4.3 EXISTING ROAD PAVEMENT CONDITION

The Rehabilitation and Repair of 160km of major streets in Maputo were done by the World Bank Programme from April to September 1999. The major works involved the pothole patching, resealing for paved roads, re-gravelling for gravel roads and cleaning of existing drainage.

In spite of passing only one year after completion of this rehabilitation project; there are some potholes at the intersections or flood prone areas. Main reasons are lack of appropriate drainage maintenance and poor performance of pavement rehabilitation.

The area roads located around central station/port area and some collector roads have not been rehabilitated so that these road surfaces are remain in a heavy deterioration. It is therefore necessary to rehabilitate the area road of the station/port area and other collector roads urgently.

During the survey period, the Study Team conducted the road pavement condition survey applying the International Roughness Index (IRI) established by the World Bank in 1986 together with the road inventory survey. The degree of the IRI is classified into twenty grades as follows:

Table 4.3.1 The Standard of IRI

Quantitative Evaluation	Roughness IRI (m/km)	
	Paved Road	Unpaved Road
Smooth/ Good	2 (routine maintenance)	4 (maintenance)
Reasonably smooth/ Fair	4 (periodic maintenance)	8 (reconstruction/ mainte.)
Medium rough/ Poor	6 (overlay)	12 (reconstruction)
Rough/ Bad	8 (reconstruction)	15 (reconstruction)
Very rough/ Very Bad	10 (reconstruction)	20 (reconstruction)

Based on the both of the surveys, the actual road pavement condition for totally 222.4km of the classified roads is shown in Table .4.3.2, Figure 4.3.1 and Figure 4.3.2.

The pavement condition of the Primary Trunk Roads are fair and the proportion of the fair/ poor sections and the bad/ very bad sections of the Trunk Roads is 84% and 16% respectively. But in case of the collector roads and the local area roads, there are only 27.8km and 23.5km roads evaluated as poor condition and the remaining are the bad/ very bad requiring urgently rehabilitation.

Table 4.3.2 Road Pavement Condition by Classification

	IRI	2		4		6		8		10-20		Total(km)	
District 1	Primary Trunk Road	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
	Trunk roads	0.0	0%	1.6	6%	24.1	86%	0.2	1%	2.2	8%	28.1	100%
	Collector Roads	0.0	0%	0.0	0%	21.5	87%	3.1	13%	0.0	0%	24.6	100%
	Local Area Roads	0.0	0%	0.0	0%	16.6	74%	6.0	26%	0.0	0%	22.6	100%
	District 1 Total(km)	0.0	0%	1.6	2%	62.2	83%	9.3	12%	2.2	3%	75.3	100%
District 2	Primary Trunk Road	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
	Trunk roads	0.0	0%	1.4	12%	9.5	79%	1.0	8%	0.0	0%	12.0	100%
	Collector Roads	0.0	0%	0.0	0%	2.7	33%	1.3	16%	4.3	52%	8.3	100%
	Local Area Roads	0.0	0%	0.0	0%	0.3	11%	0.1	6%	2.1	84%	2.5	100%
	District 2 Total(km)	0.0	0%	1.4	6%	12.5	55%	2.5	11%	6.4	28%	22.8	100%
District 3	Primary Trunk Road	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
	Trunk roads	0.0	0%	0.0	0%	11.2	67%	3.1	19%	2.4	15%	16.7	100%
	Collector Roads	0.0	0%	0.0	0%	1.1	10%	0.8	7%	8.9	83%	10.7	100%
	Local Area Roads	0.0	0%	0.0	0%	0.4	6%	0.2	3%	6.2	91%	6.8	100%
	District 3 Total(km)	0.0	0%	0.0	0%	12.7	37%	4.1	12%	17.5	51%	34.2	100%
District 4	Primary Trunk Road	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-	0.0	-
	Trunk roads	0.0	0%	0.0	0%	13.4	77%	0.0	0%	4.1	23%	17.5	100%
	Collector Roads	0.0	0%	0.0	0%	0.0	0%	1.6	60%	1.0	40%	2.7	100%
	Local Area Roads	0.0	0%	0.0	0%	2.5	21%	1.6	14%	7.6	65%	11.7	100%
	District 4 Total(km)	0.0	0%	0.0	0%	15.9	50%	3.2	10%	12.8	40%	31.9	100%
District 5	Primary Trunk Road	0.0	0%	8.3	100%	0.0	0%	0.0	0%	0.0	0%	8.3	100%
	Trunk roads	0.0	0%	0.0	0%	5.3	100%	0.0	0%	0.0	0%	5.3	100%
	Collector Roads	0.0	0%	0.0	0%	2.5	12%	0.0	0%	19.2	88%	21.8	100%
	Local Area Roads	0.0	0%	0.0	0%	3.7	16%	0.0	0%	19.2	84%	22.9	100%
	District 5 Total(km)	0.0	0%	8.3	14%	11.5	20%	0.0	0%	38.5	66%	58.2	100%
Total	Primary Trunk Road	0.0	0%	8.3	100%	0.0	0%	0.0	0%	0.0	0%	8.3	100%
	Trunk roads	0.0	0%	3.1	4%	63.5	80%	4.3	5%	8.7	11%	79.5	100%
	Collector Roads	0.0	0%	0.0	0%	27.8	41%	6.8	10%	33.4	49%	68.0	100%
	Local Area Roads	0.0	0%	0.0	0%	23.5	35%	7.9	12%	35.2	53%	66.6	100%
	District 1- 5 Total(km)	0.0	0%	11.3	5%	114.8	52%	19.0	9%	77.3	35%	222.4	100%

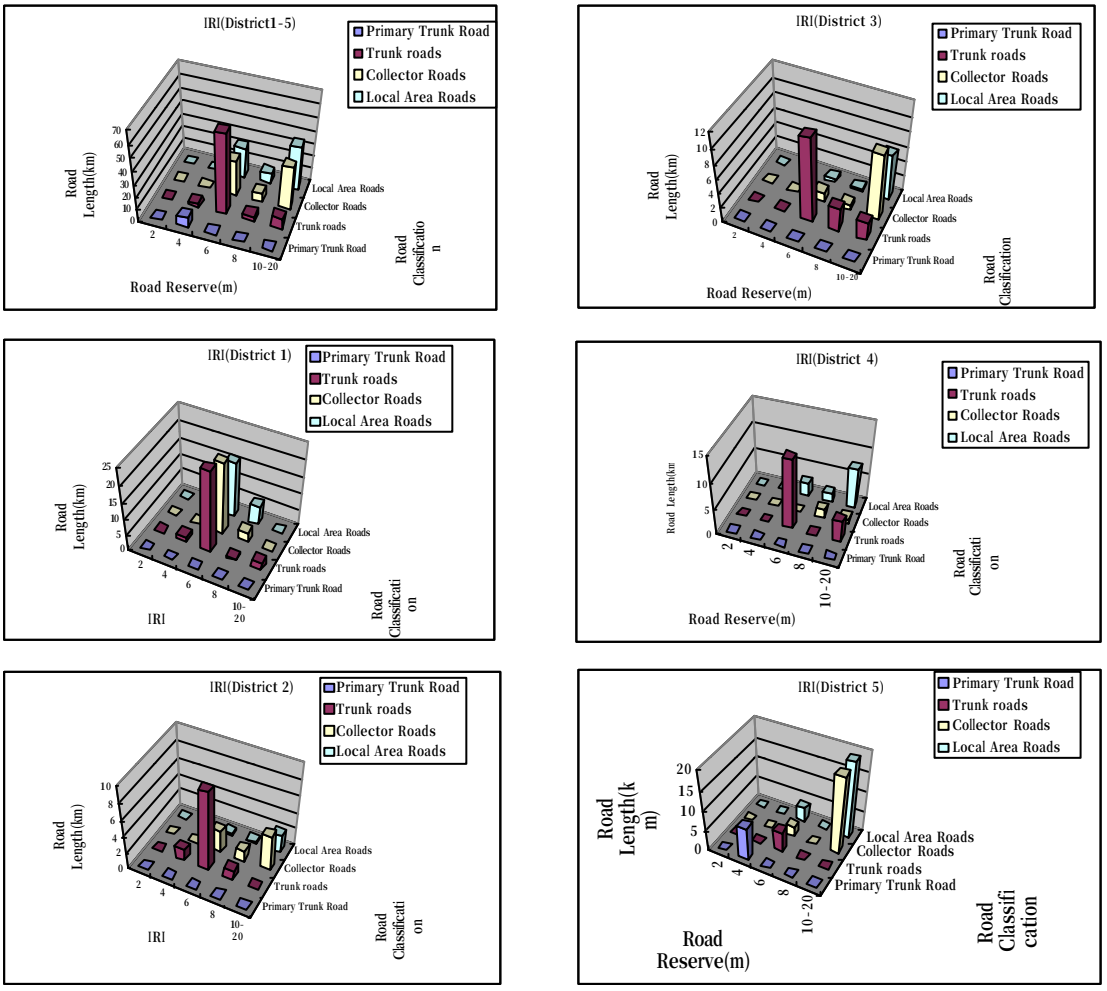


Figure 4.3.1 Road Pavement Condition by Classification

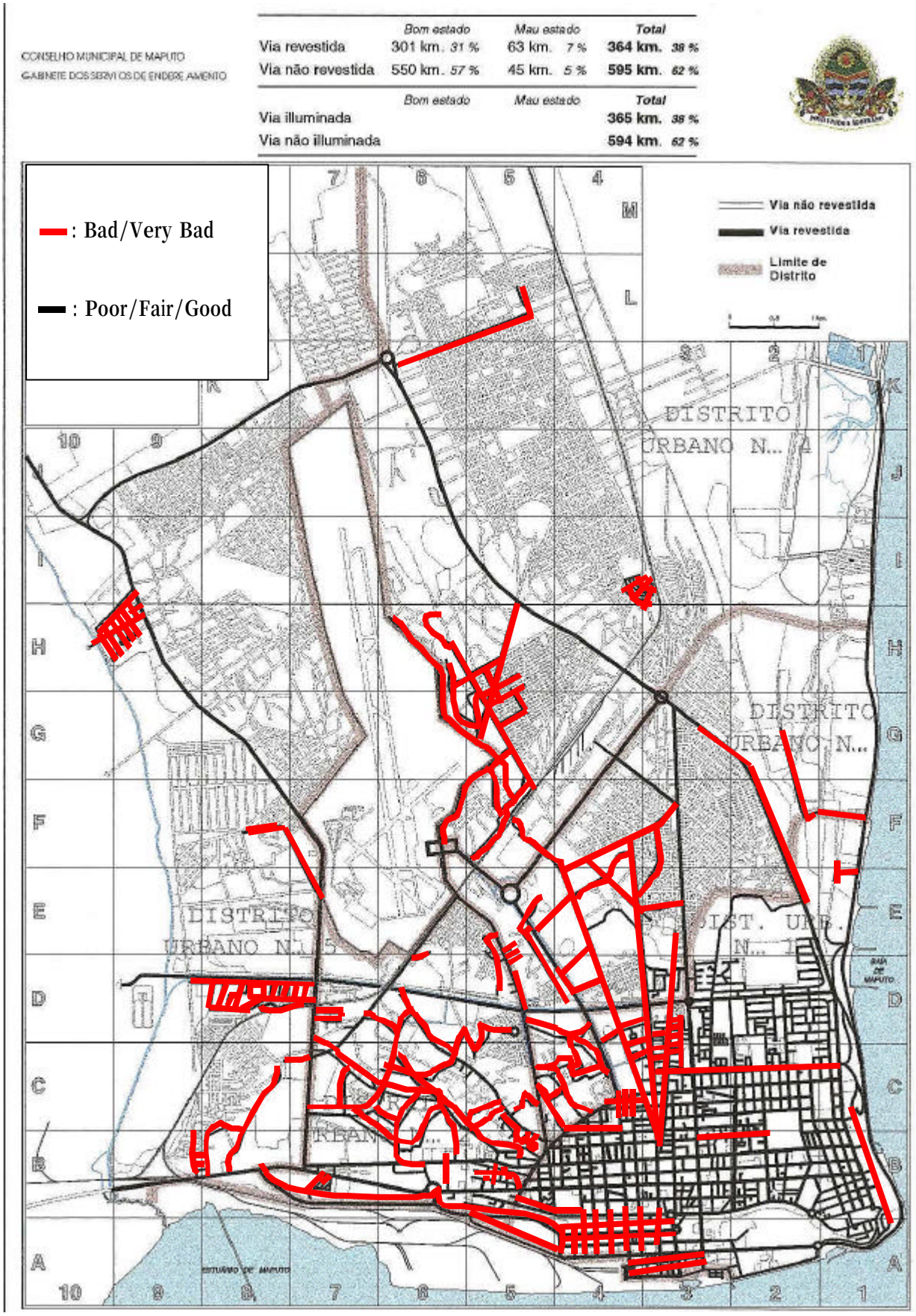


Figure 4.3.2 Existing Pavement Condition

4.4 EXISTING DRAINAGE CONDITION

The drainage systems in Maputo city consists of pipe drain and open drainage systems. The drainage system in District 1 is pipe drain installed up to the outlet collected by the catch pit located between carriageway and sidewalk. But almost of catch pits are blocked by soil/garbage due to lack of cleaning and flushing so that the drainage capacity are reduced.

The drainage condition in almost of District 2 to 5 is lacking of proper drainage except Basin "A" area along Av. Machava (Rua 3250, 3032, 2500, 2524, 5250), Av. Acodos de Lusaka, Av. de Angola and Polana Caniço"A" area. The roads of District 2 to 5 having no proper drainage system are deteriorated. It should be installed of the proper drainage along the objective roads.

There are flood prone area and erosion area caused by lack of proper drainage system, outlet and lack of drainage maintenance. The heavy erosion of Av. Julius Nyerere at Polana Caniço"A" was caused not only by the heavy rain but also by the blockage of the existing pipe drain with lacking of the drainage maintenance. The open drain is suitable for easy maintenance in Maputo City preventing of blocking by soil/garbage. The existing drainage system and the problems of drainage are shown in Fig. 4.4.1.

