PUBLIC TRANSPORT NETWORK CLASSIFICATION: A PROPOSED OUTLINE FOR TSHWANE

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ABSTRACT

With the increase in vehicle sales and traffic volumes currently being experienced, increasing congestion and the difficulty to provide more road space within urban areas, there is renewed emphasis on the role of public transport to meet the mobility needs of people. To improve public transport public transport infrastructure must, inter alia, be provided to a level adequate to address the mobility and accessibility needs related to the service. The focus of this paper is on road based public transport infrastructure. There is limited guidance available on how road based public transport infrastructure should be provided within the urban context. The aim of this paper is to provide an outline for (a) the definition of a public transport network for the City of Tshwane, and (b), the classification of such a network into primary, secondary and tertiary public transport routes. The aim is further to provide a guiding framework for the provision of public transport infrastructure for the different public transport road classes. The benefit of the approach is that it will serve as a guideline in the provision of public transport infrastructure where roads are constructed or upgraded, and will serve as a basis for the planning of and budgeting for public transport infrastructure needs on the public transport network.

1. BACKGROUND

With the increase in vehicle sales and traffic volumes being experienced, increasing congestion and the difficulty to provide more road space within urban areas, there is renewed emphasis on the role of public transport to meet the mobility needs of people.

To improve public transport the following must be addressed:

- Public transport infrastructure must be provided to a level adequate to address the mobility and accessibility needs related to the service
- Suitable public transport vehicles must be made available and be kept in good operational condition
- Public transport services must be managed in an efficient way as not only to meet the basic needs of commuters, but also to ensure that the service is attractive to road users in general.

The focus in this paper is on public transport infrastructure, and specifically road based public transport infrastructure.

Road based public transport generally makes use of the same infrastructure as other road based modes, and is subjected to the same congestion problems. Road based public transport infrastructure can broadly be categorised as:

- Road infrastructure, consisting of the roadway and traffic control measures, being shared with other transport modes.
- Measures to benefit road based public transport mobility and accessibility, including traffic signal priority, queue bypassing, queue jumping, kerb extensions, boarding islands and exclusive public transport lanes (HOV lanes, with-flow lanes, contra-flow lanes and dedicated bus ways) (COJTP, 2005).
- Measures to accommodate the flow of passengers to and from the public transport service, and to facilitate the waiting and boarding operation, such as side walks and walk ways, bus shelters, bus and taxi ranks, transfer facilities in the case of feeder and distribution services, and terminal facilities.
- Infrastructure required by public transport operators, such as holding facilities.

2. PROBLEM STATEMENT

There is limited guidance available on how public transport infrastructure should be provided within the urban context. Ideally public transport infrastructure should meet the following criteria:

- A holistic approach towards provision within the city must be followed
- Infrastructure provision should be balanced with operational needs
- Infrastructure should be provided in a standardised and evenly-spread way.

3. AIM

The aim of this paper is to:

- Provide an outline for (a) the definition of a public transport network for the City of Tshwane, and (b), the classification of such a network into primary, secondary and tertiary public transport routes
- To provide a guiding framework for the provision of public transport infrastructure along the different public transport road classes.

4. CURRENT TRENDS

The diagrams in Figure 1 schematically show the following volumes in the morning peak period on the Tshwane network (CTMM SPTP Conference, 2005):

- Number of trains and number of train passengers
- Number of buses and number of bus passengers
- Number of taxis and number of taxi passengers

