Chapter 14. PUBLIC TRANSPORTATION NETWORK PLAN

14.1 Demand Structure

Table 14.1.1 shows public transport demand in 1998 and in 2020. Demand from outside of Damascus City to the city area will increase about 2.3 times, and most of these buses will have their destination terminals located close to the city center. Among terminals, President Assad Bridge terminal located under President Assad bridge, Brankeh terminal, which has been used as the terminal for long distance inter city buses, and Abbas terminal are all located within the inner ring road. The concentration of buses from outside of Damascus City to these three terminals will cause serious traffic congestion. Figure 14.1.1 shows locations of the three terminals and their main service directions.

Table 14.1.1 Public Transport Demand

	1998		2020		2020/1998
	Trip/day	(%)	Trip/day	(%)	
City-City	561,243	41	461,214	16	0.82
City-Out	628,922	46	1,463,867	52	2.33
Out-Out	170,786	13	909,982	32	5.33
Total	1,360,951	100	2,835,063	100	2.08

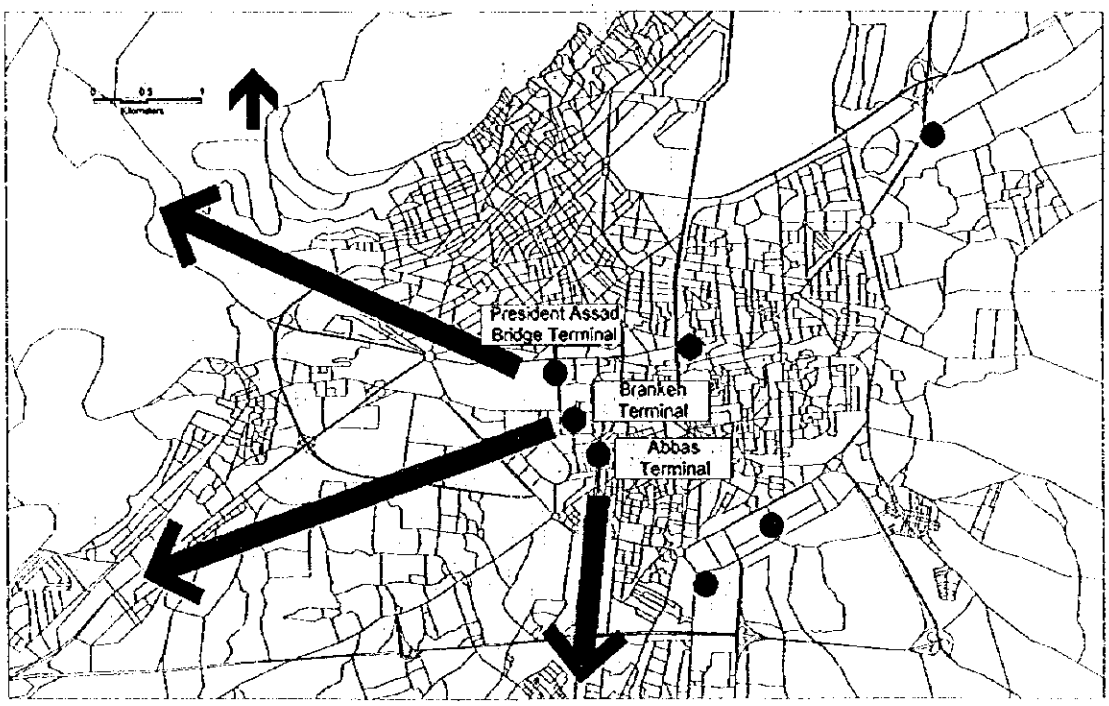

Figure 14.1.1 Main Bus Terminal Locations

Figure 14.1.2 and Figure 14.1.3 show the present and future bus passenger demand assigned to the present bus route network. The flow from Qatana in the southwest to Brankah terminal will grow significantly, while the flows within Damascus City area will remain unchanged or will decrease because of increasing private car use.

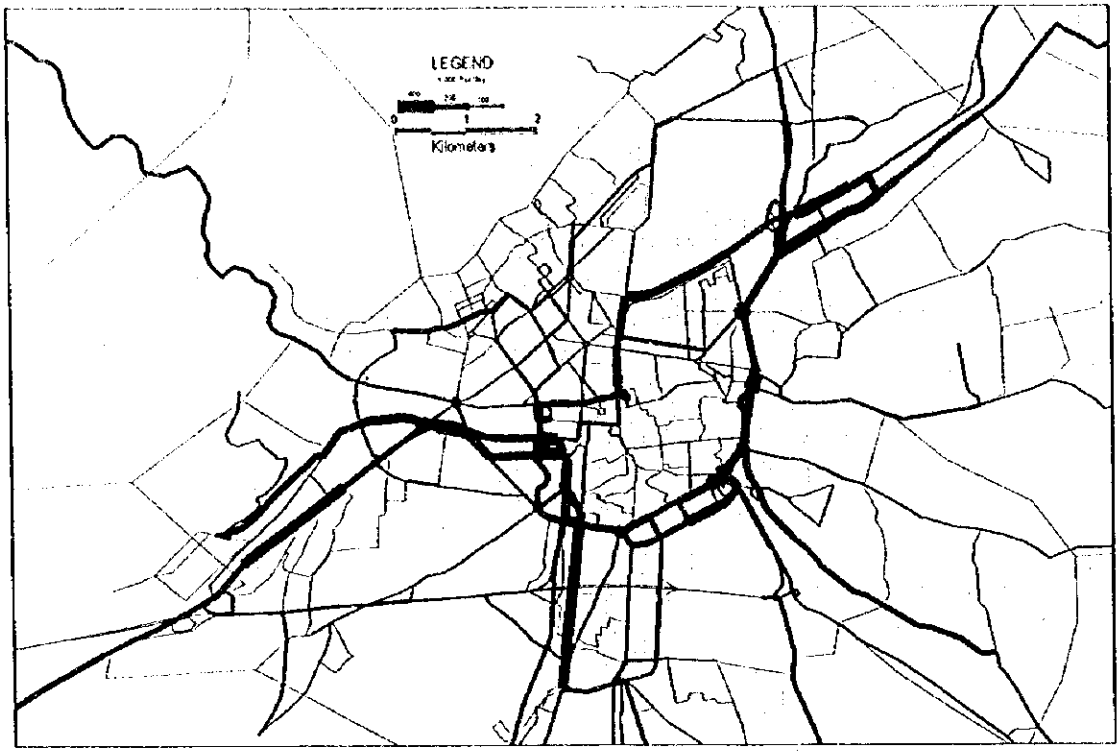

Figure 14.1.2 1998 Bus Passenger Flow on 1998 Bus Network

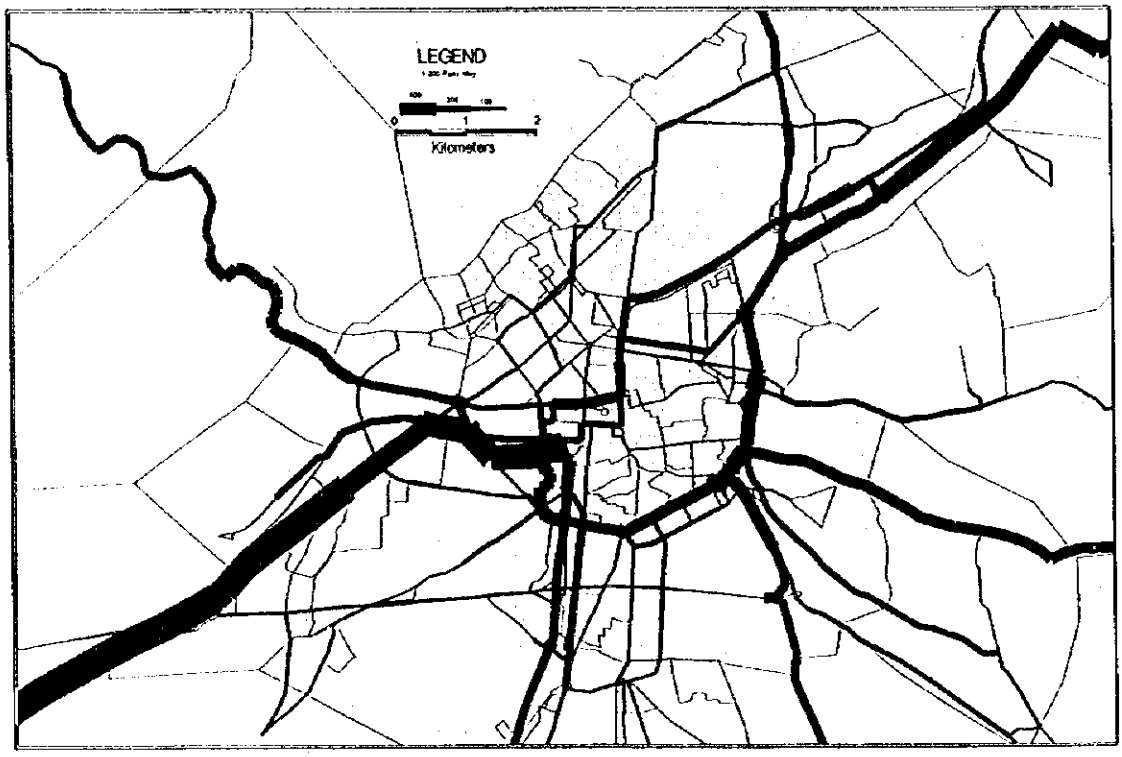

Figure 14.1.3 2020 Bus Passenger Flow on 1998 Bus Network

14.2 Planning Policy

Based on the present and future demand structure, the present bus and terminal operating system, and the forecast traffic conditions in future, the following planning policies are established.

1) The private operated buses will be maintained for the convenience of public transport passengers, for the efficient operation of public transport and to secure the job opportunities of bus operators. The present about 200 bus lines shall be modified in accordance with bus passenger demand and the present announcement-apply-approval system will function well to adjust the buses with demand.

2) On the routes, where traffic congestion is forecast due to operation of large numbers of small size buses, the use of larger size buses shall be introduced, and the necessary administration supporting system from the public sector to the individual bus owners shall be introduced to accelerate the fleet conversion.

3) On limited routes, where serious traffic congestion is forecast, the trunk bus system will be introduced. In all cases, the public sector shall take initiative for the introduction of the system but burden of installment shall be covered by private sector in principle. The routes of the private bus operators will be modified in accordance with the transfer demand from the trunk bus route, which will be achieved by the present announcement-apply-approval system.

4) In the long-term range, the use of existing railways for urban rail transit, which have more frequent headway and the construction of additional lines to form urban rail network shall be considered.

5) The main function of bus terminals located within the inner ring road shall be changed from the bus pool for waiting passengers, to that of transfer terminals. The bus pools shall be relocated to the sub-urban area.

6) From the environmental point of view, the use of Compressed Natural Gas (CNG) instead of the present diesel fuel shall be considered, and the support from the public sector for the maintenance of bus engines to have more efficient operation and less emissions shall also be considered.

7) Introduction of premium buses, which provide more convenient transport mode with air conditioning system and operate with higher fare, shall be considered, especially when the CBD parking control system to eliminate the private car commuters is introduced.

14.3 Bus Improvement Plan

14.3.1 Bus Rerouting

The present passenger demand on the present bus routes was reviewed from the point of view of operating efficiency. 95 bus routes out of 195 routes were selected. The other routes were considered as the branch routes or similar routes to these selected routes. By this aggregation of the bus routes, the average operating efficiency will increase from 5.64 passengers/veh in the 2020 Do-Nothing case to 6.29 passengers/veh. The required bus fleet in the year 2020 will also decrease from 55,900 to 50,700.

14.3.2 Introduction of larger Bus Fleet

(1) Bus Size

In addition to the present operated 12-14 passenger microbuses, buses with a capacity of 25 passengers (mini-bus), 50 passengers (standard bus), and 105 passengers (large bus) shall be introduced.

(2) Route for Larger Buses

Routes for introduction of larger bus fleet were selected based on required fleet numbers at peak hour on each bus route. 21 bus routes out of 195 were selected to have larger bus fleets. Three routes for 105 passenger buses (Figure 14.3.1), nine routes for 50 passenger buses (Figure 14.3.2) and ten routes for 25 passenger buses were selected.