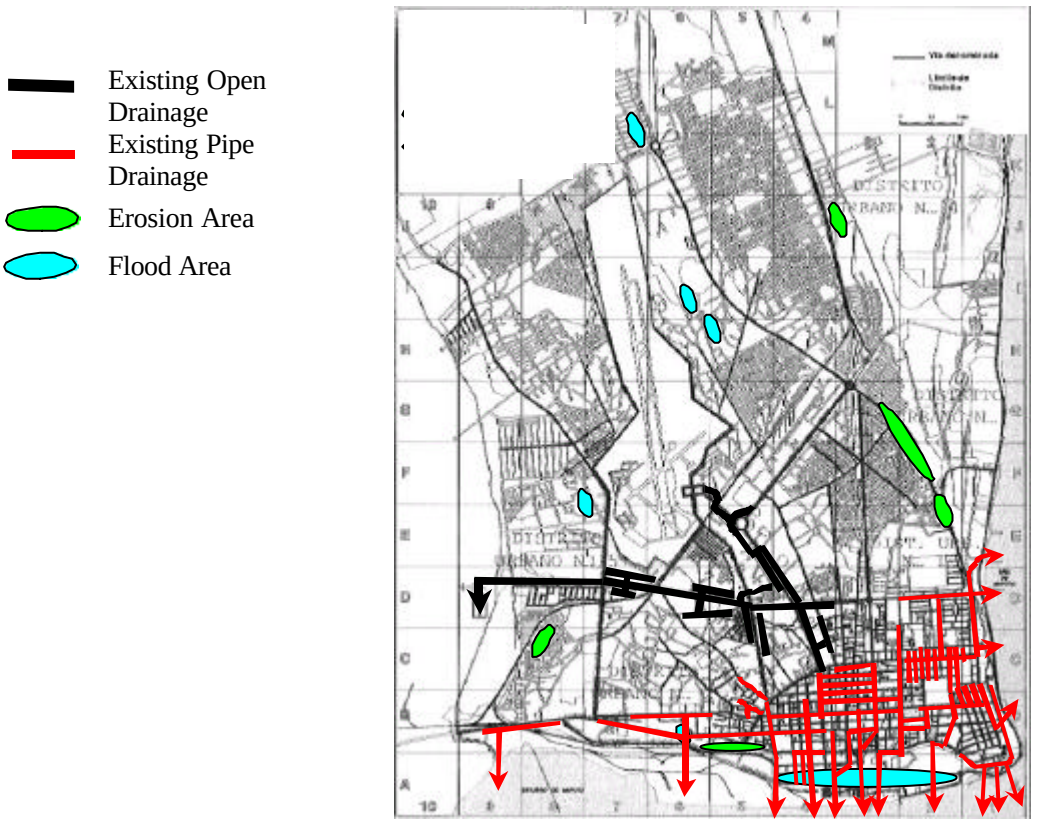


Figure 4.4.1 Existing Drainage System and Problems of Drainage

4.5 INTERSECTION FACILITIES

There is the 27 signal controlled intersections in Maputo city, still 2 places it has not been applied yet. Also, there is frequently that the signal stops the function by power failure and the traffic police is controlling the traffic.

There are no right turning signal phase and right turning lane installed even on the major intersections, it seems to be a factor of traffic congestion due to difficulty of turning movement.

4.6 OTHER FACILITIES

1) Bus Stop (Bus Bay)

Road shoulder of the width of about 1.5 m are being established in the main road of the Maputo city and be offering the stop space of buses. However, the stop of buses is inhibiting traffic in the road without shoulder or bus bay.

2) Car Parking

There is a roadside parking strip in the main road where the commercial facilities. Also, the parking space is established on the median. However, through traffic is obstructed by the vehicle that in and out from parking spaces or waiting. Furthermore there are the danger between through traffic and pedestrian due to crossing from median.

3) Road Lighting

Road lighting facilities are sufficiently established on major roads.

4) Speed Hump

Speed humps are established in the place where is necessary to control speed, i.e. residential areas or in front of school etc. However visibility of humps is poor in night time because notice signs or markings not to be established.

5) Lane Markings

On primary roads, lane markings are applied. But on the most of secondary roads, lane markings are not applied. It seems to be traffic conflicts with the narrowness of the road.
Some of at grade intersections, the stop lines are applied but not enough.

4.7 MAINTENANCE

4.7.1 Road Maintenance

Carriageway pavement is maintained by the Municipal Directorate of Road and Bridge. Main maintenance works are Carriageway, Culvert, Bridge, and Cleaning of road surface, Collapsed curb rehabilitation

Sidewalk is maintained by the Municipal Directorate of Construction & Urbanization. Planting zone maintenance is done by the Municipal Directorate of Park and Garden.

4.7.2 Road Drainage Maintenance

The jurisdictional disputes for the road drainage maintenance are different for the drainage types.

Main drainages are maintained by the Drainage Cabinet of Maputo / the Ministry of Public Works & Habitation. While the roadside cleaning between sidewalk and carriageway (garbage sweeping and solid waste removals) are done by the Hygiene and Salubrity Department. / Municipal Directorate of Salubrity & Cemeteries. Road drainage, Drainage pipe, Drainage pit, Catch pit, Collapsed curb are maintained and repaired by the Municipal Directorate of Water & Sanitation. The jurisdiction disputes for road maintenance is shown as Figure 4.7.1.

Collection of information about the annual budget for road maintenance is in progress, in cooperation with the relevant Municipal Directorate. Each organization charts are shown as Figure 4.7.2. Collection of information about the maintenance equipments belonging to the Municipal Directorate is also in progress.

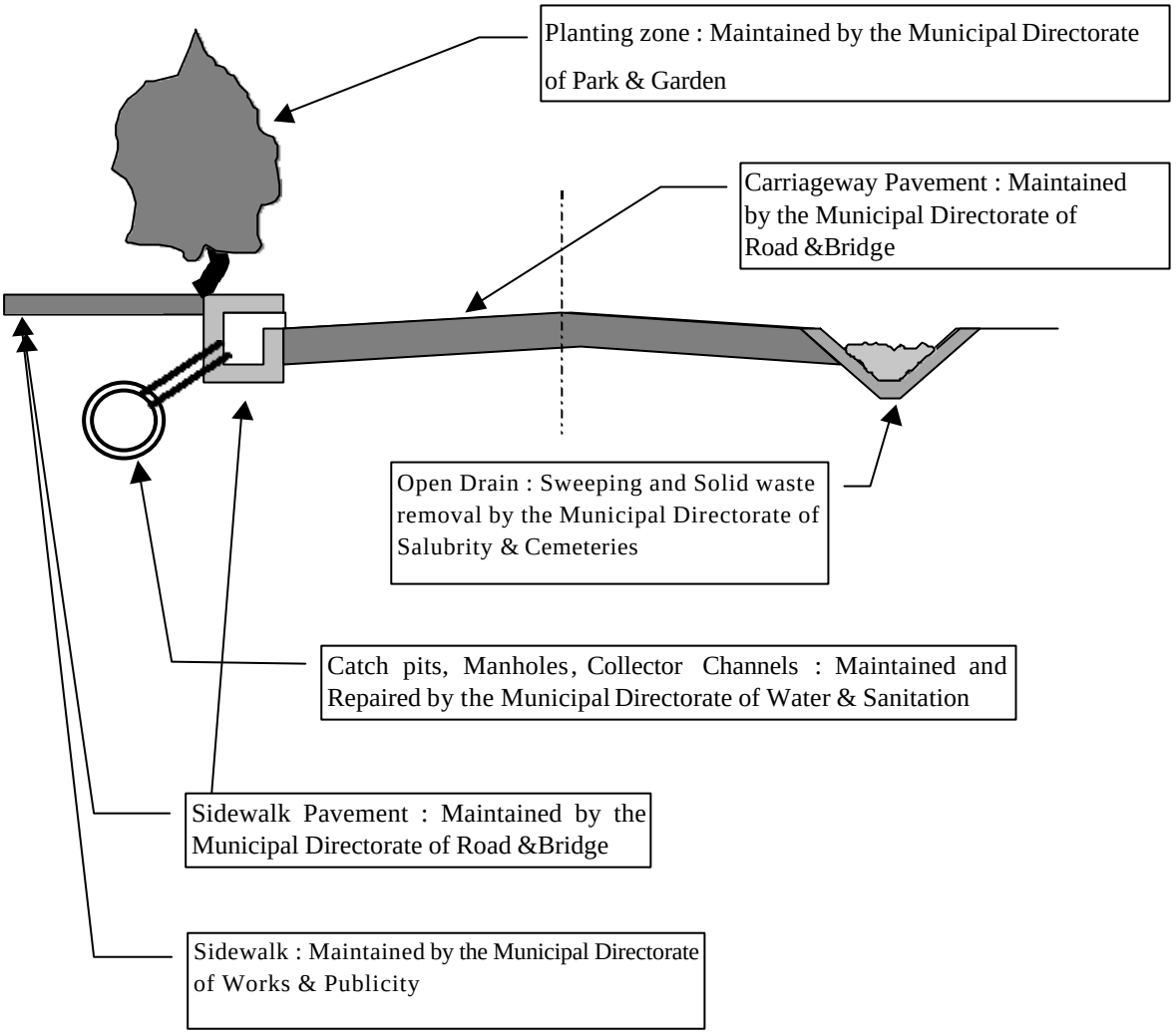
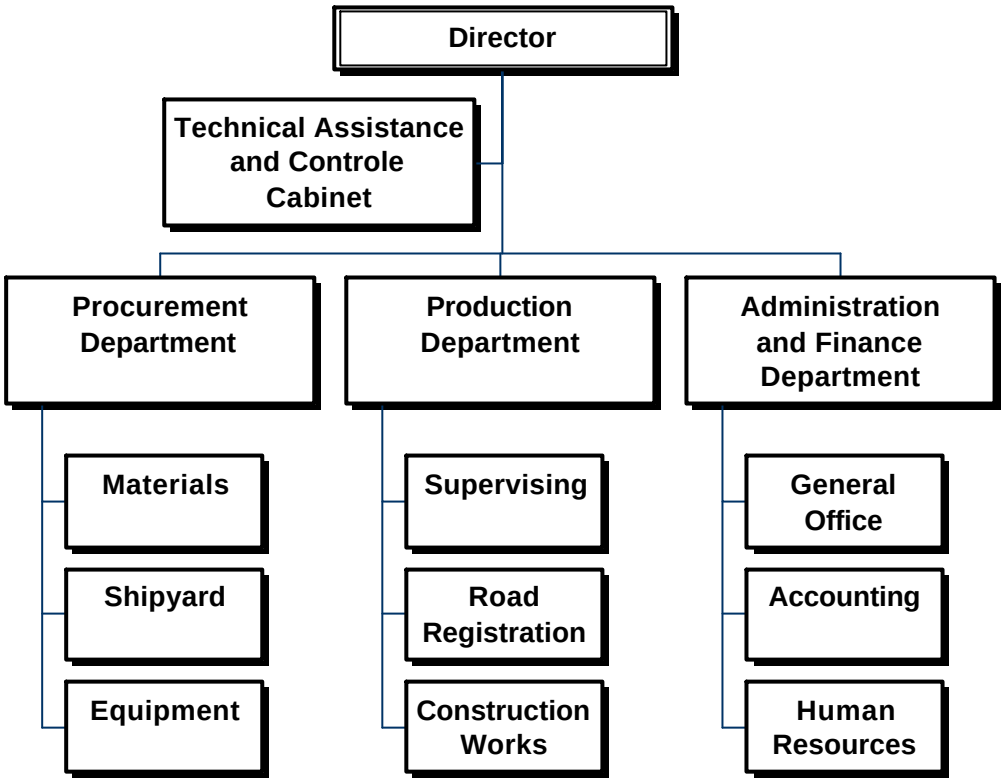


Figure 4.7.1 Jurisdictional Disputes for Road Maintenance

Organization Chart of the DMEP



Organization of The Municipal Directorate of Water and Sanitation

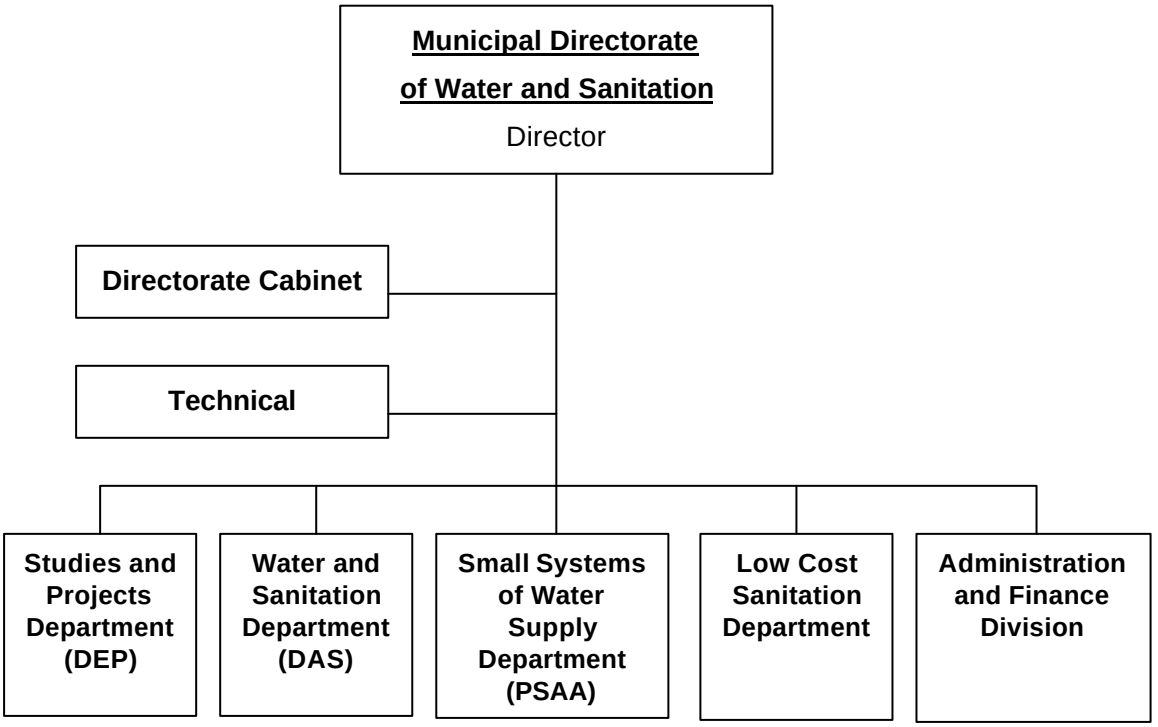


Figure 4.7.2 Organization Charts

4.7.3 Problems with Maintenance System

The maintenance budget of each Municipal Directorate is limited and the almost maintenance equipments are lack of maintenance so that it is impossible to maintain the road & drainage facilities. And also jurisdiction disputes of the road maintenance are different for each road & drainage facilities that it is impossible to maintain systematical.