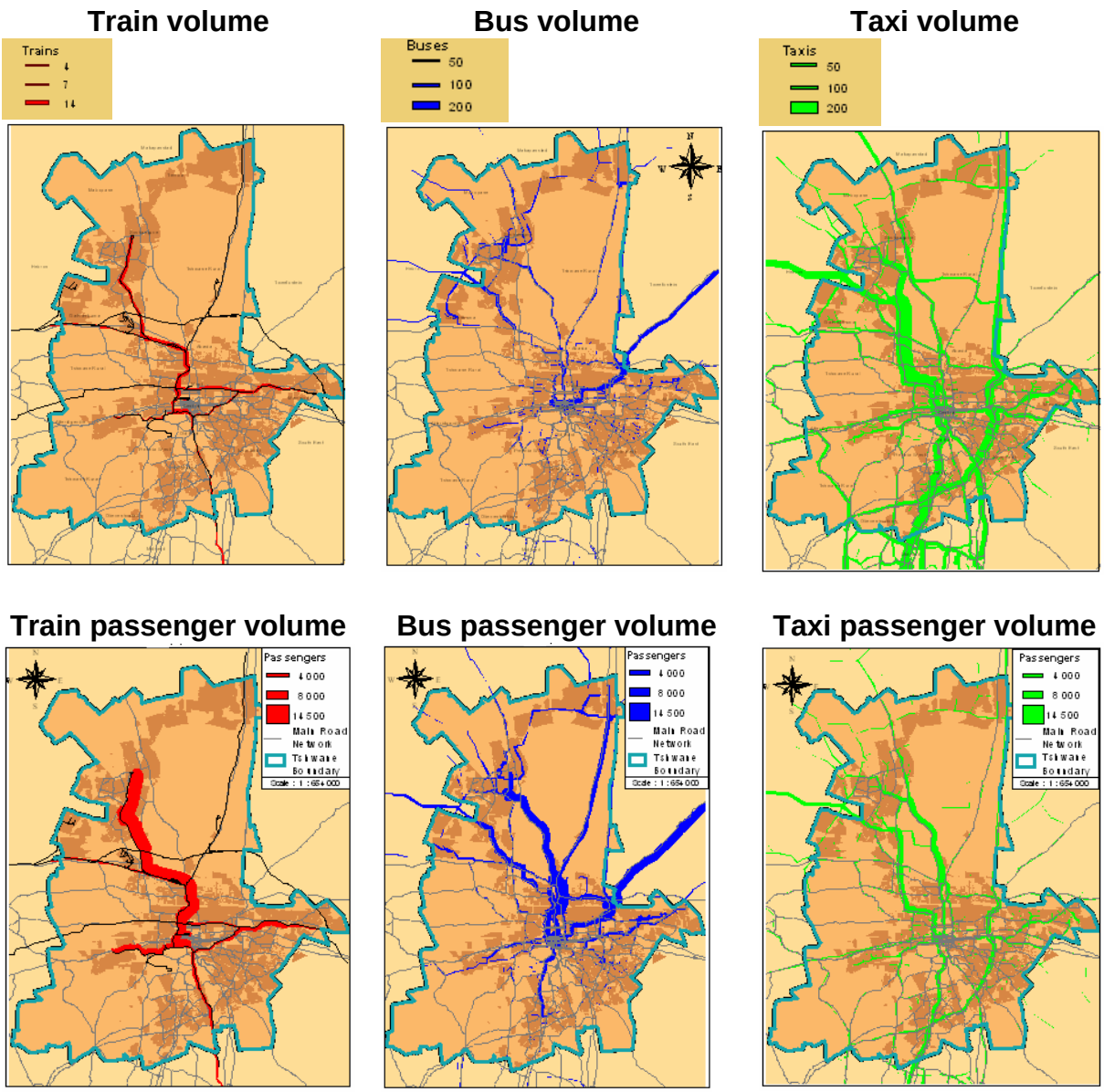


Figure 1: Current trends

5. PUBLIC TRANSPORT NETWORK

5.1 Public transport network definition

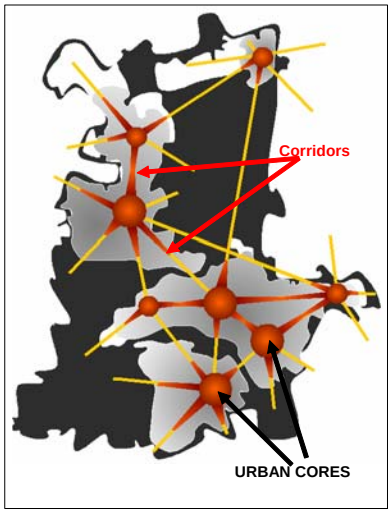
The public transport network is a network of roads forming part of the public transport system. In other words, it is the network of roads being used by road-based public transport vehicles.