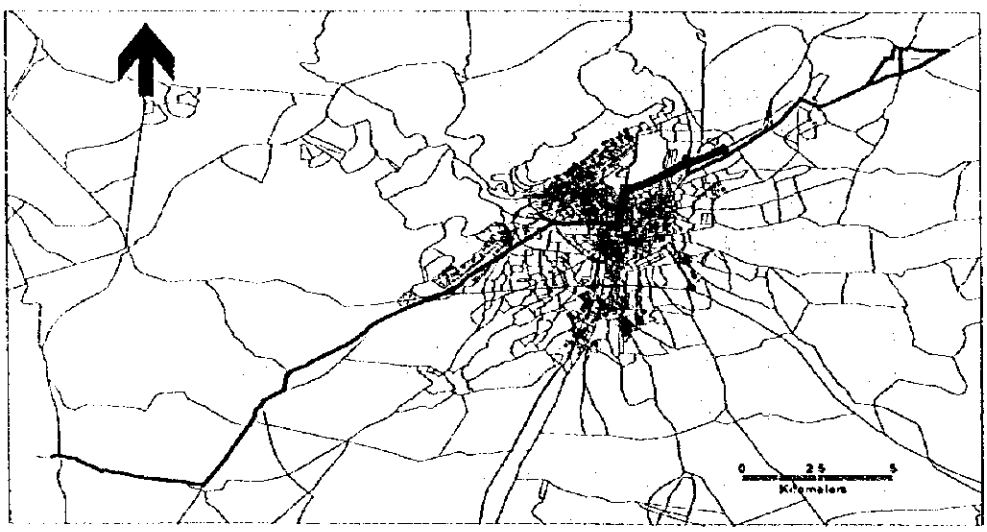

Figure 14.3.1 Bus Routes with 105 Passenger Buses

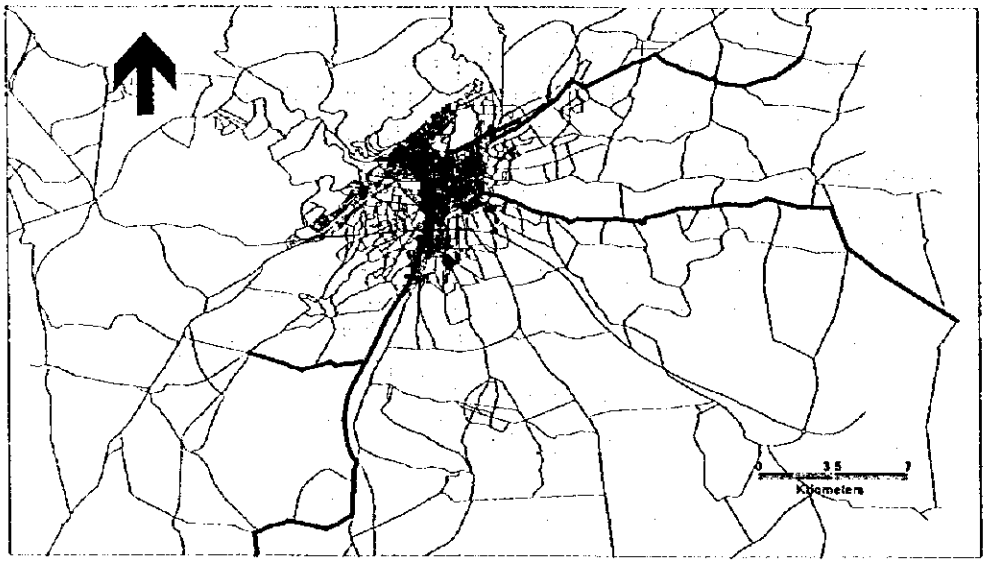

Figure 14.3.2 Bus Routes with 50 Passenger Buses

14.3.3 Introduction of Trunk-Bus System

(1) Concept of Trunk Bus System

The main purpose of the trunk bus system is to transport large volume of passengers by larger size and less number of buses to reduce traffic congestion caused by the large number of small size buses. This system will require the following components;

1) Introduction of large size buses with the capacity of 105 passengers.
2) Introduction of exclusive bus lanes to secure scheduled operating speed by segregating from other modes of traffic. The exclusive lanes shall be located at the center lanes of the street to avoid interference from the roadside parked cars.
3) Improvement of transfer stations to minimize transfer impedance between trunk route and feeder services.

(2) Route and Passenger Demand for Trunk Bus Operation

Based on the conditions explained above, the route shall have at least 4 lanes for both directions and it is preferable to pass through the demand concentrated area in the city center. The route Mezzeh-Autostrade-Shukri Al Qwatli st.-Al Ittinhad st.-Al Thawra st.-6 Oct. st. is selected as the trunk bus route. The starting terminal is located at Mezzeh and the end terminal at Kaboun where inter-city bus terminals are located. The trunk bus demand in 2020 was estimated as shown in Figure 14.3.3.

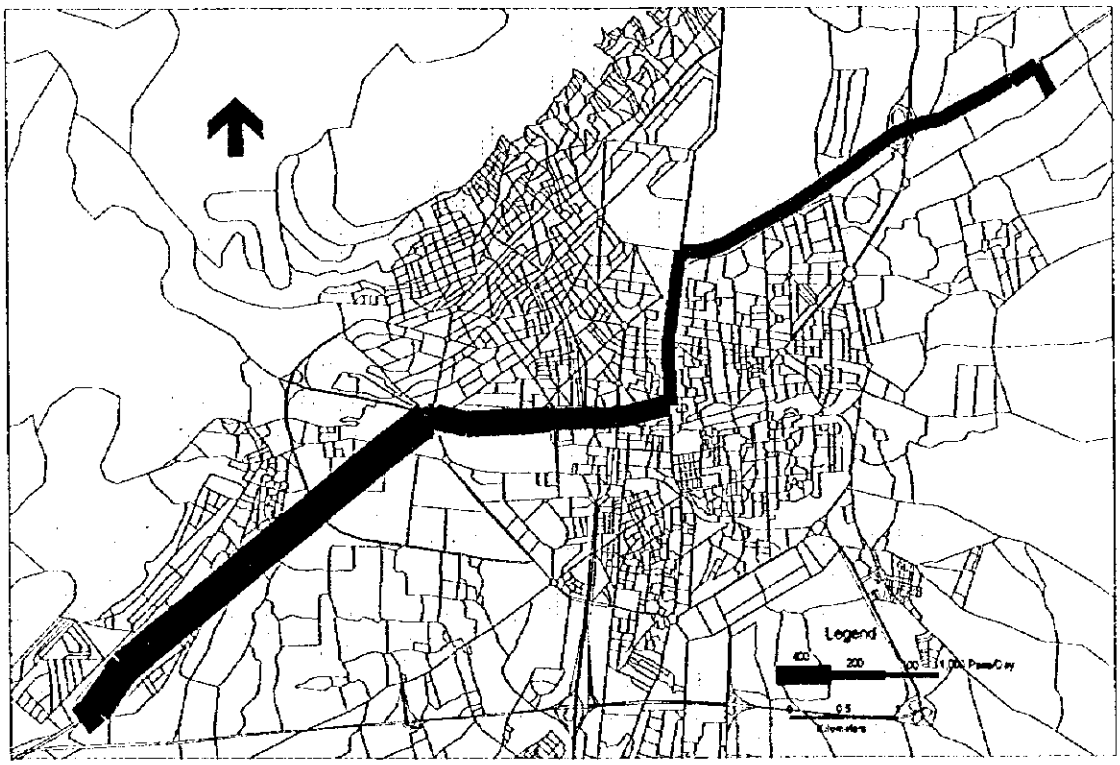

Figure 14.3.3 Trunk Bus Demand in the Year 2020

The highest demand was seen on the Autostrade in Mezzeh, where about 730,000 passengers/day for both directions is estimated.

(3) Effect of Trunk Bus System

Table 14.3.1 shows the comparison of required bus fleet and some indicators at present, the do-nothing case in the year 2020, and the cases with bus rerouting, introduction of larger buses and trunk bus system in the year 2020. If the present microbus operation is continued in the year 2020, the required bus fleet will increase to about 56,000 vehicles or about 5 times the present. On the other hand introduction of trunk bus system and larger size buses (case 2) will reduce the numbers to a total of 25,939 or about 2 times the present. The operation efficiency will also increase from 5.64 passenger/veh to 12.31 passenger/veh.

Table 14.3.1 Bus Operation Indicators

Item/Case	1998	2020		
		Do Nothing	Case1	Case 2
Rerouting			O	O
Large Buses				O
Trunk Bus				O
Required Fleet	11,271	55,896	50,668	25,939
14 pass	11,271	55,896	50,668	16,143
25 pass				4,347
50 pass				3,585
105 pass				1,864
Daily 1,000 Veh-Km	3,723.7	12,399.6	11,250.5	5,754.7
Daily 1,000 Pass-Km	20,547.1	69,890.2	70,819.3	70,819.3
Efficiency (Pass/Veh)	5.52	5.64	6.29	12.31

14.3.4 Reinforcement of Bus Fleet

(1) Bus Fleet required

Bus fleet required is estimated and shown in Table 14.3.2. Installment of larger size buses will start from relatively small size units and move to larger size. Urgent start of installment of medium size buses is highly recommended.

(2) Bus Operator's Economy

Average annual expenses and sales were estimated as shown in Table 14.3.3. Most of assumptions are quoted from a section of VOC unit calculation. Some notes to other assumptions are as follows;

- Average annual running km: 156.2 km/day (obtained from survey) x 365 days x 0.93 (estimated rate of workable).
- Total number of microbus: Total number of microbuses registered at Damascus Governorate.
- Total number of passengers: Figures expanded from Home Interview Survey results (passengers traveled inside Damascus City area).
- Working days: 365 days (Because total number of microbuses does not consider rate of workable)
- Installment including interest: Assumed market interest rate as 11% pa, payment period as 12 years and 20% of purchased value as residual value.

Table 14.3.2 Bus Fleet required by Passenger Size

Year	14 passenger	25 passenger	50 passenger	105 passenger
1998	10,793	0	0	0
1999	11,436	150	75	0
2000	12,117	298	175	0
2001	12,838	455	298	0
2002	13,603	645	436	0
2003	14,413	818	620	0
2004	15,271	1,194	744	0
2005	16,180	1,457	968	0
2006	16,722	1,538	1,149	0
2007	17,281	1,624	1,346	0
2008	17,860	1,715	1,559	0
2009	18,457	1,810	1,789	0
2010	19,075	1,911	2,037	0
2011	18,759	2,075	2,155	180
2012	18,449	2,252	2,281	358
2013	18,143	2,445	2,413	541
2014	17,843	2,655	2,554	724
2015	17,548	2,882	2,702	909
2016	17,257	3,129	2,859	1,096
2017	16,972	3,397	3,026	1,286
2018	16,691	3,688	3,202	1,479
2019	16,415	4,004	3,388	1,675
2020	16,143	4,347	3,585	1,864

Table 14.3.3 Average Annual Expenses and Sales

Items	Unit	
Assumptions		
Microbus Vehicle Price	SP/vehicle	850,000
Fuel Price	SP/Litter	6.1
Oil Price	SP/Litter	45.0
Tire Price	SP/piece	2,779
Fuel Consumption Rate	Litter/km	0.101
Oil Consumption Rate	Litter/1000km	2.75
Tire Change Cycle	Piece/km	60,000
Repair and Maintenance Cost	SP/km	0.82
Interest	% p.a.	11
Average Running km a year	km/year	53,000
Ages Usable	Year	12
Crew Salary	SP/year	91,250
Total Number of Microbus	Vehicle	4,125
Total Number of Passengers	Person	627,013
Average Fee	SP/time	5
Working Days	Day	365
Annual Expenses		
Capital Expenses		
Installment including interest	SP/year	57,260
Operating Expenses		
Fuel	SP/year	32,653
Oil	SP/year	6,559
Tire	SP/year	9,819
Repair and Maintenance	SP/year	43,460
Crew Salary	SP/year	91,250
Total Annual Expenses (a)	SP/year	241,001
Annual Sales (b)	SP/year	277,406
Profit or Administration Cost (b)-(a)	SP/year	36,405

Table 14.3.3 shows that it is difficult for an average microbus operator to buy a larger size bus from microbus operation profit.

(3) Promising Suppliers of Larger Size Bus

Promising suppliers are considered as follows;

a. Present suppliers of microbus: Some of microbus owners have many units and enjoy big profit. Introduction of new routes for larger bus is surely a good business chance for them.

b. Local companies that are interested in public transport business: Profit produced by public transport business is not big but steady. There are companies that have interest to work in this sector such as Kadmous Company in Tartous.

c. New operator, which belongs to the third sector: Joint operation of governmental body and private enterprise allows for high creditability of public sector and high productivity of private sector to be combined.

Assumed same ratio of on-board passenger to bus capacity as obtained for a microbus from field surveys, a ratio of annual profit (before tax) / investment becomes 16.8 % from the profit loss table pro forma (Table 14.3.4).

Table 14.3.4 Profit Loss Table Pro Forma for Installment of Large Buses

Items	Unit	
Assumptions (excluding same assumptions as described in Table 14.3.2)		
Vehicle Price	SP/vehicle	5,200,000
Tire Price	SP/piece	9,828
Fuel Consumption Rate	Litter/km	0.201
Oil Consumption Rate	Liter/1000km	5.78
Repair and Maintenance Cost	SP/km	6.32
Years Usable	Year	12
Annual Expenses		
Capital Expenses		
Installment including interest	SP/year	350,294
Operating Expenses		
Fuel	SP/year	64,983
Oil	SP/year	13,785
Tire	SP/year	52,088
Repair and Maintenance	SP/year	334,960
Crew Salary	SP/year	292,000
Total Annual Expenses (a)	SP/year	1,108,111
Annual Sales (b)	SP/year	1,981,470
Profit or Administration Cost (b)-(a)	SP/year	873,358

Note: Large Bus is for 105-passenger capacity

(4) System

Introduction of large bus aims to reduce the number of microbuses. This means reduction of job opportunities for microbus owner-drivers. In order to ease this situation some procurement loan for larger size bus for microbus owners-drivers shall be considered.