1) No Maintenance Programme for Long-term

Each organization has no maintenance programs. Maintenance programme (routine maintenance and periodic maintenance) should be required for road maintenance. Introduction of privatization to routine maintenance and periodic maintenance should be necessary for vitalisation of economic activity.

2) Non Functional Existing Maintenance Organization

Jurisdiction of the road maintenance is different for each road and drainage facilities so that it is necessary to restructure the existing organization and establish the new road department for systematical road maintenance.

Proposed new road department

- Road Development Planning/Design Section
- Road Maintenance Planning/Design Section
- Procurement Section
- Emergency Maintenance Section
- Mangement Section

3) Lack of the Knowledge of Road Maintenance

The organization of each municipal directorate has no knowledge of road maintenance. The maintenance equipments owned these organizations are not sufficiently. The technical cooperation/support and on the job training for road maintenance are necessary for the capacity up of the counterparts.

- The arrangement of expert for planning and design for road maintenance
- On the job training for road maintenance
- Support of maintenance equipments and establishment of Data base for road maintenance

4) Lack of the Budget

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

4.8 PUBLIC TRANSPORT

Public Transport in Maputo city consists of three categories, international, national and local transport. The central government has authority to give licenses to the international and the national transport, while the local government authorizes the local transport.

The international bus services between South Africa and Maputo city are currently operated. South African companies operate 129 buses and Mozambique companies operate 127 buses. Demand of passengers is concentrated to South African buses due to their superior accommodations and better service.

TPM (Transportation Public of Maputo) is the national transport in Maputo. A organization of a bus company in Matola is also under consideration.

4.8.1 Bus Operation of TPM

TPM extends its service to 553.8 km of operating distance with 33 regular bus routes by 145 buses. All the bus route have their origins in central Maputo and destinations are located in sub-urban area in Maputo (18 routes) and Matola city (15 routes). Operation frequency in each route is 17-18 rounds a day.

Bus fare is 2,000 Mts. for each passenger, and fares for labourer and student are discounted, disabled persons are free of charge. Since the bus fare in TPM is aiming to benefit the low income passengers, the general financial condition in TPM is not stable in terms of profitability.

According to the inspection by TPM in May, 1998, operating cost for each passenger is estimated to be 4,470 Mts., revenue just 1,500 Mts. Consequently, the total deficit is amounted to 5 thousand million Mts., which Ministry of Finance is expected to subsidize, and 1 thousand million Mts. has been subsidized so far.

In addition to this financial problem, TPM points out three subjects to concern, such as insufficient service yard, residential areas which are not served by buses due to the poor road network, and traffic accidents caused by pot holes on the road (see Figure 4.8.1).

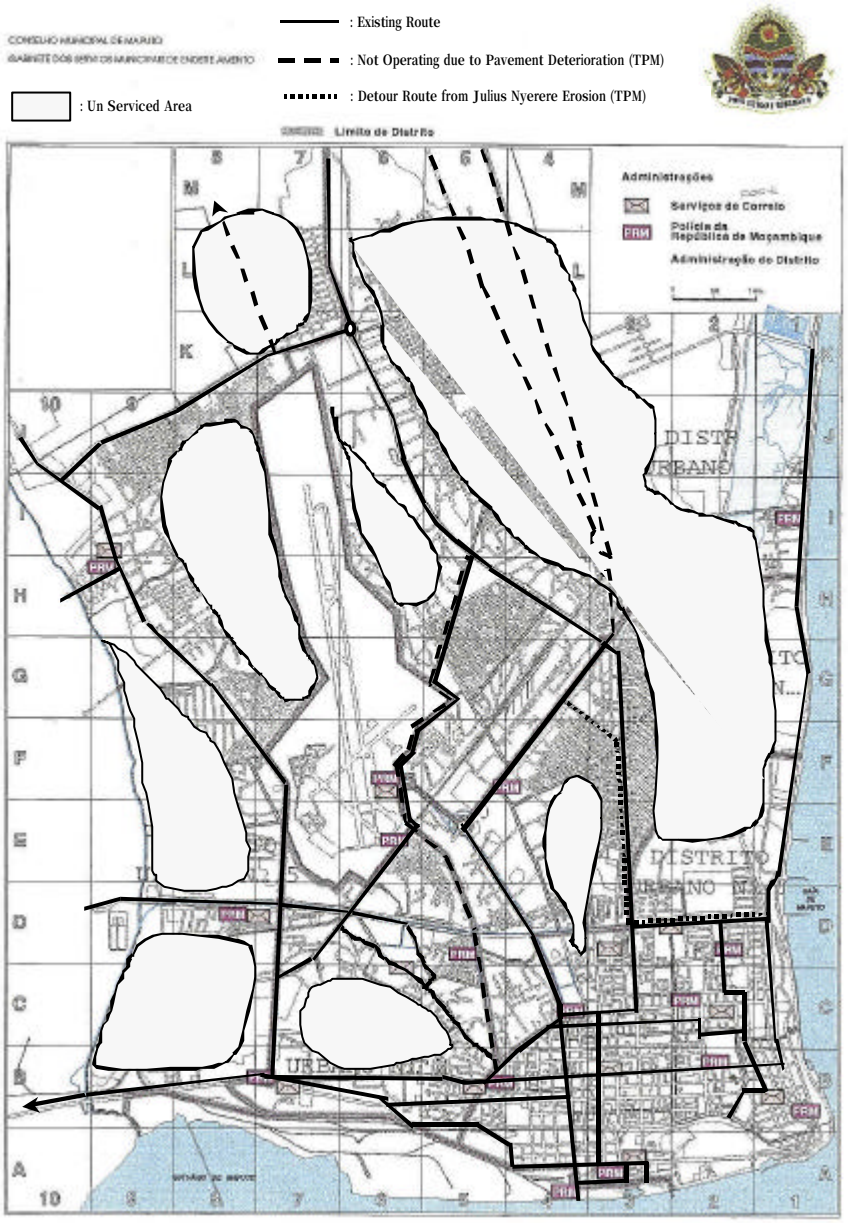


Figure 4.8.1 Bus Route

4.8.2 Local Bus Operation

The municipality of Maputo legitimates three categories of public transport, such as taxis, minibuses called "shapa", and commodity transport. All the local transport services are provided by private companies.

Operating nlicenses for minibus are provided by the Maputo municipality which determined the bus route. 2,720 licenses of minibuses are operated in Dec. 2000.

The bus route for each minibus is indicated in the alphabet attached on the front glass of the bus. This system is not welcomed by bus passengers, and too many bus routes make it much more difficult to identify bus route. Therefore, it is essential to establish a simple bus service system and information for the benefit of the passengers.

4.9 RELEVANT DEVELOPMENT PLANS AND STUDIES

The master plan of the road network development shall be conformed with the road development plan of the national development plans and / or area development plans. The following plans, the development plan in the Maputo city and the periphery area, have been completed or planned.

4.9.1 National Development Plan

Republic conference held in February 2000, budget for the "New five years plan (2000-2004), the economic and social plan (2000) and the national budget plan (2000) was adopted. The detail of these plans is as follows.

1) New Five Years Plan

The goal of the plan is to reduce the poverty and the differences of life levels between areas. The goal of the plan is to be expanding the society infrastructure of health care, education, life water for irrigation etc. the same as before, while get 7-8% of economic growth and controlling inflation. Yet, the numerical value goal is being indicated hardly there and are abstract contents.

2) The Economic and Social Plan (2000)

This plan is showing such a achievement goal that achieves the goal of the above new five years plan. In the plan, the inflation rate of 6-8%, the rate of economic growth of 8-10% is being hypothesized. This plan is intending the expansion of the recovery and maintenance, social and economic infrastructure. This plan also promotes the participation of the private division and be putting emphasis to the acceptance of foreign budget.

3) The National Budget Plan (2000)

The national budgets of the year 2000, the amount of approximately Mt. 95 billion including 51 % of self budget and 42 % of foreign donation.

4.9.2 National Road Development Plan

The following development and maintenance plans of the road division, as national development plan in Mozambique.

1) ROCS (Roads and Coastal Shipping Projects)

The purposes of ROCS are the urgent construction and rehabilitation, road maintenance of national highways, and also technical support, improvement of organization etc. It was carried out with respect to 2 phases, in 1992-2000. This project many countries and also international organizations assisted and the total amount of the project until 1998 reaches 285 million dollars. Even the bridge construction plans under Japan's aid are a part of this plan.
The total road length of the national highway that has been rehabilitated or repaired reaches to about 9,000 km, maintenance reaches to about 20,200 km. Also, the total bridge length that repaired has been reached to about 640 m.

The proportion that un-passable condition of bad section occupies in the whole national highways was improved to 81% to 41% after the implementation of this plan. Furthermore, the plan continues and an incomplete parts are scheduled to be carried out.

2) Maputo Corridor Project

Maputo Corridor Project, with the plan that constructs the toll road from Maputo port to the border of South Africa with a BOT system. The project will be completed in December 2000.

3) Road Maintenance Plan for Damaged by the Flood

The Mozambique government setting the road maintenance plan and proposed to the Rome conference, to recover roads and bridges that was ruptured by the large flood in February 2000. The whole project cost is estimated 590 million dollars, of which 15 million dollars are appropriated to the recovery of the Maputo city road.

4.9.3 Road Development Plan in Maputo City

The road of Maputo city is juridical under the control of the road and bridge department of the Maputo city council; the organization inaugurated still new and is carrying out road projects hardly as it is.

So far the ANE, road authority of the ministry of transportation and traffic, has carried out the road maintenance project of the Maputo city, on the basis of the plan of the assistance organization conducted by the World Bank.

The major road maintenance projects carried out in recent years are as follows. These plans were executed by the foreign capital local contractor.

1) Major Road Rehabilitation Plan in Maputo City (1992-1993)

Overlay of asphalt pavement on Mao Tse Tung Avenue and Julius Nyerere Avenue, interlocking block pavement on Vladimir Lenine Avenue were carried out.

2) The Project of Rehabilitation and Repair of Maputo city roads by World Bank

The Rehabilitation and Repair of 160km of major streets in Maputo were done by the World Bank Programme from April to September 1999. The major works involved the pothole patching, resealing for paved roads, re-gravelling for gravel roads and cleaning of existing drainage.

The Project was consisted of 2 Lots and Total numbers of roads were 65roads (Lot 1: 32 roads, Lot 2: 33 roads), Total of Road Length was 164.3km(Lot 1: 72.0km, Lot 2: 92.3km) and Total construction cost was 3,385,157 USD (Lot 1: 1,541,054 USD, Lot 2: 1,844,103 USD) as shown in Table 4.9.1 and Figure 4.9.1.

In spite of passing only one year after completion of this rehabilitation project; there are some potholes at the intersections or flood prone areas. Main reasons are lack of appropriate drainage maintenance and poor performance of pavement rehabilitation.

The area roads located around central station/port area and some collector roads have not been rehabilitated so that these road surfaces are remain in a heavy deterioration. It is therefore necessary to rehabilitate the area road of the station/port area and other collector roads urgently.

Table 4.9.1 The List of Rehabilitated Roads

Lot 1		Lot.2	
Road Name	**Road Length(km)**	**Road Name**	**Road Length(km)**
Ho Chi Min	2.0	Julius Nyerere 2	7,2
Av. Albert Luthuli	3,5	Via Rápida 2	5,6
Agostinho Neto	2,2	Rua de Marginal	11,5
Av. Ahmed Sekou Toure	3,7	FPLM	5,5
24.de Julho	10,0	Acordos de Lusaka	5,1
Guerra Popular	3,1	Acordos de Lusaka	1,4
Kim Sung	1,4	Julius Nyerere 1	7,0
Patrice Lumumba	1,3	Rua 2,019	0,3
Rua das Lusiadas	1,0	Av. de Moçambique	9,5
Rua da Imprensa	0,7	Rua Gorongosa	0,4
10 de Novembro	2,0	Largo de Delta	0,4
Samora Machel	0,8	Via Rápida 1	4,6
M[artires de Macha.	1,8	Rua Nkunya Kilido	0,1
Josina Machel	1,3	Rio Tembe	0,7
Mártires de Inhami	0,5	Praça de Juventude	0,3
25 de Setembro	6,2	Rua 5.750	4,1
Eduardo Mondlane	7,2	Marginal/Nyerere	1,6
Karl Marx	4,0	Rua Gago Coutinho	2,6
Olof Palme	1,6	Av. de Angola	3,2
Amilcae Cabral	1,4	Bernabé Thawe	0,9
Av. da Zâmbia	1,5	Mueda/Robert Mug.	1,6
Vladimir Lénine	3,2	Av. do Trabalho	2,8
R. Marques de Po.	0,6	Av. de OUA	3,6
G.Texeira Botelho	0,9	De Farol	0,2
Av. de ONU	3,2	Malhangalene 1	1,0
Rua de Rádio	0,3	Malhangalene 2	2,1
Av. da Tanzania	0,3	Rua 1º de Maio	1,5
Kenneth Kaunda	3,2	Av. M. Mabote	3,1
Marien Ngouabi	1,8	Rua Xipamanine	2,5
Salvador Allende	1,0	Lacerda e Almeida	1,7
Paulino Santos Gil	0,2	Rua 2275	2,1
Rua 1,081	0,1	União Fapril de Moç	1,0
		Fernando Homem	0,5
32 Roads	72.0km	33 Roads	92.3km