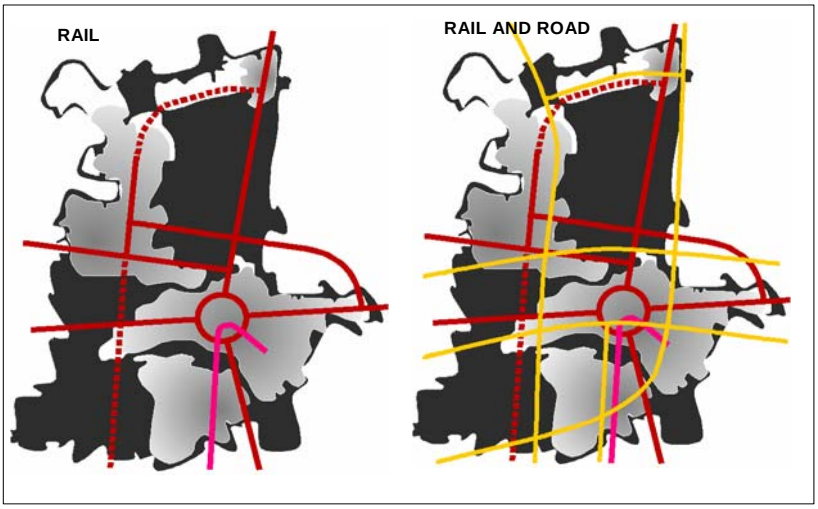
5.2 Objectives of the public transport network

The objectives with the establishment of a public transport network are as follows:

- To establish a network that brings a reliable and frequent level of public transport service within the acceptable walking distance of the trip origins and trip destinations of the inhabitants of the city, as far as is practically possible.
- To establish focused and high frequency corridors where passengers are transported over longer distances, and where public transport enjoys priority over private transport.

- To provide interconnectivity between residential areas and the main employment and business nodes, as well as between the main business nodes themselves.
- To provide Tshwane with a legible, permanent, recognizable public transport framework consisting of radial and circular routes.
- To provide nodes at the intersecting points of major routes where transfers can take place, and which can serve as catalysts for economic development.





5.3 Characteristics of the Public Transport Network

The strategic public transport network should have certain specific characteristics, which should include:

- These routes should be public transport friendly. This means that traffic management should be handled in such a way as to ensure that public transport vehicles enjoy priority over private vehicles where justified, and that the necessary infrastructure to serve vehicles and passengers is provided. Public transport journeys should be faster, safer and more convenient along these routes, compared to other routes.
- Continuity of routes should be supported. Specifically there should be continuity through nodes.
- There should be an hierarchy of public transport routes within the network:
  - The highest order should typically be the five or six most important public transport corridors within the city. These corridors should be mainly public transport orientated and the provision of dedicated roadways for public transport is a definite possibility
  - The second order should typically be the higher order arterial roads within the city.
  - The third order should be the smaller arterial and the collector routes. Indications are that these routes are spaced dense enough as to meet the walking distance criterion to and from the service (maximum 1km walking distance, as per Paragraph 6.5).
  - The lowest order of public transport routes will typically be smaller collector roads and access roads which are served with public transport to provide a service to the public. These should be restricted to special cases only.
- Transfers are in general not perceived in a positive light when the transfer is from one mode to another that does not offer a significantly better service. The reason is that the transfer involves effort and time which can be avoided by means of a direct trip with one mode and one vehicle only. Transfers are acceptable when the first mode serves a collector function and the main mode has a substantial benefit, whether in terms of comfort and speed (for example a light rail or a bus-rapid-transit (BRT) system), or whether in terms of cost (train may be cheaper than a minibus taxi over a long

distance). Network coverage of the city should therefore be as complete as possible, as this is the only way in which an attempt can be made to minimize the number of transfers.

