators for the institutional assessment, i.e.

- an enabling legislative framework relates to all changes necessary on the system level;
- the institutional capacities relates to both, the organisational and the individual level in the Government and in the private sector (e.g. taxi industry, bicycle distribution and repair etc.).

Guiding principles for institutional sustainability on the system level are:

- clear definition of functions and tasks;
- division of functions in market-driven and socially driven components;

[37] Source: Handbook in assessment of institutional sustainability, Oslo 2000

- no overlapping responsibilities and clear authorities;
- decentralisation/delegation of decision-making power for closer-to-the-people decisions;
- secure flow of sufficient funds.

Guiding principles for institutional sustainability on the organisational and individual level are:

- clear definition of functions and tasks within the entities;
- motivated and well-trained staff;
- involvement of stakeholders and private sector wherever possible;
- well-designed management information systems as basis for decision-making;
- secure flow of sufficient funds generated by user charges and/or PSOs;
- able to convert policies into services of value for the citizens / customers.

On all levels marks are given by expert judgment ranging from:

Identifiable and clearly to be observed or requiring just minor short term interventions (mark 1 = green)

to

Identifiable deficits easily to be overcome by some short to medium term interventions (mark 3 = yellow)

to

Hardly to be observed or requiring high interventions (mark 5 = red)

It has to be stressed again: the SUTMP measures suggested in this urban transport master plan will represent totally new challenges and require new skills as well as a revised legal and organisational set-up, e.g. up to now there are no skills and own experience available in Namibia on establishing a BRT system.

Chapters 4.5 ff highlighted these intervention requirements already and made suggestions in the form of accompanying measures which are also included in the implementation planning.

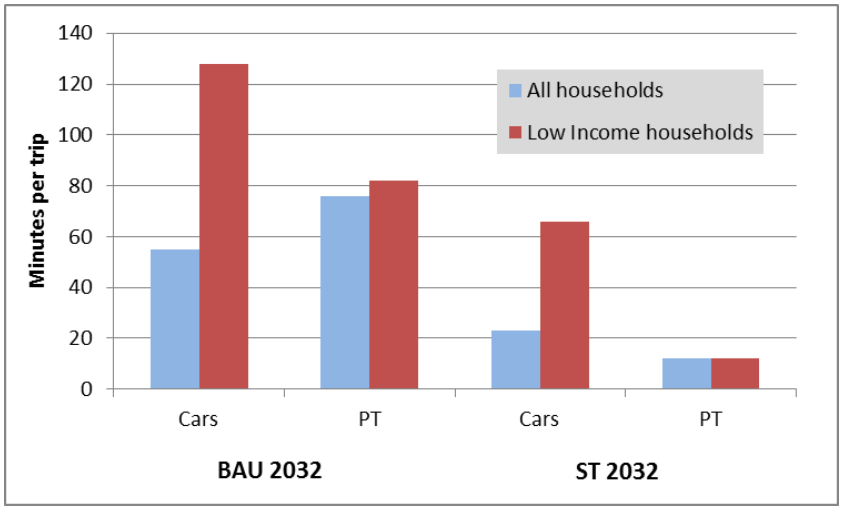
Thus, the marks given just reflect the present situation and can be encountered by the accompanying measures proposed in chapter 5 and summarised in chapter 10 in the short or medium or long run.

9.4.5 Reducing extreme poverty

Even though per capita income increases in Windhoek during the next 20 years, the in-migration of poor inhabitants will keep poverty issues on the agenda. Transport has two effects for low-income households: Firstly, transport constitutes a large burden for the small budget and secondly accessibility is constrained through low car ownership. Scenario ST2032 will alleviate these problems through the implementation of an efficient and affordable Public Transport system and the promotion of NMT.

Low income households will be affected most by the deteriorating traffic situation since their homesteads are far away from the town centre and places of employment. This situation will deteriorate in the BAU2032 Scenario where their travel times will be much higher than average households. However, ST2032 will improve speeds of low income households enormously: by using Public Transport they will save more than one hour per trip and travel with the same speed as an average household. Impacts are expected to be highest in the Northern Corridor.

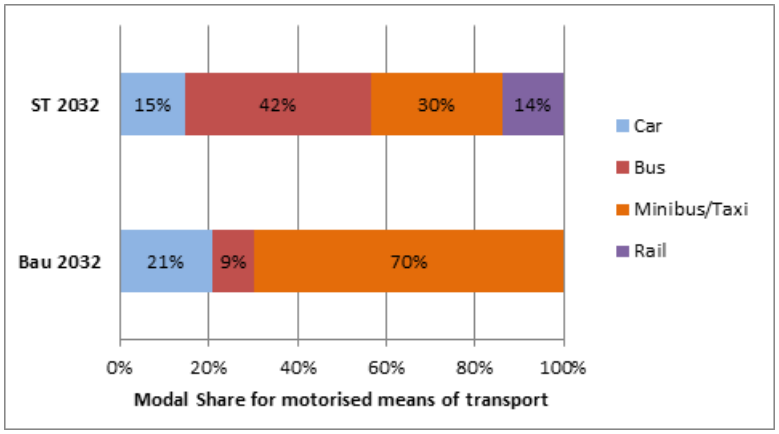
Figure 9-26: Comparison of travel times 2032 for low income and all households



One of the main goals is, to ensure that low income households have good access to public transport services. In BAU 2032 65% of the low income households reach the next bus stop within less than 15min walking. In St2032 minibuses will be introduced that serve as well low density areas and thus 95% of the population will have access to the next bus stop within 15 minutes.

Perhaps the most important impact for low income households will be determined by the modal share. While in BAU 2032 expensive car and taxi trips make up more than 90% of all motorised trips, in ST2032 this share decreases to 45%. Transport expenditure of low-income households will be reduced by 17%. This poses an enormous relief to low income household budgets of annually by more than 2000 $N; money which is available for good food, medicine, school books or other important items.

Figure 9-27: Modal share for low-income households



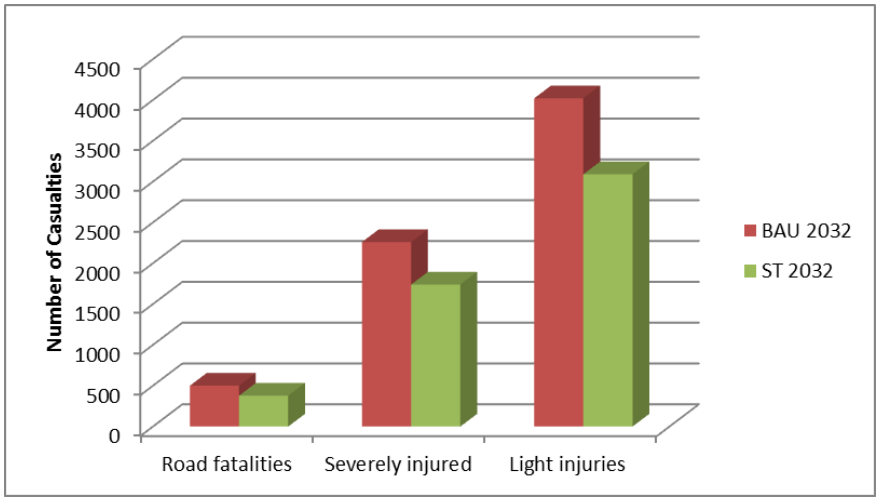
To conclude, the sustainable measures have a positive impact on poor households with a reduction of travel time, improved access to public transport and a 2000 N$ reduction of transport expenditure. Strongest impacts will be achieved through public transport improvement and the NMT network in Old Windhoek, followed by the Northern Corridor improvements. Other impacts are more or less neutral.

