

11.8 THE PLAN FOR URBAN TRAFFIC MANAGEMENT IN CBD OF THE MAPUTO CITY

11.8.1 General

The central business district (CBD) of the Maputo city has a high residential population.

Also land use pattern of the CBD is characterised that the commercial and business area is located in the old city area and the industrial and commercial area is located around the Maputo port. This pattern will be basically continued until the year of 2020.

Other industrial and commercial activities and institutional facilities are located along side the trunk roads in CBD. The role of these functions is essential for the development of Maputo city. Therefore, accessibility of traffic on the trunk road to those facilities should be paid attention.

After implementation of the road development plan mentioned in the Chapter 11.7, future traffic congestion in the year 2020 will be dissolved drastically. However, the traffic congestion in the city centre will be remained due to insufficient traffic management. Also the residential environment will become worse due to traffic demand corresponding to the population growth.

11.8.2 Area Zoning

Function of the road is for traffic, access to the commercial and residential area, also the road space provides for several people activities and so on. The traffic management measures should be different for each area depend upon the land use pattern and its requirement, thus for the first step the area zoning has been carried out for the urban traffic management plan.

The policy of the area zoning is as follows.

- Land use pattern will not be changed in the future.
- Each town block is separated by the trunk road network and public / private bus routes. Minimum unit of town block is about 400m in radius, where bus user is accessible in six minutes on foot.
- The area along the main trunk road should also be designated to as the commercial area.

Trunk road network is distributed as mentioned in the road network development plan in the Chapter 11.4 and the collector road network in the CBD should be established.

Area zoning is as shown in the Figure 11.8.1.

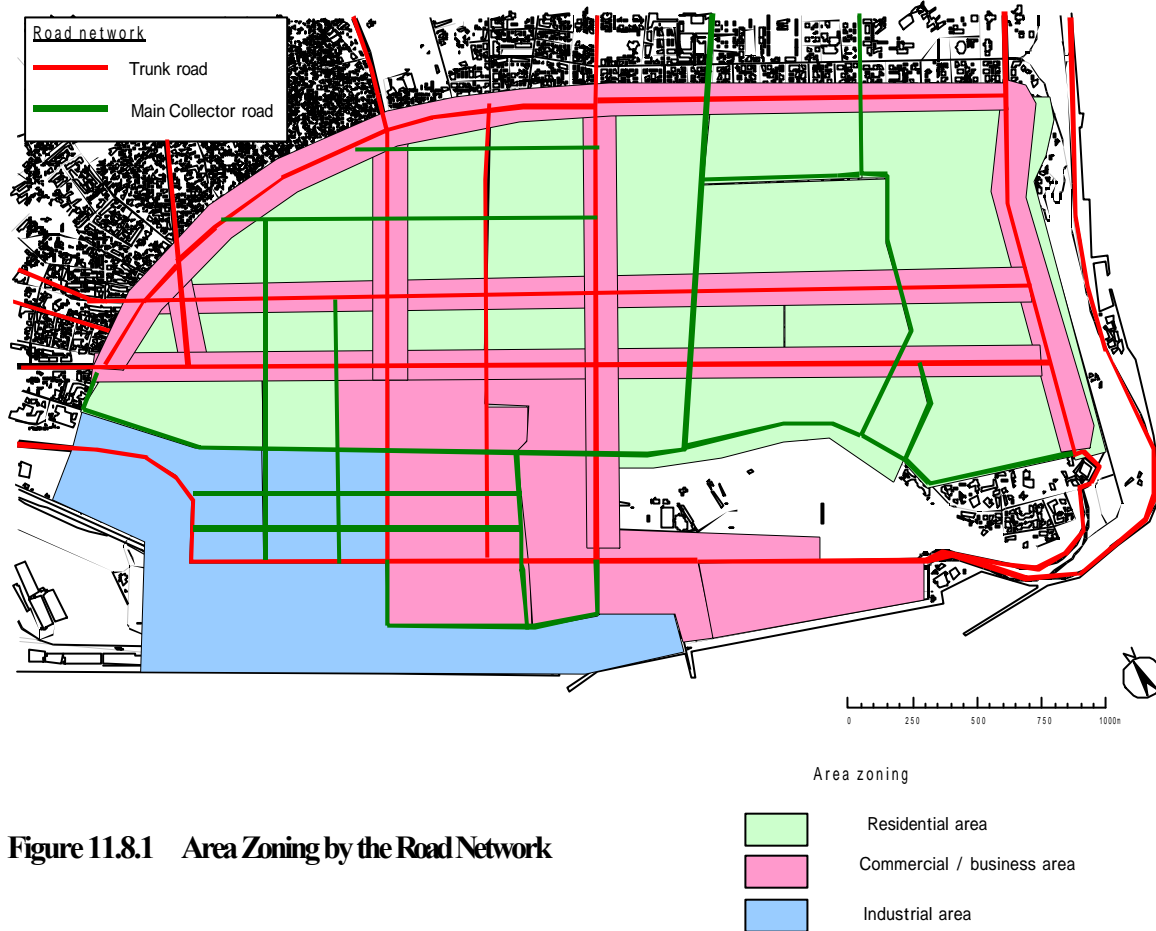


Figure 11.8.1 Area Zoning by the Road Network

11.8.3 Public Transportation Planning in the CBD

1) Distribution of Bus Routes

The development concept of the public transportation is mentioned in the Chapter 11.3. Middle / small bus route should be established on the trunk road where the public bus route is missing, and collector road corresponding to the public demand in the residential area.

At least one bus stop should be established on each town block of the residential area, to cover the residential area 400m in radius.

Distribution plan of bus routes is shown in the Figure 11.8.2.

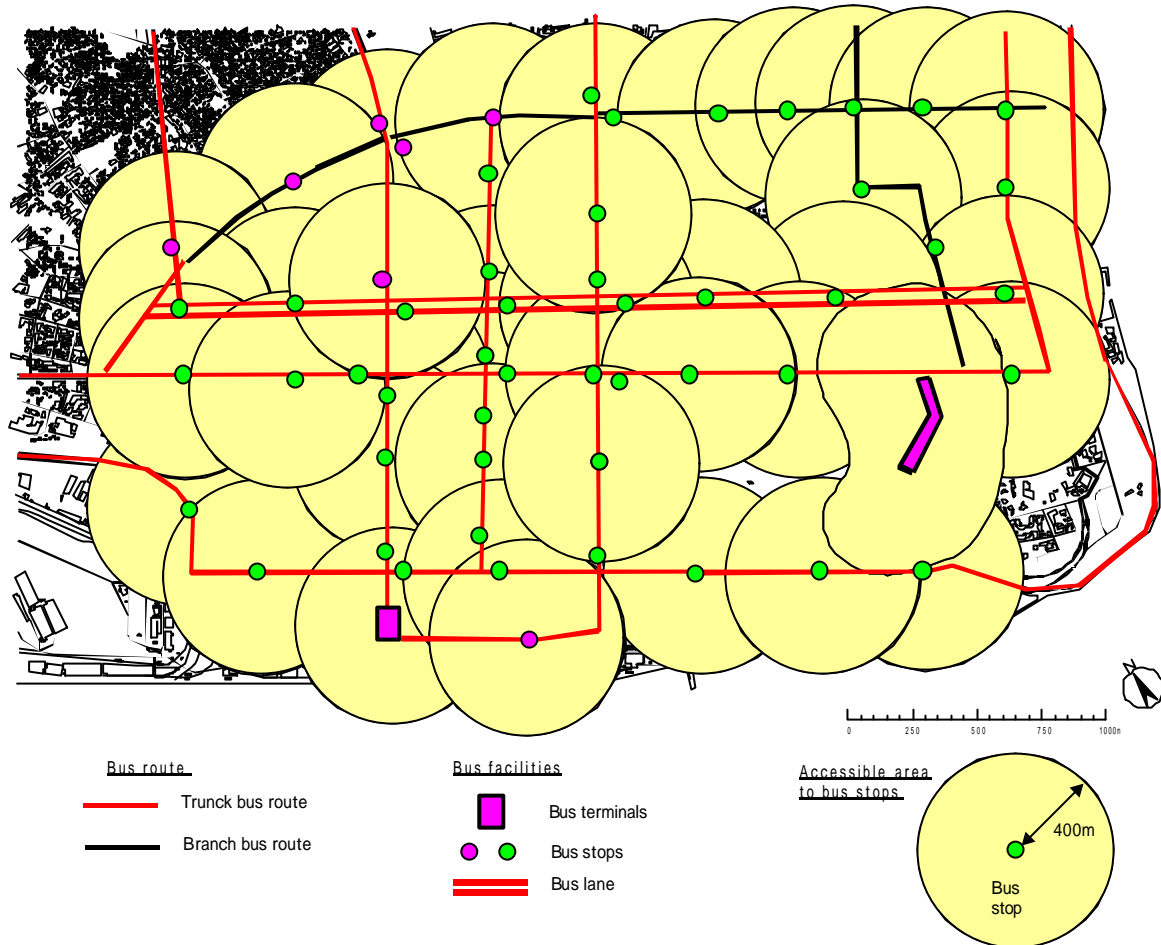


Figure 11.8.2 Establishment of Bus Route and Bus Stops

2) Improvement of Bus Stops

Removal of Bus Stops Close to Intersections

Bus stops should be removed at least in the range of 30m from intersection for additional turning lane width and to secure smooth turning movement.

Furthermore, stopping of middle / small buses out of bus stops should be strictly prohibited, enforcement should be strengthened.

Improvement of the Bus Stop

Combining to removal of bus stops, public bus stops on the trunk road should be widened to secure smooth traffic. Detailed consideration is shown in the Chapter 11.3.

Establishment of Bus Stops on the Collector Road

According to the establishment of bus stops, bus stop facilities, road marking and signs should be established.

3) Introduction of Bus Lanes

In addition to improvement of Bus Routes and Bus Stops, introduction of Bus Lane on Av. Eduardo Mondlane is proposed to enhance the Future Bus Transportation efficiency. At present, central 4lanes are applied for vehicles under 1.5t and service roads are applied for vehicles over 1.5t on Av. Eduardo Mondlane. It is effective for smooth and swift operation of Buses to turn service road into Bus priority lane or exclusive lane by opening central lanes to heavy vehicles.

11.8.4 Urban Traffic Management Measures

1) Improvement of Intersections

In order to increase the traffic capacity, the following measure shall be established to the major intersections on the trunk road network shown in the Figure 11.8.3.

Establishment of Right-turn Lane

The right-turn lane with right-turn signal should be constructed on the major intersections for safety traffic turning.

Improvement of Traffic Signals

Signal pattern timing should be adequately adjusted according to the traffic movement.

Furthermore, traffic signals should be established to the un-signalled intersections where the bus routes cross with the trunk roads.

In the longer term, introduction of self-controlled signals by vehicle detection system, linked signal, remote controlled signals are conceivable.

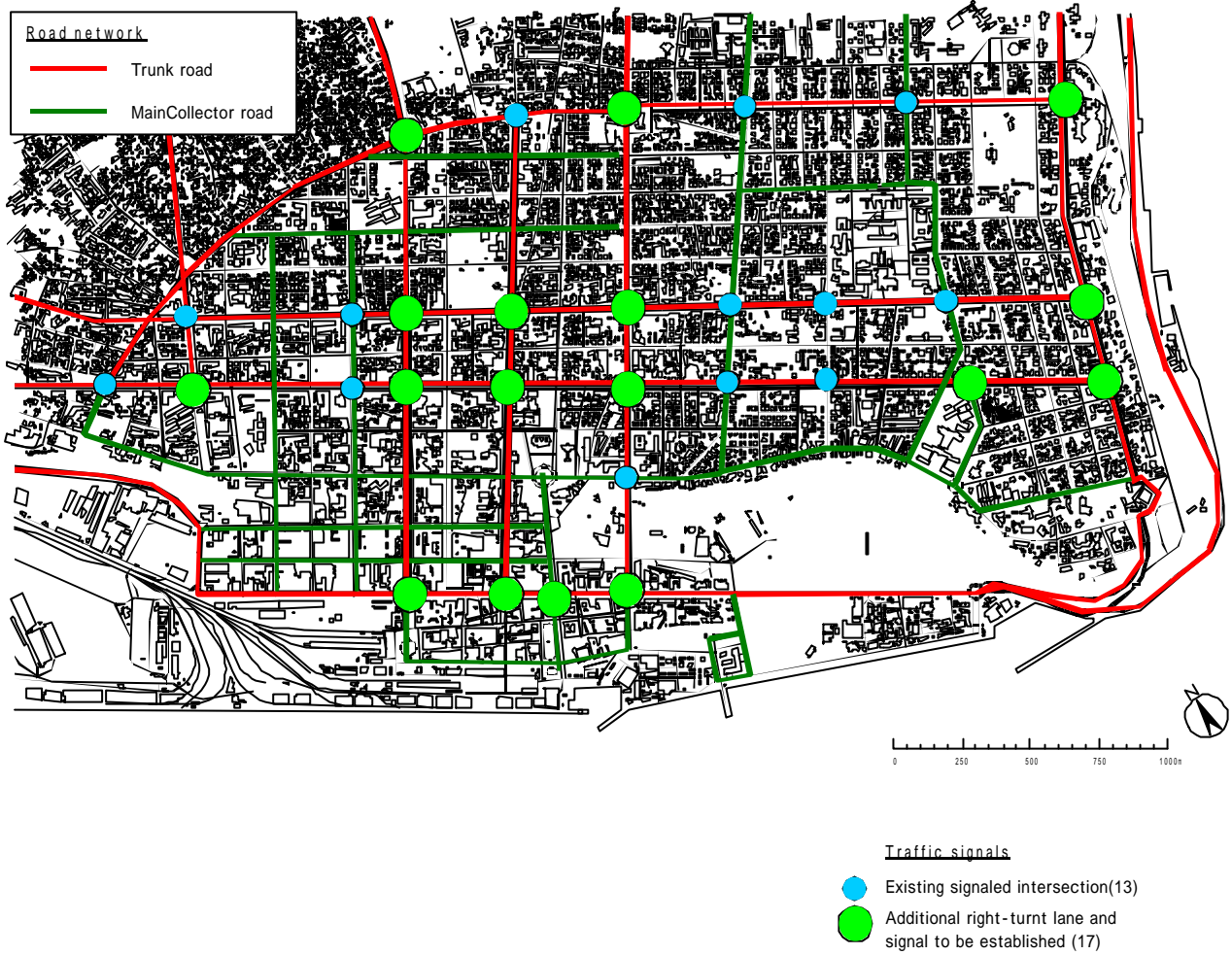


Figure 11.8.3 Location of Intersections to be Improved

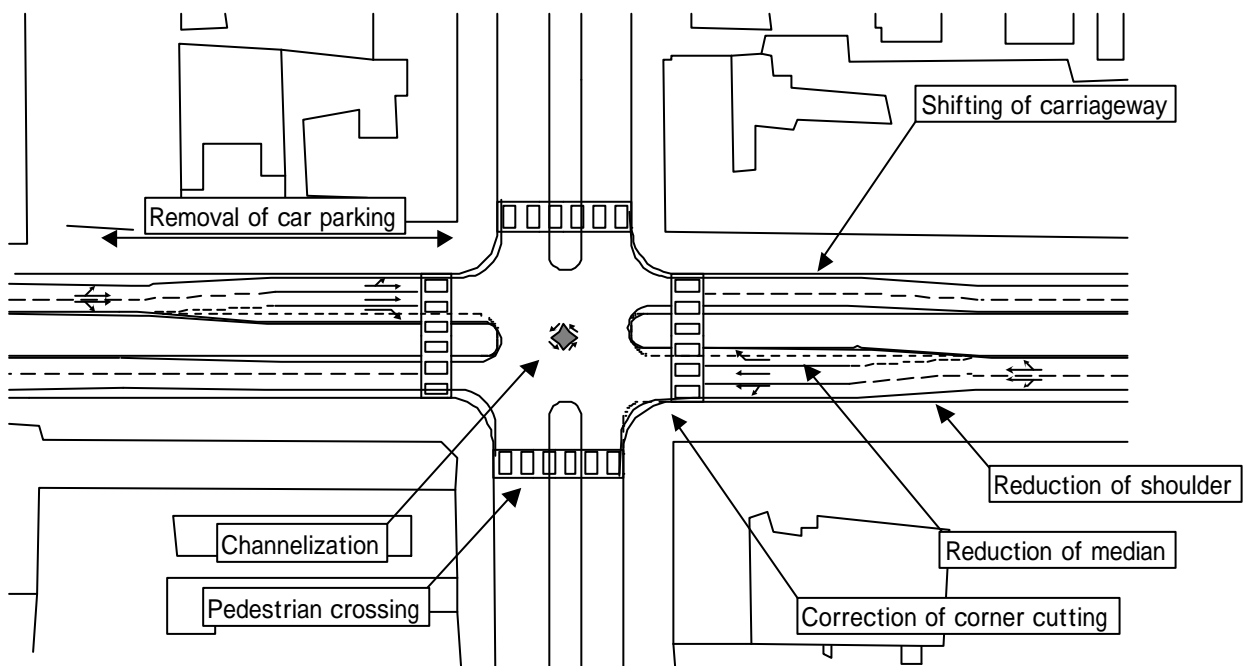


Figure 11.8.4 Establishment of the Right-turn Lane

2) Parking Control

(1) Basic policy

On-street parking often causes to reduce the traffic capacity. On the other hand the road space also meets for public and commercial parking demand. Therefore, the adequate measure for car parks shall be established according to the road use condition and demands. Basic policy of parking control in the CBD is as shown in the Figure 11.8.5.