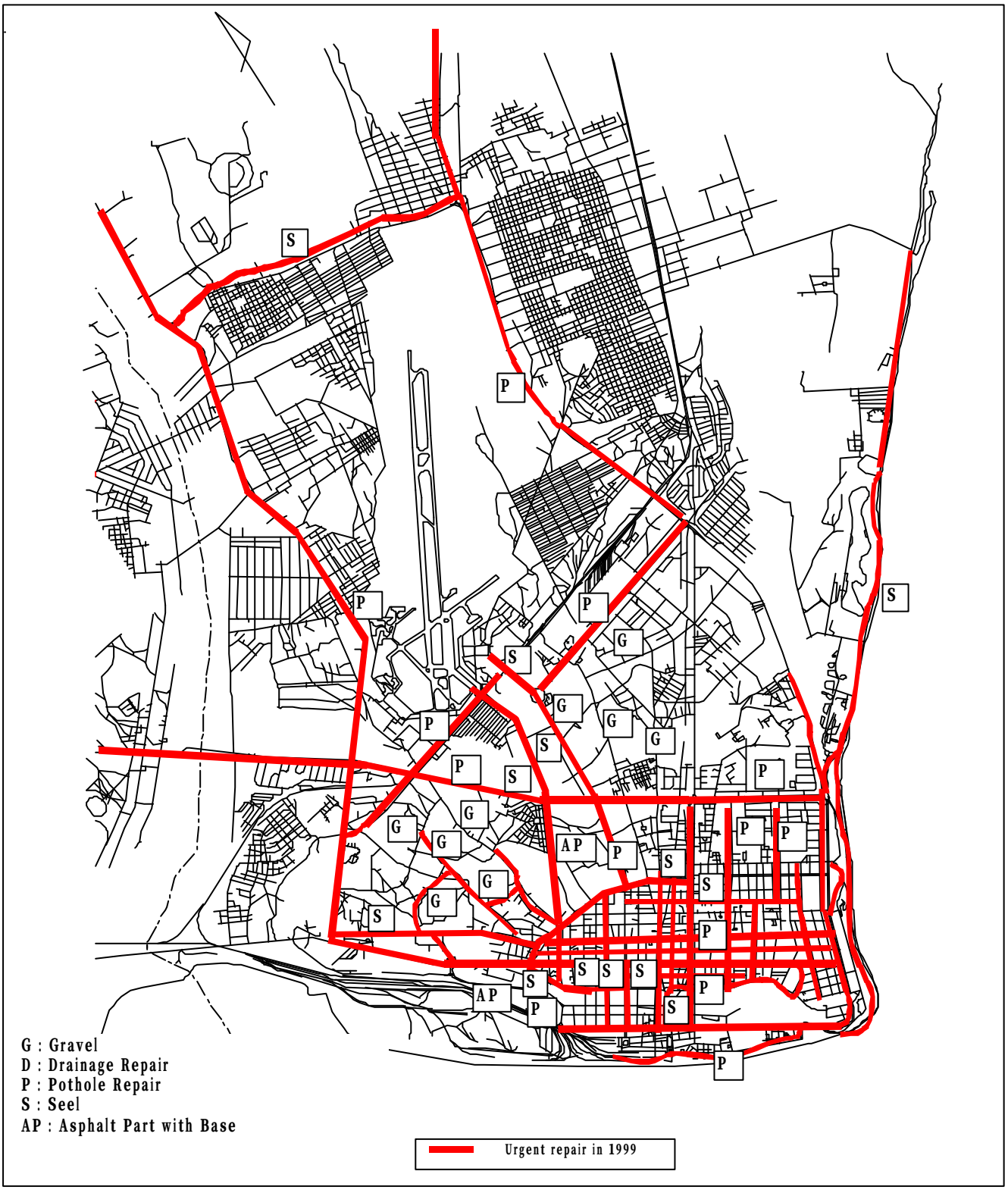


Figure 4.9.1 Location Map of Urgent Repair in 1999 by World Bank

3) Prior Road Project in Maputo City (2000)

In the fiscal year 2000 budget demand of the Maputo city, introduction of one truck and office appliance of the computer etc to the road and bridge department, repair of office, and 2 road repair projects are given as the priority project.

4) Structural Plan of the Grater Maputo City

Structural Plan of the Grater Maputo City, the development guideline of the Maputo national capital region was summarized by the World Bank. At present it has been finalized and was submitted to the municipal council of Maputo city.

The Plan proposes the frame work of the environment and land use, social economy, infrastructure maintenance aiming for 10 years to the object of the Maputo city and Matora city area. As put to the short term plan (first to second year) regarding road maintenance, the following plans were introduced.

(1) Improvement of Major Roads and Intersections

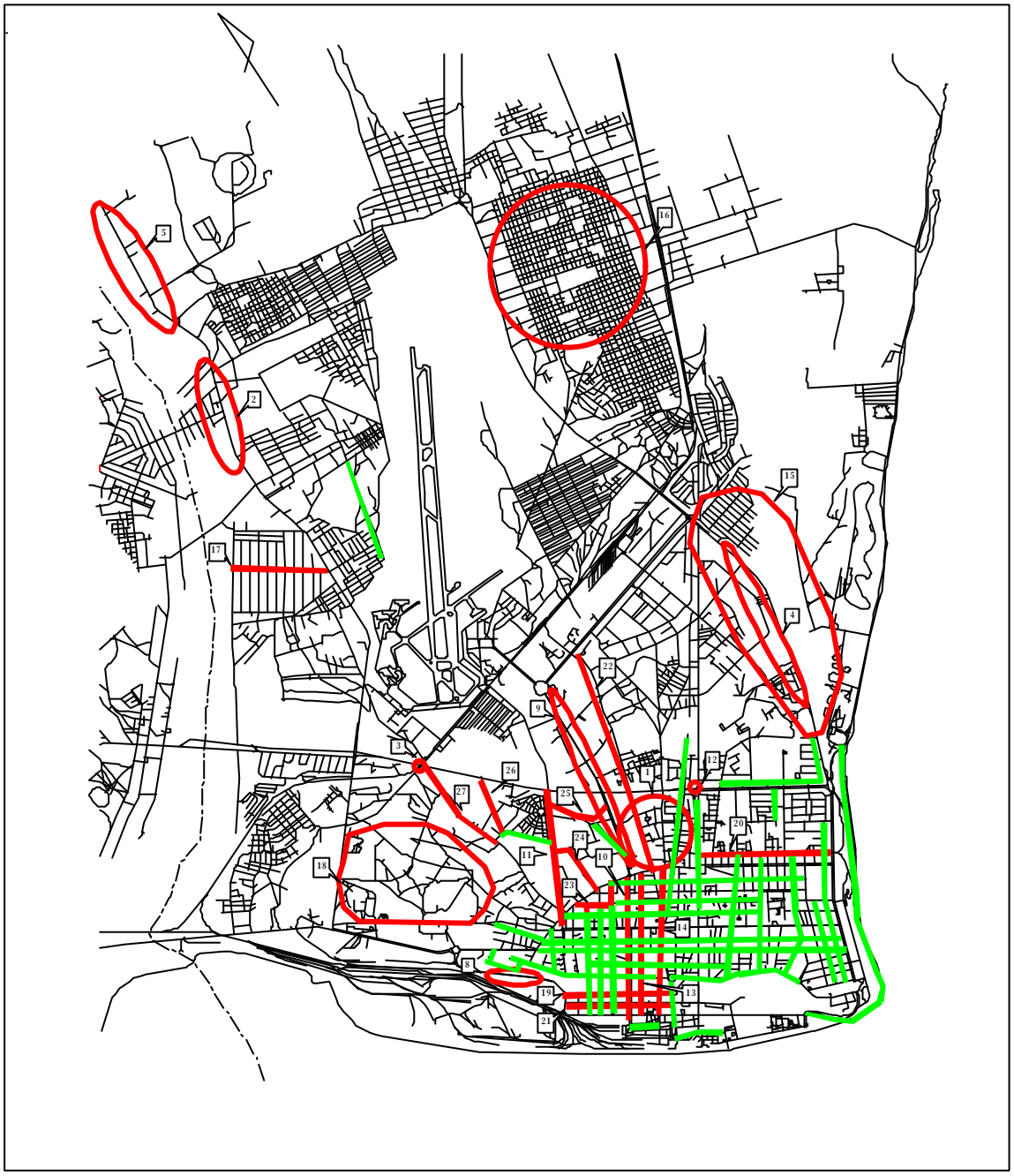
- Improvement of National Road Route 1
- Completion of the approach road construction on the intersection on Mozambique Avenue
- Completion of widening of Kenneth Kaunda Avenue
- Repair of major city road including maintenance of road drainage facilities
- Maintenance of bus stops on Vladimir Lenine Avenue
- Improvement of the intersection on the northern part of Vladimir Lenine Avenue

(2) Other Projects

- Improvement of intersections, establishment of traffic signals and road signs, maintenance of pedestrian crossing in the Maputo city
- Improvement of public transportation services
- Feasibility study on the improvement of services of the ferry between Maputo and Catembe

5) Existing Policy of Maputo City Council

The Maputo city council (MCM) has prepared a Road Improvement Plan for short term period of two years due to heavy deterioration of its city roads as shown in Figure 4.9.2.
The plan is consisting 28 road projects and is expecting to be implementing from year 2001.



Project Coat (for 2 years, the short-term) 8,405,000US$ The road affected by the heavy rain during Februay 2000/ Cost:2,2021,000US$

No	Road Length	Drain	Pavement	No	Road Length	Drain	Pavement	No	Road Length	Drain	Pavement
1	7km	drain repair	emergency repair/recon	11	5km	drain repair	repair roadside	21	5km	drain repair	recon
2	-	〃		12	-	〃	repair	22	5km	〃	soil filling
3	-	〃	earth filling	13	2km	〃	repair	23	1km	clean	repair
4	-	〃	study	14	0.7km	〃	repair	24	2km		sool filling
5	-	-	sholder repair	15	15km	〃	recon	25	1.5km		sool filling
6	unknown			16	10km	〃	recon	26	1km		sool filling
7	unknown			17	2km	〃	recon	27	1km	drain repair	recon
8	0.1km	drain repair	erosion protection	18	15km	〃	recon	28	several roads		pothol patching
9	2km	〃	repair roadside	19	5km	〃	recon				
10	0.5km	〃	repair	20	5km	〃	recon				

Figure 4.9.2 Existing MCM's Policy to be Rehabilitated

The total cost required for the implementation is 8.4 million US$ and still exceeding the financial scale/ capacity of 1.6 million US$ for the road budget of MCM.

Furthermore, MCM prepared the other/ further rehabilitation plan for 41 road rehabilitation projects with a preliminary cost of 2.0 million US$ due to the damages of those roads by the heavy rain during February 2000.

Although the deterioration of the roads are becoming heavy, actual implementation of the plan has not yet finalized and waiting financial support from the central government or the other donor community.

CHAPTER 5

PILOT PROJECT ROAD

CHAPTER 5 : PILOT PROJECT ROAD

5.1 OBJECTIVES

The objective of implementation of the pilot project is to understand natural and traffic conditions in and around the Maputo city, and to plan the optimum road structure, drainage facility structure, and traffic control facilities. These are appropriate to the road concerned, and to collect technical data on material and traffic characteristics, the material and equipment procurement situation, and construction conditions.

The procedure of implementation of the pilot project should be as shown in the Figure 5.1.1.

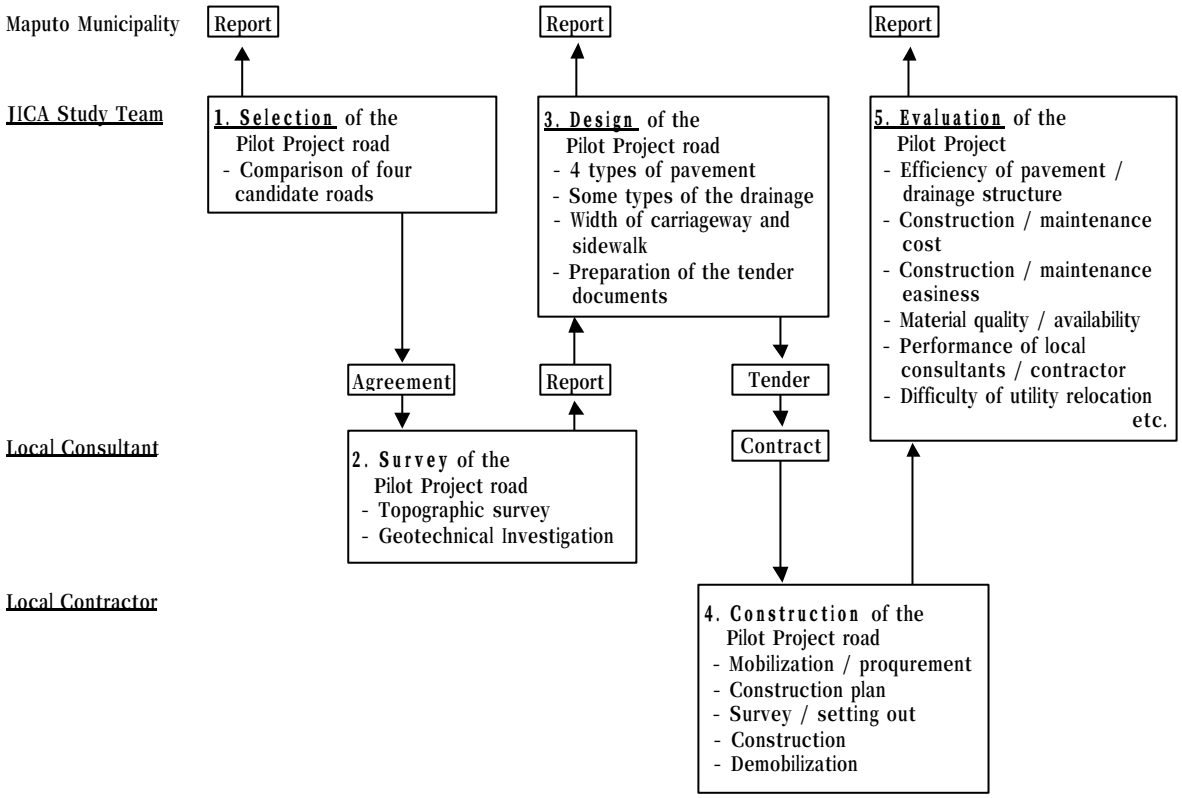


Figure 5.1.1 Procedure of the Pilot Project

5.2 SELECTION OF THE PILOT PROJECT ROAD

The location of the pilot project road is determined from four candidates with consideration of natural and traffic conditions as well as urgency learned from discussions with the Maputo City counterpart.

The pilot project road should be selected through the consideration of the items shown on the Table 5.2.1. Judging from the Table5.2.1, "Rua São Pedro" should be selected as the pilot project road. The location of the pilot project road is shown in Figure 5.2.1.