9.4.6 Health/Environment

Health and environmental effects may be assessed using the concept of external costs, which are costs caused be transport users but borne by the whole society. This study assesses the effects of accidents, climate change and air pollution. The methodology is adapted from the "Handbook on estimation of external cost in the transport sector" (Maibach 2007) using the newest specific cost from the study by CE Delft (2011) adjusted to Namibian values.

Road accident rates in Windhoek are the cause of major pain and grief amongst Windhoek's population. With the increasing transport volumes the number of road fatalities will increase as well and reach in the order of 500 in BAU2032. For comparison, in Stuttgart – the hometown of TCP International with 570,000 inhabitants – only eleven people were killed in road accidents in 2011. The ST2032 Scenario will implement a number of measures (please refer to chapter 7.3 road safety) that decreases traffic accidents by nearly a quarter as depicted in Figure 9-28 below. This means in 2032 there will be 122 lives saved, 520 less severe and 930 slight injuries. This will imply annual benefits of 652 million N$. The strongest impacts may be expected in "Old Windhoek" and the northern development corridor, where the largest share of traffic occurs.

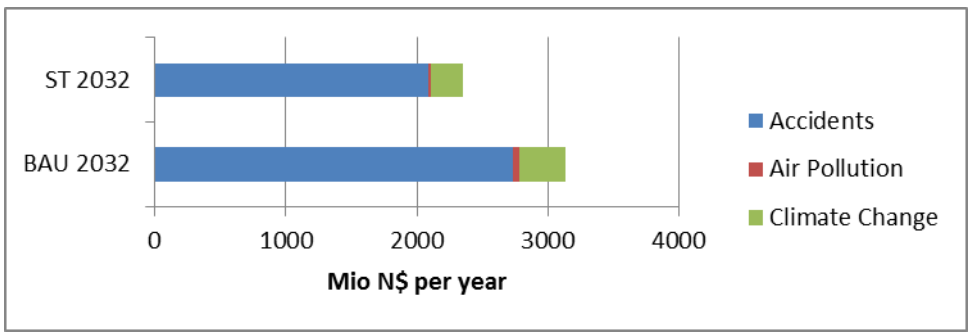
Figure 9-28: Road casualties 2032 in the Scenarios



Air pollution and climate change are other environmental effects that are considerably reduced by decreased car traffic in ST2032 that will reduce external cost by 16 resp. 115 m N$.

Total external costs amount to 3.1 bn N$ in BAU 2032 as depicted in Figure 9-29. The largest share is caused by accidents, followed by climate change effects and air pollution. The measures assumed in ST2032 will reduce external cost by annually 780 million N$.

Figure 9-29: External costs 2032 in the Scenarios



Most effects are generated in the highly populated areas of Khomas, i.e. Windhoek and the new quarters in Brakwater. The reclassification has as well very positive impacts through reduced traffic accidents.

9.4.7 Summary of Multi-criteria Assessment Results

To summarise the above findings Figure 9-31 was developed that gives an overview on the impacts and shortcomings of the sustainable transport measures developed. A dark green colour depicts the areas with the strongest impacts, while red and orange symbolise negative impacts or shortcomings.

The overall picture is positive: the planned measures have a positive impact on economic growth, public infrastructure, poverty, health and environment.

- Strong impacts on growth may be expected with a 5-6% higher growth rate and 7-8% higher employment.
- Poor households will save annually more than 2000 N$, have much better access to public transport and travel at faster speeds.
- Car users will benefit as well considerably through the improved public transport system which is reducing congestion to acceptable levels.
- Overall investments in infrastructure and rolling stock will amount to roughly 4.5 bn N$, spent over a period of 20 years which reduces costs to annually 220 Mio N$.
- These expenditures will be more than compensated by annual benefits of 4.3 bn N$; generated through reduced vehicle operating costs, decreased congestion and lower external cost.
- And last not least, each year 122 lives will be saved.

However institutional changes, necessary for a successful implementation, need to be tackled more rigorously in the future. Public transport has its strongest impacts in the densely populated areas of Old Windhoek and the new settlements in Brakwater. Non-motorised transport proves to be very good for poverty alleviation and thus is a good accomplishment of public infrastructures. The road reclassification has slightly negative impacts by on growth, but this will be by far compensated.

Figure 9-30: Multi-criteria Analyis

Goal	Economic growth	Public infrastruc-ture	Institutio-nal environ-	Redu-cing poverty	Health/ Environ-ment
Public Transport in Windhoek					
Public Transport in the Northern Corridor					
Public Transport in the Southern Corridor					
Public Transport in the Eastern Corridor					
NMT Network including pedestrian zones					
Road Reclassification					
Accompanying measures	No assessment				

9.5. Summary of System Dynamics Model – Interim Results

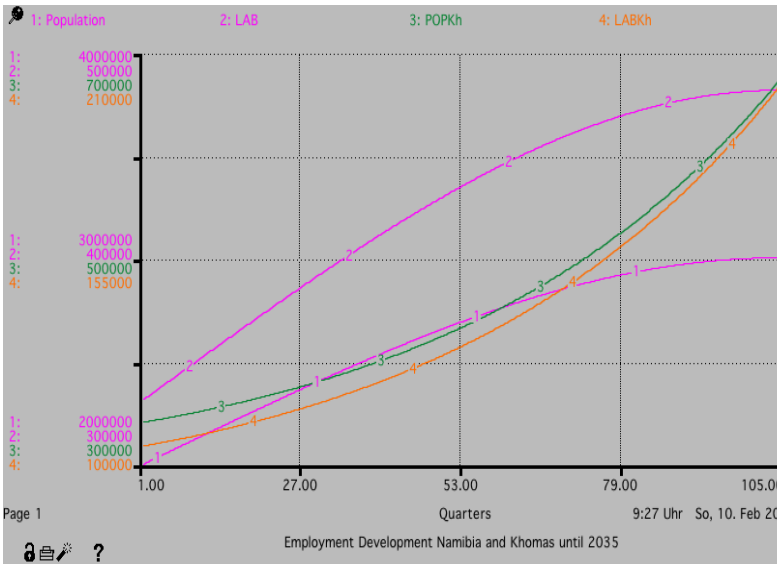
First results of SDM calculations are given in the following figures. Although all figures are mathematically accurate they indicate rough orders of magnitude and should not be over-interpreted, but they provide a clear tendency.

Scenario: Sustainable Urban Transport Master Plan

Population trends: The total population development shows decreasing growth rates for Namibia (from 2.1 to 3.05 mill. inhabitants). Reason is the presumed decline of birth rates with growing income level. Contrasting this general trend the population in the Khomas region is expected to grow with increasing rates (from 0.34 to 0.67 mill. inhabitants), which is mainly due to migration caused by income differentials. Graph 4 (employment Khomas) is steeper than graph 3 (average) in Figure 9-32.

Employment trends: Employment is influenced by growth of population, improvement of education level and production potential. The graphs show a similar shape compared with the population trends while the growth rates of employment for Khomas are higher than the growth rates of population because of the presumed increase of education level.