- In the commercial area, roadside parking on trunk roads shall be allowed at the present. However it should be prohibited or charging in near future and shifted to the off-street parking.
- In the industrial area, roadside parking for unloading will be free.
- In the residential area, roadside parking for residents will be allowed, except on the collector roads due to secure road width for public and emergency vehicles.

On the other hand, the community roads will be less to accept roadside parking and secure dual-way traffic. Therefore, these street may be object to introduce one-way control, accordingly regulatory signs should be established.

(2) Parking Control by Enforcement

The following parking control shall be introduced due to secure traffic capacity. These should be enforced priory on the trunk roads and collector roads.

Prohibition at Intersections

Prohibition of roadside parking at least in the range of 30m from intersection should be enforced, for additional turning lane width and to secure smooth turning movement. Besides, regulatory signs and markings should also be established.

Prohibition on the main Collector Roads

Due to secure the road width for public and emergency vehicle traffic, roadside parking should be prohibited on the main collector road. Accordingly, road marking and regulatory signs should be established.

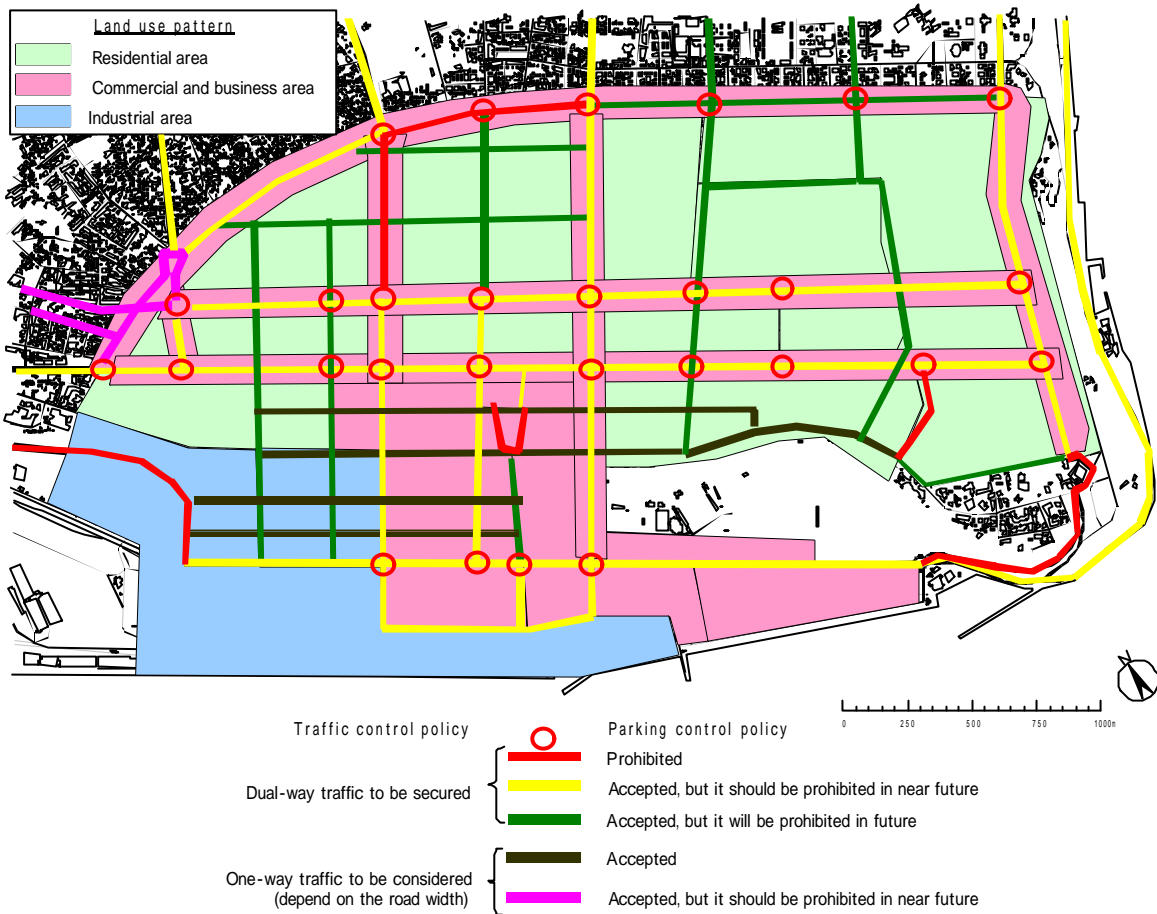


Figure 11.8.5 Parking Control Policy in the CBD

(3) Improvement of Car Parks

The following measures for improvement of car parks should be conceived. These measures should be considered to meet parking demand and road geometry, detailed plan should be evaluated in the feasibility study.

Widening of Car Parks

To shorten blocking the carriageway by parking manoeuvre, roadside parking strip should be widened around the commercial facilities where the parking demand is much. Besides, regulatory signs and markings should also be established as well as introduction of parking charge system by new private enterprises.

Introduction of In-out Direction

In-out direction of car parking on the median should be unified for smooth parking manoeuvre. Besides, regulatory signs and markings should also be established as well as introduction of parking charge system by new private enterprises.

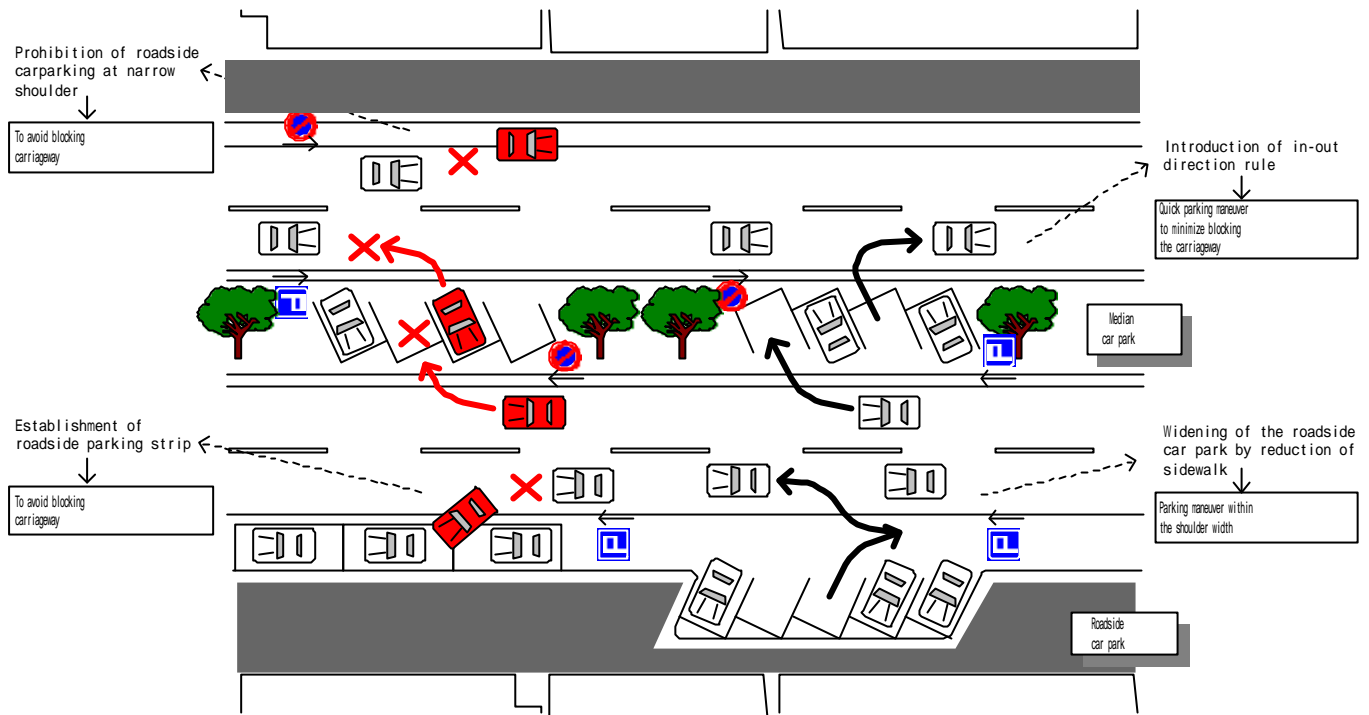


Figure 11.8.6 Improvement of Car Parks

(4) Elimination of On-street Parking

In the long term, on-street parking shall be eliminated due to secure traffic capacity. Following off-street parking facilities should be developed prior to the prohibition of the roadside parking in long term.

Multi-storied Parking Building

As for in the type of the parking facilities, the multi-storied parking is recommended from the view point of the construction cost and land acquisition through comparison with 3 plans of the underground, surface and multi-storied parking. For the off-street parking facilities, the dilapidated buildings along the trunk road shown in the Figure 11.8.7 are recommendable. These parking garages would function more effectively if higher parking fee is charged on roadside parking nearby area.

Establishment new Building Code

Considering existing substandard buildings and future chronic shortage of parking spaces with auto parking infringing on road traffic and pedestrian ways, it will be necessary new attachment of Parking Code to the Building Codes for the preservation of individual properties, especially in the CBD. The size of the parking spaces within each property should be carefully determined depending upon the total space and the propose of each buildings.

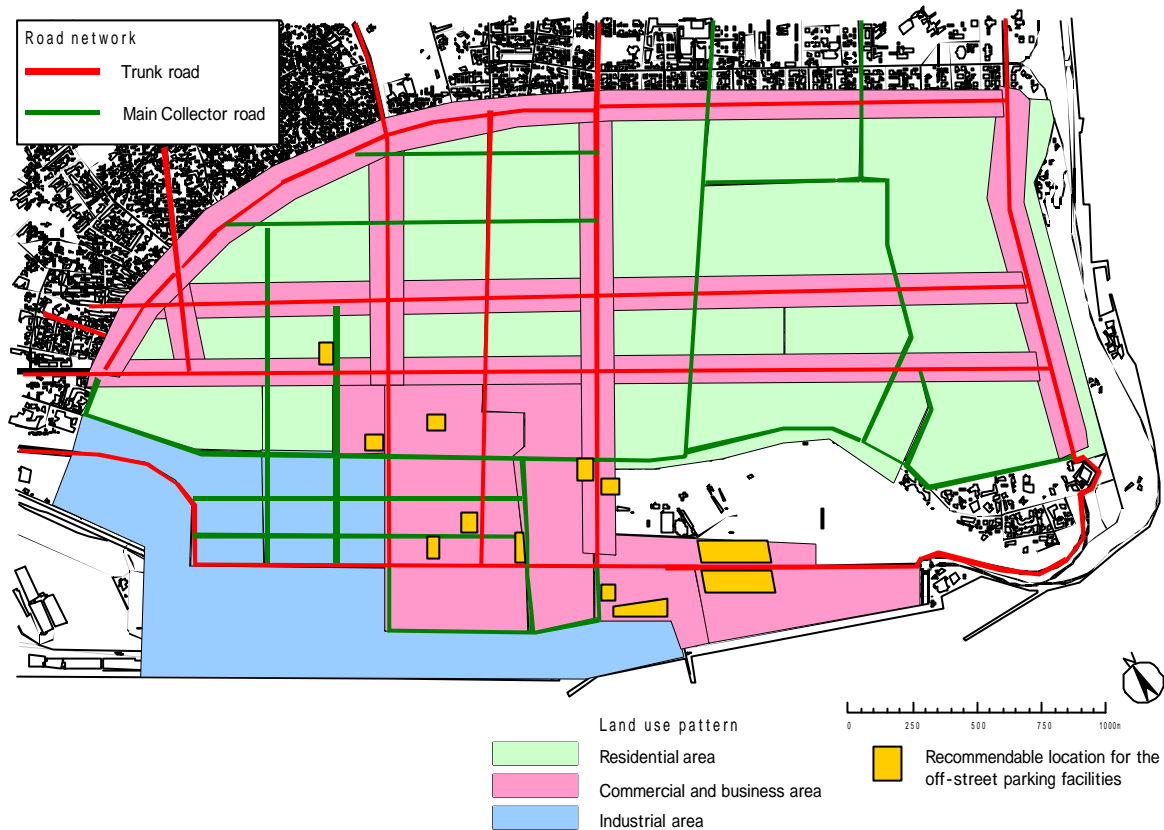


Figure 11.8.7 Recommendable Location of the Off-street Parking Facilities

3) Traffic Circulation for Averaging Road Usage

Av. 24 de Julho is directly connected with the national highway route 4, it is expected that the future traffic volume will exceed its capacity. Dispersion of traffic should be conducted to the other roads for average the traffic volume and to utilize the urban road network effectively.

Rehabilitation of Av. Organização das Nações Unidas

Av. Organização das Nações Unidas and Rua Paulino Santos Gil, which connects the national road route 4 and Av. 25 de Setembro, are seriously damaged at present. It causes of difficulty to access heavy cargo vehicle from route 4 to the industrial area.

Reconstruction of Av. Organização das Nações Unidas and Rua Paulino Santos Gil is already nominated as a priority project in the Road Development Plan.

Traffic Circulation at Av. Tanzania

The traffic circulation around Av. Tanzania is as shown in the Figure 11.8.8 Existing Traffic Crossing are on 2 intersections. The intersection no.1 (Av. 24 de Julho with Av. da Tanzania)

is controlled with Traffic Signals, but the intersection no.2 (Av. 24 de Julho with Av. da Zambia) is managed neither signal nor right-turning lane. Therefore, improvement of the intersection no.2 as a new signal controlled with equipped right-turning lane should be necessary in order to smoothing traffic as well as averaging traffic between av. 24 do Julho and Av. Eduardo Mondlene.

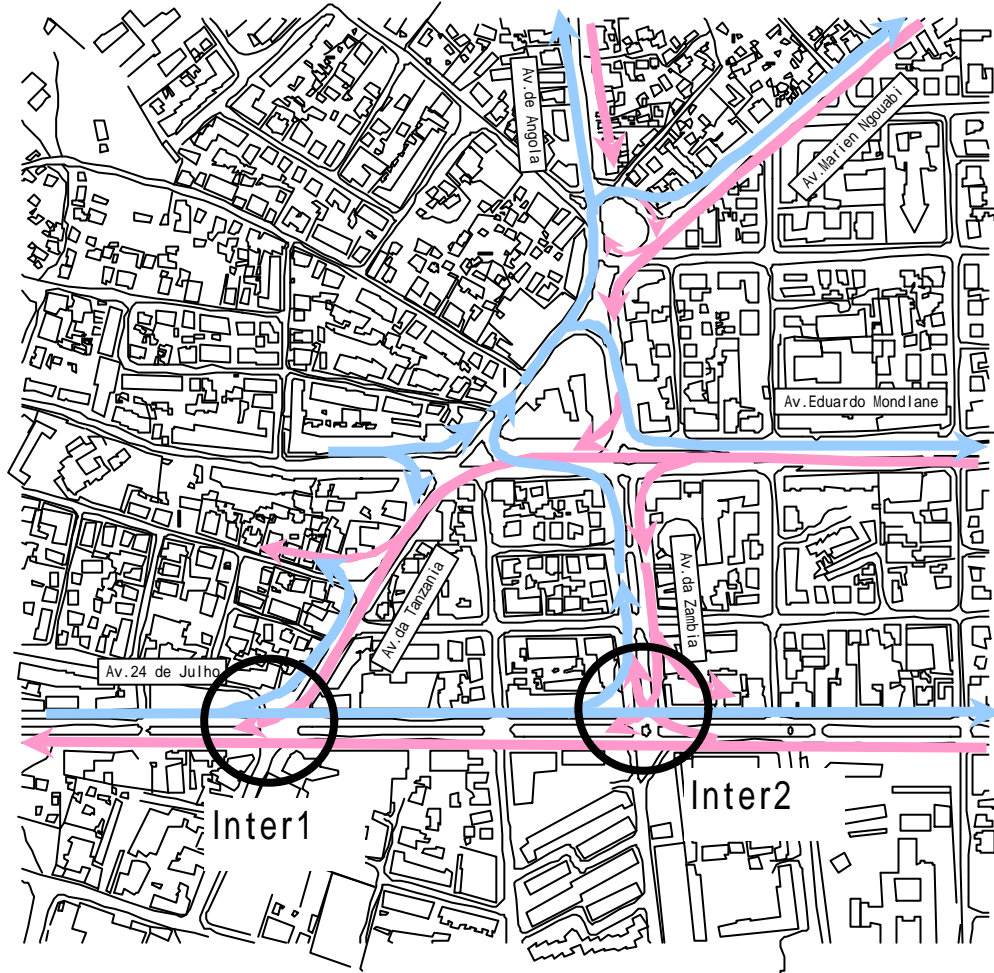


Figure 11.88 Traffic Circulation Problems on Av. Tanzania

4) Environmental Protection in the Residential Area

Collector roads and community roads have the function of access to houses and pedestrian traffic, and to form fine residential environment, deterioration of environment due to intrusion of traffic should be strictly avoided.