Table 5.2.1 Rating System / Priority Order for Selection of the Pilot Project Road

	Road Name	Av.Milagre Mabote	Av.Malhan galene	Av.Malhan galene	Av.Milagre Mabote	Rua São Pedro
	No.	1,369	1,357	3,259	3,001	5,314
1. Engineering Issue	**50**	40	40	40	40	40
1.1 Deterioration of Pavement	**30**	30	30	30	30	30
Very Bad (PSI ≦ 1.0)	30					
Bad (1.0 < PSI ≦ 2.0)	20					
Poor (2.0 < PSI ≦ 3.0)	10					
Fine (3.0 < PSI ≦ 4.0)	0					
Good (4.0 < PSI)	0					
1.2 Traffic Volume	**10**	5	5	5	5	5
500 -	10					
100 - 500	5					
-100	0					
1.3 Road Class	**10**	5	5	5	5	5
Trunk Road	10					
Collecter Road	5					
Rocalarea Road	0					
2. Existing Land use	**10**	10	10	5	5	10
C.B.D. and Industrial area	10					
Residenncial	10					
Ireagal area	5					
Rural area	0					
3. Facilities of Implementation	**30**	20	20	5	15	25
3.1 Right of way prepared	**10**	5	5	5	5	10
40m < W	10					
20m < W < 40m	10					
10m < W < 20m	5					
W < 10m	0					
3.2 Drainage	**10**	5	5	0	0	5
Drainage improved	10					
Drainage Outlet improved	5					
No Outlet improved	0					
3.3 Accessibility	**10**	10	10	0	10	10
Easy to Access	10					
Dificulty	0					
4. Policy of Maputo City	**10**	10	10	10	10	10
Priority	10					
Common	0					
Total	**100**	80	80	60	70	85

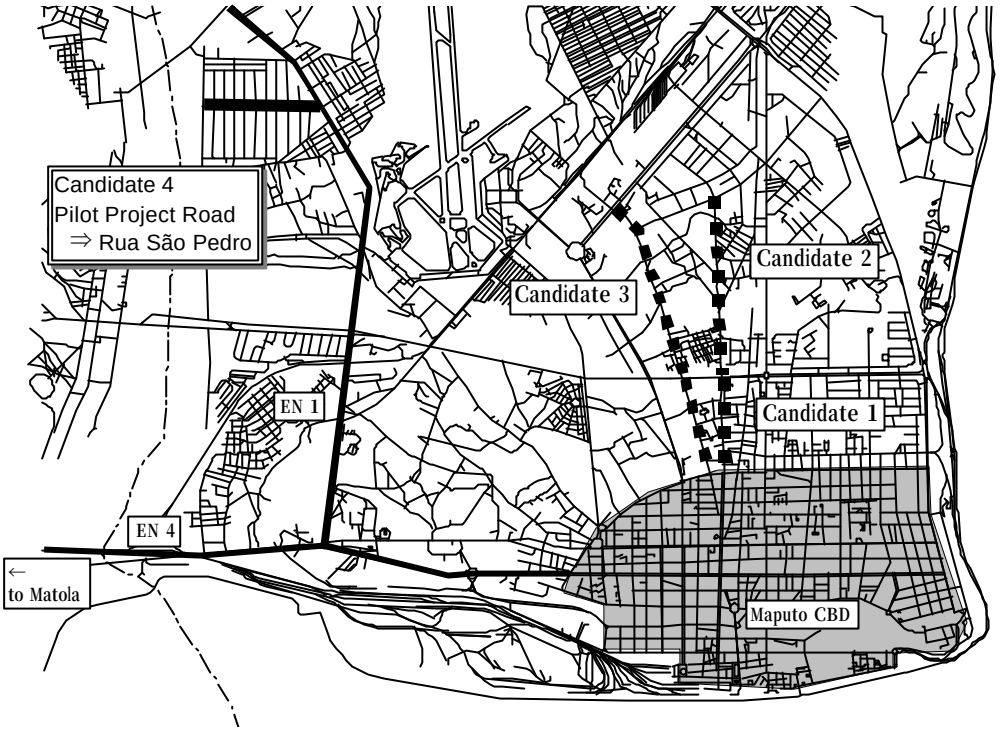


Figure 5.2.1 Location of Pilot Project Road

5.3 NATURAL CONDITIONS

5.3.1 Topography

The topographic data of the pilot project road was obtained through the topographic survey, it should be the basis of the road planning, structural designing and planning of construction. The length of survey is approximately 1,230m.

5.3.2 In-situ Soil Condition

The in-situ soil condition for the pavement design on the pilot project road was clarified through the geotechnical investigation. Through the investigation, conditions of the existing subgrade, borrow materials were obtained. Also the technical data of the stabilized material including mixing proportion of the stabilizer was obtained.

The following conclusions can be made from the result of the geotechnical investigation. Test results are attached in the appendix.

Subgrade Condition

As shown in the Figure 5.3.1, the existing road consists two layers. 0-350mm is dark

reddish brown, silty sand, this is borrow material similar used as the embankment material in the Maputo city. 250-1200mm is brown / grey, silty sand.

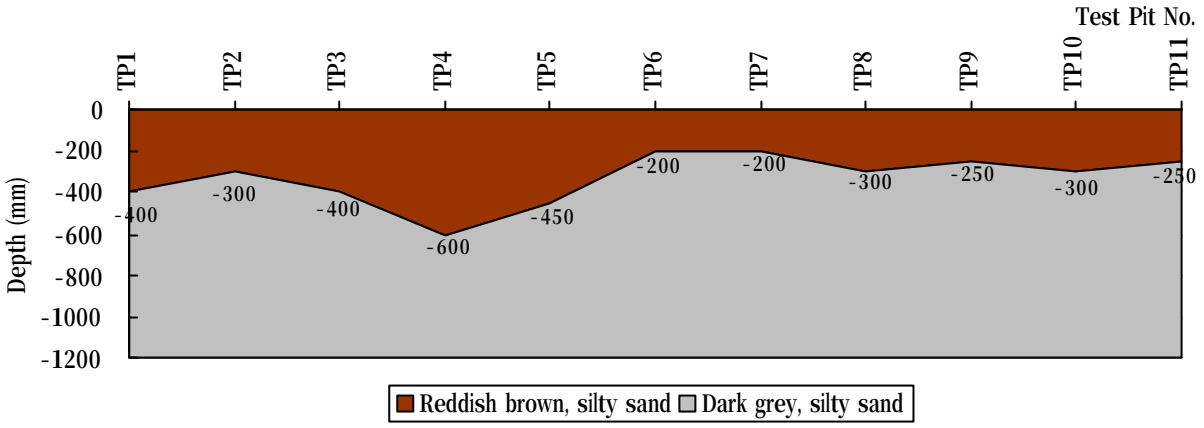


Figure 5.3.1 Thickness of Existing Layer

CBR value of the existing soil is as shown in the Figure 5.3.2. The upper layer is generally G10 in quality, is generally loose to medium dense in consistency. It is recommended that thee upper 300mm of the layer be compacted to minimum 93% dry density before the structural layers are constructed.

The lower layer is generally G9 in quality, and has good in-situ strength. It is not require any improvement.

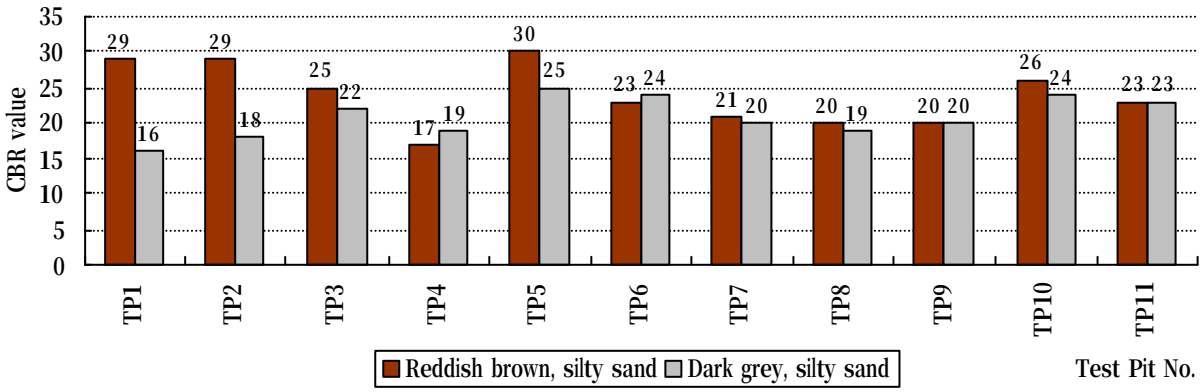


Figure 5.3.2 CBR Value of the Existing Soil

Usage for the Base Course Material by Stabilization

As shown in the Table 5.3.1, the upper layer, reddish brown sand responds well to cement stabilization, but very poorly to lime stabilization.

Table 5.3.1 Test result for stabilized in-situ material

Sample	Content (% by mass) / Type of Stabilizers *1	UCS test result (MPa) *2	Curing method
Reddish brown, silty sand	2% / OPC	1.37	6 days curing
	3% / OPC	1.73	
	4% / OPC	2.00	
	5% / OPC	3.22	
	2% / Lime	0.21	9 days curing
	3% / Lime	0.23	
	4% / Lime	0.49	
	5% / Lime	0.53	

*1 : OPC = Ordinary Portland Cement
*2 : UCS = Unconfirmed Compressive Strength

5.3.3 Material Availability

The availability of the borrow material and crushed stone were clarified through the material investigation. Through the investigation, location of the borrow pit and quarry, material quality were clarified.

Embankment Materials

There is a borrow pit under controlled by Maputo Province in the Marracuene District, approximately 40 Km north from the pilot project road. The soil condition is similar to the in-situ material used on the upper layer of the pilot project road.

Crushed Stone

Major quarries around the Maputo city are located in the west of Maputo city. One is in the Moamba area, it is located 44 Km from the pilot project road. The other is in the Boane area, 39 Km from the pilot project road.

Material from Boane quarry is reddish-colored rock, it seems to influence to the color of the concrete or pavement. It is recommendable to be used for the stone-pitching drainage etc., Moamba quarry is recommendable for usage of the aggregate.

Surface Course

Pre-mixed asphalt plant is available in Maputo city and also in Matola city.

For reconstruction of Av. Vladimir Lenine in 1995, interlocking block pavement was adopted. Block pavement is commonly used for the sidewalk, bus stops, toll plaza etc., several kind of pavement blocks are produced in the several suppliers in Maputo or Matola city.

5.4 PLAN / DESIGN

In order to achieve the objective of the pilot project, four types of pavement structure will be planned through change and combination of the subgrade and base course materials.

For the road drainage structure, a few structural types that can be constructed with locally available material will be planned.

The pavement and drainage design should be developed on the basis of collected traffic load data and the result of the natural conditions survey.

The road length covered by the pilot project is 1.0 km.

5.4.1 Design Policy

Pavement Design Policy

Quarry is less around the Maputo city, it may influence to the construction cost. On the other hand, effectiveness of stabilization using the local embankment soil is confirmed. Therefore different base course type, using graded crushed stone and stabilized material, should be compared.

For the surface course, there is a example of block pavement on Av. Vladimir Lenine. On the other hand, DBST (Double Bitumen Surface Treatment) is adopted commonly in Africa. Therefore four types of surface course, pre-mixed asphalt concrete, interlocking block pavement, block pavement and DBST should be compared.

Also several combination of these base course and surface course types should be considered.

Drainage Design Policy

Existing pipe drainage system is infunctional due to heavy inflow of sand into the road drainage facility. In consideration of easiness of maintenance, the open channel drainage should be recommendable.

The material should be used in consideration of availability of the local material, e.g. stone pitched channel or pre-casted U-shaped channel etc., should be compared.

5.4.2 Design Conditions

Design Standard

The Code of Practice for the Geometric Design of Trunk Road of SATCC will be applied to determine the geometric structure for road design. The Road Structure Ordinance of Japan will be referred to for those items which are not clearly indicated in this Manual.

Design Traffic Volume

The design traffic volume shall be considered on the basis of traffic survey by JICA Study Team. According to the result of the survey, estimated traffic volume on the pilot project road is 2,135 (pcu) per day. Therefore the design traffic volume of 2,200 (pcu) per day is adopted.

Design Speed

A sort of road design standards has not been prepared in Mozambique, while SATTC does not state about design speeds, therefore, a standardized design speed for the pilot project has to be determined comparing with Japanese Road Standards, which categorizes design speeds for urban roads into three speeds: 30km/h, 40km/h, and 50 km/h, as well as the proposed design standard for urban road prepared by the JICA Study Team.

From a reconnaissance survey conducted by the study team and discussion with counterparts, the design speed is determined to be 40km/h as for the design speed for collector road.

Rainfall intensity

Rainfall intensity is depending on Drenagem da Cidade do Maputo Bacia A.

- Return period : 2 years,
- Duration : 5 minutes
- Rainfall intensity : 95.4 mm/h (265l/s•ha)

5.4.2 Road Design

Cross Section

Cross Section Design are determined considering the design speed, land-use situation and function of road. Typical cross section is as shown in the Figure 5.4.1.

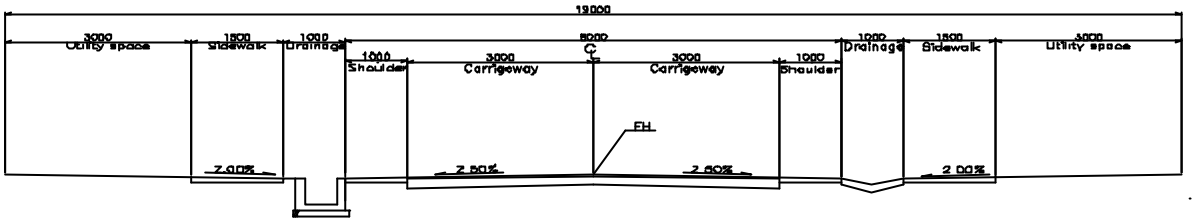


Figure 5.4.1 Typical Cross Section

Pavement Design

The Code of Practice for the Design of Road Pavement of SATCC should be applied to determine the pavement structure design. Pavement types are as shown in the Table 5.4.1 and Figure 5.4.2.

Table 5.4.1 Pavement Type to be Applied

Case	Surface Course	Base Course	Sub-Base Course
Case 0	Pre-mix Asphalt Concrete (PAC)	Graded Crushed Stone (GCS)	
Case 1	Double Bitumen Surface Treatment (DBST)	Stabilized Material (SM)	Stabilized Material (SM)
Case 2	Concrete Block (CB)	Sand Bed (SB)	Graded Crushed Stone (GCS)
Case 3	Interlocked Concrete Block (ICB)	Sand Bed (SB)	Stabilized Material (SM)

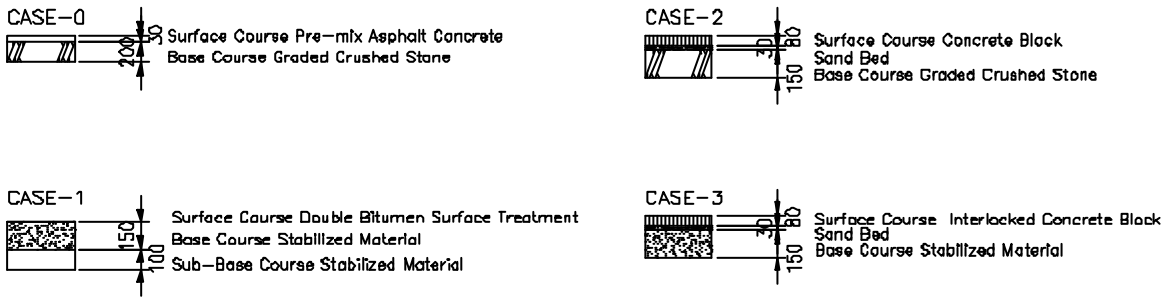


Figure 5.4.2 Pavement Type

5.4.3 Drainage Design

Road drainage system

The crossfall of the carrigeway shoulders and sidewalks should be sufficient to ensure the rapid drainage of surface water without causing any discomfort and danger to the road users. The minimum cross slope of the carrigeway to be applied for proposed road is 2.5%.