Figure 9-31: Stylized Development of Population and Employment in Namibia and Khomas



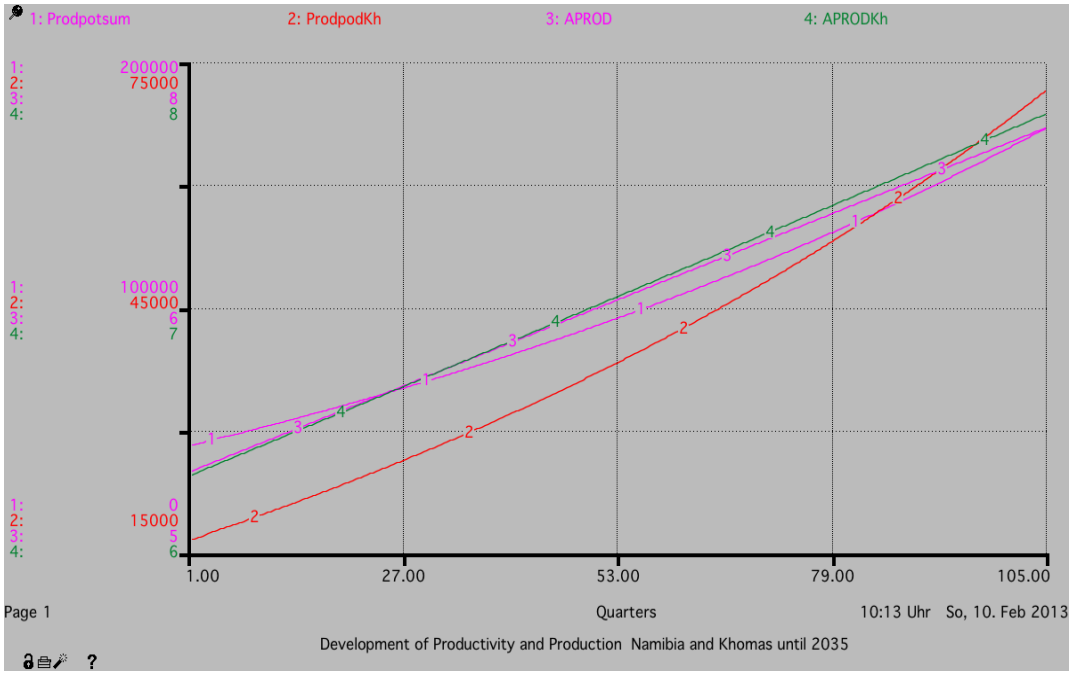
Note: Every graph has a different scale (indicated at the vertical axis, the horizontal axis gives the quarters up to the time horizon in 2035)

Graph 1: Population Namibia	Graph 2: Employment Namibia
Graph 3: Population Khomas	Graph 4: Employment Khomas

Trends of productivity and production potential: Productivity[38] in the Khomas region is developing faster compared with the national average. The productivity index is driven by net investments, education level and infrastructure quality. All drivers are assumed to be higher in Khomas than average (see Figure 9-33, graph 4 represents Khomas productivity index, developing faster than average (graph 3); therefore the Khomas development of production potential (graph 2 is steeper than average (graph 1)).

[38] The modelling approach uses the total factor productivity which indicates the efficiency of production.

Figure 9-32: Stylized Development of Productivity Index and Production Potential in Namibia and Khomas



Note: Every graph has a different scale (indicated at the vertical axis)

Graph 1: Production Potential Namibia

Graph 2: Production Potential Khomas

Graph 3: Productivity Index Namibia

Graph 3: Productivity Index Khomas

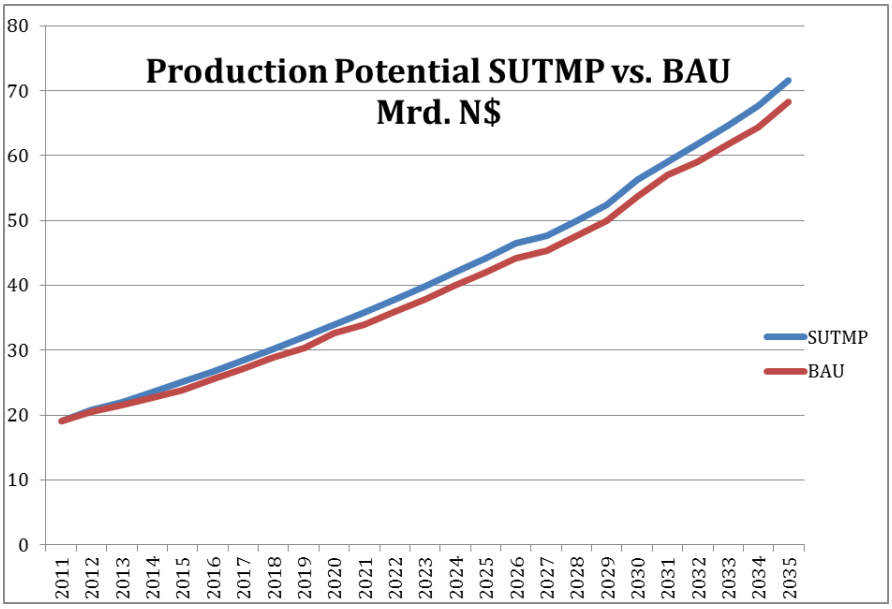
Scenario: Business as Usual

In the following we compare the indices

- ➔ productivity
- ➔ production potential
- ➔ employment

for the two scenarios SUTMP and BAU.

Figure 9-33: Stylized Development of Production Potential for Scenarios SUTMP and BAU



Graph 1: SUTMP Graph 2: BAU

The slow-down of economic development is caused by decreasing efficiency of transport in the first round of adjustments and a less efficient use or education potential in the second round of feedbacks. The productivity index goes down by 5%.

To conclude:

The loss of production potential for Khomas in the last period of the time horizon (2035) is estimated 3 Bill. N$ or in a range of 5-6%.

The reduction of employment is estimated around 12,000 work places in the Khomas region, i.e. predominantly for the urban area of Windhoek or in a range of 6-8 %.

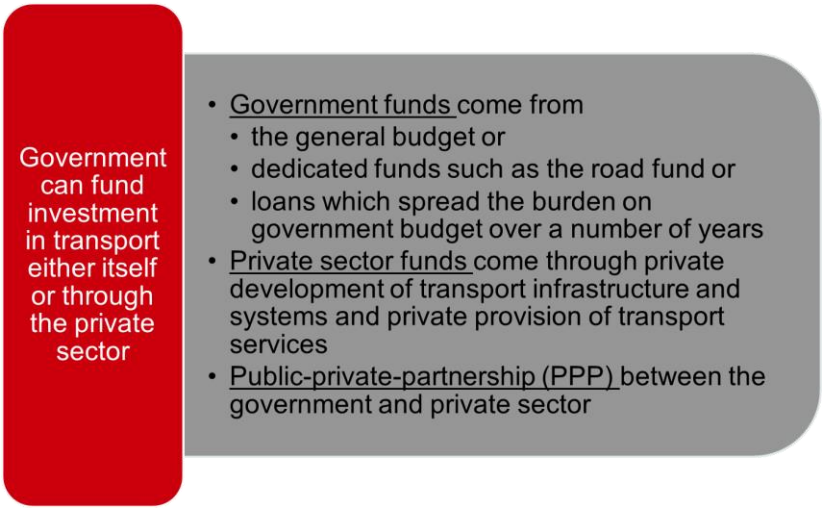
10 Financial and Implementation Plan

This chapter starts with a brief general description and outline of funding options available to the key stakeholders for SUTMP realisation. Thereafter all proposed investment and soft measures given in the chapters above are culminating in an implementation and financing plan.

10.1. Public and Private Funding Sources

General funding options for transport sector investments are given in the figure below.