To eliminate the through traffic, introduction of restriction or limitation measures for the through traffic should be conceived. Such measure should be introduced at the entrance of the road, as shown in the Figure 11.8.9. Therefore these construction works should be included to the trunk road network improvement programme.

(1) Elimination of the Through Traffic

Speed Limit Regulation

The speed limit of 30-50 km/h should be applied on the collector road, and 20-40 km/h should be applied on the community road. Accordingly, the regulatory signs should be established.

Entrance Prohibition into the Residential Area

Entrance time of the large cargo vehicle should be limited into the collector road. Entrance of the large cargo vehicle should be prohibited into the community road. Accordingly, the regulatory signs should be established.

However entrance permission may be required for a demand of goods delivery etc., permission rule and consensus to the commercial transportation sector should be considered.

Establishment of Speed Control Device

The speed control devices such as speed humps, width restrictions etc. should be established, to reduce speed of traffic and to constrain upon the through traffic.

(2) Ensure Safety for the Pedestrian

Establishment of the Pedestrian Crossing

The pedestrian crossing should be established with the intersection of the trunk road and also collector road. Besides, stop lines on the carriageway should also be established.

Repair of the Sidewalk

Damaged sidewalk should be repaired.

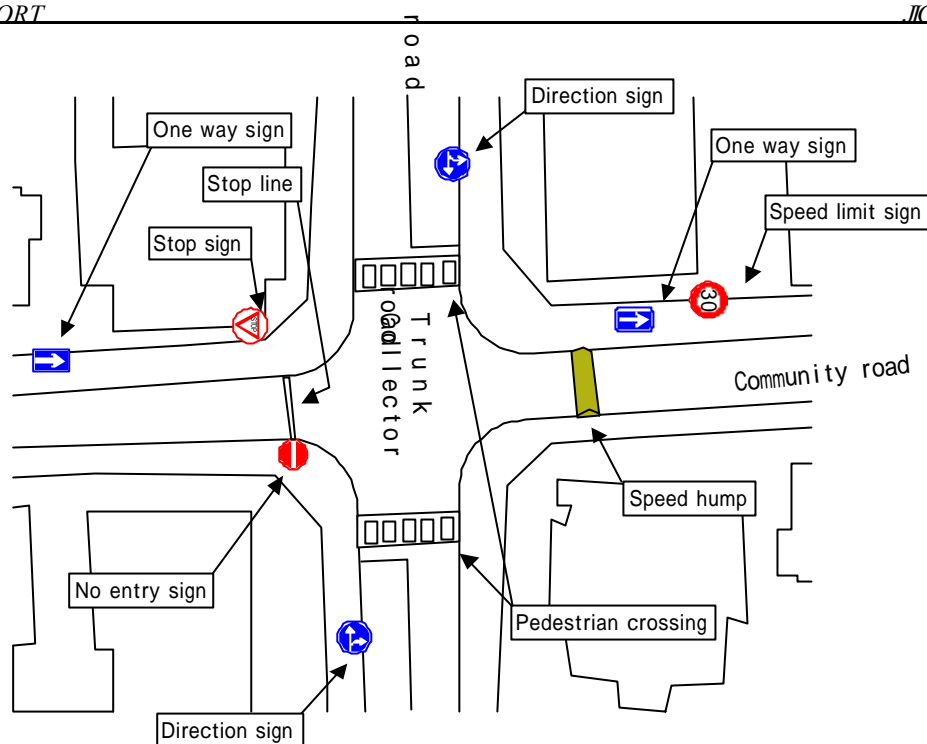


Figure 11.89 Traffic Management Facilities on the Community Roads

5) Introduction of The Traffic Demand Management

In the longer term, integrated traffic management system should be considered, it should be responsible and flexible upon the traffic demand. Furthermore, drastic traffic management measures shall be introduced. For example, these measures are conceivable.

- Introduction of advanced traffic control system such as linked traffic signals, traffic control centre etc.
- Promotion of the traffic modal shift by establishment of park & ride facilities, introduction of mass-transit systems etc.
- Controlling of traffic demand by re-structuring of the city, time regulation, road pricing etc.

11.8.5 Implementation Schedule

The time period of implementation of traffic management in CBD is to be divided into 2 phases, short-mid period (2001-2010) and long period (2010-2020) as shown in the Table 11.8.1.

The objectives of the project in each term should be as follows.

Short-mid Term (2001-2010)

- Solution of the bottleneck and traffic congestion
- Promotion of the area traffic management measure
- Development of basic traffic / transportation facilities
- Introduction of the traffic flow control by the traffic dispersion, regulation etc.

Long Term (2010-2020)

- Establishment of the traffic demand control (the drastic measure)
- Drastic solution of elimination of the road parking
- Introduction of the advanced traffic control measure

Table 11.8.1 Implementation Schedule

Traffic management measures			Roads to be introduced			Short-mid term project				Long term project		
			Trunk road	Collector road	Community road	Solution of bottleneck	Area traffic management	Development of traffic facility	Traffic demand control	Improvement of traffic dispersion	Traffic demand control	Elimination of on-street parking
Traffic management on the trunk road	Improvement of intersections	Establishment of right-turn lane										
		Establishment of right-turn signal										
		Installation of new signal										
		Re-setting of signal pattern										
	Improvement of car park	Removal of parking close to intersections										
		Widening of roadside / median car park										
		Improvement of median car park										
Improvement of public transportation	Improvement of bus operation	Establishment of regulatory signs / markings										
		Construction of off-street parking										
		Introduction of parking charge										
		Re-settlement of bus stops close to intersections										
Residential area traffic management	Elimination of through traffic	Improvement of bus stops										
		Construction of bus terminal										
	Establishment of pedestrian safety facilities	Establishment of regulatory signs / markings										
Establishment of speed control devices												
Traffic demand management measure	Promotion of the traffic modal shift	Establishment of pedestrian crossings										
		Repair of sidewalks										
	Traffic demand control	Establishment of park&ride facilities										
		Introduction of road pricing in CBD										
Introduction of advanced traffic management measure	Introduction of linked traffic signals											
	Establishment of traffic control centre											

According to the consideration of the traffic management measure and its implementation schedule, the following projects are recommendable. Project A and B are recommendable as the priority project in the short-mid term. Detailed programme of the other project will also be considered in the feasibility study.

Short-mid Term Project

A. Improvement of Intersections (Figure 11.8.10, Table 11.8.2)

- A-1 Establishment of the turn-right lane (14 intersections), including establishment of additional traffic signals
- A-2 Re-arrangement of signal pattern

B. Improvement of Bus Routes (Figure 11.8.11, Table 11.8.3)

- B-1 Improvement of bus terminal (1 nos.) and bus bay (8 nos.)
- B-2 Establishment / re-settlement of, bus strip on the TPM route (50 nos.), bus strip on the small/medium bus route (18 nos.), including sign boards, markings etc.

C. Improvement of Car Parks

- C-1 Enforcement for prohibition of car parks close to the intersections, bus stops etc.

D. Improvement of Community Roads

- D-1 Enforcement of speed limit and one-way traffic including establishment of signs, markings etc.
- D-2 Establishment of road safety facilities (pedestrian crossings, speed humps etc.)
- D-3 Rehabilitation of sidewalks
 - * Detailed plan will be considered in the feasibility study. Some part will be included in the road network improvement programme.

Long Term Project

E. Construction of Off-street Car Parking Facilities

- E-1 Construction of off-street car parking facilities
- E-2 Introduction of parking charge for on-street parking
- E-3 Enforcement for prohibition of on-street parking

F. Improvement of Traffic Control

- F-1 Introduction of linked traffic signals
- F-2 Establishment of vehicle detection system and self controlled traffic signals

F-3 Establishment of traffic control centre

G. Traffic Demand Management in CBD

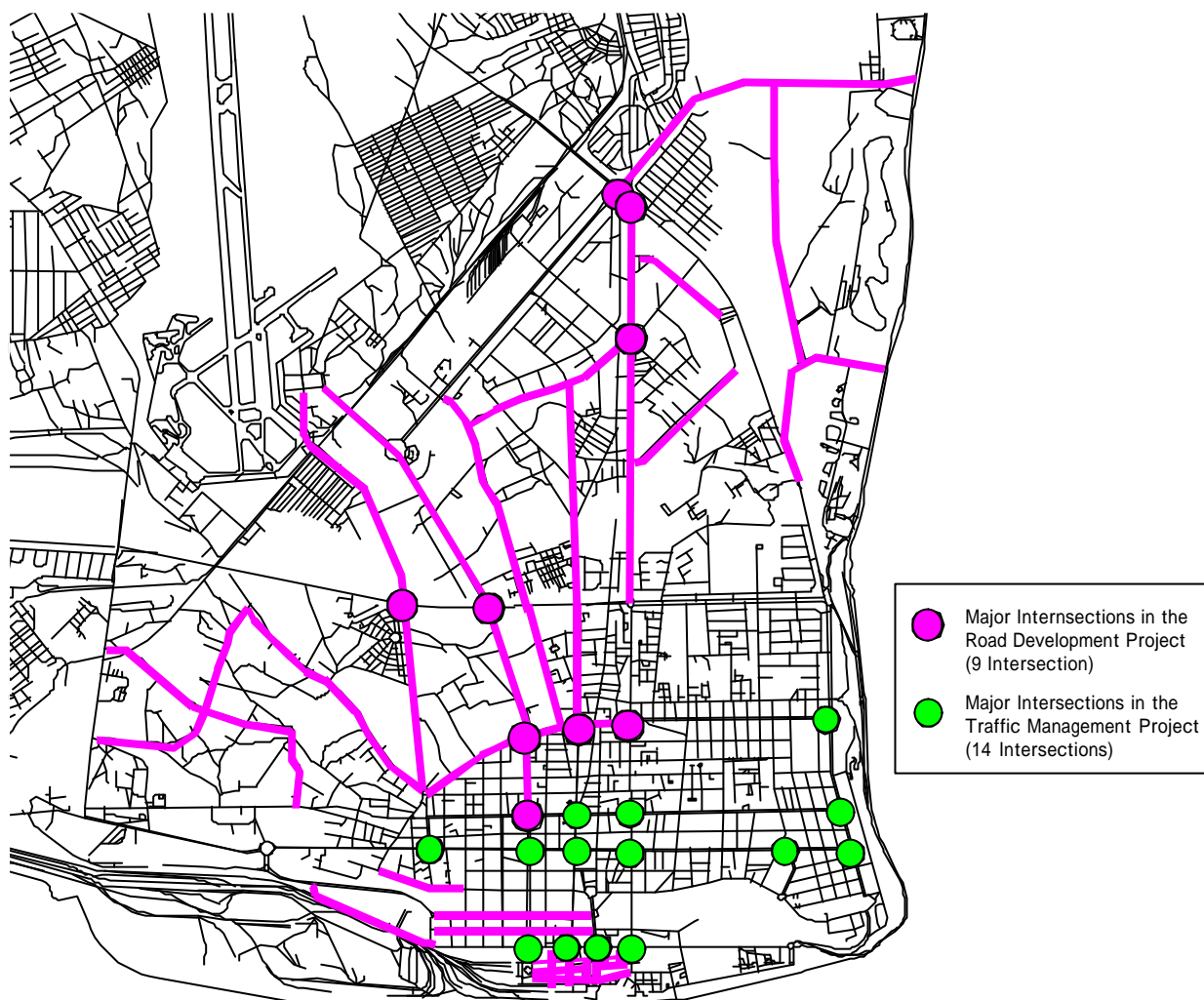


Figure 11.8.10 Location of Major Intersections to be Improved by the Project

Table 11.8.2 Contents of Improvement of Intersections

Location	Nos of Intersections		Total
	To be improved by traffic management project	To be improved by Road project	
1. M.T.Tung/ J.Nyerere	0		1
2. M.T.Tung/ V.Lenine		0	1
3. M. Ngonabi/ K.Marx		0	1
4. M. Ngonabi/ Lusaka		0	1
5. E.Mondlane/ J.Nyerere	0		1
6. E.Mondlane/ V.Lenine	0		1
7. E.Mondlane/ K.Marx	0		1
8. E. Mondlane/ G.Popular		0	1
9. 24 de Julho/ J.Nyerere	0		1
10. 24 de Julho/ R. dos Lusidas	0		1
11. 24 de Julho/ V.Lenine	0		1
12. 24 de Julho/ K.Marx	0		1
13. 24 de Julho/ G.Popular	0		1
14. 24 de Julho/ Zambia	0		1
15. 25 de Setembro/ V.Lenine	0		1
16. 25 de Setembro/ S.Machel	0		1
17. 25 de Setembro/ K.Marx	0		1
18. 25 de Setembro/ G.Popular	0		1
Total	14 nos,	4 nos,	18 nos

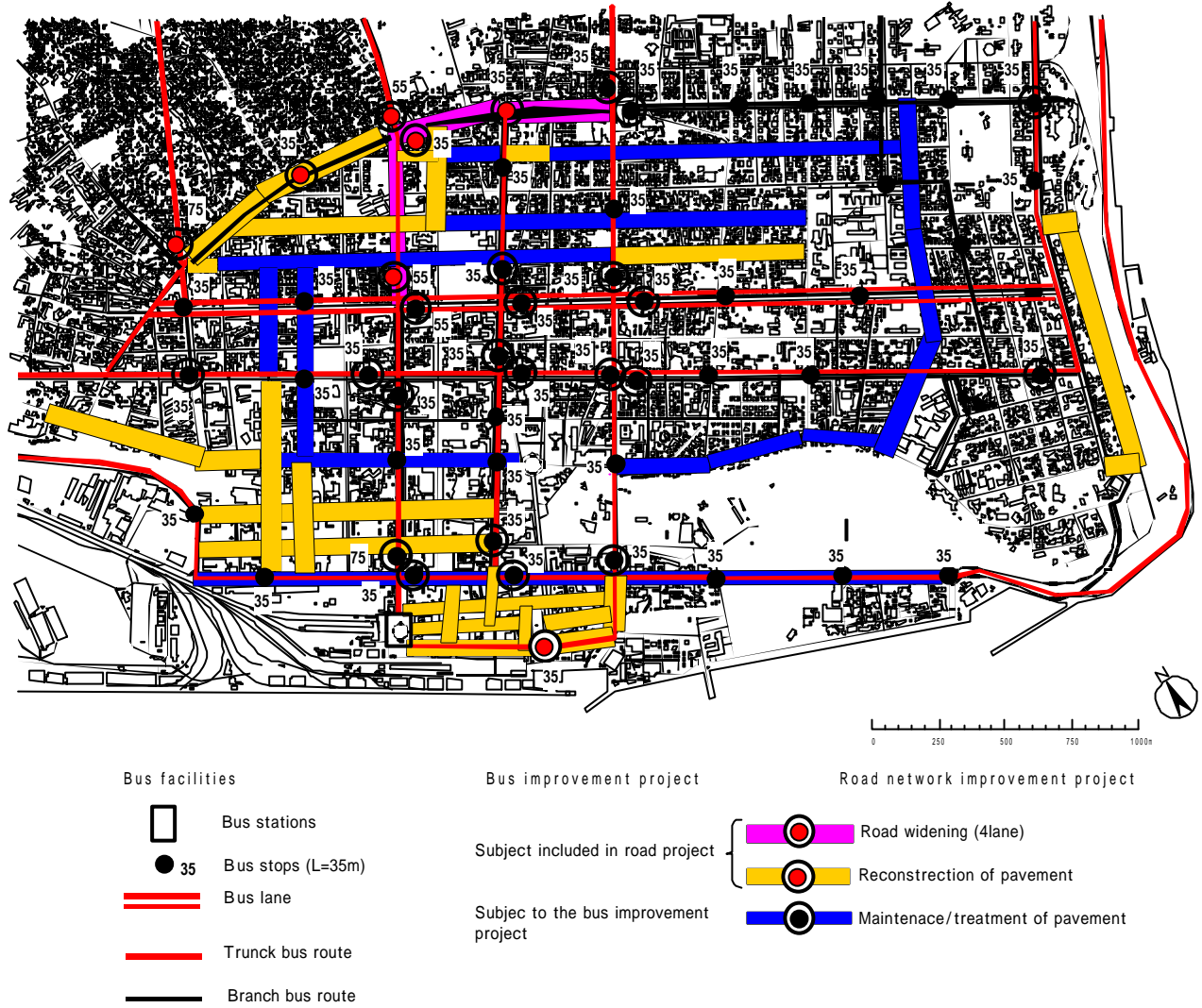


Figure 11.8.11 Location of Improvement of Bus Routes

Table 11.83 Contents of Improvement of Bus Routes

Location	Bus improvement project		Bus improvement including Road Project Bus Bay	Bus facilities to be controlled by enforcement	Total
	Bus Terminal	Bus Bay			
1. M.T.Tung /J.Nyerere			0		1
2. M.T.Tung /M.Machava				0	1
3. M.T.Tung / K.I.Sung				0	1
4. M.T.Tung /S.Allende				0	1
5. M.T.Tung /A. Cabral				0	1
6. M.T.Tung /V. Lenine		0			1
7. M.Ngonabi /K.Marx			0		1
8. M.Ngonabi / Lusaka			0		1
9. M.Ngonabi /R.F.Farinha				0	1
10. Angola /M. Ngonabi			0		1
11. E. Mondlane /J.Nyerere				0	1
12. E. Mondlane /C.A.Cardoso				0	1
13. E.Mondlane /A.Cabral				0	1
14. E.Mondlane /V.Lenine		0			1
15. E.Mondlane /K.Marx		0			1
16. E.Mondlane /G.Popular		0			1
17. E.Mondlane /R.F.Farinha				0	1
18. E.Mondlane /Zambia				0	1
19. 24 de Julho /J.Nyerere		0			1
20. 24 de Julho /S.Allende				0	1
21. 24 de Julho /A.Cabral				0	1
22. 24 de Julho /V.Lenine		0			1
23. 24 de Julho /K.Marx		0			1
24. 24 de Julho /G.Popular		0			1
25. 24 de Julho /R.F.Farinha				0	1
26. 24 de Julho /Zambia		0			1
27. 25 de Setembro /P.R.Mugabe				0	1
28. 25 de Setembro /Central C				0	1
29. 25 de Setembro /B.O.Mulanga				0	1
30. 25 de Setembro /K.Marx		0			1
31. 25 de Setembro /G.Popular		0			1
32. 25 de Setembro /M.S.Barre				0	1
33. P.dos Trabalhadores	0				1
34. P.25 de Junho			0	0	1
35. R. dos Lusíadas					1
36. C.Lusaka			0		1
	1x5=5nos	11x2=22nos	6x2=12nos	18x2=36nos	36x2=72nos

11.8.6 Preliminary Cost Estimation

Project costs for the above two projects are preliminary estimated as shown in the Table 11.8.4.