Surface water shall be collect by U-shaped drain or concrete lining open drain install out of sidewalks so that it will flow the existing drainage system nearby location.

Road drainage types to be introduced to the pilot project road are as shown in the .Table 5.4.2.

Table 5.4.2 Drainage Types to be Introduced

Case	Drainage Type
Case 0	U-shaped Drain/K-shaped Drain
Case 1	U-shaped Drain/K-shaped Drain
Case 2	Concrete Lining Open Drain
Case 3	Stone pitching Open Drain

5.4.4 Proposed Design

Drawings of proposed pavement structure and drainage are shown in Figure 5.4.3 and 5.4.4. All drawings are attached in the appendix.

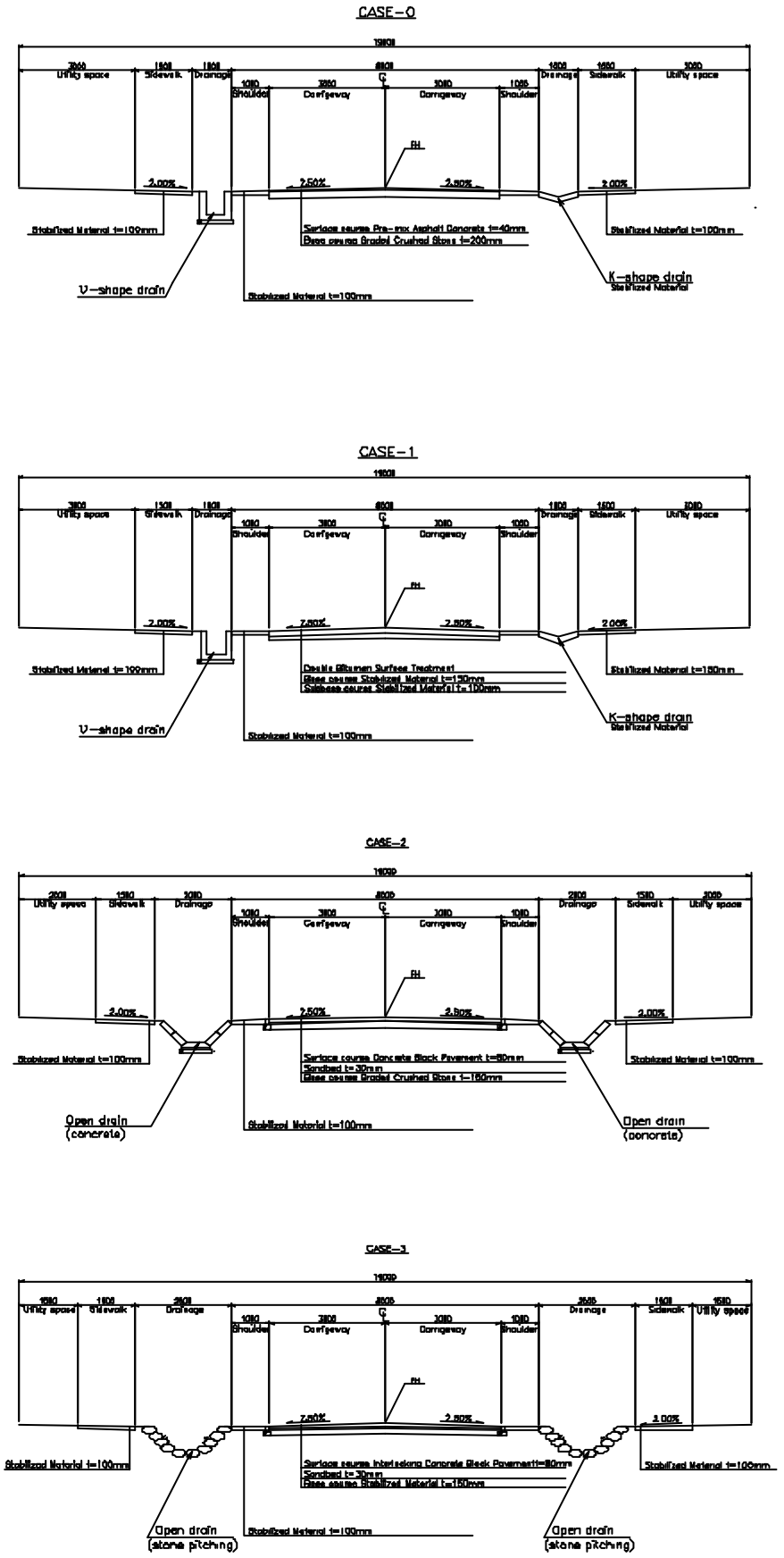
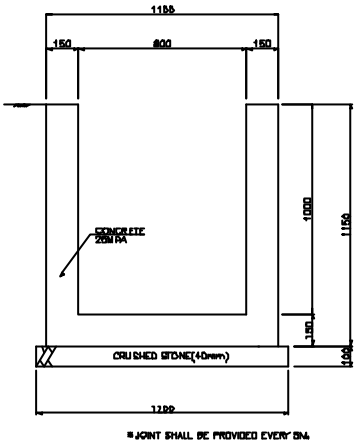
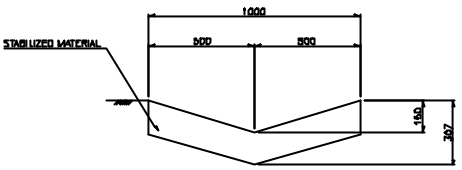


Figure 5.4.3 Typical Cross Section

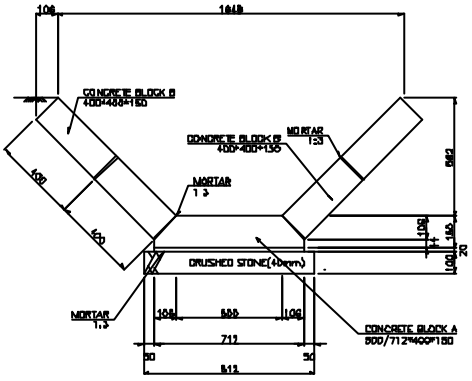
U-SHAPED DRAIN



K-SHAPED DRAIN



CONCRETE LINING OPEN DRAIN



STONE PITCHING OPEN DRAIN

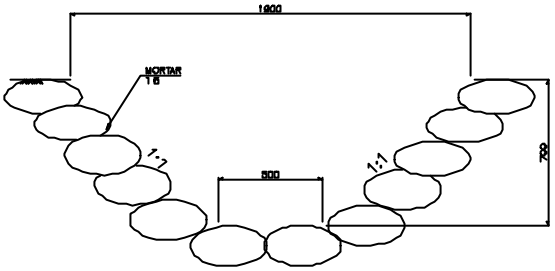


Figure 5.4.4 Drainage Detail

5.5 CONSTRUCTION

5.5.1 Contract on the Pilot Project

The tender for the pilot project is open on 19th January 2001, "Murray & Roberts Civils (Pty) Ltd." awarded the tender. The construction works was commenced on 12th February 2001.

5.5.2 Bill of Quantities

The final quantities for the construction of the pilot project road is as shown in the Table 5.5.1.

Table 5.5.1 Bill of Quantities

		Item	Unit	Quantity				
				CASE-0	CASE-1	CASE-2	CASE-3	TOTAL
DRAINAGE		U-Shape Drain (500*700)	m	170.0	284.6			454.6
		K-Shape Drain (1000*150)	m	178.7	249.4			428.1
		Open Drain (500*560) Concrete	m			341.6		341.6
		Open Drain (500*700) Stone Pitching	m				343.6	343.6
		Open Drain (500*600) Earth	m	30	50	20	20	120.0
		Pipe Culvert (375mm diameter)	m	22.5		22	41.9	86.4
		Pipe Culvert (300mm diameter)	m	16.2				16.2
		Box Culvert (600*600)	m		68.8	32.9	54.3	156.0
		Catch Pit Type-1	Set	1	2			3.0
		Catch Pit Type-2	Set		1			1.0
		Catch Pit Type-3	Set		2			2.0
		Catch Pit Type-4	Set		2			2.0
		Catch Pit Type-5	Set				1	1.0
		Catch Pit Type-6	Set				1	1.0
		Headwall Type-1	Set	2				2.0
		Headwall Type-2	Set			5	4	9.0
		Headwall Type-3	Set	2	6			8.0
		Headwall Type-4	Set			1	4	5.0
		Boundary Block	m	27	55.9	448.6	476.8	1008.3
PAVEMENT	SURFACE	Pre-Mix Asphalt Concrete t=30mm	sq.m	1645				1645.0
		Double Bitumen Surface Treatment	sq.m		2511			2511.0
		Concrete Block Pavement t=80mm	sq.m			1598		1598.0
		Interlocking Concrete Block Pavement	sq.m				1587	1587.0
	BASECOURSE	Graded Crushed Stone t=200mm	sq.m	1645				1645.0
		Graded Crushed Stone t=150mm	sq.m			1598		1598.0
		Stabilized material t=150mm	sq.m		2511		1587	4098.0
		Sandbed t=30mm	sq.m			1598	1587	3185.0
	SUBBASE	Stabilized Material t=100mm	sq.m		2511			2511.0
	SHOULDER	Stabilized Material t=100mm	sq.m	408	659	405	424	1896.0
	SIDE WALK	Crushed Stone t=100mm	sq.m	546	845	538	544	2473.0
MARKING		Stop Line W=600	m	5.2				5.2
		White Line W=100	m	30				30.0
		White Dotted Line W=100	m	85	170	105	110	470.0
EARTH-WORKS		Excavation	cb.m					1200.0
		Subgrade Preparartion	sq.m					3243.0

5.6 EVALUATION OF THE PROJECT

Through the implementation of planning, design and construction work, the following items were evaluated. These should be basis of the master plan for the road development.

Outline of the evaluation of the pilot project is concluded as follows. Some items should be evaluated enough after open by traffic, therefore detailed evaluation should again be made in the feasibility study.

Efficiency of the pavement type

Roughness and serviceability will be very important items for evaluation of the efficiency of the pavement structure. Also noise from the wheel will also be important item for evaluation of the pavement structure. These depend on the pavement type and surface condition, therefore this item should be evaluated in the feasibility study.

Efficiency of the drainage structure

Functioning of the drainage system is depend on the easiness of the maintenance. At least the open drainage is easier to maintain than the pipe drainage, drainage function should be easy to be maintained. This item is to be evaluated in the feasibility study.

Construction cost

Unit material cost for each types of pavement structure is as shown in the Table 5.6.1. As shown in the table, the cheapest total cost is DBST among the tested four cases. It means the best solution on the viewpoint of the initial cost for construction, on the other hand the purpose to be adopted should be carefully considered on the viewpoint of the operation cost, including maintenance and repair.

For the base course, crushed stone quarries are located about 40 Km from Maputo city, transportation cost may effect to the construction cost. On the other hand, stabilized in-situ material cost about 40% of the graded crushed stone base course. Its quality also confirmed, therefore stabilized material should be recommendable. Detailed material characteristics should be the object in the feasibility study.

Maintenance cost

Concrete block and interlocking block pavement will require the same material for repair. On the other hand, DBST or pre-mixed asphalt concrete will be easier to repair than the block pavement.

Maintenance cost will also be influenced by the material cost, therefore it should be evaluated in the feasibility study.

Table 5.6.1 Unit Cost for Pavement

Item		Unit Cost (US$)				Unit
		CASE-0	CASE-1	CASE-2	CASE-3	
SURFACE	Pre-Mix Asphalt Concrete t=30mm	9.24				sq.m
	Double Bitumen Surface Treatment		3.67			sq.m
	Concrete Block Pavement t=80mm			10.98		sq.m
	Interlocking Concrete Block Pavement				10.98	sq.m
	(sub total)	9.24	3.67	10.98	10.98	
	(rate)	1.00	0.40	1.19	1.19	
BASECOURSE	Graded Crushed Stone t=200mm	7.47				sq.m
	Graded Crushed Stone t=150mm			5.60		sq.m
	Stabilized material t=150mm		2.06		2.06	sq.m
	Sandbed t=30mm			0.90	0.90	sq.m
SUBBASE	Stabilized Material t=100mm		1.78			sq.m
Total		16.71	7.51	17.49	13.95	
Rate		1.00	0.45	1.05	0.83	

Construction easiness

Comparison of construction time is as shown in the Table 5.6.2. As shown in the Table, DBST is the shortest. Concrete block and interlocking concrete block pavement take much more time to construct comparing to the pre-mixed asphalt concrete pavement.

Concrete block and interlocking concrete block pavement require skilled labour. On the other hand, pre-mixed asphalt pavement requires operators on the asphalt finisher. On the viewpoint of the quality of the pavement, mechanical finishing is recommendable. But the block pavement is also considerable on the viewpoint of construction method of labour intensity.

Table 5.6.2 Duration of Works for Surface Course

Case	Task	Duration (days)	Duration (total)
Case 0 Pre-mixed Asphalt Concrete	Apply prime coat	1.0	2.0
	Laying pre-mixed asphalt	1.0	
Case 1 Double Bitumen Surface Treatment	1st seal	0.5	1.0
	2nd seal	0.5	
Case 2 Concrete Block	Placing sand bed	0.5	7.5
	Laying blocks	7.0	
Case 3 Interlocking Concrete Block	Placing sand bed	0.5	7.5
	Laying blocks	7.0	

Performance of local contractor

With consideration of performance of mobilization, procurement and management of construction works, foreign-affiliated enterprise is recommendable for implementation of project.

Difficulty of utility relocation

On the site, there are unconfirmed underground utilities, three water lines and one electric cable. It is difficult to confirm previously with the documents, due to poor management of record.

It is necessary to confirm the exact location of utilities with measures such as the trial excavation at the design stage.

CHAPTER 6

TRAFFIC SURVEYS

CHAPTER 6 : TRAFFIC SURVEYS

6.1 SURVEY ORGANIZATION

The Terms of Reference for the Study, and the proposals in the Inception Report, were used as the basis for defining the traffic surveys. The Inception Report was presented to the Steering Committee in Maputo and approved on 21 November. The proposals for surveys were outlined at that meeting and also approved.