If various size of buses served in the same line without control of operation, a smaller size bus is superior to a larger size because number of passengers collectable is same in average but operating cost is different by size (a larger bus is more expensive). From supplier point of view a system to control operation is necessary. It is needless to note that scheduled operation is desirable from user points of view. It is hence necessary to establish the system to control bus operation.

14.3.5 Transfer Terminals

(1) Demands

There will be three transfer terminals to serve passengers connecting between trunk and feeder lines, namely Kaboun, President Assad Bridge and Mezzeh transfer stations. Number of services at major terminals is estimated as shown in Table 14.3.5.

Table 14.3.5 Number of Services at Major Terminals

Terminal		1998	2005	2010	2020
Kaboun	14 Passengers	4,214	8,201	10,383	4,713
	25 Passengers	0	8,228	2,042	2,497
	50 Passengers	0	1,446	6,340	3,916
	105 Passengers	0	0	0	6,804
Assad	14 Passengers	4,607	10,285	11,631	30,978
	25 Passengers	0	0	0	7,210
	50 Passengers	0	2,594	3,636	8,416
	100 Passengers	0	0	0	6,546
Mezzeh	14 Passengers	3,459	2,187	3,584	0
	25 Passengers	0	0	0	3,944
	50 Passengers	0	2,084	3,279	0
	100 Passengers	0	0	0	5,838

(2) Mezze Terminal

The terminal is planned to be newly constructed over Mezze Autostrada. It is expected to accommodate 4,271 services of micro/mini bus in 2005. The number of services shifts to 3,944 of micro/mini bus and 5,838 of trunk bus in 2020. The plan can accommodate demands of 2020 (trunk bus at upper deck and microbus at grade). Figure 14.3.4 shows the terminal. Construction is scheduled to start from 2015.

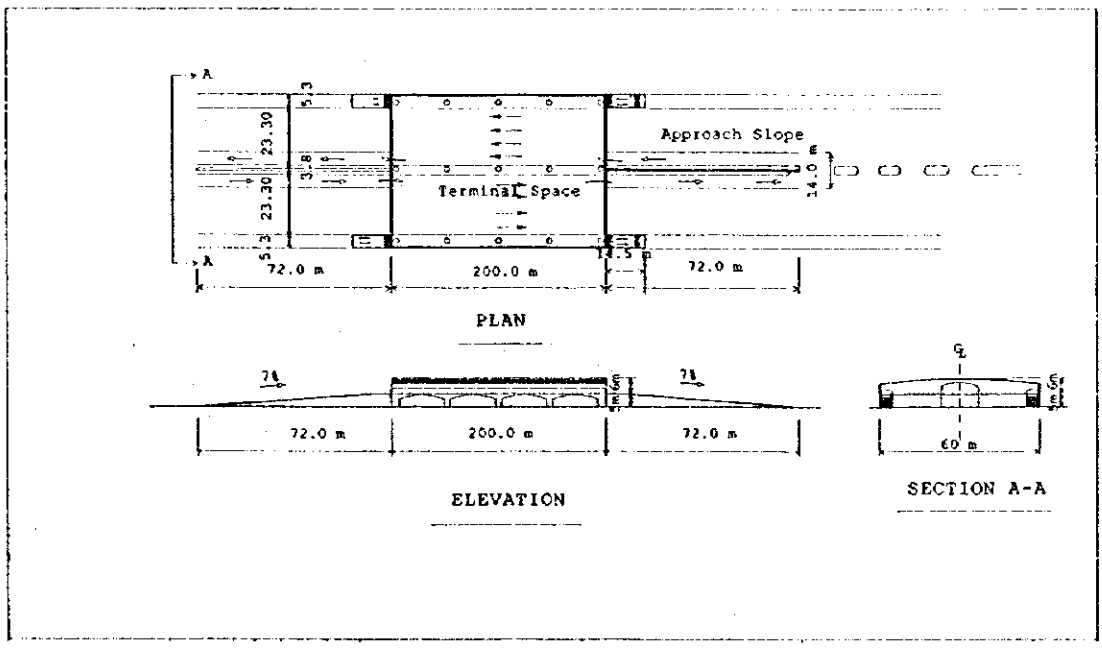

Figure 14.3.4 Mezzeh Terminal

(3) Assad Bridge Terminal

Barankah Terminal and Abbas Terminal shall be consolidated in Assad Bridge Terminal after 2010 to avoid big traffic flow between these three terminals caused by transfer passengers. Service frequencies at Assad Terminal becomes 12,880 times a day in 2005 and 53,150 including 6,546 times of trunk bus in 2020 when these three are consolidated. Figure 14.3.5 shows the terminal in first phase. This terminal is considered as the main bus terminal of Damascus City. Construction is scheduled to start from 2003 (first phase for local bus use) and 2012(second phase for trunk bus use).

Concentration of small buses to access to the terminal is a serious problem. To accommodate this large demand construction of access roads and enforcement to change to lager size buses shall be considered.

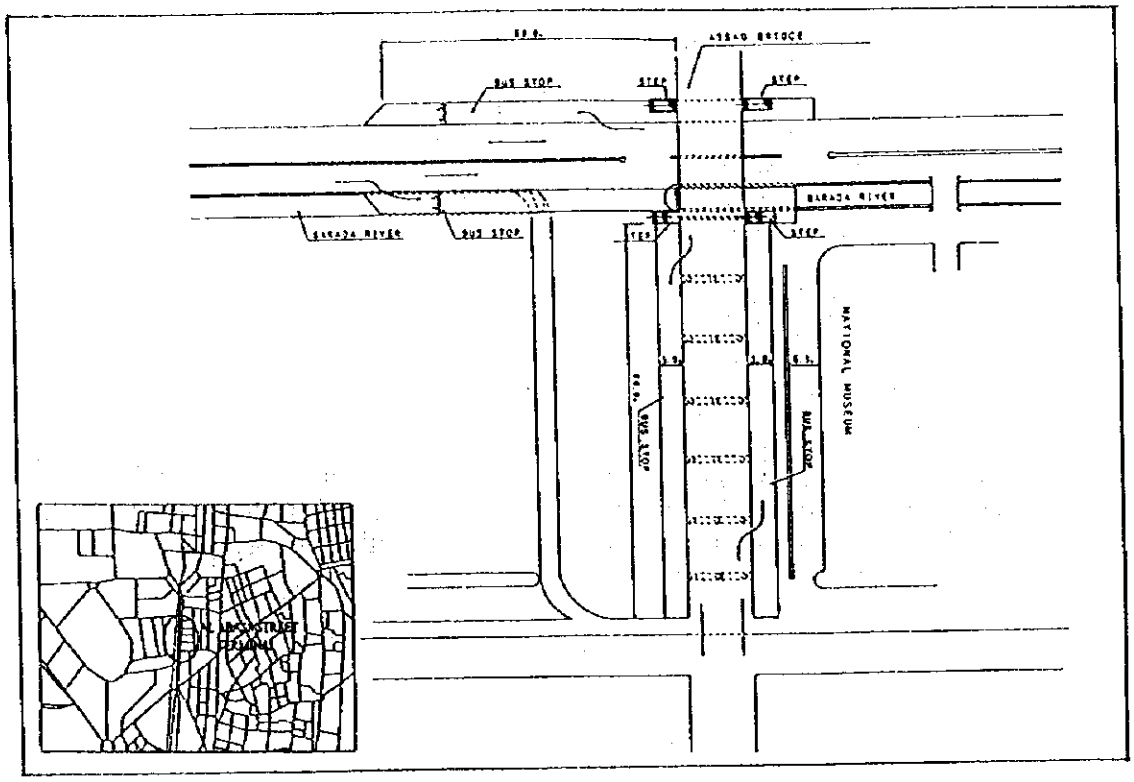

Figure 14.3.5 Assad Bridge Terminal

(4) Kaboun Terminal

The terminal expects 17,875 services of micro/mini bus in 2005. The number of services shifts to 11,126 of micro/mini bus and 6,804 of trunk bus in 2020. The plan can accommodate demands of 2020. The terminal is shown in Figure 14.3.6. Construction is scheduled to start from 2009.

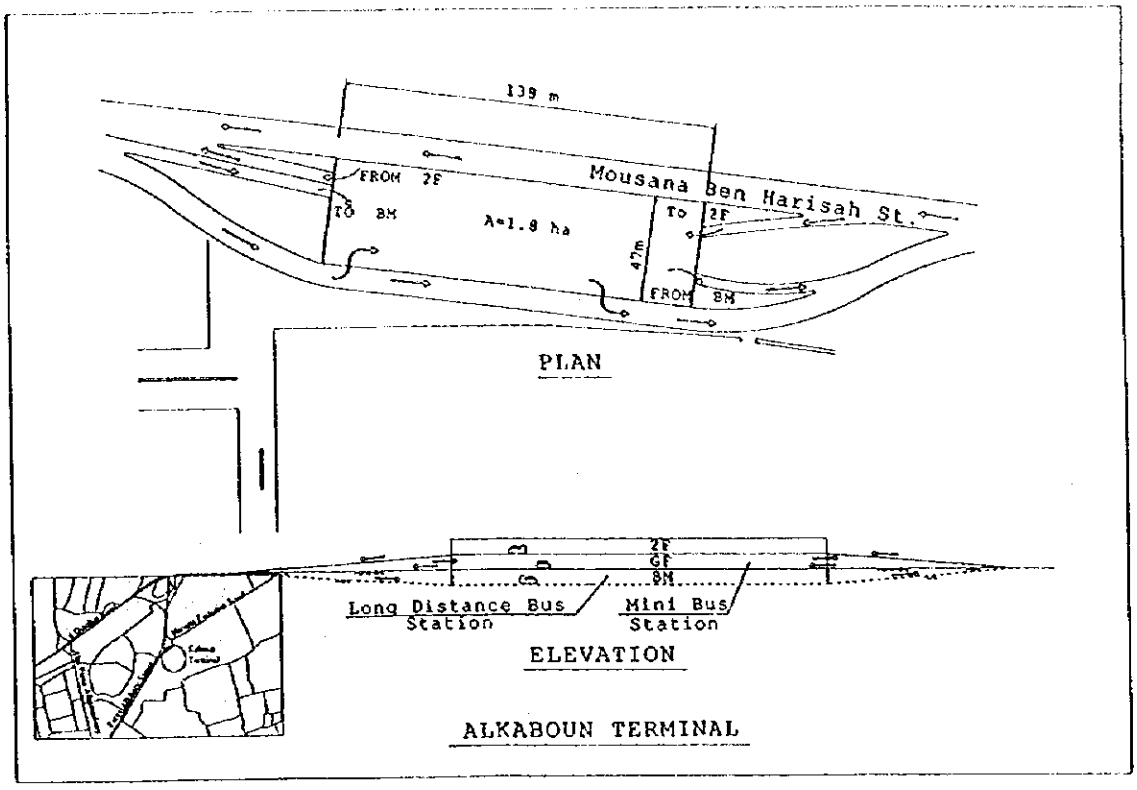

Figure 14.3.6 Kaboun Terminal

14.3.6 Financial Evaluation

Glimpses of financial features of one microbus owner and one 100 passengers capacity bus owner are given in section 14.3.4. In this section a company that owns all of bus fleet and serves all of routes is assumed for the purpose of evaluation of whole financial feature.

From OD tables, numbers of passengers are estimated by inside trips of Damascus City, inside to/from outside and outside trips. Present fares are applied to these figures and sales of the year are obtained after multiplying by 365 days (Table 14.3.6).

Table 14.3.6 Yearly Passengers and Sales

Trip Category	Inside-Inside	Inside-Outside	Outside-Outside	Sales (Mil. SP)
Year / Ave. Fare	5.0 SP/ride	8.8 SP/ride	8.8 SP/ride	
2000	253,043	322,109	93,087	4,919
2001	256,073	334,065	98,459	5,087
2002	259,138	346,465	104,140	5,261
2003	262,241	359,325	110,150	5,443
2004	265,380	372,662	116,506	5,632
2005	268,557	386,495	123,229	5,828
2006	267,381	403,832	134,015	6,070
2007	266,210	421,946	145,745	6,327
2008	265,043	440,873	158,502	6,600
2009	263,883	460,649	172,375	6,890
2010	262,727	481,312	187,463	7,199
2011	255,484	499,405	205,215	7,478
2012	248,441	518,179	224,649	7,779
2013	241,593	537,658	245,924	8,103
2014	234,933	557,870	269,213	8,453
2015	228,457	578,842	294,707	8,830
2016	222,159	600,602	322,616	9,235
2017	216,035	623,179	353,168	9,672
2018	210,080	646,606	386,613	10,143
2019	204,289	670,913	423,225	10,650
2020	198,657	696,135	463,305	11,196

Operating cost unit excluding depreciation and capital costs was estimated by type of bus based on the former section (VOC estimate) with some additional assumptions for 25 passengers and 50 passengers size bus. Bus-km of each year was calculated from traffic assignment and it was divided to bus-km of each bus type in accordance to number of buses. Yearly operating costs were estimated as summary of products of operating cost unit and running kilometers by type. Table 14.3.7 shows the result.