Table 11.8.4 Preliminary Cost Estimation for the Project in CBD

Project	Nos.	Construction Cost (USD)	Contingency (USD)	Administration cost (USD)	Engineering Service (USD)	Subtotal (USD)
A. Improvement of Intersections	13	1,510,661	151,066	30,213	151,066	1,843,007
B. Improvement of Bus stops *	76	401,003	40,100	8,020	40,100	489,224
Total		1,911,665	191,166	38,233	191,166	2,332,231

* 1 bus terminal, 1 bus bay, 2 bus strip (large), 6 bus strip (med/sml) are included in the road network improvement programme.

CHAPTER 12
*MIDDLE TERM PLAN FOR
ROAD DEVELOPMENT AND MAINTENANCE*

CHAPTER 12: MIDDLE TERM PLAN FOR ROAD DEVELOPMENT AND MAINTENANCE

12.1 ROAD MAINTENANCE PLAN

12.1.1 Road Maintenance Policy and Maintenance Cycle

1) Road Maintenance Policy

The condition of roads and drainages in Maputo city is poor because of lacking the road maintenance. The road maintenance policy should be established for sustainability.

(1) Efficiency of the road maintenance and Introduction of Privatisation

The road maintenance consists of three categories;

- Routine Maintenance
Grading/Levelling, Pot hole patching, Cleaning of road surface(removal of soil and garbage), Cleaning of existing Open drain(glass cutting, removal of garbage), Cleaning and flushing of existing pipe and catch-pit
- Periodic Maintenance
Resealing/Overlay and Reconstruction, Improvement of Drainage system
- Emergency Maintenance
Urgent repair of road deterioration

Maintenance programme for routine maintenance and periodic maintenance should be established for to operate the proper road maintenance effectively. But routine/periodic maintenance should be done by the private enterprise. The Municipal should concentrate to manage and supervise the maintenance activity of the private enterprise.

Introduction of privatisation to routine maintenance and periodic maintenance should be necessary for vitalisation of economic activity. The total cost of road maintenance will be reduced, but quality of road maintenance will increase by the competition of each private enterprise for the introduction of privatisation.

Before the introduction of privatisation, the municipal council execute the routine/periodic maintenance.

Emergency maintenance will be done by direct force and private enterprise for quick action.

(2) Introduction of New Road Department

It is necessary to restructure the existing organization and establish the new road department under the direction of the infrastructure municipals of Municipal Council of Maputo for systematically road maintenance, because the existing jurisdiction of the road maintenance is different to each part of road and drainage facilities.

The municipal directorate of Roads & Bridges (DMEP: Direcção dos Serviços Municipais de Estradas e Pontes), the sidewalk maintenance section of the municipal directorate of Works & Publicity (DMOP: Direcção dos Serviços Municipais de Obras e Publicidade) and Traffic Signal maintenance section of the municipal directorate of Transport and Traffic (DMTT: Direcção dos Serviços Municipais de Transporte e Trânsito) should be combined for establishment of a new organization for carriageway, sidewalk and traffic facilities maintenance.

And also the storm water drainage section of the municipal directorate of Water & Sanitation (DMAS: Direcção dos Serviços Municipais de Água e Saneamento) should be combined to the new road department for road/drainage design and maintenance.

The municipal directorate of Construction and Urbanization (DMCU: Direcção dos Serviços Municipais de Construção e Urbanização) should make the urban planning. New road department should make the road development plan according to the urban planning.

Primary/secondary storm water drain/channel and river should be maintained by the municipal directorate of Water & Sanitation (DMAS: Direcção dos Serviços Municipais de Água e Saneamento) .

Main policy of Restructure is below,

Clarification of the classification/role/responsibility for each section

Combination of each organisation of which concerned with road maintenance make the responsibility clarify.

Increase of the salary for the personnel are effective for the staff's spiritual uplift. The staff's salary is desirable about 90% of the salary of Private enterprise.

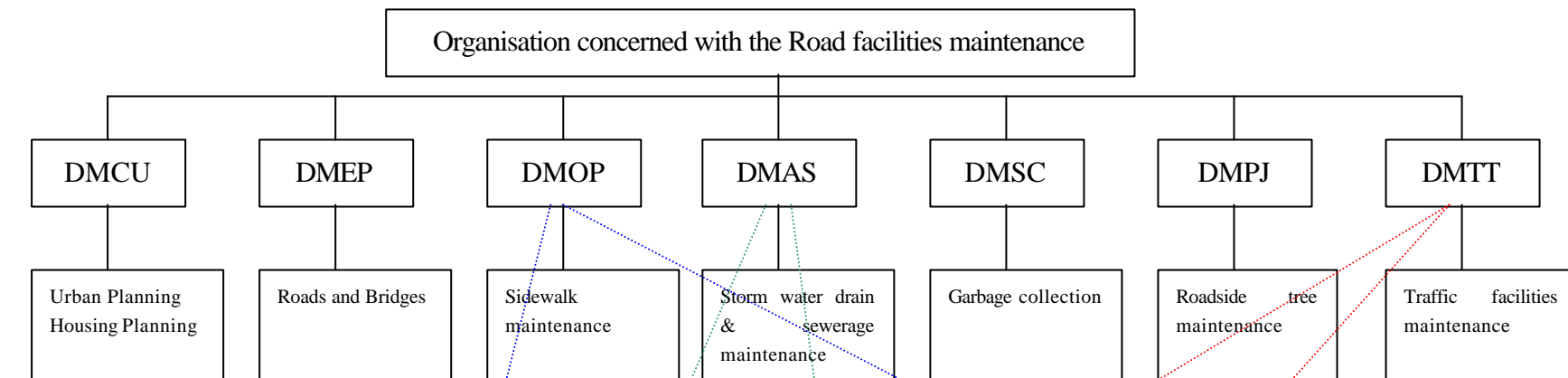
Proposed restructure plan is shown as below.

Proposed new road department consists the following five sections;

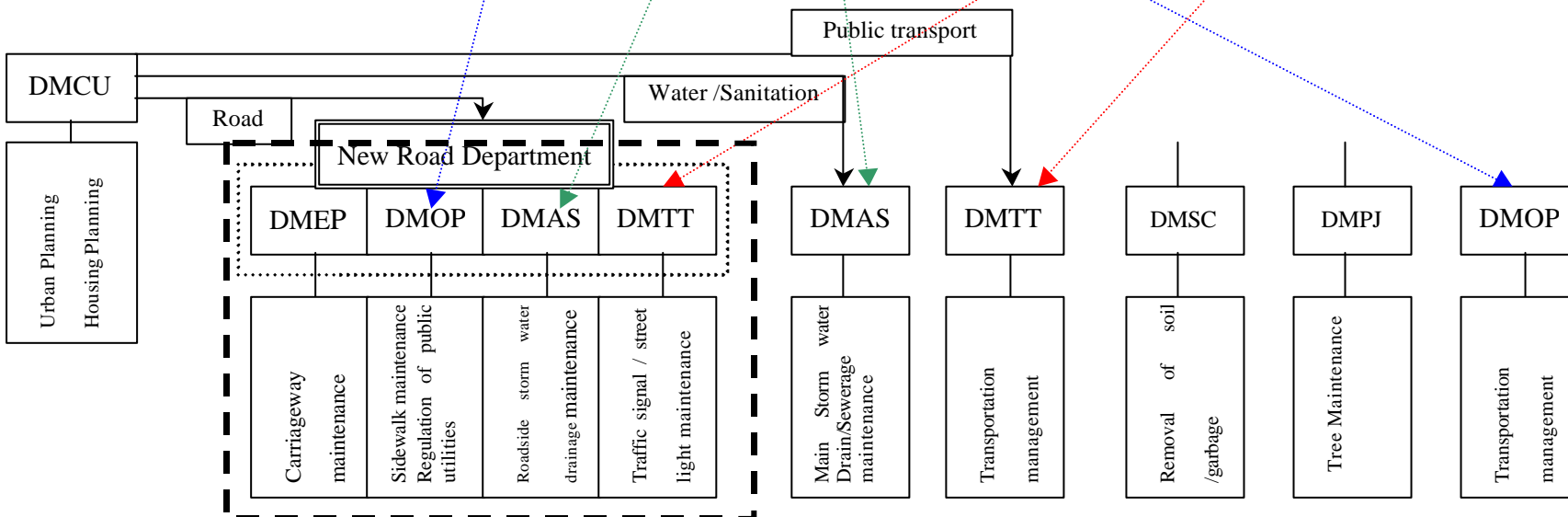
- Management Section
- Road Development Planning/Design Section
- Road Maintenance Planning/Design Section
- Procurement Section
 - Preparation of the evaluation list of contractors/consultants
 - Procurement of construction services
 - Inspection of construction services
 - Preparation of construction unit prices
- Emergency Maintenance Section

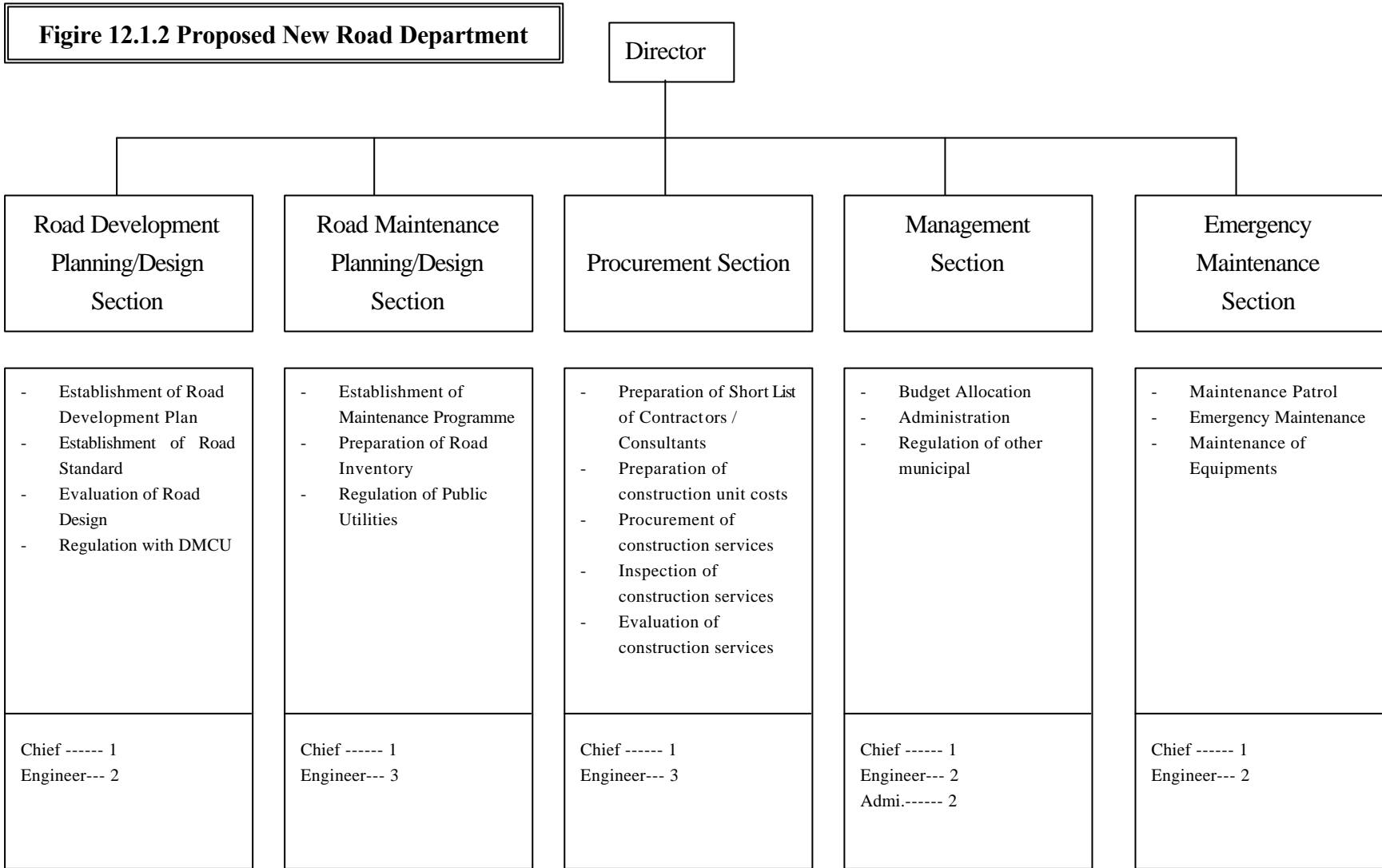
Proposed organization chart of the new road department is shown Figure 12.1.1 and 2.

Figure 12.1.1 Existing organization Chart concerned with the Road Maintenance



Proposed Organization Chart concerned with the Road Maintenance





(3) Capacity Increase of New Road Department

The organization of each municipal directorate has no knowledge of proper road maintenance.

The technical cooperation/support and on the job training for road maintenance are necessary for the capacity increase of new road department.

1 Capacity Increase of Planning and Design

- The expert for the planning and design for road development and maintenance

The expert for the planning/design for road development/maintenance should be dispatched to the municipal council for the technical cooperation/support.

The mechanical engineer and civil engineer should be dispatched for the experts at least 2 years.

The civil engineer will make the Road Development Plan and the Maintenance Programme and support of the maintenance management and budget allocation for road maintenance.

The mechanical engineer will support to maintain the maintenance equipments, the workshop facilities and control of the Traffic Signals.

- On the job training for road maintenance

- Establishment of Data Base of Road Inventory for Road Maintenance

It is important to establish and update of the database of road inventory due to make the road maintenance programme. Supply with computer system and training of the system engineer are necessary for establishment of database of road inventory.

Road inventory must be updated periodically according to change of the existing road and drainage condition.

2 Maintenance Equipments Supply

Existing condition of maintenance equipments and new equipments required the emergency maintenance are shown as follows,

Table 12.1.1 Equipments Required the Emergency Maintenance

Maintenance equipments	No.(A/B)	No. of necessity
	A: No.of working Equipments B:total no.	
Tractor	2/2	2
Compressor	1/1	1
Concrete Mixer	2/2	2
Tamper	2/2	1
Compactor	4/5(small),1/3(big)	Repair
Boiler	1/2(small),1/1(big)	Repair
Caterpillar	1/1	1
Asphalt cutter	1/1	1
Track	none	2
Roller	none	2
Asphalt spreader	none	2
Water tank	none	2
Jet cleaner	none	1

b) Supply with maintenance patrol car

Maintenance patrol car should be supplied for periodic maintenance patrol by new road department.

(4) Establishment of New Financial Support

The maintenance budget of each municipal directorate is limited.