- Transfer points/nodes where passengers collect and distribute in larger numbers, or where transfers to other modes take place, form part of the network.
- The network should also be served with terminal facilities at major starting points of routes where passengers can collect and distribute from.

5.4 Service Quality Standards affecting the Network

A range of quality standards are set with regard to the availability and accessibility of the public transport service (DPTRW, 2006). With regard to maximum walking distance to stops the following standard is recommended:

- In urban areas: 500m
- In peri-urban and rural areas: 1 000m

Figure 2 and Table 1 shows, as an example, the width of coverage along a public transport route that will apply for a maximum walking distance of 1 000m.

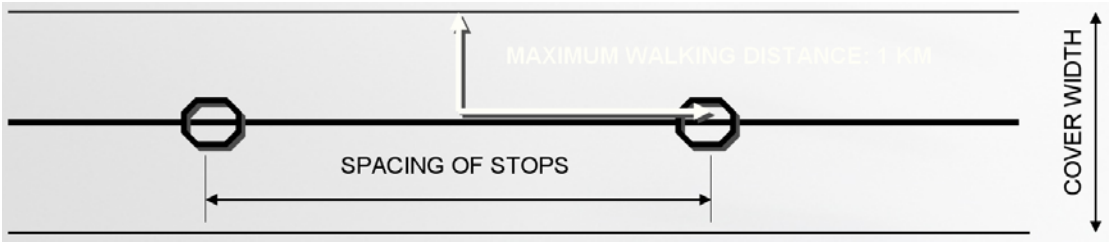


Fig 2: Width of coverage as a function of walking distance

Table 1: Width of coverage for a walking distance of 1 000m

Spacing of stops	Width of coverage
300m	1 700m
500m	1 500m
800m	1 200m

For public transport routes in urban areas the spacing of stops along a route has been taken as 500m, and in peri-urban and rural areas, 1 500m.

5.5 Approach followed with the Public Transport Network

In order to meet the criterion of maximum walking distance it was attempted to obtain maximum coverage with the network developed.

The following were taken into account in the development of the network:

- A maximum walking distance of 1 000m in semi-rural areas, and 500m in urban areas

- The location of trip generators such as commercial areas, schools, office blocks and hospitals
- Continuity of routes
- The functional road class (focus on arterials and collectors)
- Current intersection control measures
- Existing public transport routes
- The location of public transport facilities such as ranks and terminals.

It is interesting to note that in the old Pretoria area the municipal bus service (PCT) routes formed a good basis for the network, although a reduction in the number of PCT routes is generally possible. In the “zone of choice”, the low-income area towards the north, taxi routes formed a good basis, although coverage was not quite adequate and some routes had to be added.