Table 14.3.7 Yearly Operating Costs

Year	14 Passenger Bus	25 Passenger Bus	50 Passenger Bus	105 Passenger Bus	Total
2000	2,868	185	142	0	3,195
2001	2,998	276	237	0	3,511
2002	3,134	381	340	0	3,856
2003	3,279	472	474	0	4,224
2004	3,423	669	555	0	4,647
2005	3,580	796	708	0	5,084
2006	3,720	850	848	0	5,418
2007	3,866	907	1,002	0	5,775
2008	4,018	968	1,171	0	6,157
2009	4,175	1,033	1,355	0	6,564
2010	4,339	1,102	1,556	0	6,998
2011	4,332	1,228	1,732	254	7,545
2012	4,327	1,367	1,928	533	8,156
2013	4,325	1,522	2,147	848	8,841
2014	4,324	1,694	2,390	1,196	9,604
2015	4,325	1,883	2,660	1,581	10,449
2016	4,327	2,093	2,961	2,005	11,385
2017	4,329	2,325	3,294	2,471	12,419
2018	4,332	2,579	3,664	2,979	13,554
2019	4,336	2,860	4,072	3,534	14,802
2020	4,338	3,167	4,524	4,138	16,167

Operating cost and sales are closely related because both are generated from operation. Results obtained are FIRR for the first 21 years; 5.6%, NPV with 12% of discount rate; -3,470 million SP and B/C; 0.94 (see Table 14.3.8). Results are poor but the more critical fact is the negative cash flow. In the real world there is no negative cash flow. It means this company mentioned above can not survive.

The reason why the loss increases year by year is increase of trip length. The ratio of vehicle-km of 2020 over that of 2000 is 3.127, whereas the ratio of sales of 2000 over 2020 is 2.276. Sale by veh-km reduces to 0.728 times. If bus fare is corresponding to running km, NPV is improved to 8,423 million SP and cumulative cash flow can remain in black. The fare policy is vital to maintain the policy letting the private sector provide public transport service.

Table 14.3.8 FIRR, NPV and B/C at fixed Fare System at present level

Year	Costs (Unit: mil. SP)				Sales	Profit	Discounted Value	
	Bus Invest.	Operating Cost	Terminal Const.	Repair/ Maint.			Cost	Sales
2000	1,417	3,195	0	0	4,919	307	4,612	4,919
2001	1,511	3,511	0	0	5,087	65	4,484	4,542
2002	1,615	3,856	0	0	5,261	-210	4,361	4,194
2003	1,734	4,224	80	0	5,443	-595	4,298	3,874
2004	1,867	4,647	0	3	5,632	-885	4,142	3,579
2005	2,007	5,084	0	3	5,828	-1,266	4,025	3,307
2006	1,447	5,418	0	3	6,070	-798	3,479	3,075
2007	1,503	5,775	0	3	6,327	-954	3,293	2,862
2008	1,560	6,157	0	3	6,600	-1,120	3,118	2,666
2009	1,620	6,564	67	3	6,890	-1,364	2,976	2,485
2010	1,683	6,998	67	8	7,199	-1,557	2,819	2,318
2011	1,624	7,545	0	8	7,478	-1,699	2,638	2,150
2012	1,738	8,156	155	8	7,779	-2,278	2,581	1,997
2013	1,886	8,841	155	19	8,103	-2,798	2,498	1,857
2014	2,035	9,604	0	19	8,453	-3,205	2,385	1,730
2015	2,200	10,449	102	19	8,830	-3,940	2,333	1,613
2016	2,386	11,385	102	26	9,235	-4,664	2,267	1,506
2017	2,579	12,419	0	26	9,672	-5,352	2,188	1,409
2018	2,073	13,554	0	26	10,143	-5,510	2,036	1,319
2019	2,189	14,802	0	26	10,650	-6,367	1,976	1,237
2020	-66,172	16,167	-596	26	11,196	61,771	-5,243	1,161
							57,268	53,798
			FIRR =	5.6%	B/C =	0.939	NPV =	-3,470

The FIRR, NPV and B/C for fare system corresponding to riding km starting from present fare were also calculated. Results are seen in Table 14.3.9. B/C raises from 0.939 to 1.147 and NPV changes from negative value of -3,470 to a positive value of 8,423 million SP after 21 years operation. Value of FIRR is unstable due to high multi co-linearity. Cash flow can maintain positive figures. These indicators show the company can maintain operation.

Table 14.3.9 FIRR, NPV and B/C at fixed Fare System corresponding to riding km

Year	Costs (Unit: mil. SP)				Sales	Profit	Discounted Value	
	Bus Invest.	Operat-ing Cost	Terminal Const.	Repair/ Maint.			Cost	Sales
2000	1,417	3,195	0	0	5,124	512	4,612	5,124
2001	1,511	3,511	0	0	5,408	386	4,484	4,829
2002	1,615	3,856	0	0	5,709	238	4,361	4,551
2003	1,734	4,224	80	0	6,028	-10	4,298	4,291
2004	1,867	4,647	0	3	6,367	-150	4,142	4,046
2005	2,007	5,084	0	3	6,725	-369	4,025	3,816
2006	1,447	5,418	0	3	7,149	281	3,479	3,622
2007	1,503	5,775	0	3	7,605	324	3,293	3,440
2008	1,560	6,157	0	3	8,097	377	3,118	3,270
2009	1,620	6,564	67	3	8,628	374	2,976	3,111
2010	1,683	6,998	67	8	9,201	445	2,819	2,962
2011	1,624	7,545	0	8	9,755	578	2,638	2,804
2012	1,738	8,156	155	8	10,357	300	2,581	2,658
2013	1,886	8,841	155	19	11,012	111	2,498	2,524
2014	2,035	9,604	0	19	11,724	66	2,385	2,399
2015	2,200	10,449	102	19	12,499	-271	2,333	2,284
2016	2,386	11,385	102	26	13,344	-555	2,267	2,177
2017	2,579	12,419	0	26	14,263	-761	2,188	2,077
2018	2,073	13,554	0	26	15,267	-386	2,036	1,985
2019	2,189	14,802	0	26	16,361	-656	1,976	1,900
2020	-66,172	16,167	-596	26	17,556	68,131	-5,243	1,820
							57,268	65,691
					B/C =	1.147	NPV =	8,423

14.4 Urban Rail Transit

14.4.1 Outline

The present railway system in the Study area consists of the long distance railway from Kadam station to Anman and to the cities within Syria with the standard gauge, and the regional railway from Hegaz Station to Kadam Station and to Dummar. The urban railway plan is programmed to utilize these existing railway lines and the space along the new Daraa road.

Railway No.1 is planned from Hegaz station to Qatana via existing railway with extension between Kadam station to Hegaz station. Railway No.2 is planned to utilize the existing railway line from Hegaz station to El Amaween Sq. and by supplement the railway along Autostrade utilizing the center median until Muwadamiyeh station, where the line will meet with railway No.1. The 3rd line is planned to fully utilize the existing railway line to Dummar. The 4th line is planned to extend the 1st line to the north via Port Said St. and Baghdad St. by underground to Duma. The 5th line is planned to utilize the existing line by short extension to the present international airport. The lines are illustrated in Figure 14.1.1.

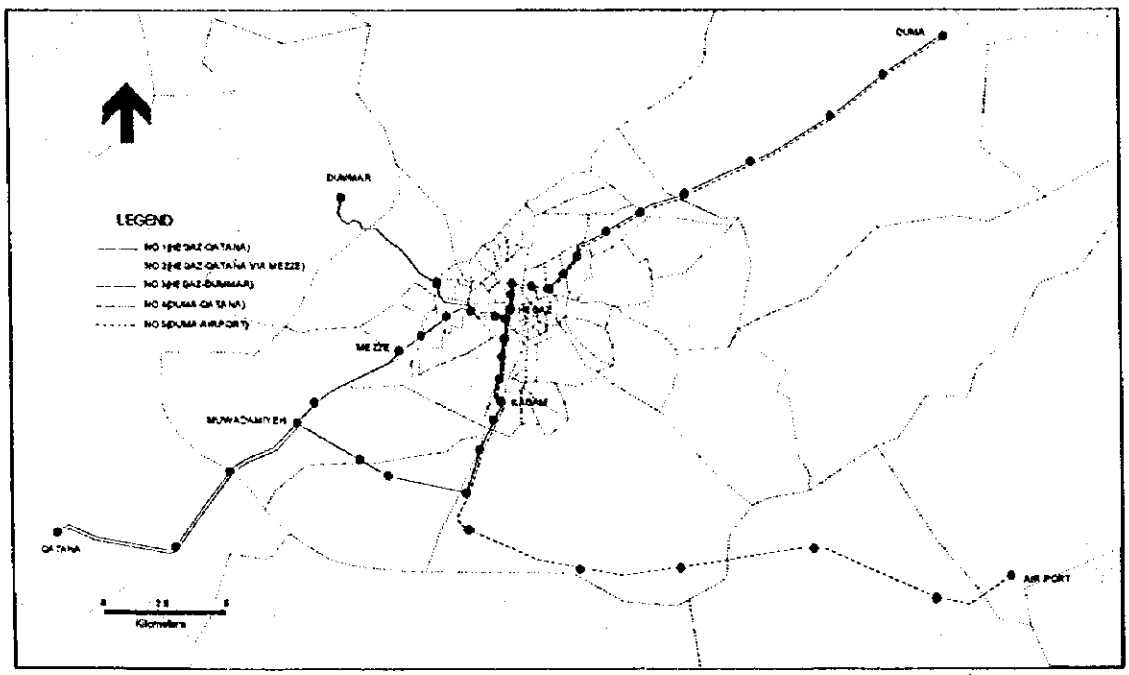

Figure 14.4.1 Railway Line Locations

14.4.2 Demand on Railway

The 2020 train passenger demand was estimated based on the route plan as shown in Figure 14.4.2. The maximum demand was forecast at about 280,000 passengers/day on line No.4. The same fare system as for the present bus system is assumed in the demand forecast.

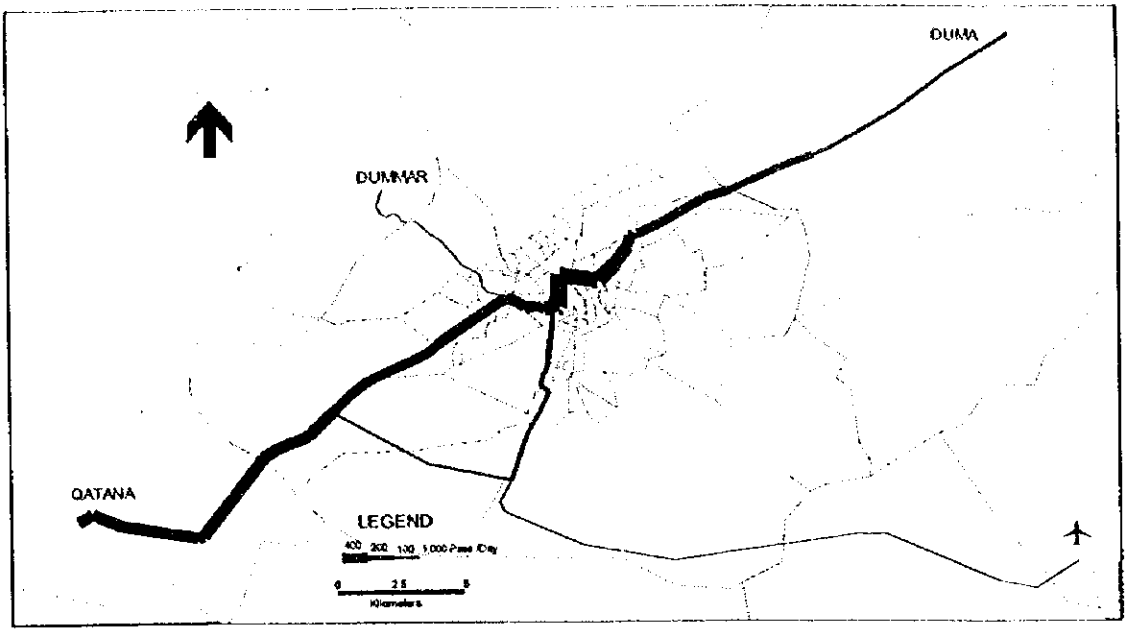

Figure 14.4.2 Railway Demand in 2020

14.4.3 Operation Plan

The railway demand is estimated in the same manner as trunk bus system. The operating indicators of railway lines are given in Table 14.4.1. The train with two Motorized Car (MC) and one trailer vehicle is selected as the basic train configuration. If the minimum head is limited to be 20 min. in the peak hour, where the peak hour factor of the public passengers is assumed to be 9%, the total required trains are estimated at 83.