It is necessary to introduce the new financial support showing as follows;

- External Financial Support
- Introduction of New Tax (City Planning Tax for District 1, On-street parking charge, Subsidy to off-street parking)
- Continuous Subsidy from road fund for maintenance

2) Maintenance Cycle

The project roads will need overlay or sealing for the periodic maintenance after 10 years from the completion of the project.

The trunk roads of which the urgent repairs have been done in 1999 will need pavement reconstruction for the periodic maintenance at least 10 years. But the collector roads of which the urgent repair has been done will need pavement reconstruction or overlay for the early periodic maintenance within approximately 5 years because of poor repair of the work and poor engineering.

The concept of maintenance cycle is shown as Fig. 12.1.3 And the road maintenance activities required for this road master plan are shown as below;

- A. Routine Maintenance of Maputo City Roads (Total length 830 km)
- B. Periodic Maintenance of the Road Development Project Roads
- C. Periodic Maintenance of the Roads of which the Urgent Repair have been done in 1999

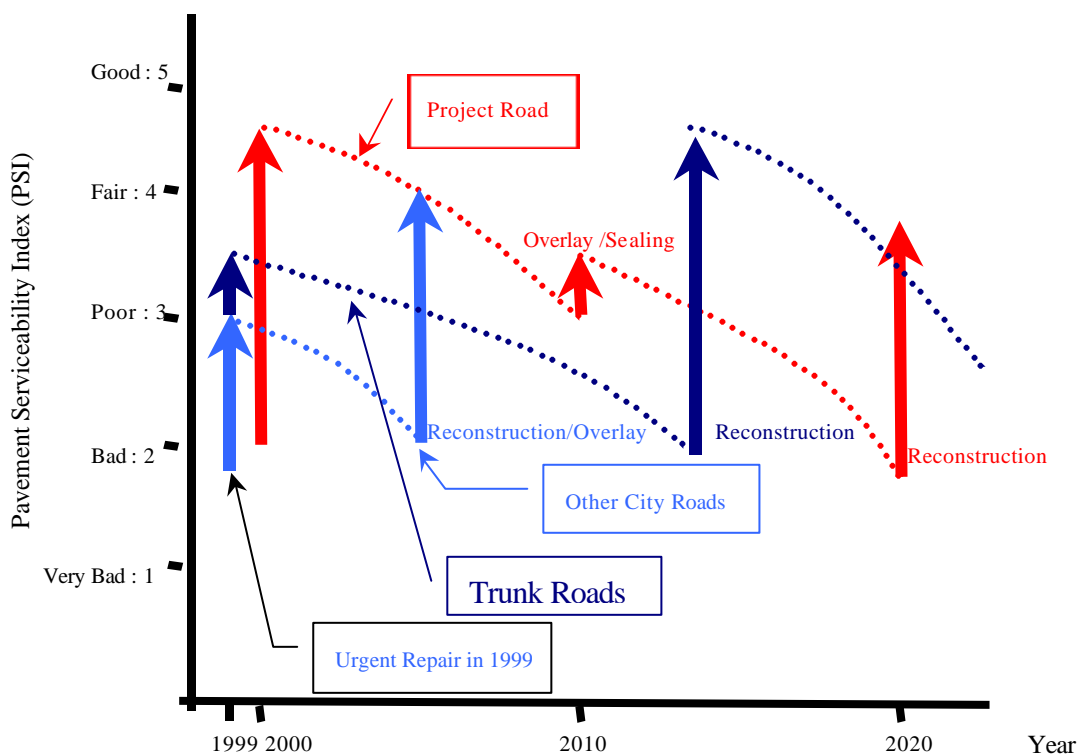


Figure 12.1.3 Maintenance Cycle

12.1.2 Identification of the Objective Road to be improved during the Middle Term Plan

In case of the Do Minimum, the bottleneck links having more than 1.5 volumes to capacity ratio can be identified at almost all links on the Trunk Roads by the year 2010. This shows the road network of the Do Minimum will not functioned well against the mid-term traffic demand.

Av. de Mozambique, Av. Acordos de Lusaka, Av. de Angola and Av. Vladimir Lenine will become overflowed traffic capacity in 2010 because of disconnecting of Av. Julius Nyerere at the present as shown in Fig. 12.1.4.

The Road Development required until 2010 are shown as follows;

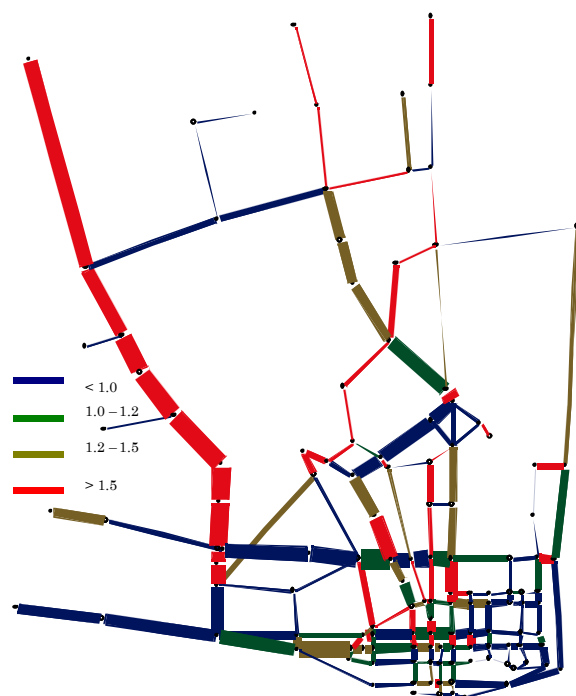


Figure 12.1.4 Traffic Demand in 2010 (Mid Term) Do Minimum

The objective Roads required to be rehabilitated and improved at Mid Term (2010) are shown as below.

Widening and Reconstruction of Av. de Mozambique

- Widening from Av. do Trabalho junction to Rue 5750 junction (8.3 km)
- Reconstruction Existing road from Rue 5750 junction up to the border (6.8km)

New construction of Missing Link (2 lane) of Av. Julius Nyerere

Rehabilitation of Av. Acordos do Lusaka and Widening of Av. Guerra Popular

- Rehabilitation of Av. A. do Lusaka (2.9km)
- Widening from 2 to 4 lane carriageway with construction of proper size of Bus-bay on the existing 2 lanes section of Av. Guerra Popular. (From Av. Eduardo Mondlane to Av. Marien Ngouabi)

Reconstruction of Av. de Angola and Rua S. Cabral/Largo de Deta

- The pavement of Av. Angola requires reconstruction. (3.1km)
- The pavement of Rua S. Cabral/Largo de Deta requires reconstruction. (0.6km)

Improvement of Av. V. Lenine

Widening and Reconstruction of Av. Marien Ngouabi

Reconstruction of Rua Paulino Santos Gil and Av. ONU

- Reconstruction of Rua Paulino Santos Gil (0.2km)
- Reconstruction of Av. ONU (1.5km)

12.1.3 Implementation Alternatives of Mid Term Plan and Cost Estimate

1) Implementation Alternatives at mid-term(2010)

Based on the development concepts with the necessary measures to be improved for Road Development and Road Maintenance, the following three-implementation alternatives for Road Development and Maintenance for mid-term target (year 2010) have been proposed.

Base Plan:

- Road Development Project:

The Trunk Road of Plan 3 of which Rua Igreja, Potential Area Roads and extension Rua 5750 are excepted and The Collector roads (District 1 to 5) are improved and rehabilitated during the mid-term (2010).

- **Road Maintenance Project:**

The objective roads of the Road Development Project will be maintained by the routine maintenance activities by the road department after the completion of the Road Development Project.

Other Trunk Roads and the collector Roads of District 1 should be maintained by Pothole patching/Overlay and rehabilitation of drainage system as the Road Maintenance Project, because these roads will be deteriorated within several years as poor repair. This road maintenance project should be implemented during the implementation of the road development project. Before the implementation of the road maintenance project, these roads should be maintained by the routine maintenance by the road department.

After the implementation of the road maintenance project, the routine/periodic maintenance should be done by a private enterprise. It is necessary to introduce of the privatisation to routine/periodic maintenance until mid-term stage.

Alternative 1:

- Road Development Project:

The Road Development of this case is consisted the Base Plan and an improvement of the Potential Area Trunk Roads.

- Road Maintenance Project:

This case is as same as the base plan.

Alternative 2:

- Road Development Project:

The Trunk Road of Plan 3 of which Rua Igreja, Potential Area Roads and extension Rua 5750 are excepted and The Collector roads (District 1 to 3) are improved and rehabilitated during the mid-term (2010) .

- Road Maintenance Project:

This case is as same as base plan.

Table 12.1.2 Summary of Implementation Alternatives at Mid-term(2010)

Implementation Alternatives									
Plan	Project Roads	2020 Plan 3		2010 Base		2010 Alternative 1		2010 Alternative 2	
Road Development	Trunk Road								
	- Av. de Mozambique Trabalho Jct. to Rua 5750 Jct.	4 lane		4 lane		4 lane		4 lane	
	(2) reconstruction of from Rua 5750 Jct. to tha border	2 lane		2 lane		2 lane		2 lane	
	- Av. Julius Nyerere new construction of Missing Link	4 lane		2 lane		2 lane		2 lane	
	- Av. A. do Lusaka(Reconst.) / Av. Guerra Popular(Widening)								
	- Av. de Angola / Rua S. Cabral/Largo de Deta (Reconstruction)								
	- Rua de Igreja	2 lane		-		-		-	
	- Potential Area			-				-	
	Collector Road								
	- District 1.2.3								
	- District 4.5							-	
	Area Road								
	- District 1			-		-		-	
		Periodic	Routine	Periodic	Routine	Periodic	Routine	Periodic	Routine
Road Maintenance	Trunk Road								
	- Project Road	O.L.	A	-	A	-	A	-	A
	- Non Project Road	O.L.	A	O.L.	B	O.L.	B	O.L.	B
	Collector Road								
	- District 1.2.3	S	A	-	A	-	A	-	A
- District 4.5	S	A	-	A	-	A	-	B	
	Area Road								
	- District 1	S	A	O.L.	B	O.L.	B	O.L.	B

Routine Maintenance A : After Project

Routine Maintenance B : Before Project

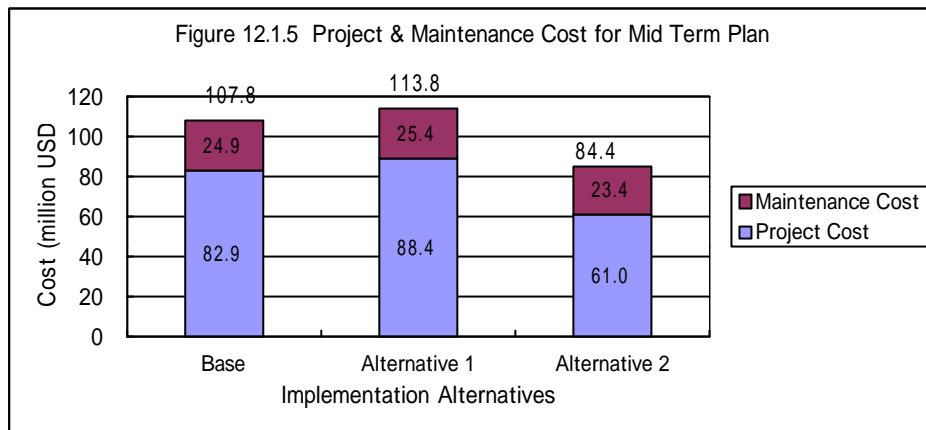
Periodic Maintenance S : Sealing

O.L. : Overlay

Re : Reconstruction

2) Cost Estimation for Alternatives

The methodology of preliminary cost estimate is same condition describing in **11.4.2 2) Preliminary Cost Estimate**. The calculation results of preliminary cost estimate for mid-term alternative plan are shown as Appendix. 5 and Figure 12.1.5.



12.1.4 Future Traffic Assignment of Mid Term Plan(2010)

Table. 12.1.2 shows the results of future traffic congestion of mid-term alternative plan.

The bottleneck links will become minimum on the Trunk Road network of each case of mid-term plan except in the city centre. These bottlenecks especially at the intersections will be settled out through the improvement of intersections and Traffic Management Plan.

12.1.5 Economic Analysis of Implementation Alternative s of Mid Term Plan

In order to select the best implementation schedule in terms of economic efficiency, economic analysis is conducted on alternative implementation schedules such as “Base plan”, “Alt 1”, and “Alt 2”.

The methodology of economic analysis is the same to the one applied in the economic analysis for the Master Plan of year 2020. Traffic assignment is conducted for a network of each alternative implementation schedule of year 2010, then benefit is calculated in comparison with “Do minimum” case of year 2010. It is assumed that benefit is growing in progressive manner as shown in Table 12.1.2. The growth rate is calculated from the difference of benefits between year 2010 and year 2020. The benefit from 2003 to 2009 is assumed to increase as years go by.

Distribution of cost in each year is assumed as shown in the Table 12.1.3. This distribution structure is following a typical cost distribution of the road network development programme observed in other projects.

Table 12.1.3 Economic Analysis of Implementation Alternatives

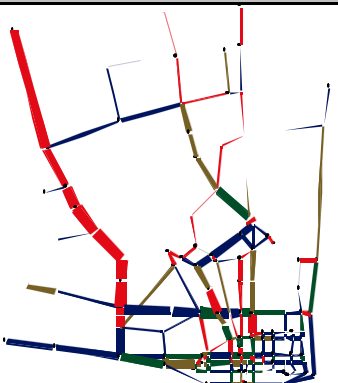
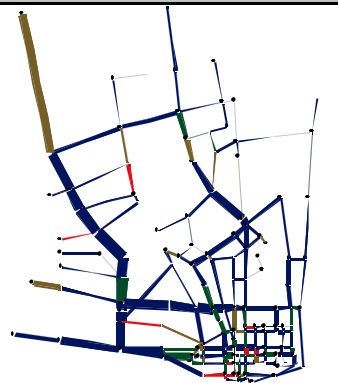
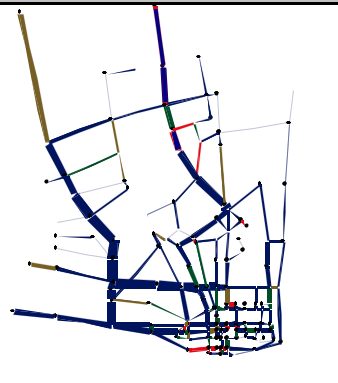
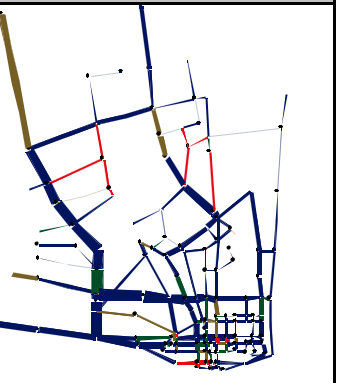
Unit: Mil. USD

Year	Do Minimum		Base Plan		Alt 1		Alt 2		Cost Distribution
	Cost	Benefit	Cost	Benefit	Cost	Benefit	Cost	Benefit	
2003	0.8	0	23.4	5.0	25.1	5.0	16.3	3.3	30%
2004	0.8	0	19.4	5.7	20.8	5.8	13.4	3.8	25%
2005	0.8	0	11.3	6.7	12.2	6.7	7.8	4.4	15%
2006	0.8	0	7.3	8.0	7.9	8.1	4.9	5.3	10%
2007	0.8	0	3.3	10.0	3.6	10.1	2.1	6.7	5%
2008	0.8	0	3.3	13.4	3.6	13.5	2.1	8.9	5%
2009	0.8	0	3.3	20.1	3.6	20.2	2.1	13.3	5%
2010	0.8	0	3.3	40.1	3.6	40.4	2.1	26.7	5%
2011	0.6	0	23.8	45.0	22.0	45.2	30.9	31.1	30%
2012	0.6	0	15.7	50.4	14.5	50.7	20.4	36.4	20%
2013	0.6	0	7.5	56.5	6.9	56.8	9.9	42.5	10%
2014	0.6	0	7.5	63.4	6.9	63.6	9.9	49.6	10%
2015	0.6	0	3.5	71.1	3.2	71.3	4.7	57.9	5%
2016	0.6	0	3.5	79.7	3.2	79.9	4.7	67.7	5%
2017	0.6	0	3.5	89.3	3.2	89.5	4.7	79.0	5%
2018	0.6	0	3.5	100.1	3.2	100.3	4.7	92.3	5%
2019	0.6	0	3.5	112.3	3.2	112.3	4.7	107.8	5%
2020	0.6	0	3.5	125.9	3.2	125.9	4.7	125.9	5%
			/	2.86	/	2.78	/	2.64	

Source: JICA Study Team

From the above table, it is obvious that Base Plan is the most efficient plan.