Detailed terms of reference for the surveys were given to three local consultants. All three responded with competent bids and ETENG Lda were engaged to undertake the traffic surveys. A contract with ETENG was signed on 24 November and the surveys commenced on 28 November. The overall survey programme is shown as Table 6.1.1 and locations are shown in Figures 6.8.1 and 6.8.2. Survey forms are reproduced in Appendix A.

Table 6.1.1 Overall Survey Programme

Date	Day	Number of Surveyors	Types of Surveys	Locations (see Tables 6.2, 6.3, 6.4)
28 de Novembro	Terca Feira	24	6 x Traffic Counts	2.1, 2.2, 2.3, 2.4, 2.5, 2.6
29 de Novembro	Quarta Feria	24	6 x Traffic Counts	1.1, 1.2, 1.3, 1.4, .5, 1.6
30 de Novembro	Quinta Feira	24	6 x Traffic Counts	2.7, 3.1, 3.2, 3.3, 3.4, 3.5
1 de Decembro	Sexte Feira	32	8 x Traffic Counts	3.6, 3.7, 3.8, 3.9, 4.7, 4.8, 1.7, 4.10
4 de Decembro	Segunda Feira	40	4 x Traffic Counts 6 x Bus Occupancy	4.3, 4.4. 4.5, 4.6 4.3, 4.4, 4.4, 4.6, 4.7, 4.8
5 de Decembro	Terca Feira	40	5 x Traffic Counts 3 x Traffic Lights 3 x Origin Destinations	4.11, 4.12, 1.8, 4.9, 4.10 5, 6, 9, 3.1, 3.2, 3.3
6 de Decembro	Quarta Feira	36	5 x Traffic Lights 3 x Traffic Lights 3 x Origin Destinations	21, 22, 23, 24, 25 1, 3, 4, 3.7, 3.4, 2.3
7 de Decembro	Quinta Feira	36	8 x Traffic Lights 3 x Origin Destinations	17, 18, 19, 20, 7, 8, 11, 12 3.8, 3.9, 2.6

Date	Day	Number of Surveyers	Types of Surveys	Locations (see Tables 6.2, 6.3, 6.4)
8 de Decembro	Sexte Feira	40	4 x Bus Occupancy 4 x Traffic Lights 2 x Traffic Counts 3 x Origin Destinations	1.1, 1.2,, 4.1, 4.2 13, 14, 15, 16 4.1, 4.2 1.1, 1.2, 1.4
11 de Decembro	Segunda Feira	32	3 x Origin Destination 2 x Bus Occupancy 1 x Journey Time	2.1, 2.2, 2.4 1.4, 1.5 1
12 de Decembro	Terca Feira	36	1 x Journey Time 8 x Bus Occupancy	2 3.1,3.2, 3.3, 3.4, 3.7, 3.8,,2.2, 4.9
13 de Decembro	Quarta Feria	40	1 x Journey Time 8 x Bus Interviews	3 2192, 2131, 4.4, 4.5, 4.6, 2.3, 2.4, 4.8
14 de Decembro	Quinta Feira	34	1 x Journey Time 9 x Passenger Car Interviews	5 4.4, 4.5, 4.6, 4.7, 3.1, 3.2, 3.3, 3.4, 3.7
15 de Decembro	Sexte Feira	40	1 x Journey Time 1 x Passenger Car Interviews 7 x Bus Interviews	6 3.8
18 de Decembro	Segunda Feira	40	1 x Journey Time 3 x Axle Load 1 x Bus Interviews	4

6.2 TRAFFIC COUNTS

Traffic count locations are listed in Table 6.2.1. Road traffic was counted between 0500 and 2100 hours (16 period). At sites 3.7 and 4.4 24 hour counts were also undertaken. The following disaggregations of traffic were adopted:

- Pedestrians
- Cars, including pick ups
- Private minbuses
- Public Mini buses (Chapas)
- Public Midi buses
- Big buses
- Light Goods
- Medium Goods
- Heavy Goods
- Motorcycles

In accordance with the inception report 3 cordon/screenlines were established :

External : at the city boundary
Outer : flowing the railways line on a south-west north-east axis
Central : around the CBD area

The cordon locations are shown in Figure 6.8.3. A full description of the site locations is given in Table 6.2.1

Table 6.2.1 Traffic Counting Locations

Station No.	Type	Location	Comment
1.1	Outer Cordon	Avenida da Namaacha (Matola Road) at City Boundary	Immediately west of Railway bridge vehicles can pull over
1.2	Outer Cordon	Machava Road at City Boundary	At existing Police check point
1.3	Outer Cordon	Rua 5.579 at City Boundary	Road in poor condition to Zona Verde. Optional site.
1.4	Outer Cordon	Marracuene Road at Zimpeto	North side of junction, vehicles can pull over
1.5	Outer Cordon	Marracuene Road north of junction with Rua 5.780	
1.6	Outer Cordon	Rua 4.755 north of Mahotas	Poor condition road
1.7	Outer Cordon	Avenida da Marginal, north of junction with Rua 4.680	
1.8	Outer Cordon	Catembe Ferry, on vessels	Special survey form
2.1	Railway Screenline	Avenida da Mocambique, over railway	Use shoulders for interviews
2.2	Railway Screenline	Rua Gaga Coufinho (2.287), next to railway, above Machave Road	Use entrance to market/Water and Sanitation for interviews
2.3	Railway Screenline	Lago da Deta, at level crossing	Northbound traffic north of railway. Southbound traffic south of railway and bus stop
2.4	Railway Screenline	Av. Accordos da Lusaka	South of railway bridge
2.5	Railway Screenline	Rua 4.029	Optional
2.6	Railway Screenline	Av. Julius Nyerere, below railway line	North of railway line
2.7	Railway Screenline	Rua 4.680 crossing railway line	Optional

Station No.	Type	Location	Comment
3.1	Inner Cordon	Av 24 de Julho, west of Av da Tanzania	
3.2	Inner Cordon	Av de Trabalho, west of Av da Tanzania	One way East-bound
3.3	Inner Cordon	Av de Angola, north of Pr 21 de Outobro	
3.4	Inner Cordon	Av de Accordos de Lusaka, north of Marlen Ngoubai	
3.5	Inner Cordon	Av Milaga Mabote, , north of Marlen Ngoubai	
3.6	Inner Cordon	Av da Manhangalena, , north of Marlen Ngoubai	
3.7	Inner Cordon	Vladimir Lenine, , north of Marlen Ngoubai	
3.8	Inner Cordon	Av Julius Nyerere, north of Kwame Nkrmah	
3.9	Inner Cordon	Av da Marginal, behind Polona hotel	
4.1	Trafffic Volume	Av Julius Nyerere, south of R ua 4.750	
4.2	Trafffic Volume	Av da Mzombique , south of R 5.500	
4.3	Trafffic Volume	Av Marlen Ngoubai, west of Valimir Lenine	
4.4	Trafffic Volume	Av Eduardo Mondane, west of Valimir Lenine	
4.5	Trafffic Volume	Av 24 Julho, west of Valimir Lenine,	
4.6	Trafffic Volume	Rua da Radio, west of Valimir Lenine	
4.7	Trafffic Volume	Av 25 de Septembro, west of Rua da Impresa	

Station No.	Type	Location	Comment
4.8	Trafffic Volume	Valadimir Lenine, soth of Rua da Soveste	
4.9	Trafffic Volume	Av des Forcas Populares de Liberaco de Mocambique, south of Rua da soveste	
4.10	Trafffic Volume	Rua Sao Pedro, 5.314	Pilot Project Road
4.11	Trafffic Volume	Maria Matola	
4.12	Trafffic Volume	Av Kenneth Kaunda	
2192	Bus Interview	Praca da Juventude	
2131	Bus Interview	Praca dos Combatentes	

6.3 TRAFFIC SIGNALLES INTERSECTIONS

Surveys were undertaken at the 22 signalled intersections in the city. Of these 20 are located in the central business district, and 2 are located on the Machava Road at the junctions with Av. de Angola, and Av. Accordos de Lusaka. Towards the end of the survey period a number of new signal installations were added in Maputo, but these were not surveyed. At each intersection the following were surveyed over a 12 hour period (0600 to 1800 hours) :

- Turning movements, by vehicle type (car, goods, bus)
- Signal phasing and timings
- Queue lengths

The traffic signal survey programme is shown in Table 6.3.1, and locations in Figure 6.8.4

Table 6.3.1 Traffic Light Survey Programme

No.	Junction Description		Date
1	Av 24 de Julho	Av da Tanzania	6 de Dec
3	Via da Machava	Av de Angola	6 de Dec
4	Av. Marien Ngoubai	Av Accordos de Lusaka	6 de Dec
5	Av. Marien Ngoubai	Av Karl Marx	5 de Dec
6	Av. Marien Ngoubai	Av Valdimir Lenine	5 de Dec
7	Av Eduardo Mondlane	Av Albert Luthuli	7 de Dec
8	Av Eduardo Mondlane	Av Guerra Popular	7 de Dec
9	Av Eduardo Mondlane	Av Karl Marx	5 de Dec

No.	Junction Description		Date
10	Av Eduardo Mondlane	Av Vladimir Lenine	5 de Dec
11	Av Eduardo Mondlane	Av Amilcar Cabral	7 de Dec
12	Av Eduardo Mondlane	Av Salvador Allende	7 de Dec
13	Av 24 de Julho	Av Albert Luthuli	8 de Dec
14	Av 24 de Julho	Av Guerra Popular	8 de Dec
15	Av 24 de Julho	Av Karl Marx	8 de Dec
16	Av 24 de Julho	Av Vladimir Lenine	8 de Dec
17	Av 24 de Julho	Av Amilcar Cabral	7 de Dec
18	Av 25 de Septembro	Av Guerra Popular	7 de Dec
19	Av 25 de Septembro	Av Karl Marx	7 de Dec
20	Av 25 de Septembro	Av Vladimir Lenine	7 de Dec
21	Av 25 de Septembro	Av Samora Machel	6 de Dec
22	Av Eduardo Mondlane	Av Salvador Allende	6 de Dec
23	Av Mozambique	Av do Trabalho	6 de Dec
24	Machava road	Av de Angola	6 de Dec
25	Machava road	Av Accordos de Lusaka	6 de Dec

6.4 ORIGIN – DESTINATION ROADSIDE INTERVIEWS

As part of the traffic surveys carried out for this project a major programme of roadside interview surveys was planned. However, time constraints prevented the full co-operation of the local traffic police in the programme. Hence the original programme was amended to make best use of the resources available.

In the event, surveys were successfully carried out at 14 locations, resulting in 2,320 completed interviews. We believe that this represents around 1.7% of total daily vehicle trips in Maputo, and is an acceptable sample size. Survey locations for the roadside interviews are listed in Table 6.4.1

Table 6.4.1 Origin Destination Survey Locations

Survey Location	Type of Location	Station Name	Date Surveyed	Completed Interviews
1.1	Outer Cordon	Matola Road	8 December	200
1.2	Outer Cordon	Machava Road	8 December	74
1.8	Outer Cordon	Catembe Ferry	15 December	65
2.1	Screenline	Av. de Mozambique	8 December	121
2.3	Screenline	Largo de Deta	6 December	141
2.4	Screenline	Av Accordos de Lusaka	12 December	276
2.6	Screenline	Av Julius Nyerere	7 December	158
3.1	Central Area Cordon	Av 24 de Julho	5 December	224
3.2	Central Area Cordon	Av de Trabalho	5 December	96
3.3	Central Area Cordon	Av. de Angola	5 December	214
3.4	Central Area Cordon	Av Accordos de Lusaka	6 December	152
3.7	Central Area Cordon	Av. Vladimir Lenine	6 December	191
3.8	Central Area Cordon	Av. Julius Nyerere	7 December	183
3.9	Central Area Cordon	Av de Marginal	7 December	110
4.9	Traffic Count Location	Av Forces Popular Liberacao de Mozambique	12 December	116
Total				2,320

Surveyors asked the following questions

- Vehicle type
- Number of passengers
- Origin
- Destimation
- Journey Purpose
- Frequency of trip
- Load carried (if goods)
- Whether car drivers had an off-street parking space at home

Light goods vehicles were defined as having 4 tyres, but excluding pick-ups. Medium goods were defined as having two axles and six tyres. Heavy goods vehicles had 3 axles or more.

6.5 JOURNEY TIME SURVEYS

Six journey time routes were established for the city in order to survey traffic speeds. . The six routes are shown in Figure 6.8.5 and listed in Table 6.5.1.