Table 14.4.1 Railway Operating Indicators in the Year 2020

Route Unit	Round Trip Distance Km	Max. Section Passenger Daily Pass/day	Max. Section Passenger Peak hour Pass/hr	Train Capacity Pass/Train	Peak Hour Head Freq/hr	Peak Hour Head min	Round Trip Travel Time hour	Required Train No.
01	56.7	63,105	5,679	750	5	12.0	1.6	9
02	46.5	50,236	6,028	750	5	12.0	1.3	7
03	20.3	9,135	1,096	750	0	20.0	0.6	1
04	90.6	277,227	33,267	1,500	14	4.3	2.6	37
05	110.8	85,708	10,285	750	9	6.7	3.2	29
Total	324.9							83

The daily operating frequency is estimated as shown in Table 14.4.1.

14.4.4 Construction Cost

The construction costs of the five railways are estimated based on experience in other countries. The unit construction cost by km and by surface/under ground/elevated is given in Table 14.4.2. The cost of under ground section is 3.6 times of the surface section.

Table 14.4.2 Unit Construction Cost of Railway

(Unit: million SP/km)	Surface Section	Under Ground Section	Elevated Section	Station (Mil. SP./station)
Track	31.50			
Structure		911.40	218.40	
Rail	18.90	18.90	18.90	
Power Feed	57.12	57.12	57.12	
Power Line	139.02	139.02	139.02	
Signaling	80.22	80.22	80.22	
Telecommunication	11.76	11.76	11.76	
Total	338.52	1,218.42	525.42	84

Some of the sections are duplicated; therefore, the construction cost by line is estimated assuming the construction order from No.1 to No.5. The total construction cost of the five lines is estimated at 43,003.80 million SP. (Table 14.4.3).

Table 14.4.3 Railway Construction Cost

Line	Distance	Surface	Underground	Elevated	Station	Total
Quantity (km)						
01	28.327	27.01	1.32		15	
02	23.267	6.58	1.97	1.79	6	
03	10.169	7.76			2	
04	45.298	16.90	5.13		14	
05	55.396	25.13			6	
Amount (million SP)						
01		9,137.94	1,604.40	0.00	1,260.00	12,002.34
02		2,225.16	2,397.36	938.70	504.00	6,065.22
03		2,626.26	0.00	0.00	168.00	2,794.26
04		5,717.46	6,243.30	0.00	1,176.00	13,136.76
05		8,501.64	0.00	0.00	504.00	9,005.64
Total		28,208.46	10,245.06	938.70	3,612.00	43,003.80

(Unit: million SP/km)

The cost of the rolling stock at the year 2020 is estimated as shown in Table 14.4.4. The total necessary initial investment for the urban railway operation is 54,570.60 million SP.

Table 14.4.4 Rolling Stock Cost

Line	Required Train	Vehicle Number	Cost (million SP.)
01	9	27	867.72
02	7	21	674.94
03	1	3	96.60
04	37	222	7,132.86
05	29	87	2,795.52
Total	83	360	11,566.80

14.4.5 Operating Cost

The annual operating cost is estimated by line, based on records in other countries and considering local conditions. Total annual operating cost of the five lines is estimated at 1,735.44 million SP without depreciation cost of the rolling stock and at 2,313.78 million SP including depreciation as shown in Table 14.4.5.

Table 14.4.5 Annual Operating Cost

Item	No.1	No.2	No.3	No.4	No.5	Total
Wage	99.96	81.90	35.70	160.02	195.30	573.30
Power	21.00	13.44	1.26	290.64	55.44	381.78
Maintenance	2.52	2.10	0.42	20.58	7.98	33.18
Material	27.30	0.00	0.00	0.00	0.00	27.30
Ticket Sale	15.96	13.02	5.88	25.62	31.08	91.56
Cash Transport	6.72	5.88	2.52	10.92	13.44	39.48
Cleaning	7.98	6.30	2.94	12.60	15.12	44.52
Security	23.52	19.32	8.40	37.38	45.78	133.98
Promotion	31.08	25.62	11.34	49.56	60.90	178.50
Insurance	19.74	16.38	7.14	31.50	38.64	113.40
Public Service	3.36	2.52	1.26	5.46	6.30	18.90
Administration	17.22	14.28	6.30	27.72	34.02	99.96
Subtotal	276.36	200.76	82.32	672.00	504.42	1,735.44
Depreciation of Rolling Stock	43.26	33.60	4.62	356.58	139.86	578.34
Total	319.62	234.36	87.36	1,028.58	643.86	2,313.78

(Unit: million SP.)

14.4.6 Impact on Traffic Condition

Table 14.4.6 shows the preliminary economic evaluation result of the railway system. The benefit is calculated as the difference of the distance and time related Vehicle Operating Cost in the Do Nothing Case in the year 2020, and those in the case with railway and the railway operating cost. To obtain the B/C, the initial investment amount was converted to the annual amount applying the 12% of interest rate and 30 years project life.

The introduction of the railway system will produce high benefit and a good B/C rate of 8.32.

Table 14.4.6 Preliminary Economic Evaluation of Railway

	Annual Operating Cost				Annual	Investment				B/C
	VOC		ROC	Total	Benefit	Road	Rail	Total	Annual Amount	
	Distance	Time								
Do Nothing	64,018.2	81,392.8		145,411.0						
With Rail	24,512.2	26,497.1	2,313.8	53,323.1	92,087.9	23,078.7	46,075.5	69,154.2	11,064.1	8.32

(Unit: million SP)

14.4.7 Financial Evaluation

The annual turnover of the five lines is calculated assuming the average fare of 8 SP and 13 SP per ride, which corresponds to the year 2020 average fare of bus in Table 14.3.8 and Table 14.3.9 respectively.

The annual operating cost is calculated for two cases. In case 1 only the depreciation of rolling stock at a rate of 5% is considered, whereas in case 2 the depreciation of infrastructure at a rate of 2% is also considered.

As shown in Table 14.4.7 and Table 14.4.8 the operating index in case 2 is smaller than 1 in all lines taking an average fare of 8 SP, whereas with an average fare of 13 SP the index become larger than 1 in Line 4.

Line 4 will be the most feasible line under the assumption of the large population increase in the suburban area, especially in Quatana estimated to 1.1 million.

Table 14.4.7 Comparison of Annual Operating Cost and Annual Turnover

(Unit: million SP)

Line	Boarding/Alighting Passenger/day	Annual Turnover		Annual Operating Cost	
		8 SP per ride	13 SP per ride	Case 1	Case 2
01	288,089	345.8	561.9	319.6	559.6
02	132,813	159.4	259.0	234.4	355.7
03	26,691	32.0	52.0	87.4	107.9
04	826,939	992.3	1,612.5	1,028.6	1,291.3
05	389,439	467.4	759.5	643.9	824.0
Total	1,663,971	1,996.9	3,244.9	2,313.8	3,173.9

Table 14.4.8 Operating Index: Turnover/Operating Cost

	8 SP		13 SP	
	Case 1	Case 2	Case 1	Case 2
Line 1	1.08	0.62	1.76 (1.46)	1.00 (0.90)
Line 2	0.68	0.45	1.10 (0.93)	0.73 (0.65)
Line 3	0.37	0.22	0.59 (0.50)	0.36 (0.33)
Line 4	0.96	0.77	1.57 (1.31)	1.25 (1.08)
Line 5	0.73	0.57	1.18 (0.98)	0.92 (0.80)
Total	0.86	0.63	1.40 (1.17)	1.02 (0.89)

Note: The figures inside of ( ) show the index with operating costs shown in Table 14.4.5 increased by 20%.

14.5 Taxi Service Improvement Plan

Demand for better quality taxi service is expected to materialize in the near future, though demand for services of quality in coordinate to fit at present level is needless to say majority of the taxi use demand.

It is advisable to establish the system of higher-class taxi service. The discussion on this matter however does not grow deeper because it is out of the power of Damascus Governorate.

Chapter 15. TRAFFIC MANAGEMENT PLAN

15.1 Overview

Due to high density of houses and many cultural heritage sites inside the Inner Ring Road area, it is difficult to construct new roads or widen existing ones there. In order to mitigate traffic congestion, it is necessary to put priority on traffic management projects, which require no land acquisition. In this plan, the following subjects are discussed.

- improvement of the intersections by channelization;
- improvement of the intersections by grade-separations;
- installation of traffic signals and a signal control system;
- on-road parking regulation and establishment of off-road parking facilities;
- traffic safety system and pedestrianization; and
- establishment of related organizations

15.2 Intersection and Traffic Signal

15.2.1 Intersection

(1) Saturation Degree of Intersection

The saturation degree (λ) of the 26 main intersections in the city are calculated as shown in Table 15.2.1 and Figure 15.2.1. At present intersections where saturation degrees exceed 0.9 are concentrated along the ring road and Ath Thawra St. It is estimated that by the years 2005 and 2020 at most of the intersections λ will exceed 0.9, and therefore improvement plan for intersections is necessary.

Table 15.2.1 Saturation Degree at Main Intersections

Inter-Section no.	Intersection name	Approach number	Peak hour volume (v/h)			Saturation Degree		
			1998	2005	2020	1998	2005	2020
1	Umawiyeen Sq.	7	11853	13986	15410	1.16	1.36	1.50
3	Jamark Sq.	4	5907	6971	7679	1.06	1.25	1.37
5	Abou Bakr Sadik St. – 17th April	3	4812	5678	6256	1.04	1.22	1.35
6	Dawar Kafr Soussa	5	7695	9079	10002	0.99	1.17	1.29
7	Al Ba'ath Sq.	4	6833	8063	7881	0.99	1.16	1.28
8	Al Mujtajed – Khalid Ibn Walid	4	6453	7614	8389	0.75	0.88	0.97
9	Al Yarmouk Sq.	5	7268	8576	9448	0.88	1.04	1.15
11	Hassan Al Kharat Sq.	4	7196	8492	9356	0.89	1.05	1.16
12	Bab Sharki intersection	5	8330	9830	10830	0.80	0.95	1.04
13	Shiekh Raslan Sq.	5	7411	8746	9634	1.19	1.40	1.54
15	Azzablatani Sq.	5	9049	10678	11764	1.00	1.22	1.34
17	Al Abbassiyeen Sq.	7	7790	9192	10127	1.19	1.41	1.13
18	Al Abbassiyeen Complex int.	4	2793	3296	3630	0.40	0.47	0.52
27	Hitteen Sq.	6	5546	6544	7210	0.96	1.13	1.01
58	Russian embassy intersection	4	10166	11995	13214	1.00	1.18	1.25
59	At Thawra – Morshed Khater St.	7	11331	13371	14729	0.90	1.06	1.17
61	At Thawra – Al Itihad St.	4	12731	15023	16552	1.35	1.59	1.46
62	At Thawra – Annassen St.	3	6996	8255	9093	1.59	1.87	2.06
64	Al Jihad Sq.	7	7115	8395	9250	1.00	1.19	1.31
65	Sana Agency intersection	4	6653	7851	8649	0.81	0.96	1.06
68	Al Jala'a – Al Mahdi Bin Baraka	4	4397	5189	5717	0.84	1.00	1.10
70	Amous Sq.	7	5812	6859	7556	0.94	1.11	1.22
74	Al Sabe'a Bahrat Sq.	6	5699	6724	7409	0.74	0.88	0.97
76	Damascus Governorate bldg. Sq.	5	4730	5582	6149	0.62	0.74	0.81
78	Victoria bridge	5	9469	11174	12311	1.46	1.72	1.68
79	Al Hijaz Sq.	5	4602	5430	5981	0.81	0.96	1.06

Table 14.4.7 Comparison of Annual Operating Cost and Annual Turnover

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79	Al Hijaz Sq.	5	4602	5430	5981	0.81	0.96	1.06

In particular the intersections having high saturation degrees are;

- Ath Thawra St. and Abbassen intersection
- Victoria bridge intersection
- Sheikh Raslan
- Umawiyeen Sq.
- Ath Thawra St. and Al Itihad St. intersection
- Jamarek Sq.
- Abou Baker Al Saddik St. and 17th April St. intersection
- Azzablatani Sq.

Figure 15.2.1 Saturated Main Intersections

(2) Improvement of Intersections

The improvement plan is divided into the following 2 classes.

Class A: Intersections where traffic volume is high and signalization and at-grade improvement will be insufficient. Grade separation is required.
Class B: Intersections where improvements of signalization and channelization are required.

Table 15.2.2 shows the intersections categorized by improvement class. Figure 15.2.2 shows the locations of the intersections to be improved and improvement plans for some intersections respectively. Intersection improvement (class B) of Arnous Square is shown in Figure 15.2.3.