Table12.1.4 Mid Term (2010)

Case	Do Minimum	Base	Alternative 1	Alternative 2			
Traffic Assignment							
Traffic Congestion	The bottleneck links having more than 1.5 volume to capacity ratio could be identified as almost all links on the Trunk Roads by the year 2010.	The bottleneck links would become minimum on the Trunk Road network except in the city center. These bottlenecks especially at the intersections will be settled out through the improvement of intersections and Traffic Management Plan.					
Cost Estimate		Total Cost (million USD)	107.8	Total Cost (million USD)	113.8	Total Cost (million USD)	84.4
		Construction Cost(million USD)	82.9	Construction Cost(million USD)	88.4	Construction Cost(million USD)	61.0
		Maintenances Cost(million USD)	24.9	Maintenances Cost(million USD)	25.4	Maintenances Cost(million USD)	23.4
Road Length		126km		139km		72km	
Economic Analysis		2.86		2.78		2.64	
Evaluation		Recommended					

12.1.6 Conclusive Evaluation of Road Development for Mid-term Plan

As the results of the future traffic estimations on each alternative road networks, the road networks of all cases are well suited to the future traffic demand in the year 2010. The results of the economic evaluation of the road development mid-term alternatives and the financial sustainability of the funding show that the road development/maintenance mid-term plan : Base Plan is the most economically efficient and financially sustainable.

12.1.7 Project Components of the Road Development and Road Maintenance of Middle Term Plan

1) Road Development Project (Total L=124.1km)

The project components of the road development plan are shown as follows,

A. Construction of Primary Trunk Road (Total L=15.1km)

A-1 Widening and Reconstruction of Av. de Mozambique
(8.3km(widening),6.8km(reconstruction))

B. Construction of Trunk Road (Total L=15.6km)

B-1 New Construction of Missing Link(2 lane) of Av. Julius Nyerere(L=4.8km)
B-2 Improvement of Av.V.Lenine
B-3 Rehabilitation of Av. Acordos do Lusaka (L=2.8km)and Widening of Av. Guerra Popular(L=0.7km)
B-4 Reconstruction of Av. Angola(L=3.1km) and Rua S. Cabral/Largo de Deta(L=0.6km)
B-5 Reconstruction of Rua Paulino Santos Gil(L=0.2km) and Av. ONU(L=1.5km)
B-6 Widening (0.9km)and Reconstruction (L=1.0km)of Av.Marien Ngouabi

C. Construction of Collector Roads(Total L=93.4km)

● Reconstruction of collector and selected area roads in District 1 (18.7km)

Road Name	Road Length	Remarks
Av. Milagre Mabote(1369)	1.00	
Av. da Malhangalene(1357)	0.94	
Av. Para O Palmar(1426)	1.40	
Av. Kawame Nkrumah(1250)	1.61	
Av. Paulo Samuel Kankhomba(1152)	0.55	
Av. Emilia Dausse(1138)	0.85	
Av. de Maguiguana(1130)	0.75	
Av. Josina Michel(1070)	0.90	
Av. Fernao de Magalhaes(1038)	1.30	
Av. Zedequias Manganhela(1034)	1.30	
Av. Mohamed Siad Barre(1203)	0.85	
Av. RomaoFernandes(1199)	0.85	
Av. Filipe Samuel Magaia(1183)	0.40	
R. Consiglieri Pedroso(1022)/R. Joaquim Lapa(1020)	0.80	
R. do Bagamayo(1016)/R. de Timor Leste(1014)	0.80	
Av. Martires de Inhaminga(1006)	0.80	
Port Area(6 roads)	1.50	
Rua 1229	0.25	
Av. das Estancias(1030)	0.58	
Av. Friedrich Engels(1009)	1.20	

● Reconstruction of collector roads in District 2 (10.2km)

Road Name	Road Length	Remarks
Rua 2282/2265	2.36	
Rua 2275	2.01	
Rua de Xipamanine(2291)	1.13	
Rua dos Imaos Roby(2289)	1.30	
Rua 2315/2313	0.70	
Rua 2309/2324	1.00	
Rua 2522	1.25	
Av. das Estancias(2000)	0.49	

● Reconstruction of collector roads in District 3 (9.5km)

Road Name	Road Length	Remarks
Rua da Goa(3027)	0.80	
Rua da Lixeira(3030)	0.79	
Av. Milagre Mabote(3001)	1.98	
Av. da Malhangalene(3259)	1.83	
Rua 1 de Maio(3374)	1.49	
Rua 3306	0.49	
Rua 3523	1.00	
Rua 3576	1.10	

● Reconstruction of collector roads in District 4 (29.6km)

Road Name	Road Length	Remarks
Rua 4029/4040/CFM(4027)	2.50	
Rua 4160	1.11	
Rua 4453/4821	2.40	
Rua 4935/4844/4755	2.55	
Rua 4412	2.10	
Rua 4787/4433/4345	3.10	
Rua 4286/4282	1.40	
Rua do Aeroporto(4109)	1.13	
Rua da Beira(4113)	1.60	
Rua da Beira(4349)	0.62	
Rua 4395/4342	1.40	
Rua das Mahotas(4060)	1.45	
Rua 4680	3.60	
New Road(bypass of Av. Julius Nyerere)	2.30	
Reconstruction of Rua 4870	2.30	

● Reconstruction of collector roads in District 5 (24.3km)

Road Name	Road Length	Remarks
Rua 5578	0.70	
Rua 5650/5584	2.00	
Rua 5512	0.90	
Rua 5578-5512(new road)	1.30	
Rua 5514	1.75	
Rua da Paz(5501)	1.75	
Rua do Bagamayo((5319)	1.35	
Rua de Sao Paulo(5312)	0.69	
Rua 5500	0.90	
Rua 5280/5296	1.50	
Rua 5260	1.65	
Rua 5315	2.90	
Rua 5003/5021	1.90	
Rua do Jardim(5088)	1.45	
Rua da Agricultura(5086)	1.60	
Rua 5754	0.80	
Rua 5763	1.15	

2) Road Maintenance Project(Total =23.3km)

The following Road Maintenance Project should be implemented by the periodic maintenance due to prevent the pavement deterioration at the implementation of the Road Development Project.

A Urgent Repair of Trunk Roads (Total L=11.8km)**A-1 Pothole patching/overlay of Trunk Roads in District 1 (L=2.9km)**

Road Name	Road Length	Remarks
Av. 25 de Setembro(1028)	2.9km	

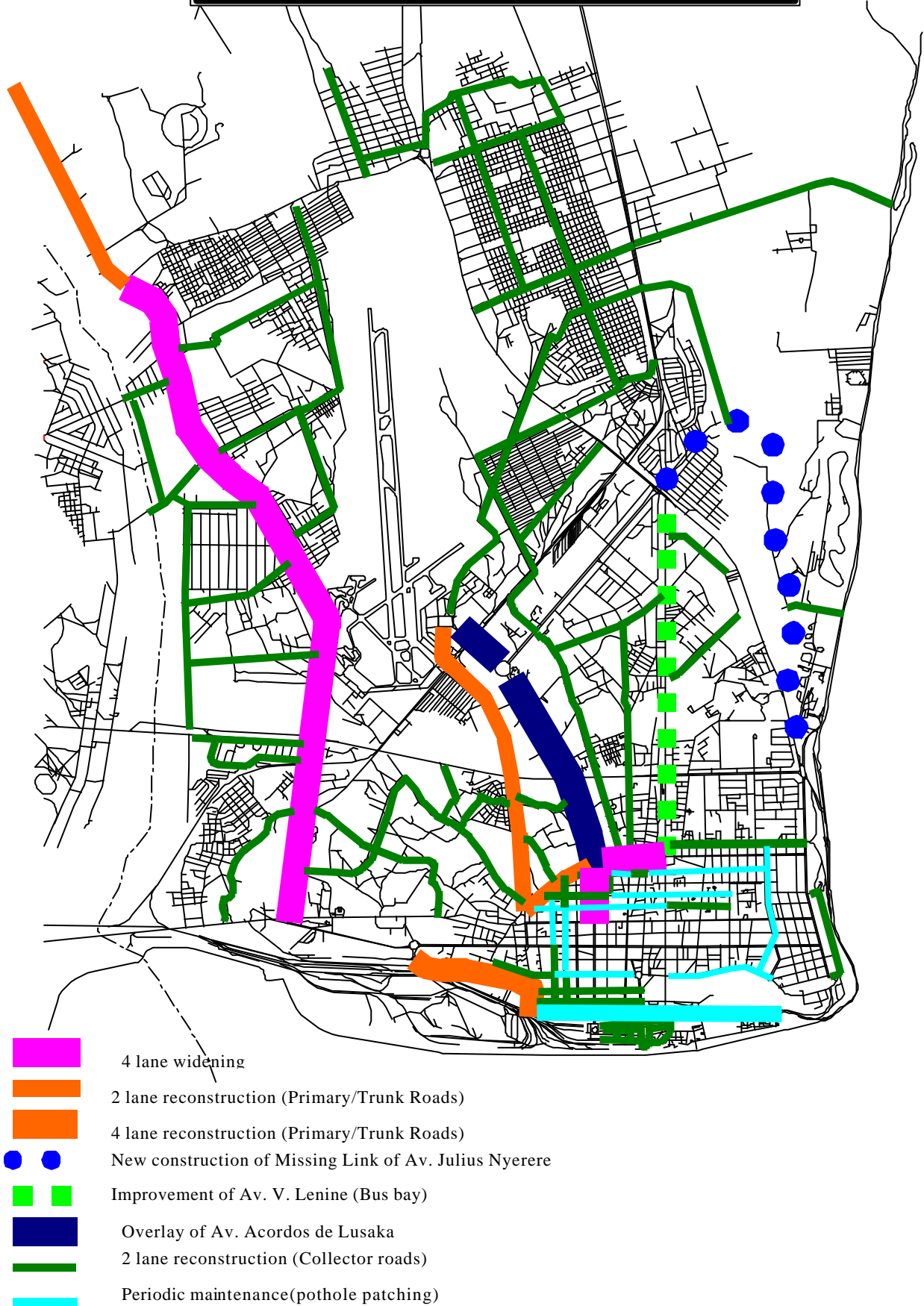
A-2 Pothole patching/overlay of Trunk Roads in District 2 (L=5.9km)

Road Name	Road Length	Remarks
Av. do Trabalho(2250)	2.6km	
Av. 24 de Julho(2010)	0.9km	
Rua Gago Coutinho(2287,2545)	2.4km	

B Urgent Repair of Collector Roads(Total L=11.5km)**B-1 Pothole patching/overlay of Collector Roads in District 1 (L=11.5km)**

Road Name	Road Length	Remarks
Av. Tomas Nduda(1039)	1.6km	
Av. Paulo Samuel Kankhomba(1152)	1.9km	
Av. Emilia Dausse(1138)	1.5km	Urgent repair in 1999
Av. de Maguiguana(1130)	1.7km	Urgent repair in 1999
Av. Filipe Samuel Magaia(1183)	1.4km	
Av. Romao Fernandes Farinha(1199)	0.8km	
Av. Mohamed Siad Barre(1203)	0.6km	
Av. Josina Michel(1070)	0.8km	Urgent repair in 1999
Av. Patrice Lumumba(1064)	1.2km	Urgent repair in 1999

Figure 12.1.6 Project Component of Middle Term Plan



12.1.8 Public Transport Middle Term Plan

Corresponding to the Middle Term Road Development Plan, Public Transport Middle Term Plan is established.

1) Improvement of Bus facilities on the improved Trunk Bus Routes.

To enhance the efficiency of Middle Term Road Development Plan, construction of Bus facilities along the Trunk Bus Route developed by the Middle term Plan is necessary.

- Av. Julius Nierere
- Av. Acordos do Lusaka and Av. Guerra Popular
- Av. De Angola
- Av. Lenine

2) Improvement of Bus Facilities at the Bottle Necks

Improvement of Bus facilities at the bottlenecks in 2010 is necessary to alleviate the congestion.

- Av. Guerra Popular (City Center)
- Av. Lenine (City Center)

3) Improvement of Bus Facilities on the Concentrated Trunk Routes

Improvement of Bus facilities on the concentrated Trunk Bus Routes is proposed for smooth traffic and for the benefit of Bus Passengers.

- Av. Eduardo Mondiane
- Av. 24 de Junho
- Av. F.P.L.M

4) Application of Bus Routes to the Improved Collector Roads

In order to extend the bus-serviced areas, branch Bus Routes are applied to the improved Trunk Roads and Collector Roads.

- Av. Marien Ngouabi
- Av. De Malhangalene and Rua 1^o de Maio

5) Construction of Bus Terminals near the Market

To settle the Congestion on the roads near the Markets, Bus terminals with proper spaces for buses, taxis, and trucks are proposed.

- Placa dos Combatentes
- Placa dos Trabalhadores

Existing Bus Terminal in Museu has ample space for 40Big Buses. Therefore, reconstruction of existing Bus Terminal is not necessary, though long time parking should be restricted and routes and types of Buses should be allocated to each Bus Stop properly.

Fig.12.1.7 shows Public Transport Middle Term Plan.

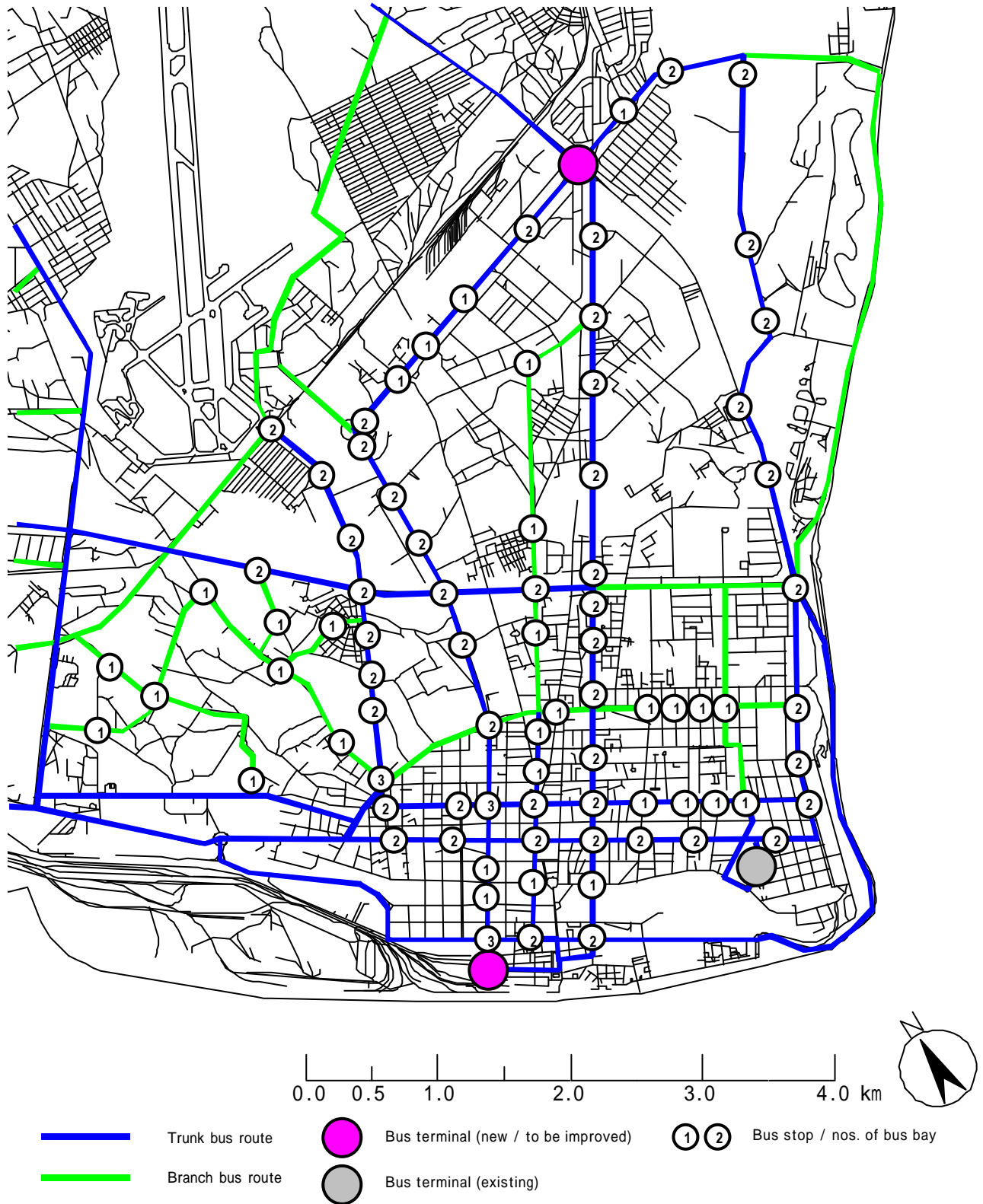


Fig.12.1.7 Public Transport Middle Term Plan

12.2 IMPLEMENTATION PROGRAMME

12.2.1 General

The Implementation Programme consists of the Road Development, the Road Maintenance/Operation, the Public Transport Development and the City Centre Traffic Management Plan.