Figure 10-1: General funding options for transport sector investments



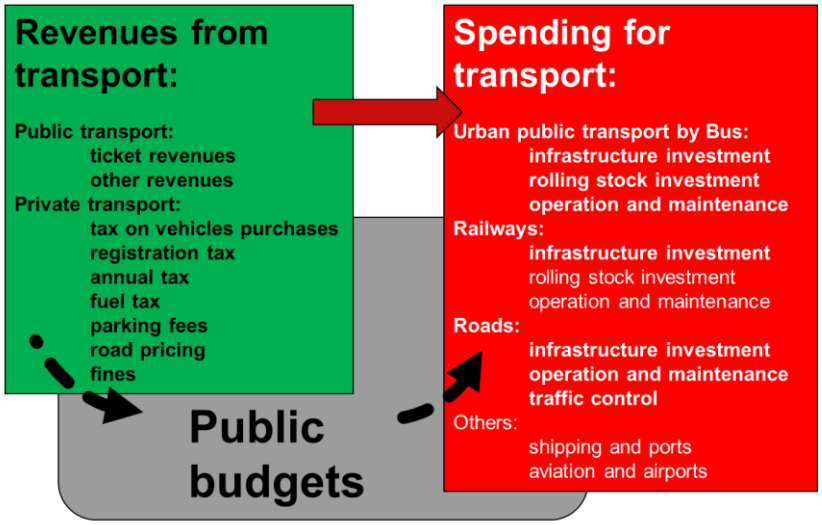
It is strongly advised that a mixture of all financing options ought to be considered when it comes to SUTMP implementation financing.

In addition, economic and fiscal instruments form an important part of any sustainable transport strategy[39]. In fact economic and fiscal instruments need to be optimised in view of the targeted modal shift towards public and non-motorised transportation without interfering too much in the transport market. With other words, fiscal interventions ought to be undertaken with a view to the user-pays-principle, the internalisation of external costs and incentive based demand-side management.

The following figure provides an overview of revenues, expenditures and budget provisions which need to be optimised in view of the SUTMP objectives. The task is the optimisation of the cash flows indicated by the red and black arrows.

[39] Refer also to GIZ Sourcebook Sustainable Transport – Module 1b) Economic Instruments, January 2004 and module 1f –Financing Sustainable Urban Transport, July 2010.

Figure 10-2: General Cash flow in the transport sector



Capital investments for infrastructure are normally expensive, fixed assets such as railways, busways, cycle paths, tramlines, stations, roads and bridges. This also includes investments in new technologies such as the purchase of vehicles and well as system-wide technologies such as intelligent transport systems.

For the city of Windhoek, those investments (including PT in the new settlement area without roads and NMT in the new settlement areas), require large levels of financial resources and this cannot be solely met from local sources. Therefore, the role of the national government and international donors is crucial.

Recurrent expenditure requires a continuous stream of financial resources long after the capital investment have taken place. This includes the operation of public transport, paratransit and other transport services and the maintenance of infrastructure, administrative costs for city administrations, police, and other public functions, support for policies and programmes such as legislation, regulation and traffic rules, air quality management programmes, safety campaigns, and traffic management – including signalling, bus lanes, priorities at crossings, etc. Those recurrent costs should be generally met by users of the transport system (e.g. via road tolls, parking fees, etc.)

If not all of those elements are supported somehow, the financial and economic sustainable urban transport system is not given. In fact to address this overall financial framework will be one of the major tasks of the proposed Special Commission on Sustainable Transport.

In principle, it is preferable that the government does not step in the administrative complexity of operating subsidies but bear the cost of the infrastructure[40]. For example, the Government ought to provide the bus terminals and stations free of charge as well as land for depots at below-market costs and the provision of rail tracks and stations enabling commercialised rail and bus operators using the system.

[40] Please refer also to GIZ Sourcebook on Sustainable Transport – Economic Instruments, January 2004

10.1.1 Budgetary funding options

The entire repairs and maintenance budget of *the City of Windhoek* is ca. 200 mln N$ per year, thereof ca. 115 mln N$ for the urban roads and storm water repairs. Thus, there is some room for accommodating revisions of the road design of existing roads within the next 20 years and an increasing share of NMT and PT infrastructure. For the budget year 2013 / 2014 the City of Windhoek assigned for kick-off measures of the SUMTP the amount of ….. However, there is no room to accommodate a major up-grading in the pace necessary and additional funding sources are required.

The *Ministry of Works and Transport (MWT)* has also the potential to bear a considerable part of the planning and capital costs for more sustainable transport measures. However, they need to balance interest and capital needs within all sub-sectors. Guiding principle for such a balance ought to be the creation of a fair levelled playing field among the transport modes and their contribution to accommodate the mobility needs of the society and the economy in a most effective way. The positive impacts of a shift towards more sustainable transportation were already clearly proven in chapter 9 above and the MWT has already assigned a SUTMP start of budget for 2013 / 14 budget year in the amount of xxx and inserted SUTMP measures in its medium term budgetary framework.

An important player is the *Road Fund Administration*. Already now, the road fund supports urban road construction works in CoW to a minor extent[41]. This could be possibly increased especially as some measures such as the redesign of the urban road space and assigning parts of it to NMT and PT users will contribute to reduced maintenance costs in the future.

In many countries, road user charges are also rechanneled to enhance public transportation. The reason is that PT reduces the need for road capacity extensions and also reduces congestion on existing networks, thus allowing also the private road users a better service quality on the existing network.

Presently, the room for manoeuvre of the RFA is rather limited and financial means are hardly suitable for the tasks assigned to the RFA. Thus, in the strategic decision meeting it is rightfully stated that the potential for increasing fuel levy in order to finance PT and NMT needs to be investigated. This investigation is aggravated by the fact, that the fuel levy is governed by the Ministry of Mining and underlies other rationalities as purely transport related ones.

The *Ministry of Regional and Local Government, Housing and Rural Development (MRLGHRD)* proved already their commitment by inserting a SUTMP implementation budget for the year 2013/2014. However, the exact amounts are not yet known to the Consultant. There is also the potential and the willingness for inserting certain SUT measures in the medium term budgetary framework. Also the Ministry could play an important role in cascading the principles towards other cities and regions in Namibia.

There are various *International Financing Institutions (IFI)* interested in financing sustainable urban transport projects especially if such investments are financially and economically viable, contribute to a considerable extent to reduce greenhouse gases and towards poverty reduction and economic growth. Positive impacts could be clearly proven for all of those decisive factors (see chapter 9).

Especially to mention is the interest of the "Kreditanstalt für Wiederaufbau (KFW), who is already engaged in the transport sector in Namibia and certainly could be interested in financing parts of the SUTMP measures, too. Furthermore, the AfDB has expressed interest in the SUTMP project and might step in on Government request. It is strongly advised to take-up contact with the respective IFI's as soon as possible. Especially when it comes to the Public Transport Feasibility Study, an IFI might want to have a say in the study outline in order to be able to step according to their respective rules and regulations.

[41] Presently, the RFA supports the CoW road budget with ca. 12 %

There needs to be a clarification among the three main key stakeholders about which measures can or have to be taken over by the CoW itself, which measures are the obligation of the MWT and its affiliates and which measures can and should be supported by the line ministry of the cities and regions, i.e. the MRLGHRD and which parts could be possibly taken over by credit funding. In the investment plan in chapter 10.5 the third column gives some indications in this respect. The fourth Steering Committee Meeting decided about a coordination meeting in order to obtain clarification in this respect and this issue will also be an important first task of the Special Commission of Sustainable Transport (SCST) to be established.

10.1.2 Private and Public-Private Funding Options

Whereas infrastructure provision also for public transport and non-motorised transport infrastructure is the main domain of the State, eventually supported by international financing institutions (IFIs), operations and services are more prone towards private provision and also private funding.

A commercialisation of operations and services was also envisaged in strategic directions given to the project team. A possible scenario could be that Government outsources bus operations and take a strategic and experienced private investor on board in order to achieve an influx of know-how and capital. This applies especially for the envisaged BRT but also for the envisaged commuter train measures.