Table 15.2.2 Improvement of Intersections

No. of Inter-section	Name of Intersection	Class of Improve-ment	Year of Plan	Details of Improvement
1	Umawiyeen	A	2005	It is a compounded intersection spot. Traffic is high at all intersection approaches, and at-grade improvement only is not sufficient.
		A	2020	Shukri Al-Quwatli St. interval turns into Fayez Mansoor St. on the upper level
3	Jamark	B	2005	Improvement of an inflow lane of Palestine St., signal phase.
		A	2020	Removal of off- and on-street parking. Traffic management between Palestine St. and Abu Baker As Siddiq St.
5	Ali Ben Abi Talib Street with Musaad Ben Omair Street	B	2005	Improvement of intersection approach of 17th April St. and Abu Baker As Seddiq St. to provide smooth traffic flow in this section good and serve as ring road.
		A	2020	17th April St. and Abu Baker As Seddiq St. interval traffic management.
6	Dawar Kafr Sussah Square	B	2005	Improvement of signal phase.
		A	2020	Widening of intersection approach of Abu Baker As Seddiq St.
7	Al Ba'ath Square	B	2005	Channelization of intersection approach of Abu Baker As Seddiq St. Improvement of Signal phase.
		B	2020	Improvement of intersection approach of Abu Baker As Seddiq St. and total improvement of signal phase.
8	Al Mujtahed Street with Khalid Ben Al-Waleed St.	B	2005	Improvement of signal phase.
		B	2020	Channelization of intersection approach of Abu Baker As Seddiq St.
9	Al-Yarmouk Square (Bub Mussalla)	A	2005	Improvement of Intersection approach.
		A	2020	The two-way traffic of Abu Baker As Seddiq St. and Ibn Assaker St. interval is turned into Al Mujtahed St. at grade separation.
11	Hassan Al-Kharat Square	B	2005	The rotary intersection is simplified and improved into simple T-intersection. Improvement of signal phase.
		A	2020	The road from Old City direction is made to access and Ibn Assaker St. section is turned into Bab Sharqi with grade separation.
12	Bab Sharki	B	2005	Improvement of signal phase.
		A	2020	Lane widening of Azzablatani and Ibn Assaker St. approaches and signal phase.
13	Sheikh Rasfan Square	B	2005	The rotary intersection is simplified and U turn of approaches of Bab Sharqi St. and Annasirah St. is regulated. Improvement of signal phase.
		A	2020	Improvement of Bab Sharqi St. and widening of approaches of Annasirah St. and signal phase.
15	Azzablatani (Bilal) Square	B	2005	Improvement of lane approaches of Al Abbassiyeen St. and Urwa Bin Mas'oud Ath Thaqali St. and signal phase.
		A	2020	Urwa Bin Mas'oud Ath Thaqafi St. section turns into Al Abbassiyeen St. by grade separation.
17	Al-Abbassiyeen Square	B	2005	Located on the east side of the city. Phase assignment for a compounded intersection approach of Annasirah St. and signal phase. Improvement of Fares Al Khuri St. and lane Improvement of intersection approach Annasirah St. and signal phase.
		A	2020	In addtion to lane widening of Fares Al Khuri St., Annasirah St., lane widening of Aleppo St. also planned
27	Hitten Square	B	2005	Improvement of signal phase.
		A	2020	Since there is interseciton conflict, only signal management is not enough and channelization improvement is also included.
58	Russian Embassy	B	2005	Inflow traffic to the city center city is heavy, especially, traffic between Ath Thawra St. Plan improvement of 6th of October St. and establishment of left turn lane of 6th of October St. and signal phase.
		A	2020	Grade separation between 6th of October St. and Ath Thawra St.
59	Ath Thawra St. with Murshed Khater St.	B	2005	Ath Thawra St. intersection approach is complicated, and it is improved by channelization and traffic regulation (U-turn prohibition).
		B	2020	Channelization of intersection approach of Ath Thawra St..
61	Ath Thawth St. with Itihad St.	A	2005	Traffic is heavy between Ath Thawra Bridge and Al Itihad St., especially left side traffic of intersection approach of Al Itihad St.
		A	2020	In present intersection, management is impossible. Improvement as above.
62	Ath Thawra St. with Murshed Khater St.	A	2005	Traffic between Ath Thawra St. and Al Nasr St. is heavy, and management is impossible at present intersection. Moreover, large pedestrian movement and grade separation is necessary in respect of traffic management and safety.
		A	2020	For management of northern-and-southern traffic, the improvement of Al-Hijaz Sq. intersection and Al Jihad Sq. Intersection is performed.
64	Ath Thawra St. with Annasser St.	A	2005	Rotary intersection complicated by the presence of a railway route and a bus terminal station.
		A	2020	For management of northern-and-southern traffic, the improvement of Ath Thawra St. Al-Hijaz Sq. intersection and Al Jihad Sq. Intersection is performed.

No. of Inter-section	Name of Intersection	Class of Improve-ment	Year of Plan	Details of Improvement
65	SANA Agency	B	2005	Improvement of signal phase.
		B	2020	Improvement of signal phase accompanied with a movement plan of adjoining terminal bus station.
68	Al Jala'a Street with Al-Mahdi Bin Barakeh Street	B	2005	Improvement of signal phase.
		A	2020	Grade separation along Othman Bin Abdul Aziz St.
70	Amous Square	B	2005	Improvement of signal phase, and channelization.
		A	2020	Grade separation along Omar Bin Abdul Aziz st.
74	Al Sabe' Buhraat Square	B	2005	Improvement of signal phase, and channelization.
		B	2020	Channelization of intersection approach of 29th of May St.. Improvement of signal phase.
78	Victoria Bridge	B	2005	Improvement of signal phase.
		B	2020	Channelization of intersection approach of 29th of May St.. Improvement of signal phase.
79	Al-Hijaz Square	B	2005	Improvement of signal phase.
		A	2020	Channelization of intersection approach of 29th of May St. and Nasser St.. Improvement of signal phase.

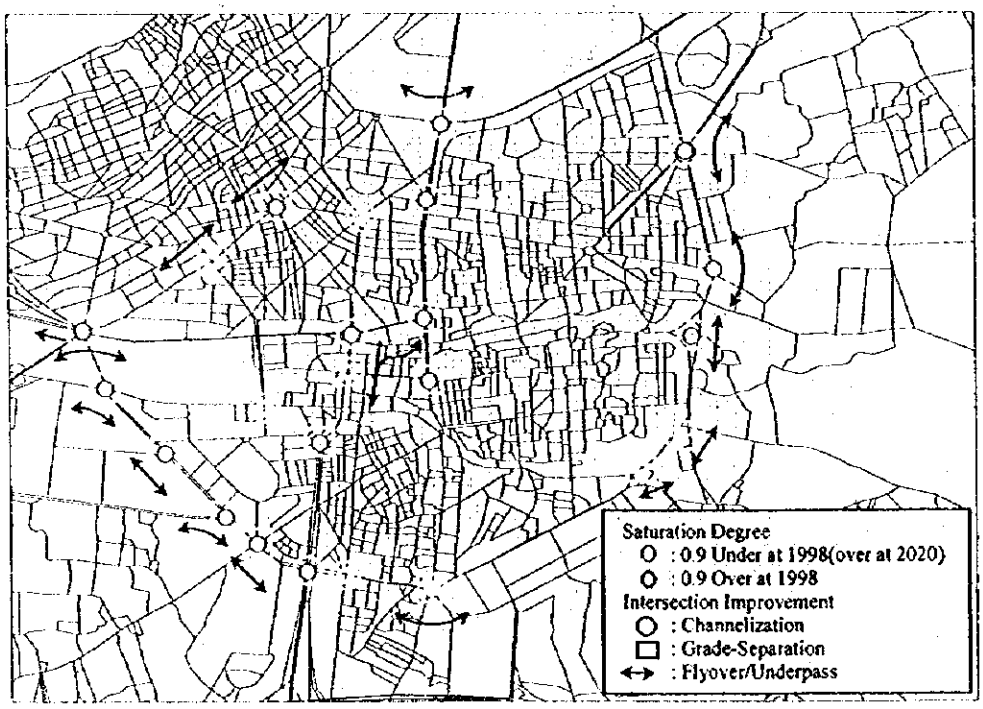


Figure 15.2.2 Location of Intersections to be improved

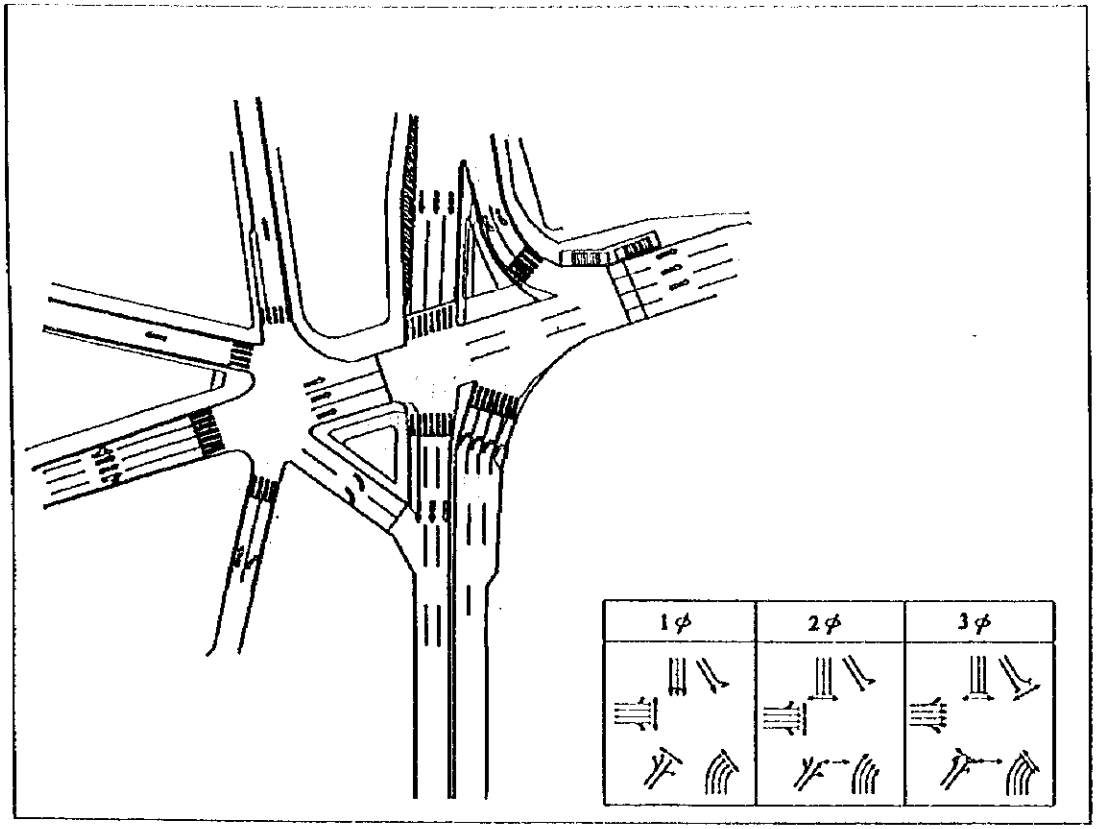


Figure 15.2.3 Intersection Improvement Plan - Arnous Square

15.2.2 Traffic Signalization

(1) Problems Related to Signal Control

Problems identified during the site survey are as follows.

- Inflexible signal control
- Lack of coordination
- Poor quality of signal head

(2) Area Traffic Control System

To solve those problems, Area Traffic Control System (ATC system) is proposed. ATC system is a computerized system in which all signal controllers within a coverage area are connected to a computer in a control center and operate under its supervision.

ATC system has become very popular because of its advantages, which include the following.

- Sophisticated and efficient signal control is realized, which results in a saving of travel time and enhancement of traffic safety.
- Signal equipment can be maintained in a good working condition, because the computer monitors the operation of all equipment.
- Early detection of problems and swift implementation of countermeasures are possible, as the control center becomes a traffic command center in the city.
- Various traffic data can be gathered and accumulated for analysis and future planning.

Class B improvements of intersections are achieved by instalment of ATC system.

a. Functional requirements

The requirements for an ATC system for Damascus City can be summarized as follows.

- Traffic responsive and traffic adaptive signal control using real-time traffic information
- Enhanced traffic surveillance function
- Automatic collection of traffic data
- User friendly and error tolerant man-machine interface
- Flexibility to cope with changes in road network and traffic demand
- Expandability in space and functions

b. Coverage area and stage construction

The traffic signals are systemised by ATC system in two stages as shown in Figure 15.2.4.

Stage 1, is to introduce a control system that covers an area on and inside the Inner Ring Road so as to increase the capacity of intersections at the center. At the same time, traffic inflow from outside of the Ring Road is to be restrained in order to increase the effectiveness of this control system. This control scheme also promotes smooth flows of through traffic along the Ring Road.

Stage 1 is further divided into two phases.
Stage 2 attempts to control roads in the area outside the Ring Road mainly the arterial roads.