5.6 Network

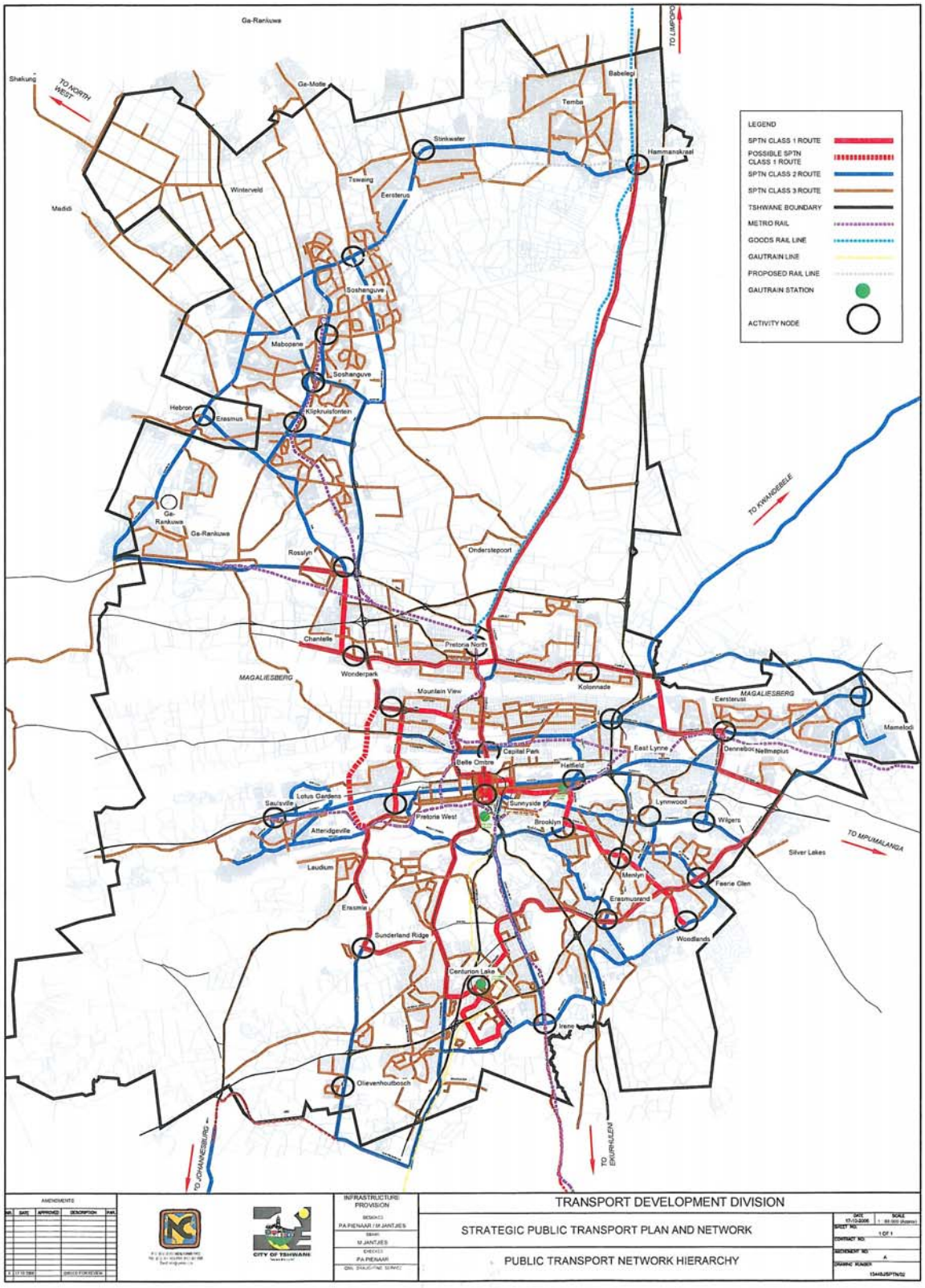
The classified public transport network is shown in Figure 3. An example of the coverage obtained is shown in Figure 4.

5.7 Operational Aspects

The public transport network should not be seen as consisting of infrastructure only, but of infrastructure carrying public transport vehicles which offer a service to the public. Operational needs and requirements should be incorporated into the design of the network. Specifically the services should be provided in such a way as to minimize the need for transfers. With buses and minibus taxis traveling within the normal traffic stream, these vehicles should move from the lower order roads to the higher order roads as they collect passengers and transport them to a destination.

Where transfers are required services should be coordinated in such a way as to minimize the impact of the transfer on the passenger.