SUTMP mind shift requires promotion. There is a keen interest of the private sponsors as shown already in the past, present and future e.g. in private sponsoring of cycle race events or road safety campaigns or free of charge advertisements in some media or by the intended establishment of a velodrom with children traffic education facilities included. The state should actively encourage and initiate such promotional sponsoring measures not just for financial reasons but also for increasing private participation and ownership.

Last but not least the manifold SUTMP accompanying measures ought to be financed also by a combination of state and private stakeholders, eventually further on supported by the German – Namibian development cooperation for those parts requiring specialised technical expertise and inputs.

10.1.3 Budgetary Savings and Potential for Additional Revenue Generation

The total investment costs of 4.4 bn N$ are enormous. But, it has to be stressed again that those investments are outweighed already by the monetised economic benefits of the SUTMP measures in the same amount (please refer to chapter 9.4.3) without even speaking of positive non-monetised impacts. And, they are partially outweighed by direct financial savings in governmental expenditures or additional revenues for the government or in savings in the foreign currency reserves of Namibia:

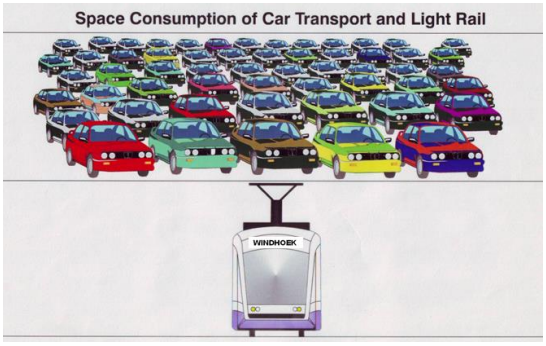
a) The expected decrease of accidents and especially of fatalities and injuries will have a considerable impact on

- MVA funding needs
- Health budgets

b) Public transportation requires less road space compared to the same amount of trips made by individual traffic. For example when driving with a speed of 50 km/h, a private car or taxi requires 170 m^2 per passenger and a bus only 4.6 m^2 per passenger or with other words only 2.5%

of the space consumption of a private vehicle[42]. The following figure gives a visual impression on this fact.

Figure 10-3: Space consumption of private vehicles versus public transportation



Thus, the introduction of public transportation on existing road space contributes considerable to increasing the capacity of the entire road network. Road extension and up-grading measures can be deterred or might even not be necessary at all within the study horizon. The calculation of the net-effect requires highly sophisticated and detailed modelling and planning and is not possible within this strategic master planning process. However, it is obvious that those impacts on existing road budgets are expected to be enormous.

c) Already in chapter 9.4.6 the positive impacts of the ST Scenario on pollution levels are shown. As pollution is directly related to the consumption of oil / gasoline, it can be stated that a noteworthy reduction in oil consumption is achieved. Namibia as a net oil importer can reduce foreign currency needs.

d) Decriminalisation of traffic offences will make enforcement measures more effective and will certainly result in higher revenues from fines.

e) The same applies for the parking management measures envisaged at a later stage of SUTMP implementation. It is expected that parking fees will also result in higher income for the Government. Concerning parking management it is strongly advised to revise the present regulation of earmarking those fees for creation and maintaining of parking space.

f) Opposite to the present operational losses for the municipal busses as well as within TransNamib, the improved PT is expected to fully cover its operational costs and will also have a positive gross margin to the overall infrastructure costs.

g) Last but not least, the positive employment, growth and multiplicator effects stemming directly from the infrastructure investments and indirectly via the delivery of a better public service will lead to additional tax income of the state. However, the positive direct impacts from investments can only be realised if in the tender procedures and consequently in each contract award it is made sure that the majority of material production and labour is from Namibian resources and not imported. Imports are only recommended for those goods where no local production can be ensured, e.g. for commuter trains or BRT buses.

[42] Underlying assumption is that the private vehicle transports in average 1.4 passengers per car and the bus load factor is 50%.

10.2. Financing of public and non-motorised investment

The total financing needs for all SUTMP measures, i.e. direct SUTMP related investments plus accompanying measures amounts to 4'846 mio. N$ (please refer also to Figure 114 in chapter 9.2) within the next 20 years.

The accumulated budget requirement in million N$ until the time horizon is

- ➔ 2017 is 1'279
- ➔ 2022 is 1'007
- ➔ 2027 is 700
- ➔ 2032 is 1'860

So the burden can be spread over the next 20 years and will go along with the increasing population of the CoW and its neighbouring cities.

It has also to be noted that this total figure does not at all mean that all costs have to be covered by the Government of Namibia and its affiliated entities. Depending on the future organisation of the public transport system, the main part of the vehicle costs and some infrastructure costs might be taken over by private investors.

Furthermore, some cost items especially in the accompanying measures relate to originating tasks of the Government. They might have become more urgently required and induced through the SUTMP project but are anyhow necessary to be introduced.

It was already stated that there is a need for additional budgets as within existing CoW, MWT and MRLGHRD budgets the project cannot be realised. Thus, only view additional remarks will amend statements made in chapter 10.1 already.

The project team was advised that the Government could get along with the additional burden of the investments within the next 20 years, as long as there is an efficient service provision and a net stream of economic benefits.

As indicated the normal capital outlay for the CoW is around N$300 million a financial year and to secure N$30 million for NMT alone (=10%) would be a great start in order to have the entire envisaged NMT network (without Western Bypass) established within 11 years' time. This 10% correspond also with a postulation for better NMT infrastructure of the UNEP backed by many development partners.[43]

If supported by the line ministry and the MWT this financial burden on CoW budgets could be even practicable.

For PT and accompanying measures an important first task of the Special Commission on sustainable transportation is the financial engineering, i.e identifying the optimum mixture of Government funds, IFI support spreading the burden over several years as well as private investors and sponsor involvement.

There is one important point to consider: main NMT and PT lines mostly feature along the same arterial routes. In addition, the implementation of the road reclassification measures touches also the same routes. Aggravating is the fact, that PT measures require longer planning cycles than NMT measures. Intensive and effective project management is required in order to sequence road improvement and reconstruction measures in a way that doubling of construction work as well as expensive later revisions of already established structures is avoided or at least kept to a minimum. Thus, in the next planning phases of the SUTMP project implementation, cost allocation needs to

[43] UNEP / FIA, Share the Road – Investment in Walking and Cycling Road Infrastructure, November 2010.

be fine-tuned and study teams for the feasibility study, the road re-classification study as well as for the NMT Design need to be closely coordinated.

10.3. Financing of public transport operation

Calculations clearly revealed (see chapter 9.3) that operational costs can be covered with a slightly increased tariff compared to the existing situation. This slight increase appears to be justified when considering the much better service quality and with a view to the GDP per capita increases to be expected within the time horizon. Revenues might be further increased by e.g. advertising space at bus stations and other PT facilities and by land development and rents e.g. at bus terminals / stations, they might also be further increased by zone based tariff systems and other tariff optimisation schemes in the long run.

However, it is highly recommended to introduce public service obligations for all cases where for political reasons certain parts of the populations (students, elderly, veterans etc.) or access reasons public transport services are requested which are not cost covering.

In the next phase of the project (feasibility phase), the overall scheme needs to be optimised in view of more PT targeted stated preferences and similar behavioural surveys, sensitivity analysis for the tariff schemes and optimisation/detailing of alignment, construction, line extension and transport capacity schedules.

However, it has also to be clearly stated that this will only materialise when the government sets the rules and regulations for public transport in a commercialised and transparent manner allowing efficient and effective service delivery.

10.4. Implementation Plan

All major proposed measures were translated in activities and cumulated in an implementation plan, giving the priorities identified in the technical chapters. The implementation plan starts with accompanying measures necessary for ensuring a smooth implementation of the entire master plan. The following figure shows the cumulated implementation plan and gives the overall actions.