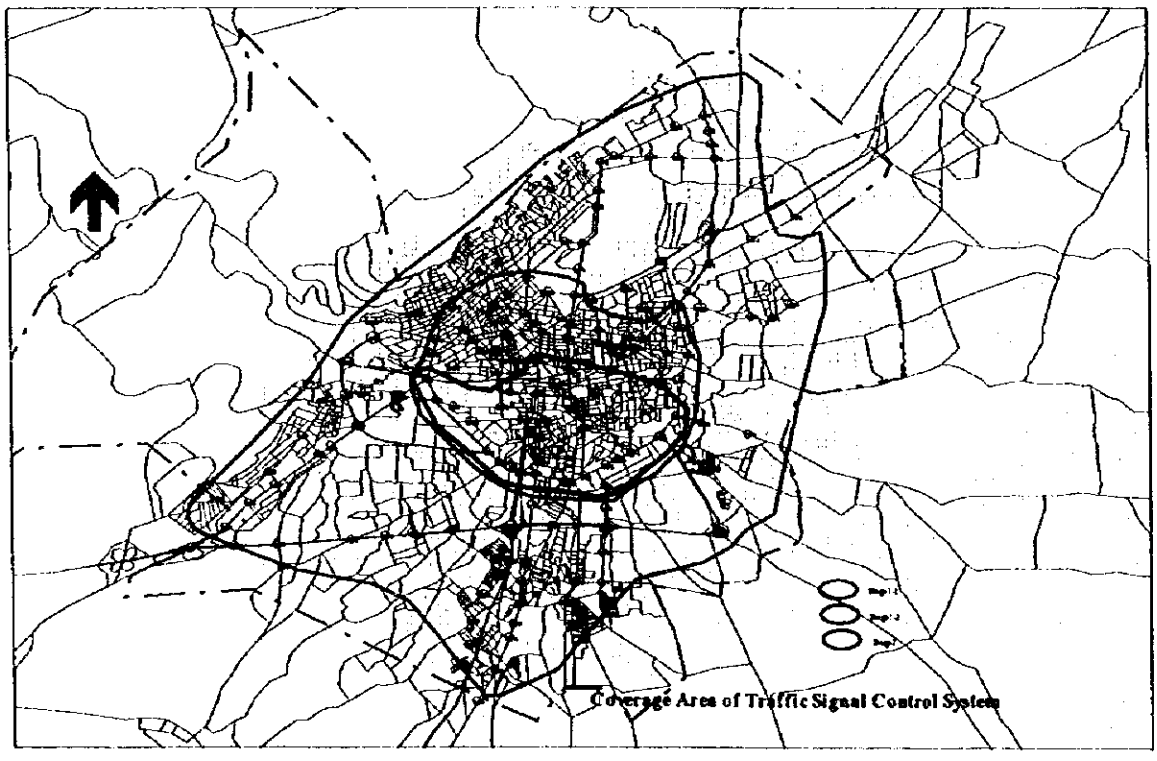


Figure 15.2.4 Coverage Area of Traffic Signal Control System

c. System Components

The conceptual configuration of the proposed ATC system is shown in Figure 15.2.5.

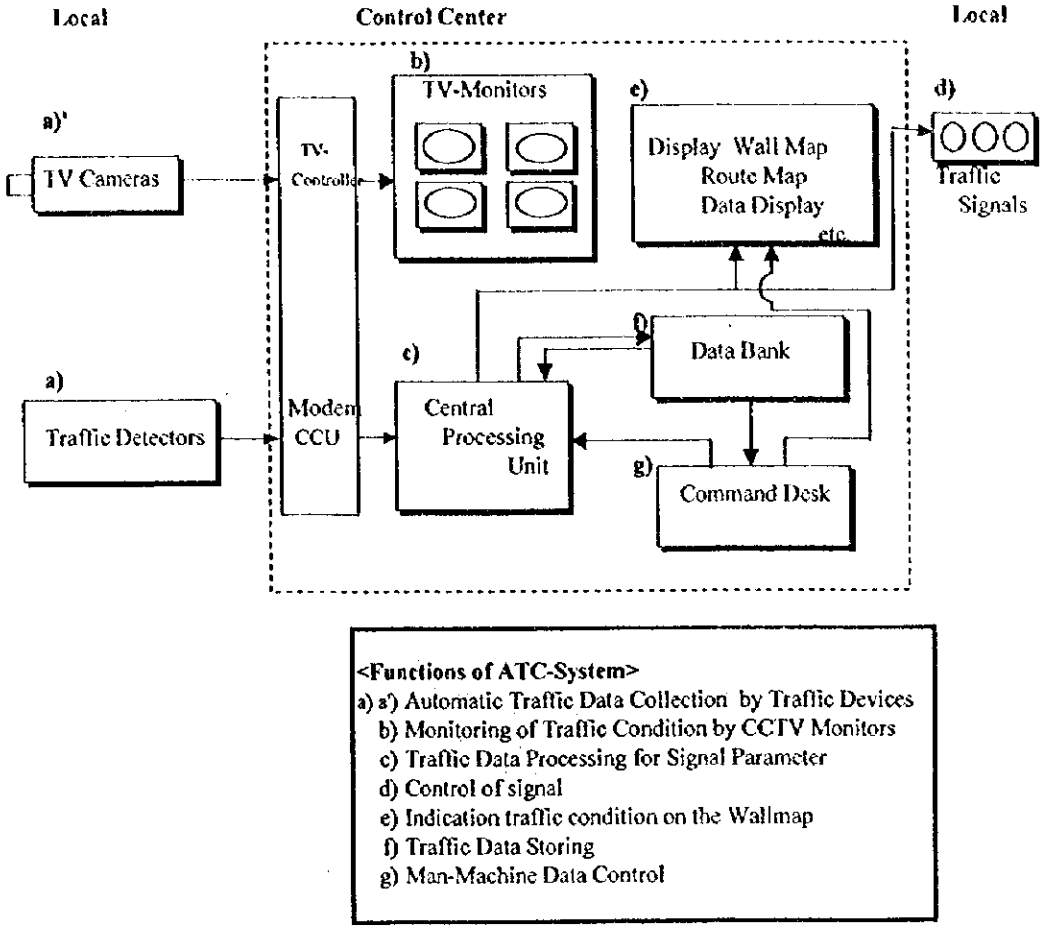


Figure 15.2.5 Function and Hardware of the Traffic Control System

Signal control is the core function of an ATC system. The system consists of signal controller installed at each intersection that actually operates signal indication, central equipment that monitors the signal operation and performs signal coordination functions, and communication network that connects these two devices.

Signal operation must be constantly monitored by signal controller itself and other devices of the signal control system.

Vehicle detector is a device to detect the presence of a vehicle in its sensing area. Normally, vehicle detector is a part of signal system and installed at approach, exit side or mid-block of street to gather the traffic flow data.

Closed circuit television system provides visual information of traffic conditions, which is most useful for system operator in grasping traffic situation and making sound decisions. Visual data, although often not expressed in quantity, contain much more information than the data a vehicle detector can provide. Recording and replaying of image data on videocassette recorder (VCR) is a useful way of analyzing traffic.

Terminal equipment such as signal controller, vehicle detector and TV camera must be connected with the central equipment in the control center through a communication network. Most of the terminal equipment requires telephone grade circuit but TV camera requires wide band high frequency channel for vide signal transmission.

Control center is the nucleus of an ATC system. Although today's signal controller is intelligent and able to process a large amount of data, the road administrator stationed in the control center has to make constantly critical decisions, requiring engineering and administrative judgements.

15.3 Parking Control

15.3.1 Parking Demand

(1) Parking Control Policy

The parking plan shall concentrate on the city central area where the parking problem is largely effecting the smooth flow of traffic during daytime. The parking control plan shall be formulated by balancing between the traffic regulations on the one hand and provision of facilities on the other hand. The area for provision of parking service shall be determined.

(2) Forecast of Parking Demand and Determination of Parking Service Area

1) Parking Demand Forecast

The parking demand was forecast by purpose (school, work, shopping, business) based on the results of the Home Interview survey as shown in Figure 15.3.1. The present parking demand and forecast parking demand are shown in Figure 15.3.2 and Figure 15.3.3.

In terms of area, the zones where the work, business and shopping purpose parking demand is significantly high are zone numbers 17, 18, 19 and 40. These zones are predominantly commercial in terms of land use.

2) Determination of Parking Service Area

With the exception of arterial roads, streets where there is sufficient road width to allow for on-street parking without negatively influencing the traffic flow have been examined and the parking capacity of those streets was assumed as existing parking supply.

The balance between demand and supply is shown in Figure 15.3.4 for the year 1998 and in Figure 15.3.5 for the year 2020.