Fig 3: Proposed Public Transport Road Network Hierarchy



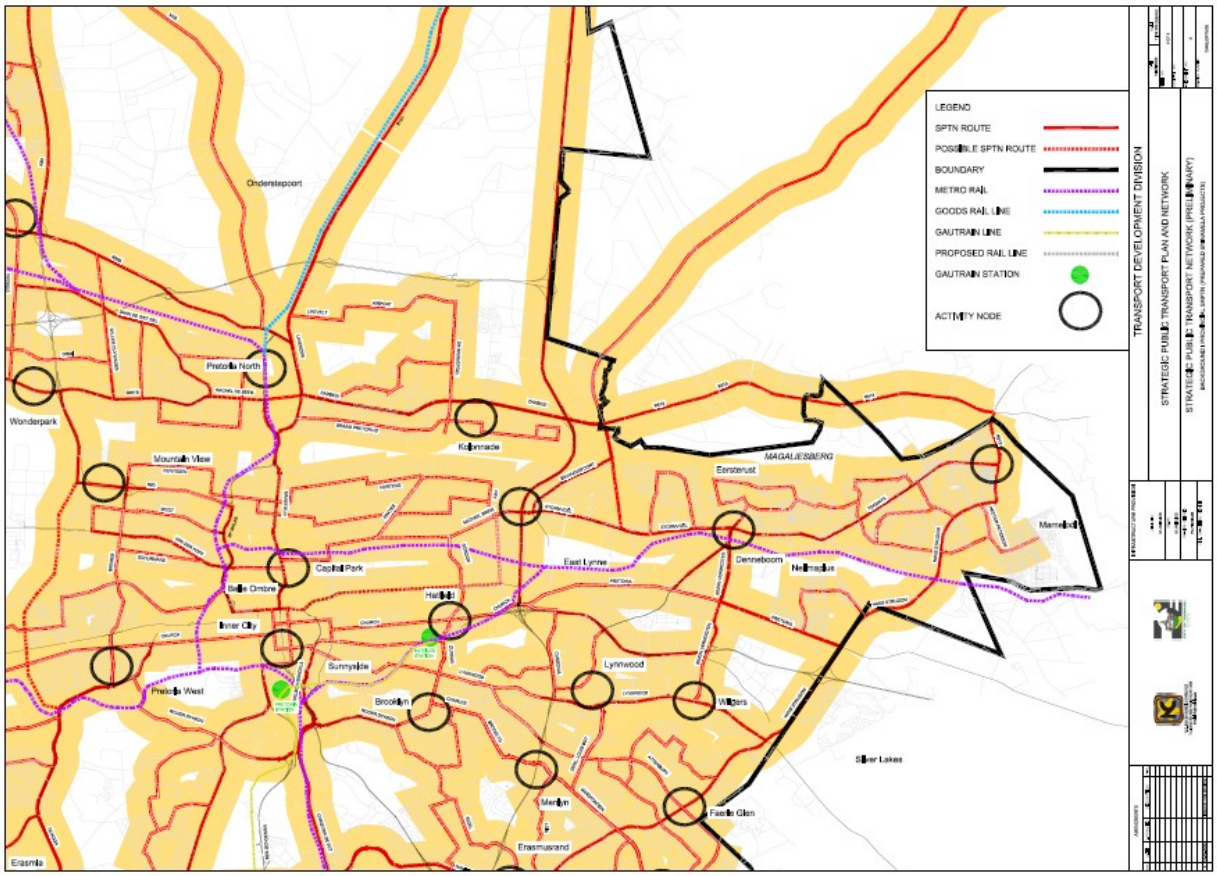
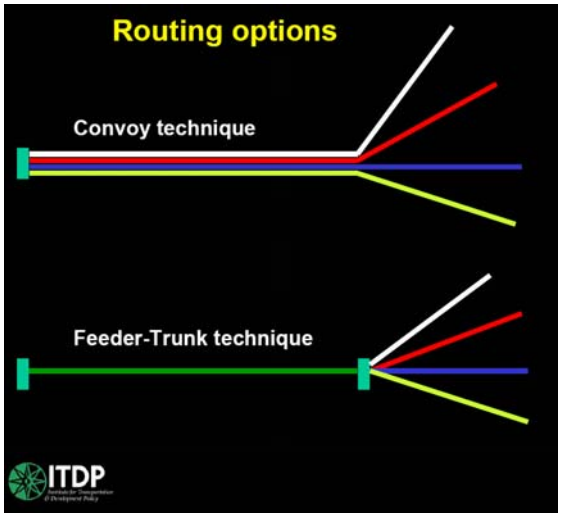