A first task of SUTMP implementation, in addition to ensuring of the financing for the next phases (please refer also to the next chapter 10.5), must be to build sub-actions for each item given in the following figure.

Implementation and Action Plan		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	beyond 2032
Cross-cutting measures																						
A1	Intergovernmental Institutional, Legal and Funding Special Commission (SCST) on Sustainable Transport																					
A2	Capacity Building in the Government Sector for future SUTMP planning																					
A3	Capacity Building in the Government Sector for Public Transport Regulation																					
A4	Capacity Building in the Government Sector for PT Planning and Operation																					
A5	Capacity Building in the Government Sector for NMT and TM Planning and Implementation																					
A6	Stakeholder Engagement and Public Hearings in the planning processes																					
A7	Accompanying Consultancy for SUTMP Implementation Plan																					
A8	Additional Staff in the Governmental Sector for SUT implementation																					
A9	Establishing a National Transport Agency for Public Transport (NaTA) with municipal branches																					
A10	Intensified enforcement to discourage illegal road user behaviour and ensure safety and security of NMT and PT users																					

Implementation and Action Plan		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	beyond 2032
A11	Education and Awareness Campaigns for Sustainable Transport in the CoW																					
Public Transport Measures																						
B1	Feasibility Study for proposed BRT / LRT lines and accompanying bus network																					
B2	Tender documents (functional tender) for engineering design of Central Bus Station																					
B3	Detailed planning for short term improvement of existing bus network according to SUTMP measures																					
B4	Planning and Construction for Central Bus Station																					
B5	Construction of BRT lines 1 and 2 (red and blue route) first phase																					
B6	Preparation of Concessioning, Marketing, Passenger Information and Ticketing System																					
B7	Integrate the PT taxi operators via incentive schemes into the overall integrated PT System in 5 regions																					
B8	Inauguration and start of operation lines 1 + 2, including rearrangement of existing bus lines and taxis services for feeder lines																					
B9	Construction of Bus lines 3 and 4 and extension BRT line 1																					

Implementation and Action Plan		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	beyond 2032
B10	Inauguration and start of operation lines 3 and 4 and whole line 1, incl. rearrangement of existing bus lines / taxis services for feeder lines																					
B11	Integrate the PT taxi operators via incentive schemes into the overall integrated PT System in 5 regions																					
B12	Construction of bus lines 5 and 6																					
B13	Inauguration and start of operation lines 5 and 6, including rearrangement of existing bus lines and taxis services for feeder lines																					
B14	Integrate the PT taxi operators via incentive schemes into the overall integrated PT System in 5 regions																					
B15	Construction of bus line 7																					
B16	Inauguration and start of operation line 7, including rearrangement of existing bus lines and taxis services for feeder lines																					
B17	Integrate the PT taxi operators via incentive schemes into the overall integrated PT System in 5 regions																					
B18	Construction of commuter railway system																					
B19	Inauguration and start of commuter railway system, including rearrangement of existing bus lines and taxis services for feeder lines																					

Implementation and Action Plan		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	beyond 2032
B20	Planning and Tendering PT Service to Rehoboth																					
B21	Construction of PT Service to Rehoboth																					
B22	Planning and Tendering PT Service to Okahandja																					
B23	Construction of PT Service to Okahandja																					
B24	Planning and Tendering PT Service to Hosea Kutako International Airport																					
B25	Construction of PT Service to Hosea Kutako International Airport																					
B26	Introduction of PT priorities at main intersections																					
Non-motorised Measures																						
C1	Preparing tender documents and Engineering Design for Core Cycle and Pedestrian Network (NMT principal network)																					
C2	Pilot Implementation for NMT Network																					
C3	Architectural Design Competition for Closure of parts of Independence Av.																					
C4	Principle NMT Network red route																					

Implementation and Action Plan		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	beyond 2032
C5	Principle NMT Network light red route																					
C6	Principle NMT Network pink route																					
C7	Principle NMT Network yellow route																					
C8	Principle NMT Network orange route																					
C9	Principle NMT Network brown route																					
C10	Principle NMT Network green route																					
C11	NMT link network yellow area																					
C12	NMT link network brown area																					
C13	NMT link network green area																					
C14	NMT additional links around educational sites pre-school and primary school incl. facilities																					
C15	NMT additional links around educational sites - Secondary Schools incl. facilities																					
C16	NMT additional links around educational sites Tertiary incl. facilities																					
C17	NMT additional links around CBD and shops incl. facilities																					

Implementation and Action Plan		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	beyond 2032
C18	NMT additional links around major public transport stops or interchanges incl. facilities																					
C19	NMT additional links around major employment zones incl. facilities																					
C20	Green Travel Plans																					
C21	Way finding, place setting and aesthetics																					
C22	Promotional Activity - Car Free day																					
C23	Awareness Creation Activities																					
C24	Other promotional events																					
C25	Scholars educational activities																					
C26	Promotion of increased bicycle ownerhsip																					
C27	Pedestrianisation of CBD																					
C28	Pedestrianisation of further sections of CBD																					
C29	Detailed design of NMT lane along Western Bypass																					
C30	Construction of NMT lane along Western Bypass																					

Implementation and Action Plan		2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	beyond 2032
Transport Management Measures																						
D1	Tender for reclassification of urban network study including design standards and revision of red book																					
D2	Planning of accompanying road traffic management for closure of CBD and introduction of segregated NMT / PT.																					
D3	Two pilot projects for re-design of road space																					
D4	City-wide introduction of re-classified road standards																					
D5	Introducing parking management schemes																					
	= main action			= preparatory or continous action																		

10.5. Investment Plan

The next step in the planning phase was the translation of the implementation plan in an investment plan.

Costs given are only investment costs as further explained in the respective chapters above. There is no distinction made between CoW budget, MWT budget or budget from other stakeholders such as the MRLGHRD and eventually private or IFI contributions. However, the fourth column indicates from which budgets the investment might stem from.

Actions		Basic Assumption	Potential Source of Funding	2013 - 2017	2018 - 2022	2023 - 2027	2028 - 2032	Total Investment in N$
Cross-Cutting Measures								**86.570.000**
A1	Intergovernmental Institutional, Legal and Funding Special Commission (SCST) on Sustainable Transport	Government officials assigned to the committe within their normal duties. Amount refers only to assumed permanent secretariat of the SC and additional consultancy needs	MWT budget	**11.000.000**	**0**	**0**	**0**	**11.000.000**
A2	Capacity Building in the Government Sector for future SUTMP planning	On-the-job training, internships and train-the-trainer, seminars and study tours for existing and additional staff with a view to a holistic SUT approach	CoW and MWT supported by IFI	**5.000.000**	**0**	**0**	**0**	**5.000.000**
A3	Capacity Building in the Government Sector for Public Transport Regulation	On-the-job training, internships and train-the-trainer, seminars and study tours for existing and additional staff	CoW and MWT supported by IFI	**3.000.000**	**0**	**0**	**0**	**3.000.000**
A4	Capacity Building in the Government Sector for PT Planning and Operation	On-the-job training, internships and train-the-trainer, seminars and study tours for existing and additional staff	CoW and MWT supported by IFI	**6.000.000**	**0**	**0**	**0**	**6.000.000**
A5	Capacity Building in the Government Sector for NMT and TM Planning and Implementation	On-the-job training, internships and train-the-trainer, seminars and study tours for existing and additional staff	CoW and MWT supported by IFI	**6.000.000**	**0**	**0**	**0**	**6.000.000**
A6	Stakeholder Engagement and Public Hearings in the planning processes	intensified stakeholder engagement at the beginning of detailed planning. Thereafter normal schedule of yearly CoW public hearings.	CoW and MWT and MRLGHRD	**1.000.000**	**0**	**0**	**0**	**1.000.000**
A7	Accompanying Consultancy for SUTMP Implementation Plan	Assumption 1 international long-term and additional short-term expertise.	MWT supported by IFI	**12.500.000**	**0**	**0**	**0**	**12.500.000**
A8	Additional Staff in the Governmental Sector for SUT implementation	>5 more staff members permanent for advancing sustainable urban transport (engineers, planners, procurement specialists, etc.)	CoW and MWT	**6.000.000**	**0**	**0**	**0**	**6.000.000**
A9	Establishing a National Transport Agency for Public Transport (NaTA) with municipal branches	Transferal of the additional staff members (A8) to the newly established transport agency. Future higher staff requirements and thus higher costs will be outweighed by increased fees for service.	MWT	**6.000.000**	**10.000.000**	**10.000.000**	**10.000.000**	**36.000.000**
A10	Intensified enforcement to discourage illegal road user behaviour and ensure safety and security of NMT and PT users	within the normal Namibian and Municipal police tasks	CoW and NamPol	**0**	**0**	**0**	**0**	**0**
A11	Education and Awareness Campaigns for Sustainable Transport in the CoW	Advertisements, signs, press releases, technical conferences, from 2023 onwards costs to be born the PT operators, tourism board etc.	CoW, MWT + IFI + private sponsors	**30.000**	**40.000**	**0**	**0**	**70.000**