Table 6.5.1 Journey Time Route Descriptions

1	2
Junction Av de Julius Nyerere/Av. de Kenneth Kaunda	Marracuene Road/Maria Mutola
Vladimir Lenine (Roundabout)	Praca dos Juvenelos
Accordos de Lusaka (Robot)	Praca dos Combatentes
Angola (Robot)	Keneth Kaunda/Vladimir Lenine
Av de Mozambique (Bridge)	Mao Tse Tung/Vladimir Lenine
Mac Mahon Brewery	Eduardo Mondane/Vladimir Lenine
Machava Police Checkpoint	24 de Julho/Vladimir Lenine
	Rua da Radio/Valdimir Lenine
	25 de Septembro/Vladimir Lenine
3	**4**
Marracuene Road/Maria Mutola	Praca dos Combatentes
Machava Road (Ponte)	Praca dos Heros Mocambicois
Av de Mozambique/ Rua Gaga Coufinho	Accordos de Lusaka/Kenneth Kaunda
Av de Mozambique/ Av do Trabalho	Accordos de Lusaka/Marlen Ngoubai
Av 24 de Julho/Av OUA	Guerra Popular/Eduardo Mondane (Robot)
Av 24 de Julho/Av da Tanzania	Guerra Popular/24 de Julho (Robot)
Av 24 de Julho/ Av Guerra Popular	Guerra Popular/Josina Machel
Av 24 de Julho/Av Vladimir Lenine	Guerra Popular/25 de Septembro
Av 24 de Julho/Av Amilcar Cabril	25 de Septembro/Rua da Impresa
Av 24 de Julho/Av Julius Nyerere	Praca Robert Mugabe
5	**6**
Julius Nyere/Kenneth Kaunda	Praca dos Heros Mocambicois
Julius Nyere/Moa Tse Tung	Airport Entrance
Mao Tse Tung/Vladimir Lenine	Rua Gago Coufinho (Bridge over road)
Marlen Ngoubai/Accordos de Lusaka	Rua Gago Coufinho/Av de Mozambique
Pr da 21 Outobro	Av da Mozambique/Av de Trabalho
Av da Zambia/Eduardo Mondane	Av de Trabalho/Av da Tanzania
Guerra Popular/Eduardo Mondane	Pr 21 de Outobro
Guerra Popular/Josina Machel	Av da Zambia/Eduardo Mondane
Rua da Radio/Valdimir Lenine	Guerra Popular/Eduardo Mondane
Praca Travessia de Zambeze	Vladimir Lenine/Eduardo Mondane
Rua dos Luladas/24 de Julho	Amicar Cabral/Eduardo Mondane
24 de Julho/Julius Nyerere	Salvador Allende/Eduardo Mondane
Julius Nyere/Moa Tse Tung	Julius Nyere/Eduardo Mondane
Julius Nyere/Kenneth Kaunda	

An observation car was used to time individual stages of each route. A moving observer technique was used in which the observation car attempted to maintain an average speed of

traffic using the road by keeping its relative position in the platoon of vehicles Each route was surveyed over one or two days in both directions. The number of runs carried out on each route is shown in Table 6.5.2

Table 6.5.2 Number of Journey Time runs

Route Number	Runs
1	28
2	20
3	16
4	24
5	19
6	20
Total	127

Results were analysed in three time periods :

- Morning Peak : 06.00 to 10.00 hours
- Inter Peak : 10.00 to 16.00 hours
- Evening Peak : 16.00 to 19.00 hours

6.6 BUS OCCUPANCY SURVEYS

Surveys were carried out to determine bus passenger flows on the major corridors. Surveyors located at the roadside either counted or estimated the number of passengers on every bus passing between 0600 and 1800 hours. Where passenger loads were high and it was not possible to directly count, surveyors estimated the number of passengers from bus capacity data provided for each type of vehicle operating in the city

These counts were carried out at 18 locations comprising 36 counting stations listed in Table 6.6.1

Table 6.6.1 Bus Occupancy Survey Locations

Survey Point (site)	Location
1.1	Matola Road at city boundary
1.2	Nachava Road, at city boundary
1.4	Marracuene Road, junction with Av de Mozambique
1.5	Marracuene Road, junction of Rua 5.780
3.1	Av 24 de Julho, north of junction with Av de Tanzania
3.2	Av de Trabalho, north of junction with Av de Tanzania
3.3	Av De Angola, north of junction with Marien Ngoubai
3.4	Av Accordos do Lusaka, north of junction with Marien Ngoubai
3.7	Av Vladimir Leniine, north of junction with Av Mao Tse Tung
3.8	Av Julius Nyerere, north of Av Kwame Nkrumah
4.1	Av Julius Nyerere, at Rua 4.750
4.2	Av de Mozambigue, at junction of Rua da Sao Pedro
4.3	Av Marien Ngoubai, at junction of Av Mao Tse Tung
4.4	Eduardo Mondlane, west of Av Vladimir Lenine
4.5	Av 24 de Julho, west of Av Vladimir Lenine
4.7	Av 25 de Septembro west of Av Vladimir Lenine
4.8	Av Vladimir Lenine, south of Rua Soveste
4.9	Av FPLM, Cruz Vermelha

6.7 BUS PASSENGER SURVEYS

Bus passengers were interviewed to determine origin-destination data. It is not possible to interview passengers inside vehicles because of the extreme crowding in small buses. Therefore surveys were carried out bus terminals and bus stops where passengers were waiting for buses at the lcoations listed in Table 6.7.1

Table 6.7.1 Bus Passenger Interview Locations

Site No.	Location	Completed Interviews
4.8	Vladimir Lenine, south of Rua Soveste	275
3.1	Av 25 de Julho, at junction of Av de Tanzania	302
8	Av Eduardo Mondlane/Av Guerra Populare	72
16	Av 25 de Julho/Av Vladimir Lenine	272
1096	Rua dos Luslards (Bus terminal)	304
2131	Praca dos Combatentes	241
2192	Praca dos Juventudes	423
2221	Mercado Junta	369
Total		2258

Bus passengers were asked the following :

- Origin of Current Trip
- Destination of current trip
- Mode of travel to bus stop
- Type of bus to be boarded
- Onward mode of transport subsequent to disembarking the bus
- Fare(s) paid for this trip

6.8 CAR DRIVER INTERVIEWS

Car drivers who had already parked were interviewed at 5 locations set out in Table 6.8.1

Table 6.8.1 Car Driver Interview locations

Location	Interviewed Drivers
Mercado Centrale	273
Interfrace, Av 25 de Julho	194
Av Mao Tse Tung (Nando's)	89
Praca 25 de Junho	155
Lago de Deta, Aeroports	224
Total	935

Drivers were asked the following :

- Origin
- Destination
- Journey Purpose
- Amount paid for parking (including security)

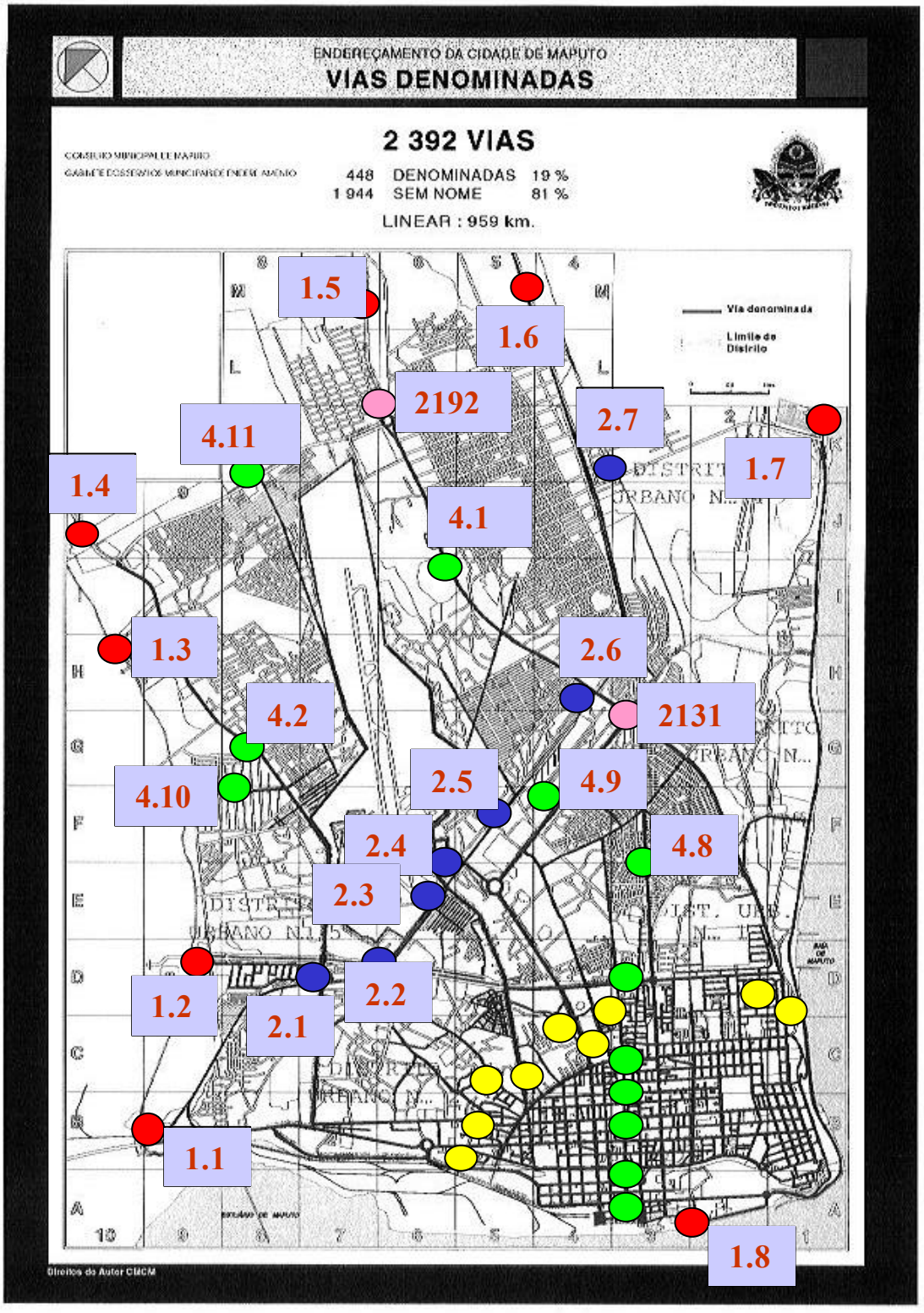


Figure 6.8.1 Survey Locations

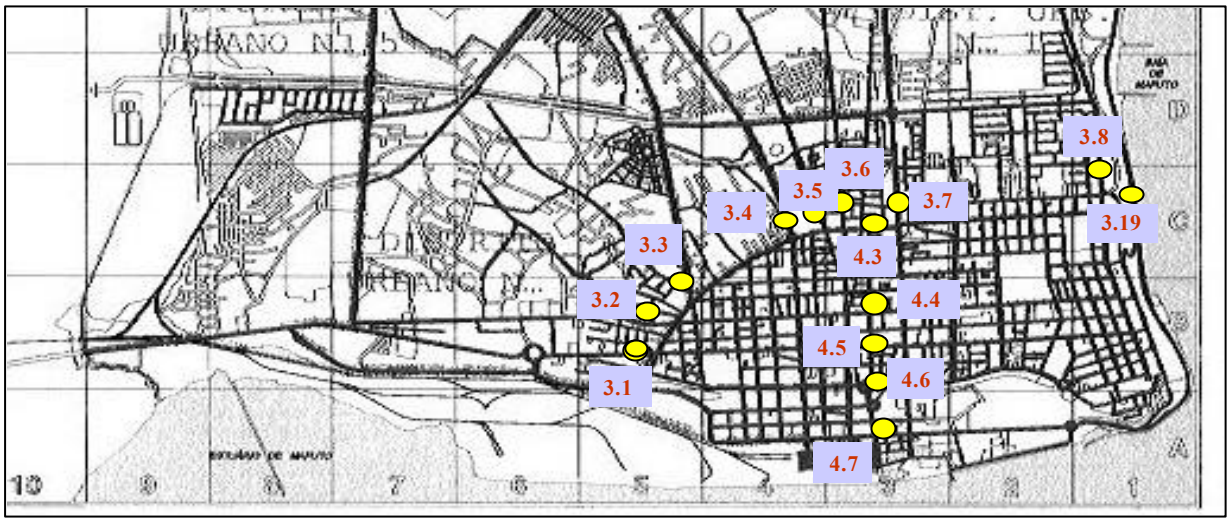


Figure 6.8.2 Central Area Survey Locations

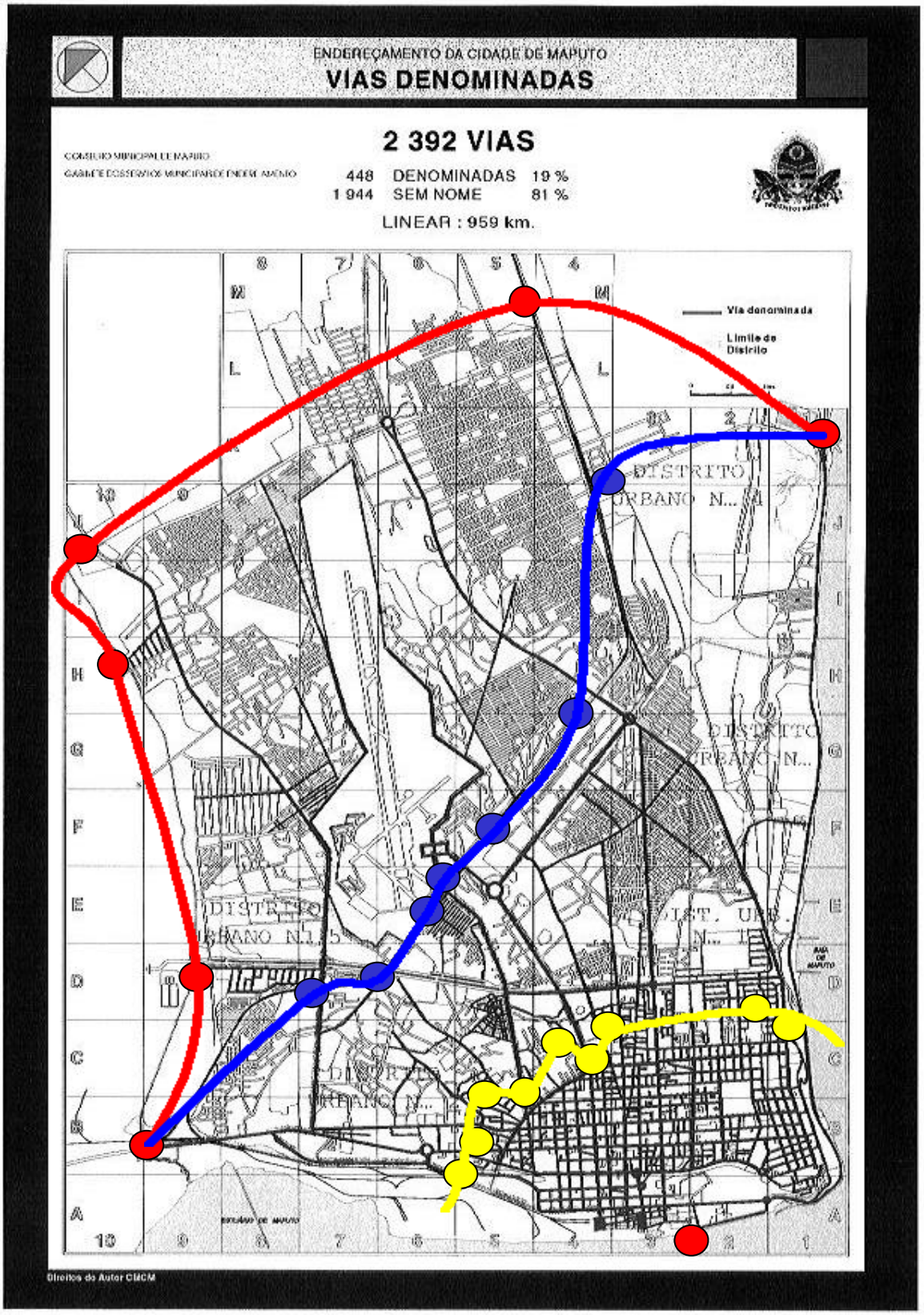


Figure 6.8.3 Cordon Locations