As reported in Chapter 11 and Chapter 12.1, the goal period of Road Development is planned in Short Term and Middle Term. Identification of each project required during each term has already been proposed as shown in the Chapter 12.1.7. The Implementation Programme of Middle Term Road Development Plan should be established paying attention to the following items;

- Respect the storm water basin and drainage system,
- Priority given to the easiness of implementation,
- Priority given to the rehabilitation of missing link, and
- Establish a flexible institution.

12.2.2 Project Packaging for Respecting Storm Water Basin

In order to implement the construction works practically for the road and road related development plans, a drainage work becomes one of the key element of the project implementation.

Based on the existing storm water basin, the MCM has prepared the area distribution of each drainage system as shown in Figure 12.2.1 and Table 12.2.1. Therefore, the packaging of the projects by each drainage system/ storm water basin is necessary.

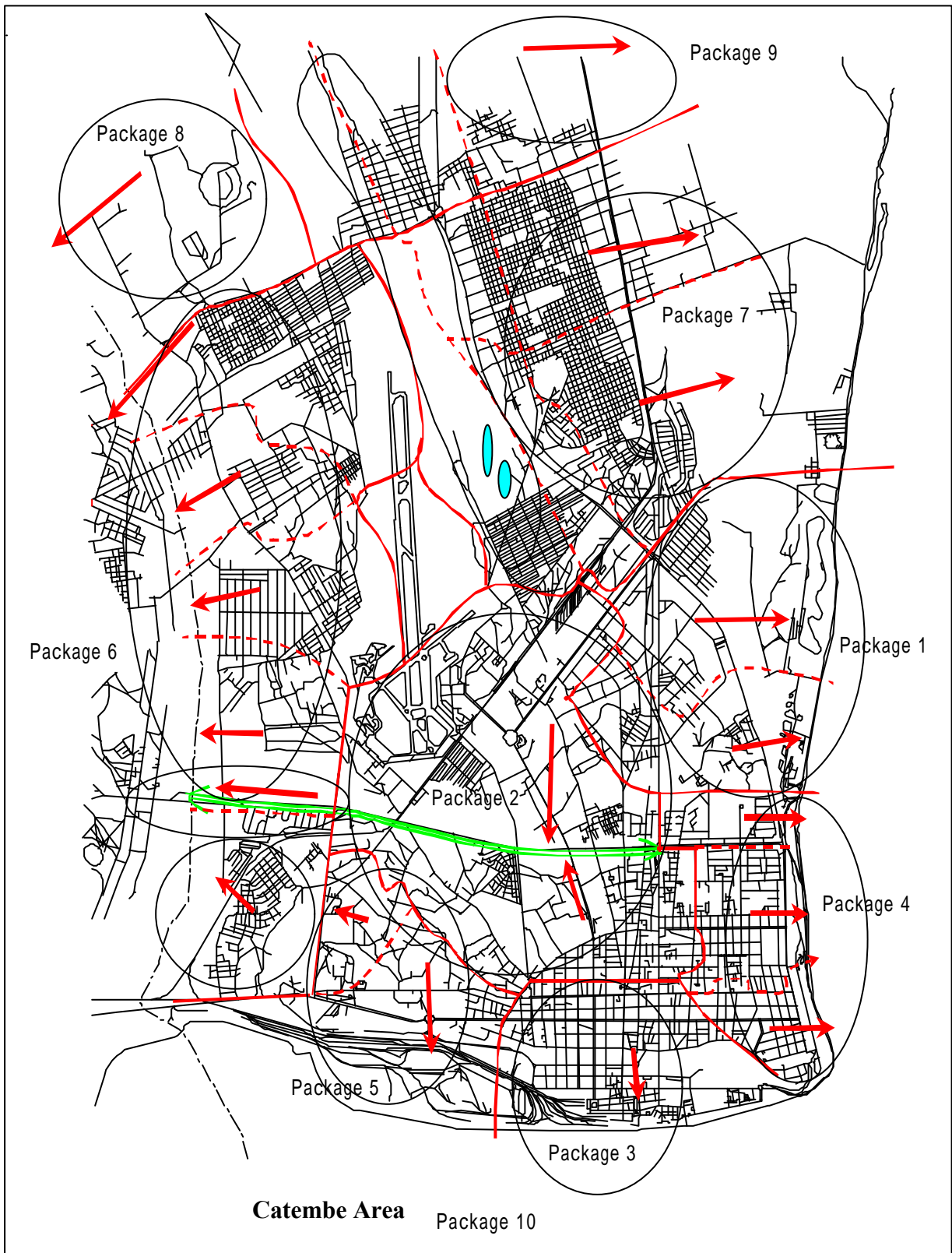


Figure 12.2.1 Storm Water Basin

Table 12.2.1 Packaging for Respecting Storm Water Basin

Construction Order	Contents
Package 1	<ul style="list-style-type: none"> ◇ New construction of new J. Nyerere ◇ Improvement of Av. V. Lenine ◇ Rehabilitation/improvement of collector and local area roads in the east area of District 3
Package 2	<ul style="list-style-type: none"> ◇ Rehabilitation of Av. A. Lusaka ◇ Widening of Av. G. Popular ◇ Reconstruction of Av. Angola ◇ Widening and reconstruction of Av. M. Ngouabi ◇ Rehabilitation/improvement of collector roads in the northwest area of District 1 ◇ Rehabilitation/improvement of collector and local area roads in the northeast area of District 2 ◇ Rehabilitation/improvement of collector and local area roads in the west area of District 3
Package 3	<ul style="list-style-type: none"> ◇ Reconstruction of Rua P. S. Gil and Av. ONU ◇ Rehabilitation/improvement of collector roads in the south area of District 1 ◇ Rehabilitation/improvement/installation of traffic management facilities ◇ Construction of bus terminal
Package 4	<ul style="list-style-type: none"> ◇ Rehabilitation/improvement of collector roads in the east area of District 1
Package 5	<ul style="list-style-type: none"> ◇ Rehabilitation/improvement of collector and local area roads in the south area of District 2 ◇ Maintenance of drainage and pavement of Av. Trabalho
Package 6	<ul style="list-style-type: none"> ◇ Widening of Av. Mozambique ◇ Rehabilitation/improvement of collector and local area roads of District 5
Package 7	<ul style="list-style-type: none"> ◇ Reconstruction of Rua de Igreja ◇ Rehabilitation/improvement of collector and local area roads of District 4
Package 8	<ul style="list-style-type: none"> ◇ Extension of Rua 5750 ◇ Reconstruction of Rua 5751
Package 9	<ul style="list-style-type: none"> ◇ Reconstruction of Rua Igreja(4647)(North Section)
Package 10	<ul style="list-style-type: none"> ◇ Reconstruction of collector roads in Catembe area

12.2.3 Implementation Programme

1) Project Classification

In order to determine the sequence of the implementation of the packages, the priority order has been given to either the easiness of the project implementation, such as no necessary of the house compensation, or the rehabilitation project of the missing link.

After the evaluation of the priority, the project packages are able to consist of three terms,

which are the short term, the middle term and the long term.

(1) Short Term

The short term should be included the missing link for the emergency project. Furthermore, in order to restore to the deterioration of the road and avenue in CBD area, District 1 is most important area as the short term project. Because the city function and cultural facilities of Maputo City are almost in CBD. And traffic demand is gathering from surrounding District 2 and District 3 to CBD. As the results of the packaging, each construction/ rehabilitation project components for the District 1 to 3 for the short term plan has been composed to five packages as shown in Table 12.2.2.

The project packages for the short term plan have been divided into three categories.

- Emergency Implementation Package; Package 1
- Necessary Implementation Package; Package 2
- Easy Implementation Package; Package 3, 4 and 5

Table 12.2.2 Short Term Project Plan

Construction Order	Contents
Package 1	<ul style="list-style-type: none"> ◇ New construction of new J. Nyerere ◇ Improvement of Av. V. Lenine ◇ Rehabilitation/improvement of collector and local area roads in the east area of District 3
Package 2	<ul style="list-style-type: none"> ◇ Rehabilitation of Av. A. Lusaka ◇ Widening of Av. G. Popular ◇ Reconstruction of Av. Angola ◇ Widening and reconstruction of Av. M. Ngouabi ◇ Improvement of Av. Das FPLM(4000) ◇ Rehabilitation/improvement of collector roads in the northwest area of District 1 ◇ Rehabilitation/improvement of collector and local area roads in the northeast area of District 2 ◇ Rehabilitation/improvement of collector and local area roads in the west area of District 3
Package 3	<ul style="list-style-type: none"> ◇ Reconstruction of Rua P. S. Gil and Av. ONU ◇ Rehabilitation/improvement of collector roads in the south area of District 1 ◇ Rehabilitation/improvement/installation of traffic management facilities ◇ Construction of bus terminal
Package 4	<ul style="list-style-type: none"> ◇ Rehabilitation/improvement of collector roads in the east area of District 1
Package 5	<ul style="list-style-type: none"> ◇ Rehabilitation/improvement of collector and local area roads in the south area of District 2 ◇ Maintenance of drainage and pavement of Av. Trabalho

(2) Middle Term Project

Following this manner, each project components of the middle term plans have also been classified as shown in Table 12.2.3. The middle term project plan should be defined by considering to develop as the suburban residences from CBD and to deteriorate the road surface condition in district 2 and district 3. Therefore, package 6 and 7 should be included in the middle term project plans.

Table 12.2.3 Middle Term Project

Construction Order	Contents
Package 6	<ul style="list-style-type: none"> ◇ Widening of Av. Mozambique ◇ Rehabilitation/improvement of collector and local area roads of District 5
Package 7	<ul style="list-style-type: none"> ◇ Reconstruction of Rua de Igreja ◇ Rehabilitation/improvement of collector and local area roads of District 4

(3) Long Term Project

The long term project plans are defined by consisting of package 1, 2, 4, 8, 9 to 10 as shown in Table 12.2.4.

Table 12.2.4 Long Term Project

Construction Order	Contents
Package 1	◇ Widening of Av. Julius Nyerere (North Section)
Package 2	<ul style="list-style-type: none"> ◇ Construction of two Grade Separations ◇ Widening/Rehabilitation of Av. Marien Ngouabi(1166)
Package 4	<ul style="list-style-type: none"> ◇ Widening of Av. Julius Nyerere (South Section) ◇ Reconstruction of Rua Igreja(4647)(South Section)
Package 8	<ul style="list-style-type: none"> ◇ Extension of Rua 5750 ◇ Reconstruction of Rua 5751
Package 9	◇ Reconstruction of Rua Igreja(4647)(North Section)
Package 10	◇ Reconstruction of collector roads in Catembe area

The Implementation Programme of the short term and middle term plans will be established following the above mentioned manner as well as the evaluation of the magnitude of the cost required as shown in Table 12.1.2.

2) Institutional Reform

Before starting the project implementation, preparatory works, such as a designing and planning of the project, house compensation, other budgetary arraignment and a institutional strengthening, should be implemented.

Among the preparatory works, the institutional reform will be a key element of the project implementation. Therefore, the Implementation Programme of the middle term and the long term plans should include the institutional reform as shown in Proposed Organization.

3) Implementation Programme of Each Project

Implementation Program of each project for the short, the middle and the long-term plans is prepared based on the objective of each term as shown in Table 12.2.5 and Figure 12.2.2.

According to Table 12.2.5, Project Road of the short term plan is consisted with 57 km and is estimated the project cost as thirty-seven million US dollars by 2005. Project Road of the middle term plan is consisted with 69 km and is estimated the project cost as forty-seven million US dollars by 2010. The short/middle term plan should be implemented in approximately nine years.

Road Project of the long-term plan is consisted with 32 km and is estimated the project cost as thirty-four million US dollars by 2020. The long-term plan should also be implemented in approximately five years.

Furthermore, the maintenance cost such as routine maintenance and periodic maintenance are added until the target year in 2020 after completing of Project Road.

Table 12.2.5 Implementation Programme

Project Name	Project Term	Package No.	Project Length (km)	Project Cost (mil. USD)	2001	2005	2010	2015	2020
Road Development	Short Term	1	9.05	9.75					
		2	24.60	16.09					
		3	11.38	5.78					
		4	5.66	2.42					
		5	6.11	2.99					
Road Development			56.80	37.03					
Road Maintenance Project	Short Term	2	20.30	18.96					
		3							
		4							
		5							
Pub. Transpot	Short Term	3	0.00	1.69					
Tr. Manage	Short Term	3	0.00	2.33					
Short Term Project Plans			77.10	60.01					
Road Development	Middle term	6	39.39	33.58					
		7	29.36	13.63					
Middle Term Project Plans			68.75	47.21					
Road Development	long term	1	4.90	8.68					
		2	1.88	6.05					
		4	3.95	4.85					
		8	6.55	5.24					
		9	5.75	3.04					
10	9.00	6.25							
Long Term Project Plans			32.03	34.11					
Total Project Plans			177.88	141.33					

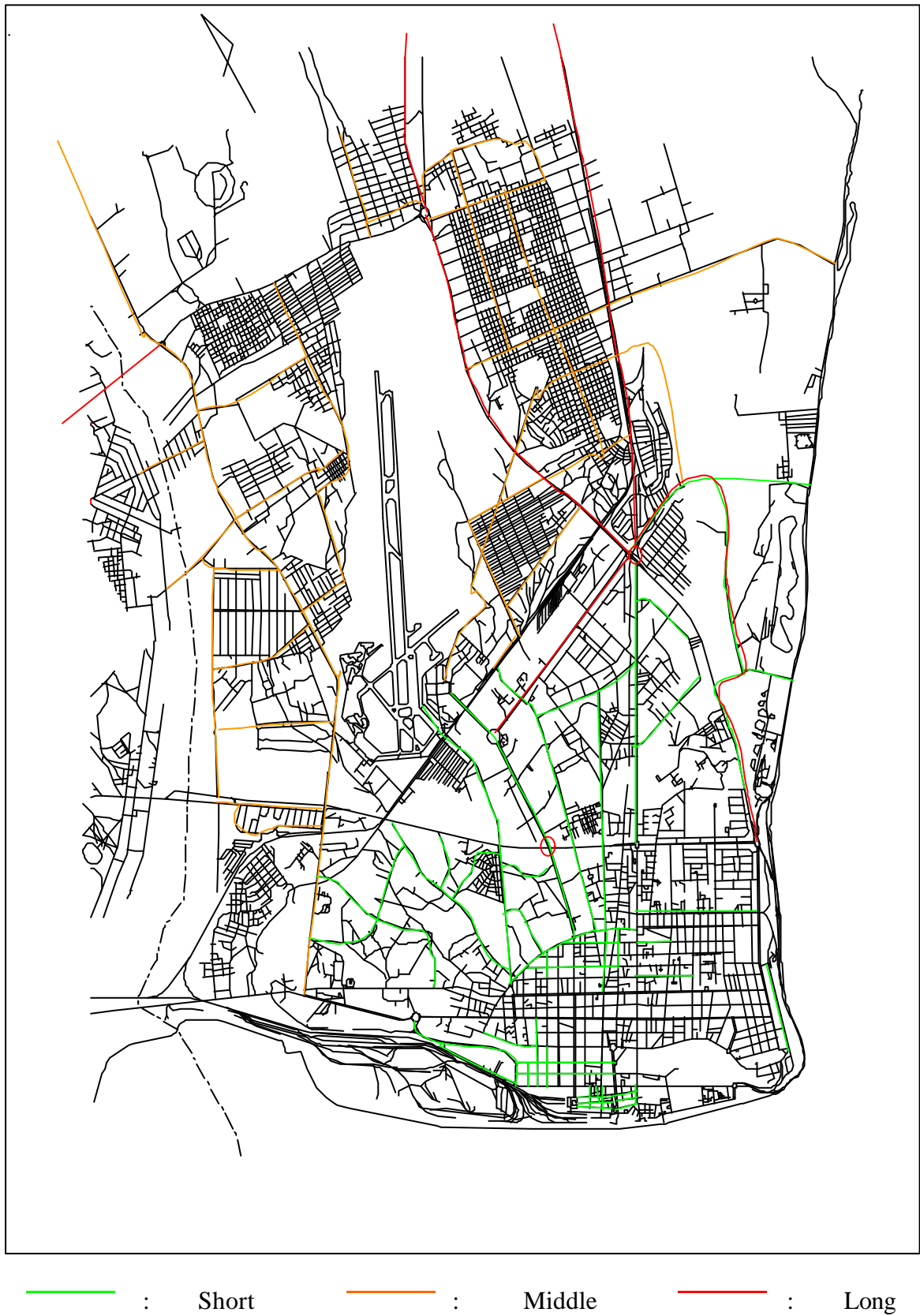


Figure 12.2.2 Implementation Programme of Each Term

CHAPTER 13

IDENTIFICATION OF THE FEASIBILITY STUDY

CHAPTER 13 : IDENTIFICATION OF THE FEASIBILITY STUDY

13.1 IDENTIFICATION OF THE PROJECT FOR THE FEASIBILITY STUDY

As the results of the preliminary evaluation of the middle term project and the middle term implementation programme, the project components of the priority road development, rehabilitation/improvement road, public transport development and traffic management plan have been confirmed.