Actions		Basic Assumption	Potential Source of Funding	2013 - 2017	2018 - 2022	2023 - 2027	2028 - 2032	Total Investment in N$
Public Transport Measures								**4.101.300.000**
B1	Feasibility Study for proposed BRT / LRT lines and accompanying bus network	Optimising and detailing the MP concept	MWT + CoW supported by IFI	**8.000.000**	**0**	**0**	**0**	**8.000.000**
B2	Tender documents (functional tender) for engineering design of Central Bus Station	This task can be already started because there will be no principal change in the amount of bus lines and in the capacity of the station	CoW supported by IFI	**1.000.000**	**0**	**0**	**0**	**1.000.000**
B3	Detailed planning for short term improvement of existing bus network according to SUTMP measures	incl. revised operational schedules, marketing, customer information, fare collection system + detailed design ofbus stations (new and rehabiliation of existing)	CoW	**4.000.000**	**0**	**0**	**0**	**4.000.000**
B4	Planning and Construction for Central Bus Station	including intercity bus terminal, costs depending on selected design	CoW + private developers	**50.000.000**	**0**	**0**	**0**	**50.000.000**
B5	Construction of BRT lines 1 and 2 (red and blue route) first phase	including design, construction and vehicles	CoW supported by IFI + PSP	**824.000.000**	**0**	**0**	**0**	**824.000.000**
B6	Preparation of Concessioning, Marketing, Passenger Information and Ticketing System	Costs included in B5	MWT + National Agency for PT + CoW	**0**	**0**	**0**	**0**	**0**
B7	Integrate the PT taxi operators via incentive schemes into the overall integrated PT System in 5 regions	Costs relate mainly to vehicle costs for provision of the entire regulated service.	Private Investors + MWT + CoW + NaTA	**28.400.000**	**0**	**0**	**0**	**28.400.000**
B8	Inauguration and start of operation lines 1 + 2, including rearrangement of existing bus lines and taxis services for feeder lines	Costs included in B5	MWT + National Agency for PT + CoW	**0**	**0**	**0**	**0**	**0**
B9	Construction of Bus lines 3 and 4 and extension BRT line 1	including design, construction and vehicles	CoW supported by IFI + PSP	**0**	**679.250.000**	**0**	**0**	**679.250.000**
B10	Inauguration and start of operation lines 3 and 4 and whole line 1 incl. rearrangement of existing bus lines and taxis services	Costs included in B9	MWT + CoW + NaTA	**0**	**0**	**0**	**0**	**0**
B11	Integrate the PT taxi operators via incentive schemes into the overall integrated PT System in 5 regions	Costs relate mainly to vehicle costs for provision of the entire regulated service.	Private Investors + MWT + CoW + NaTA	**0**	**28.400.000**	**0**	**0**	**28.400.000**
B12	Construction of bus lines 5 and 6	including design, construction and vehicles	CoW supported by IFI + PSP	**0**	**0**	**578.750.000**	**0**	**578.750.000**

Actions		Basic Assumption	Potential Source of Funding	2013 - 2017	2018 - 2022	2023 - 2027	2028 - 2032	Total Investment in N$
B13	Inauguration and start of operation lines 5 and 6, including rearrangement of existing bus lines and taxis services for feeder lines	Costs included in B12	MWT + CoW + NaTA	**0**	**0**	**0**	**0**	**0**
B14	Integrate the PT taxi operators via incentive schemes into the overall integrated PT System in 5 regions	Costs relate mainly to vehicle costs for provision of the entire regulated service.	Private Investors + MWT + CoW + NaTA	**0**	**0**	**28.400.000**	**0**	**28.400.000**
B15	Construction of bus line 7	including design, construction and vehicles	CoW supported by IFI + PSP	**0**	**0**	**0**	**287.375.000**	**287.375.000**
B16	Inauguration and start of operation line 7, including rearrangement of existing bus lines and taxis services for feeder lines	Costs included in B15	MWT + CoW + NaTA	**0**	**0**	**0**	**0**	**0**
B17	Integrate the PT taxi operators via incentive schemes into the overall integrated PT System in 5 regions	Costs relate mainly to vehicle costs for provision of the entire regulated service.	Private Investors + MWT + CoW + NaTA	**0**	**0**	**0**	**28.400.000**	**28.400.000**
B18	Construction of commuter railway system	including design, construction and vehicles	MWT + PSP + IFI	**0**	**0**	**0**	**1.525.925.000**	**1.525.925.000**
B19	Inauguration and start of commuter railway system, including rearrangement of existing bus lines and taxis services for feeder lines	Costs included in B18	MWT + CoW + NaTA	**0**	**0**	**0**	**0**	**0**
B20	Planning and Tendering PT Service to Rehoboth	Costs included in A9	MWT + NaTA	**0**	**0**	**0**	**0**	**0**
B21	Construction of PT Service to Rehoboth	mainly vehicle costs	NaTA + PSP	**12.000.000**	**0**	**0**	**0**	**12.000.000**
B22	Planning and Tendering PT Service to Okahandja	Costs included in A9	MWT + NaTA	**0**	**0**	**0**	**0**	**0**
B23	Construction of PT Service to Okahandja	mainly vehicle costs	NaTA + PSP	**9.100.000**	**0**	**0**	**0**	**9.100.000**
B24	Planning and Tendering PT Service to Hosea Kutako International Airport	Costs included in A9	MWT + NaTA	**0**	**0**	**0**	**0**	**0**
B25	Construction of PT Service to Hosea Kutako International Airport	mainly vehicle costs	NaTA + PSP	**8.300.000**	**0**	**0**	**0**	**8.300.000**