Figure 4: Example of coverage obtained

Funding must be provided for infrastructure maintenance, not only infrastructure provision.

The operation of public transport services should be organised in such a way that both the following functions are addressed:



- Passengers are collected along a route, which means that there should always be some capacity on the vehicle in order to accommodate passengers boarding the service (unlike minibus taxis, which generally wait for a full load).

- Passengers are collected within a limited area, and then transported over a relatively long distance in a fast and effective way, i.e. by not stopping at all stops along the route.

5.8 Network Length

The length of the total Tshwane road network is shown in Table 2 and the roads forming part of the public transport network in Table 3.

Table 2: Length of the Tshwane Network

Tshwane Road Network	Total (km)
CBD	54
Freeway	305
Metro	363
Provincial	821
Residential	7 136
Total	8 678

Table 3: Length of the Tshwane Public Transport Network

Public Transport Network	Total (km)
Class 1	330
Class 2	630
Class 3	1 118
Class 3 Additional	244
Total	2 322

“Class 3 Additional” refers to roads that at this stage form part of the network, but should be considered for removal from the network as adequate coverage are already obtained. Once removed, the length of the public transport network will be reduced to 2 078 km, which is approximately 24% of the total network.

Routes forming part of the public transport network should be advertised and marketed. These routes should also be well-defined, for example street light poles could be colour-coded to indicate primary network or feeder routes.

6. PUBLIC TRANSPORT INFRASTRUCTURE FRAMEWORK

A draft framework for infrastructure and service provision was proposed for the road network, shown in Table 4.

Table 4: Public Transport Infrastructure Framework

Public transport route class:			**Primary**	**Secondary**	**Tertiary**	**Local**
Associated road class:			Principle arterials	Local arterials	Collector roads	Access streets
Properties	Strategic importance	Network function	High	Average	Low	Only
	Passenger volume within morning peak period in peak direction	> 4 000				
		2 000 to 4 000				
		500 to 2 000				
		< 500				
Infrastructure required	Road facility	Dedicated roadways				
		Priority lanes				
		Normal road, 2+ lanes per direction				
		Normal road, 1 lane per direction				
	For passengers to board	Bus terminus/station				
		Bus shelter and bay				
		Bus bay				
		Bus stop only				
	Ablution facilities	Available at nodes				
		Not available at nodes				
	Collection and distribution of passengers	Park-and-ride, kiss-and-ride facilities				
		PT feeder/distribution services				
		Paved sidewalks				
		No formal sidewalk				
Level of service required by passenger	Maximum walking distance	1 500m				
		1 000m				
		500m				
	Spacing of stops - typically	800m				
		600m				
		450m				
		300m				

Table 4: Public Transport Infrastructure Framework (continued)

Public transport route class:			**Primary**	**Secondary**	**Tertiary**	**Local**
Associated road class:			Principle arterials	Local arterials	Collector roads	Access streets
Level of service required by passenger (continued)	Frequency of service in peak period in peak direction	Every 5 to 10 min typically	■			
		Every 10 to 20 min typically		■		
		Every 20 to 30 min typically			■	
		Every 30 to 60 min typically				■
	Frequency of service in off-peak period	Every 20 min typically	■			
		Every 40 min typically		■		
		Every 60 min typically			■	
		Every 120 min typically				■
	Travel time (PuT), compared to private vehicle travel time (PrT)	PuT < 1,0 PrT	■			
		PuT < 1,5 PrT		■		
		PuT < 2,0 PrT			■	
		PrT > 2,0 PrT				■
Environmental impact	Emission gasses	Very low	■			
		Low		■	■	
		Average			■	■