Based on the above evaluation, the identification of the high priority project for the Feasibility Study has to be conducted. In order to select a most important, necessary and consistent road development plan, a conclusive evaluation of road development projects has been developed based on the following five criteria:

(1) Importance

Importance is the road importance on the viewpoint of engineering aspects. The indicators consist following sub-criteria:

- Road classification; Trunk and Collector road is classified as A and Urban area road is classified as B and Rural area road is C.
- Existing Traffic Volume: Traffic volume ($>5000\text{pcu}$): A, Traffic volume ($>2000\text{pcu}$): B and Traffic volume ($<2000\text{pcu}$): C

(2) Necessity

Necessity is the road conditions how the existing road facing the problems on the viewpoint of engineering aspects. The indicators consist following sub-criteria:

- Existing Pavement Roughness: $\text{IRI}>8$: A, $\text{IRI}>6$: B, $\text{IRI}>4$: C
- Traffic congestion: existing traffic par capacity ratio(t/c) >1.0 : A, $t/c>0.5$: B and $t/c<0.5$: C

(3) Impact

Impacts are the effect whether the road development has effects on its surroundings in terms of socio-economy and environmental aspects. The indicators consist following sub-criteria.

- Improvement accessibility to roadside area: Commercial and industrial area: A, Residential area: B and Rural area: C
- Environmental impact: Numbers of houses need to be relocated (No. <50): A, No. <200 : B and No. >200 : C

(4) Contribution

Contribution is the effects whether the road projects contribute to the improvement of the Basic Human Needs (BHN). The indicators consist following sub-criteria:

- Accessibility improvement to public community facilities
- Accessibility improvement of Emergency vehicle services

(5) Consistence

Consistency is the degree of consistency with the government policy

Table 13.1.1 shows the result of the evaluation of the road development projects for the medium term plan and the high priority projects to be evaluated during the further Feasibility Study are the entire projects nominated in the medium term plan. In addition, the priority projects identified for the public transport development and the traffic management as well as the institutional projects are also important projects to be evaluated during the further engineering study.

13.2 ENVIRONMENTAL ITEMS TO BE STUDIED DURING THE FEASIBILITY STUDY

13.2.1 General

Regarding the projects to be covered by the feasibility study described in previous chapter, it is necessary to establish EIA (Environmental Impact Assessment) items. The stages for extraction of EIA items are divided to screening and scoping while classifying environmental impacts into natural environment items, social environment items and environmental pollution items.

13.2.2 Screening

Screening checklist is evaluated in accordance with the JICA Guidelines and new items are added in consideration of specific conditions to Maputo's environment such as flood and earthquake as shown in Table13.2.1. The items of JICA form of screening checklist are shown from 1 to 23, and additional items are under 24 and 25 in the checklist.

Table 13.2.1 High Priority Road Development project of Feasibility Study

	Length km	1 Importance		2 Necessity		3 Impact		4 BHN Access		5 Govern- mental Policy	6 Total	7 Priority Project for F/S
		Road Class	Present Traffic	IRI	Conges- tion	Land Use	No. of Settle- ment	Public Facility	Emergen Vehicle			
A. Primary Trunk Road												
A.1 Widdening of Av. de Mozambique + Rehabilitation of Northern Section	15.05	A	A	C	B	A(Com. Res)	19 A	A	A	A	A'	
B. Trunk Road												
B.1 Construction of Missing Link on Av. Julius Nyerere	4.80	A	A	A	A	A(Com. Res)	162/2=81 B	A	A	A	A	
B.2 Improvement of Av. Vladimir Lenine	3.20	A	A	A	A	A(Com.)	0 A	A	A	A	A	
B.3. Improvement of Av. Acordos de Lusaka	2.85	A	A	A	B	A(Com. Res)	0 A	A	A	A	A	
B.4. Improvement of Av. Angola	3.09	A	A	B or C	A	A(Com. Res)	0 A	A	A	A	A	
B.5. Improvement of Av. Marien Nguoubi	1.88	A	A	A	A	A(Com./Res)	31 A	A	A	A	A	
C. Collector Road												
C1. Improvement of Industrial and Commercial Area Roads												
- Av. ONU												
- Av. Estancias												
- Av. Josina Machel												
- Av. Fernao de Mgalhaes												
- Av. Zedequias Mangahela												
C2. Improvement of Port Area Roads	17.04	A	A	A	A or B	A	0 A	A	A	A	A	
- R. Consiglien Pedroso - Parca 25 de Junho - R. Margues de Ponbal												
- R. do Bagamoyo - R. Joaquim Lapa												
- Av. Martires de Inhaminga												
- R. de Timor Lecte												
C3. Improvement of Residential Area Roads												
Dist. 1	1.60	A	A	A	A or B	A(Com. Res)	10 A	A	A	A	A	
Dist. 2	10.23	A	A or B	A	B	A(Com./Res)	140 B	A	A	A	A	
Dist. 3	8.48	A	A or B	A	B	A(Com./Res)	126 B	A	A	A	A	
Dist. 4	28.41	A	B	A	B	B(Res.)	8 A	A	B	A	A'	
Dist. 5	25.54	A	B	A	B	B(Res.)	49 A	A	B	A	A'	

122.17

A:Tru.Collc.

A>5,000 A:IRI > 8 A>1.0

A<50

B:Ubn.Ar.Rd.

B>2,000 B:IRI > 6 B>0.5

B<200

C:Rural

C<2,000 C:IRI < 4 C<0.5

C>200

Table 13.2.2 Screening checklist

Environmental Items		Content	Evaluations	Remarks(Basis)	
Social Environment	1	Resettlement	Resettlement of occupants from proposed land (removal of rights of residence)	Yes No UN	Residences exist in the project area
	2	Economic Activities	Loss of a productive opportunity such as land, and change of economic structure	Yes No UN	Roads and traffic will change the economic activities
	3	Traffic and Public Facilities	Influence of existing traffic such as congestion, accidents on schools and hospitals	Yes No UN	Public facilities such as markets, hospitals and schools exist in the project area
	4	Split of Communities	Split of communities by obstruction of traffic	Yes No UN	Split of community by the construction and widening will occur
	5	Cultural Property	Loss of cultural property and falling of value	Yes No UN	Historical and cultural properties under state protection exist in the city
	6	Water Right and Common Right	Obstruction of fishing rights, water rights, common rights of forest	Yes No UN	No impact on water rights
	7	Public Health Condition	Deterioration of a hygienic environment by production of refuse and noxious insects	Yes No UN	Lots of refuse will not be produced
	8	Waste	Occurrences of waste dumps and solid waste	Yes No UN	Lots of solid waste will be produced during construction and operation stage
	9	Hazards(Risk)	Increase of likely of danger of landslide and accident	Yes No UN	Construction of drainage system will reduce likely danger of landslide and accident
Natural Environment	10	Topography and Geology	Change of valuable topography and geology by excavation or fill	Yes No UN	Change in topography and geography is not anticipated
	11	Soil Erosion	Flow of surface soil by rainwater after land development and forest felling	Yes No UN	There will be no large excavation by the construction of road and widening
	12	Groundwater	Pollution by drainage or leach water by excavation construction	Yes No UN	Ground water will not be pumped, and the drainage system will reduce the water pollution
	13	Hydrological Situation	Change of flux and riverbed by reclamation and inflow of drainage	Yes No UN	There is no river in the project area.
	14	Coast and Sea Area	Change of beach erosion and vegetation by a change of reclamation or sea condition	Yes No UN	There is no construction of new road through the coast and sea area .
	15	Flora and Fauna	Breeding obstruction and extinction of species by a change of an inhabitable condition	Yes No UN	Mangroves, open green space and street trees exist in the project area.
	16	Meteorology	Change of temperature and wind conditions by the large-scale land development and architecture	Yes No UN	Large-scale felling and construction of high buildings is not planned.
	17	Landscape	Change of topography by land development and harmonious obstruction by structural objects	Yes No UN	Existing landscape will not be changed by the widening.

Environmental Items		Content	Evaluations	Remarks(Basis)	
Environmental Pollution	18	Air Pollution	Pollution by emission gas and dust from vehicles	Yes No UN	Impact by emission gas from increasing car use is concerned.
	19	Water Polluton	Pollution by inflow of earth and sand and industrial water waste	Yes No UN	Construction site can be managed not to create water pollution.
	20	Soil Contamination	Pollution by dust and asphalt emulsion	Yes No UN	Construction site can be managed not to create soil contamination.
	21	Noise and Vibration	Occurrences of noise and vibration by vehicles	Yes No UN	Impact by noise and vibration by vehicles is concerned.
	22	Land Subsidence	Subsidence by change of ground and fall of groundwater level	Yes No UN	Ground water will not be pumped, so construction causing ground subsidence will not occur.
	23	Offensive Odors	Occurrences of exhaust gas and offensive odors	Yes No UN	There is no factor of producing offensive odors nor gas.
Others	24	Flood	Damage on road construction stability	Yes No UN	Existing roads are damaged by flood frequently. A drainage system which will properly drain storm water should be designed and constructed.
	25	Earthquake	Possibility of earthquake	Yes No UN	There is no possibility of earthquake in the project area
Comprehensive Assessment: Is it necessary to implement on IEE or EIA for the development project?			Yes No UN		

Note: UN Unknown

13.2.3 Scoping

1) Summary of the IEE

All environmental items shall be evaluated from the viewpoint of the Initial Environmental Evaluation (IEE). According to JICA Guideline, the evaluation of environmental impact can be carried out in accordance with the rating method using four categories as shown in Table 13.2.3 In this method, every environmental item which is evaluated as category “ A ” or “ B ” is considered to require study in the form of an Environmental Impact Assessment (EIA). For items evaluated as category “ C ” further studies are required to clarify the impact.

Table 13.2.3 Environmental Evaluation Categories

Category	Examination and Evaluation	Remarks
A	Serious impact will be anticipated	EIA is required
B	Some impact will be anticipated	EIA is required
C	Extent of impact is unknown	Further study will be required
D	No impact will be anticipated	—

As a result of the discussion and the examination conducted in previous sections, the projects should be evaluated and summarized as shown in Table 13.2.4.

In addition to the above mentioned evaluation, environmental items which could be predicted to have any positive impact by the implementation of the improvement projects are marked as “ P ” in the “ Remarks ” column of the table.

Table 13.2.4 Scoping Checklist of the IEE

Environmental Items		Evaluation	Reasons	Remarks	
Social Environment	1	Resettlement	B	Resettlement will occur due to construction of new roads and widening of the existing routes.	
	2	Economic Activities	C	Construction of new roads and widening of the existing routes will cause changes of economic activities.	P
	3	Traffic and Public Facilities	C	Public facilities such as religious and public utilities (hospitals and schools) will be affected by noise and vibration by vehicles	
	4	Split of Communities	D	Proper mitigation measures shall be required.	
	5	Cultural Property	C	There are historical buildings, statues and so on in the city.	
	6	Water Rights and Common Rights	D	Water rights and common rights do not exist.	
	7	Public Health Condition	D	Large amounts of refuse will not occur. Road side gutters for rain and domestic water shall be improved and covered.	P
	8	Waste	D	Proper solid waste management shall be required during widening construction stage.	
	9	Hazards(Risk)	D	Construction of drainage system will reduce the possibility of danger of landslide.	P
Natural Environment	10	Topography and Geology	D	There will be no large excavation by the construction of road and widening.	
	11	Soil Erosion	D	Large-scale changes of lands will not be planned.	
	12	Groundwater	D	There will be no large excavation by the construction of road and widening. The drainage system will reduce the water	P
	13	Hydrological Situation	D	There is no river in the project area.	
	14	Coast and Sea Area	D	There are no construction of new road through the coast and sea area .	
	15	Flora and Fauna	C	Mangroves, open green space and street trees exist in the project area. Study on the flora and fauna is necessary in the road construction area and widening section.	
	16	Meteorology	D	There is no large-scale construction and modification of the land configurations.	
	17	Landscape	D	Widening and other improvement measures shall be constructed to harmonize with the surrounding landscape.	P
Environmental Pollution	18	Air Pollution	B	Air pollution level may be lightened by traffic control and reduction of traffic congestion, but affect of increase in traffic volume should be studied.	
	19	Water Polluton	D	No direct impact on the water will be anticipated by the execution of improvement of roads.	
	20	Soil Contamination	D	There will be no activities, which causes soil contamination.	
	21	Noise and Vibration	B	Noise level may be lightened by the reduction of traffic congestion, but impact of noise and vibration during and after construction of roads should be studied.	
	22	Land Subsidence	D	There is no excavation and construction that will affect ground	
	23	Offensive Odors	D	There is no factor of producing offensive odors.	

Classification of evaluation: A : Serious impact will be anticipated
 B : Some impact will be anticipated
 C : Extent of impact is unknown (Further study will be required)
 D : No impact will be anticipated
 P : A positive impact will be anticipated

2) Conclusion of IEE

(1) Environmental items requiring EIA

Evaluation is required to carry out a further Environmental Impact Assessment (EIA) for high priority road development in Maputo city.

According to the results of the IEE study in the previous sections, the items which are evaluated as category “ B ” are considered to be affected by the execution of projects to be covered by the feasibility study. Consequently, the environmental components which will be required to implement EIA can be shown below:

- Resettlement
- Air pollution
- Noise and vibration

a) Resettlement

To evaluate an environmental impact on resettlement of residents, the number of households and facilities (commerce facilities, etc.) along targeted high priority roads should be identified. In addition to these, it should be important to understand the economic conditions of inhabitants, living environment and household opinion on improvement project and resettlement issues, etc.

Regarding compensation for resettlement, there is a compensation system for involuntary resettlement in Mozambique. However, there is neither any precise regulation nor law on resettlement. Generally, it is agreed upon in the talks between local people and the Maputo city government to pursue resettlement with help of consultants. Therefore, past experience on resettlement and compensation measures shall be reviewed and the feasibility of applying them shall be evaluated. In addition, there should be necessity to establish a rule on compensation for resettlement by the government.

Issues arising from resettlement of residents along targeted high priority roads and the need for mitigation will take the following considerations:

- Likely social and cultural tensions between newly arrived residents and residents living in adjacent areas.
- Likely cultural anxieties among resettled residents due to loss of livelihood or inability

to continue livelihood in new areas

b) Air pollution

By predicting total amounts of pollutants emitted from vehicle exhausts, their impact to the environment and possible mitigation measures to be introduced to high priority roads should be carefully studied. In addition, mitigating measures to combat excessive particulate matter during road construction should be examined in practical manner.

Regarding prediction of air pollution in the target year, there are several prediction methods. The principal method is to calculate them by using several parameters such as traffic volume by each vehicle type, vehicle velocity (km/h) and meteorology (wind speed (m/s)), etc. Therefore, these parameters shall be obtained or assumed from existing data or other studies at the EIA stage to make the necessary prediction.

c) Noise and vibrations

A prediction of the noise level and vibration level generated from automobile traffic and road construction machinery along targeted high priority roads to adjacent residential areas should be made. Based on qualitative assessment, proper mitigation targets can thus be estimated.

Regarding prediction of the noise level in the target year, there are several prediction models currently used in other studies. Selection of the suitable model in this study should be made by considering the situation of the study area and the purpose of this study. As one of the models, the equivalent continuous A-weighted sound pressure level (L_{eq}) can be calculated by use of several parameters such as average power level (dB(A)), vehicle average interval (m), vehicle velocity (km/h), distance between noise source (m) and the monitoring position.

Regarding prediction of the vibration level, a model proposed by the Public Works Research Institute of the Ministry of Construction of Japan can be considered to utilize. According to this model, the highest value of 80% range of vibration level (L_{10}) can be calculated by use of several parameters such as traffic volume by each vehicle type, vehicle velocity (km/h), situation of road construction and road surface, etc.

Therefore, these parameters on calculation of noise and vibration level shall be obtained or assumed from existing data or other studies at the EIA stage to make the necessary prediction.

(2) Other environmental items requiring further study

Other environmental items which were evaluated as category“ C ” require further studies in the areas where high priority roads of improvement projects exist as discussed in the previous section. Environmental items for further study and a brief study plan are, therefore, shown in Table 13.2.5.

Table 13.2.5 Environmental Items for Further Study and Brief Study Plan

Environmental Item		Study Plan
Social Environment	Economic Activities	To study future land use plan and future economic structures in the target areas of the improvement project. To predict impacts on economic activities.
	Traffic and Public Facilities	To identify the distribution of public facilities (such as markets, hospitals and schools, etc.) in the target areas of the projects. To predict impacts such as congestion, accidents on the public facilities.
	Cultural Property	To survey and identify the distribution of the cultural properties in the target areas of the projects. To predict impacts on the cultural properties.
Natural Environment	Flora and Fauna	To study and identify the inhabitants of the flora and fauna in project areas. To predict impacts on inhabitants.