Actions		Basic Assumption	Potential Source of Funding	2013 - 2017	2018 - 2022	2023 - 2027	2028 - 2032	Total Investment in N$
B26	Introduction of PT priorities at main intersections	within the normal CoW traffic planning and maintenance tasks - no extra costs assigned	CoW	**0**	**0**	**0**	**0**	**0**
Non-motorised Measures				**0**	**0**	**0**	**0**	**555.400.000**
C1	Preparing tender documents and Engineering Design for Core Cycle and Pedestrian Network (NMT principal network)		MWT, CoW + IFI	**4.000.000**	**0**	**0**	**0**	**4.000.000**
C2	Pilot Implementation for NMT Network	planning and start of construction, including awareness creation measures (see also C23)	MWT + CoW	**30.000.000**	**0**	**0**	**0**	**30.000.000**
C3	Architectural Design Competition for Closure of parts of Independence Av.	For preparing design competition tender and accompanying measures outside normal work of tendering departments of CoW	CoW	**1.250.000**	**0**	**0**	**0**	**1.250.000**
C4	Principle NMT Network red route	Detailed design and construction	MWT + IFI	**13.800.000**	**0**	**0**	**0**	**13.800.000**
C5	Principle NMT Network light red route	Detailed design and construction	MWT + IFI	**24.000.000**	**0**	**0**	**0**	**24.000.000**
C6	Principle NMT Network pink route	Detailed design and construction	MWT + IFI	**16.125.000**	**5.375.000**	**0**	**0**	**21.500.000**
C7	Principle NMT Network yellow route	Detailed design and construction	MWT + IFI	**24.225.000**	**8.075.000**	**0**	**0**	**32.300.000**
C8	Principle NMT Network orange route	Detailed design and construction.	MWT + IFI	**11.050.000**	**11.050.000**	**0**	**0**	**22.100.000**
C9	Principle NMT Network brown route	Detailed design and construction	MWT + IFI	**0**	**32.700.000**	**0**	**0**	**32.700.000**
C10	Principle NMT Network green route	Detailed design and construction	MWT + IFI	**0**	**19.000.000**	**0**	**0**	**19.000.000**
C11	NMT link network yellow area	Detailed design and construction	CoW	**13.400.000**	**40.200.000**	**0**	**0**	**53.600.000**

Actions		Basic Assumption	Potential Source of Funding	2013 - 2017	2018 - 2022	2023 - 2027	2028 - 2032	Total Investment in N$
C12	NMT link network brown area	Detailed design and construction	CoW	**0**	**21.700.000**	**0**	**0**	**21.700.000**
C13	NMT link network green area	Detailed design and construction	CoW	**0**	**20.050.000**	**20.050.000**	**0**	**40.100.000**
C14	NMT additional links around educational sites pre-school and primary school incl. facilities	Detailed design and construction	MWT + MoE	**30.000**	**0**	**0**	**0**	**30.000**
C15	NMT additional links around educational sites - Secondary Schools incl. facilities	Detailed design and construction	MWT + MoE	**40.000**	**0**	**0**	**0**	**40.000**
C16	NMT additional links around educational sites Tertiary incl. facilities	Detailed design and construction	MWT + MoE	**35.000**	**35.000**	**0**	**0**	**70.000**
C17	NMT additional links around CBD and shops incl. facilities	Detailed design and construction	CoW	**10.000**	**20.000**	**0**	**0**	**30.000**
C18	NMT additional links around major public transport stops or interchanges incl. facilities	Detailed design and construction	MWT + CoW	**0**	**100.000**	**0**	**0**	**100.000**
C19	NMT additional links around major employment zones incl. facilities	Detailed design and construction	CoW + private sponsors	**20.000**	**10.000**	**0**	**0**	**30.000**
C20	Green Travel Plans	Eventually several ones for different parts of the network or for different adressees such as scholars, tourists etc.	CoW + Tourist Board + private sponsors	**250.000**	**100.000**	**100.000**	**100.000**	**550.000**
C21	Way finding, place setting and aesthetics	involves pedestrian and cyclist specific directional and information signage as well as map displays and visual improvements	CoW + MWT	**0**	**150.000**	**100.000**	**50.000**	**300.000**
C22	Promotional Activity - Car Free day	Pilot event and in case of success frequent repetition	CoW + GIZ	**0**	**0**	**0**	**0**	**figure from GIZ**
C23	Awareness Creation Activities	Traffic Signs for attention of walkers and cyclists crossing, awareness creation for the vulnerability of NMT users together with NRSC etc	CoW for signs, NRSC for rest	**600.000**	**300.000**	**300.000**	**200.000**	**1.400.000**
C24	Other promotional events	Cycle / walk to school or to work events to be realised in PPP with private sponsors and associations.	CoW + private sponsors	**80.000**	**20.000**	**60.000**	**40.000**	**200.000**

Actions		Basic Assumption	Potential Source of Funding	2013 - 2017	2018 - 2022	2023 - 2027	2028 - 2032	Total Investment in N$
C25	Scholars educational activities	Establishment of an educational training ground and offering 1/2 day traffic and cycle training to school classes	CoW + private sponsors + MoE	**1.750.000**	**700.000**	**250.000**	**250.000**	**2.950.000**
C26	Promotion of increased bicycle ownerhsip	via employer incentives, community based bicycle repair shops, SME promotional activities, bike sharing activities	CoW, MWT + private initiatives such as BEN	**100.000**	**250.000**	**250.000**	**0**	**600.000**
C27	Pedestrianisation of CBD	closure of parts of indepencence, incl. walkways, cycle lanes, redistribution of existing traffic flows, costs depend on selected design, parts of costs incl. in red route	CoW	**24.000.000**	**0**	**0**	**0**	**24.000.000**
C28	Pedestrianisation of further sections of CBD	as above	CoW	**0**	**0**	**24.000.000**	**0**	**24.000.000**
C29	Detailed design of NMT lane along Western Bypass	after solution for outstanding legal and institutional issues via the SCST	not to be determined yet	**50.000**	**0**	**0**	**0**	**50.000**
C30	Construction of NMT lane along Western Bypass	costs not included in the evaluation as construction became necessary for political reasons	not to be determined yet	**92.500.000**	**92.500.000**	**0**	**0**	**185.000.000**
Transport Management Measures								**103.500.000**
D1	Tender for reclassification of urban network study including design standards and revision of red book	to be done in close cooperation with C1 and in coordination with B1	MRLGHRD + MWT supported by IFI	**5.000.000**	**0**	**0**	**0**	**5.000.000**
D2	Planning of accompanying road traffic management for closure of CBD and introduction of segregated NMT / PT.	to be done in close cooperation with C1 and B1, B2 and B3, including ca. 10 traffic microsimulations and reprogramming of robots. For introduction refer to C27	CoW	**3.500.000**	**0**	**0**	**0**	**3.500.000**
D3	Two pilot projects for re-design of road space	Design and reconstruction - preferably for living streets including public hearing / private sector participation	CoW	**5.000.000**	**0**	**0**	**0**	**5.000.000**
D4	City-wide introduction of re-classified road standards	The cost estimate does not contain the roads which are supposed to be on proposed PT or NMT lines	CoW, MWT, MRLGHRD	**7.500.000**	**37.500.000**	**37.500.000**	**7.500.000**	**90.000.000**
D6	Introducing parking management schemes	Income from parking management ought to outweigh measures of parking management. Thus no cost is assigned	CoW	**0**	**0**	**0**	**0**	**0**

Actions	Basic Assumption	Potential Source of Funding	2013 - 2017	2018 - 2022	2023 - 2027	2028 - 2032	Total Investment in N$
Total SUTMP additional budget requirements per year			**1.279.645.000**	**1.007.525.000**	**699.760.000**	**1.859.840.000**	**4.846.770.000**
Assumptions:							
- - all figures are given in Namibian Dollar, for foreign currency components, assumption is 1 Euro = 11 N$ - - only measures which are not already budgeted or included in the regular budget - - assumption that some of the consultancy measures with international inputs							

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Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

P.O Box 8016
Windhoek, Namibia,
www.sutp.org

Ministry Works and Transport

Head Office Building
6719 Bell St
Snyman Circle
Windhoek