7. NODES

7.1 Definition of a Public Transport Node

A public transport node is any concentration point/area where public transport activity takes place. Nodes have one or more of the following functions:

- Collector/distribution function: An example is a public transport terminus where a particular high order services starts or terminates
- Transfer function: An example will be where passengers are transferred either from one mode to the other, or from one route to another.

7.2 Classification of Nodes

Not all nodes have the same strategic function in terms of the public transport network. Nodes can be classified as:

- Primary nodes: These are nodes handling large volumes of passengers, typically on the primary public transport network, or at the intersecting point of two of more primary routes. Such nodes include terminals and transfer facilities. Examples of nodes of this nature in Tshwane include Mabopane Station, Belle Ombre Station, Denneboom Station and Pretoria Station. In future the following will be added: Gautrain stations (Centurion Lake and Hatfield) and the proposed Pretoria-North multi-modal facility
- Secondary nodes: These are nodes handling intermediate volumes of passengers, typically on the secondary road network. Examples of nodes of this nature in Tshwane include: Hammanskraal, Rosslyn, Atteridgeville Station, Denneboom Station, Brooklyn and Menlyn.
- Teriary nodes: The remaining nodes identified.

Figure 3 shows a number of proposed public transport infrastructure nodes. Work still needs to be done on the classification of all the nodes identified.

7.3 Infrastructure required at nodes

Table 5 shows the typical infrastructure required at the various node classes.

8. CONCLUSION

In the paper an outline was provided for (a) the definition of a public transport network for the City of Tshwane, and (b), the classification of such a network into primary, secondary and tertiary public transport routes. A framework for the provision of public transport infrastructure along the different public transport road classes was suggested. Reference was also made to the role of public transport nodes, and the classification of nodes.

The benefit of the approach offered is that it will serve as a guideline in the provision of public transport infrastructure when roads are constructed or upgraded, and it will serve as a basis for the planning of and budgeting for public transport infrastructure needs on the public transport network.

Table 5: Infrastructure required at Nodes

Public transport node class:			**Primary node**	**Secondary node**	**Tertiary Node**
Associated public transport route class:			Primary routes	Secondary routes	Tertiary routes
Properties	Strategic importance	Node function	High	Average	Low
	Passenger volume within morning peak period	> 20 000			
		10 000 to 20 000			
		< 10 000			
Infrastructure required	For passengers to board	Bus terminus/station			
		Bus/taxi rank			
		Bus bay / bus stop			
	Ablution facilities	Available at nodes			
		Not available at nodes			
	Collection and distribution of passengers	Park-and-ride, kiss-and-ride facilities			
		PT feeder/distribution services			
		Paved sidewalks			
Services required	Ammenities/shops	Provide a variety of facilities to meet the needs of customers			
		Provide a few essential services only			
		Minimum level of service provision			
	Security and information services	High level of service required			
		Intermediate level of service required			
		Low level of service required			

9. REFERENCES

[1] CTMM SPTP Conference: 29 and 30 Nov 2005. Transport Development Division, City of Tshwane Metropolitan Municipality, Tshwane, 2005.

[2] Department of Public Transport, Roads & Works (DPTRW): Gauteng Road Public Transport Transformation Project: Contracted Services Component: Quality standards for road public transport contract services, 2006.

[3] Nyeleti Consulting. Tshwane Strategic Public Transport Plan and Network. Transport Development Division, City of Tshwane Metropolitan Municipality, Tshwane, 2006.

[4] City of Johannesburg Transportation Planning (COJTP): Strategic Public Transport Network: Guidelines for implementation. Final Report, 2005.