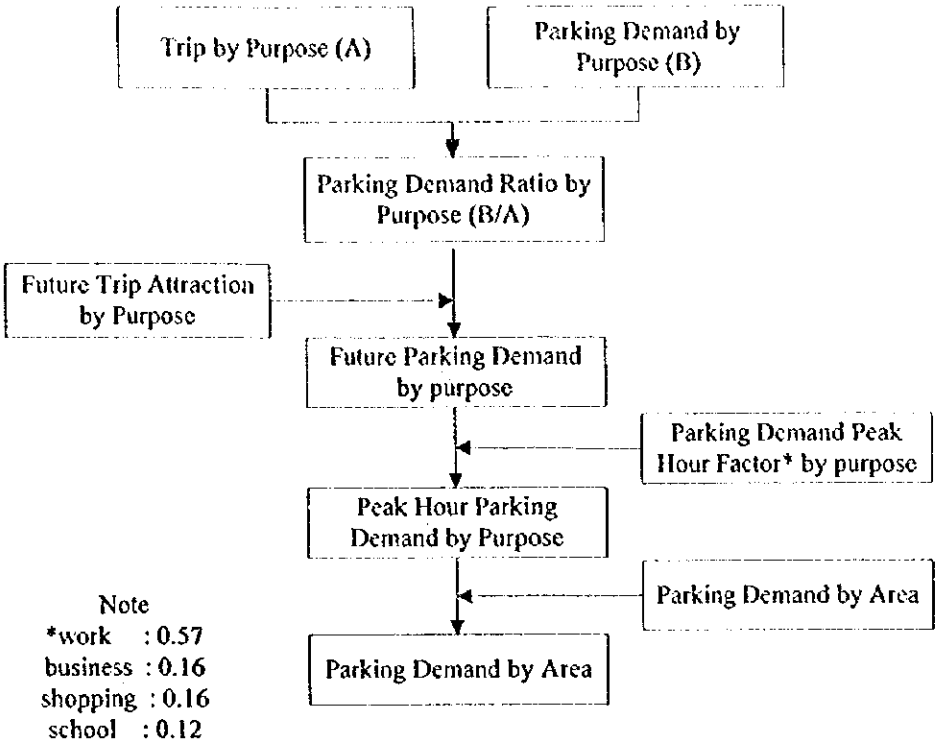


Figure 15.3.1 Flow Chart Estimate Parking Demand by Area

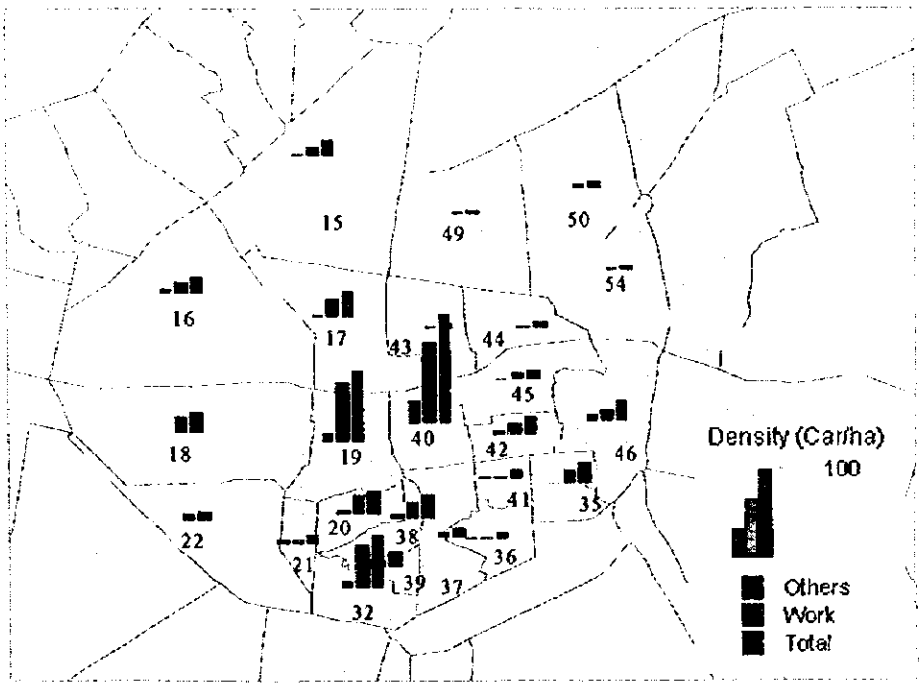


Figure 15.3.2 Peak Hour Parking Demand Density in 1998

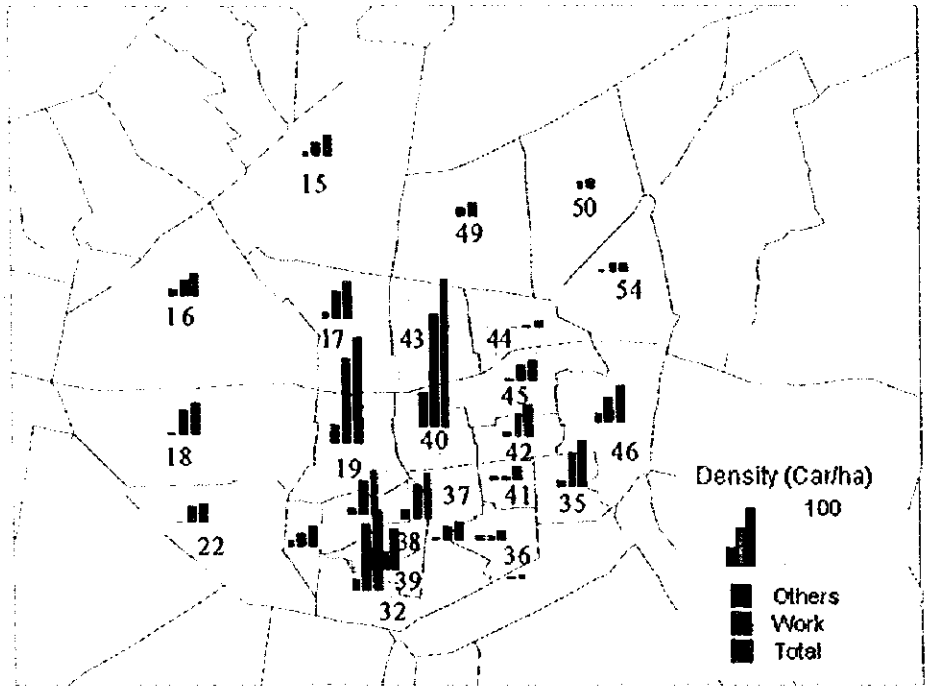


Figure 15.3.3 Peak Hour Parking Demand Density in 2020

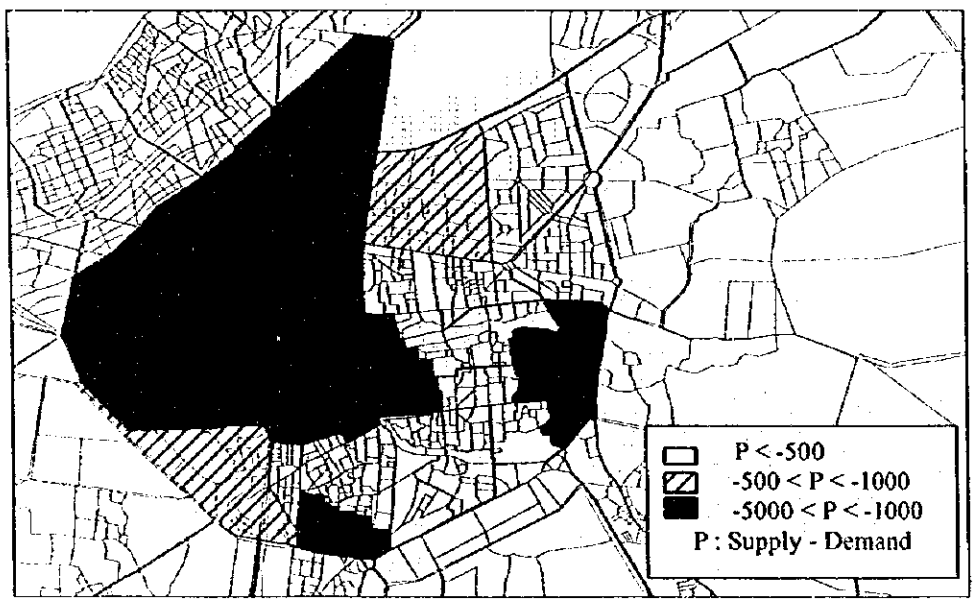


Figure 15.3.4 Peak Hour Parking Supply Demand in 1998

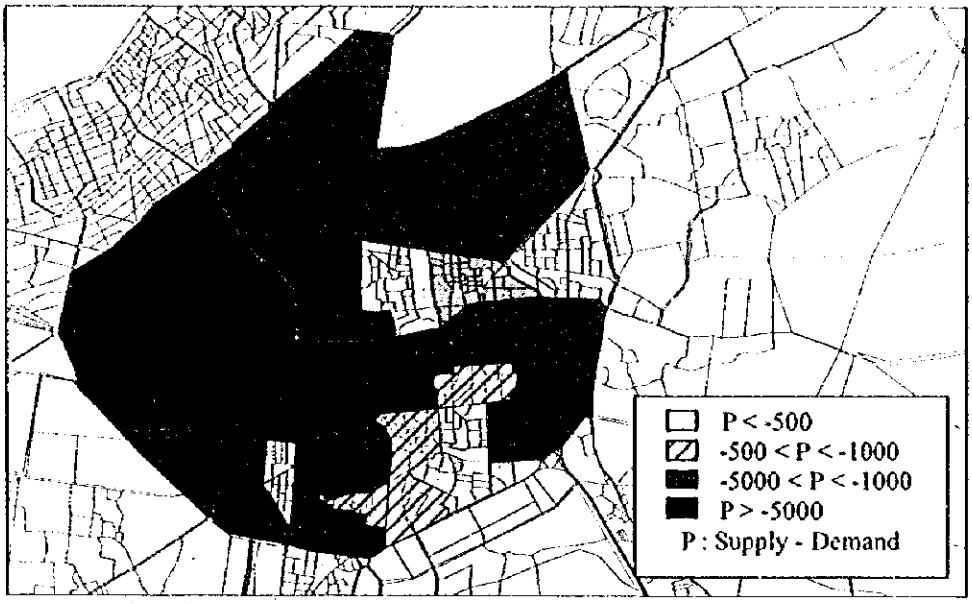


Figure 15.3.5 Peak Hour Parking Supply Demand in 2020

From those figures, it is clear, that most of the city center zones suffer lack of sufficient parking facility supply. Therefore this area which includes zone numbers 16-3, 17, 18, 19, and 40 was selected as a priority area for improvement of parking service, especially for the site selection of the off-street parking facilities.

3) Parking Demand Balance in Service Area

Table 15.3.1 shows the estimated parking demand balance for the total trips in 2005, 2010 and 2020. As shown in the table, there will be an excess demand for parking equal to 11,660 vehicles in the year 2005, 15,090 vehicles in the year 2010 and 21,940 vehicles in 2020.

Table 15.3.1 Supply Demand Balance in peak hour

Zone No	Parking Capacity (2 lane Road)	Parking Demand			Total	Balance
		Work	School	Business Shopping		
Year 2005						
16-3	666	1,126	7	196	1,329	-663
17	522	1,742	13	420	2,175	-1,653
18	628	2,914	53	459	3,426	-2,798
19	303	3,173	8	611	3,793	-3,490
40	412	2,599	6	863	3,468	-3,056
Total	2,531	11,555	2,092	2,550	14,191	-11,660
Year 2010						
16-3	666	1,327	8	241	1,575	-909
17	522	2,134	14	541	2,689	-2,167
18	628	3,533	49	589	4,171	-3,543
19	303	4,042	9	843	4,893	-4,590
40	412	3,236	7	1,045	4,288	-3,876
Total	2,531	14,272	2,097	3,258	17,617	-15,086
Year 2020						
16-3	666	1,728	9	330	2,067	-1,401
17	522	2,918	18	782	3,719	-3,197
18	628	4,771	43	847	5,662	-5,034
19	303	5,779	10	1,306	7,095	-6,792
40	412	4,510	8	1,408	5,926	-5,514
Total	2,531	19,708	2,108	4,674	24,469	-21,938

15.3.2 Parking Facilities Plan

1) Provision of On-street Parking Facility

Roadside toll parking with parking meters should be prepared along the secondary trunk roads in relatively wide sections. In this plan, 170 parking meters are to be provided on sections of 1.5 km long, about 7% of the roads which are indicated in Figure 15.3.6 and Figure 15.3.7. The project roads are as follows;

- Al hurrieh St.
- Jamal Abdun Nasser St.
- Yousef Al Athme St., etc.

At the same time stricter enforcement of parking prohibition on the designated arterial roads (as shown in Figure 15.3.6 and Figure 7.9.1) must be established.

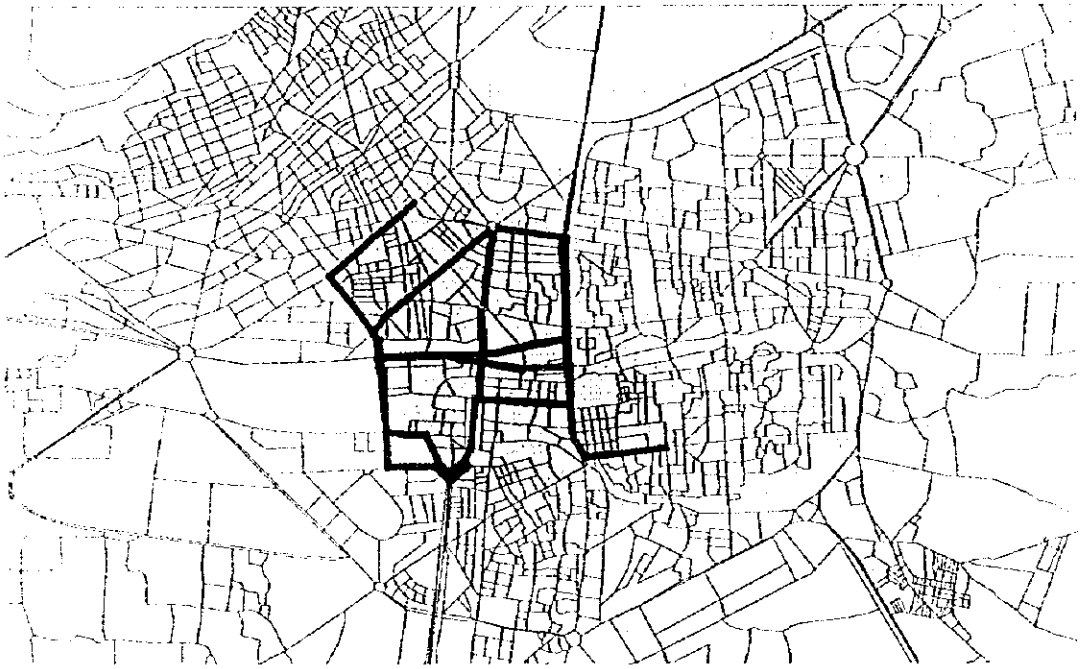


Figure 15.3.6 Parking Prohibition in the Parking Service District during Peak Hour

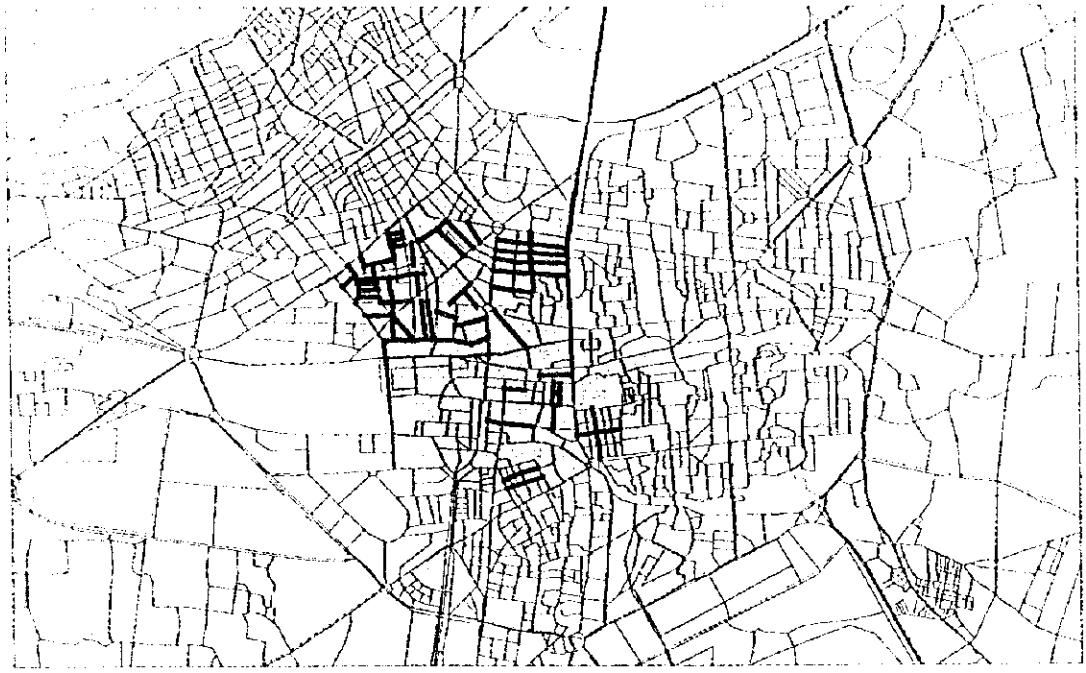


Figure 15.3.7 On Street Parking Permitted Road & Parking meter Installation Road

2) Provision of Off-street Parking

Five off-street parking sites with a total parking capacity of 1,660 vehicles were selected as shown in Table 15.3.2 and Figure 15.3.8. The sites were selected considering the following factors.

a. Toll parking.
b. Adjacent to the main roads in the District.
c. Suitable for multi-story structures and easily accessible.
d. Possible to adopt BOT scheme for operation and management.
e. On public land.

Table 15.3.2 Future Off-Street Parking Facility Project (2010)

Zone No	Name	Location	No. levels	Total Area (sqm.)	Capacity (Lots)
17	①Amous Square	8th of March Square	2	12,500	500
17	②Square near Azmeh St.	Near Governorate Office	2	10,000	400
17	③Souk Al Hal-Qadim	Under Square	1	8,000	320
18	④Al Na'naa	Near Takia	2	5,000	200
19	⑤Al Nasr	Under Street	1	6,000	240
	Total			41,500	1,660

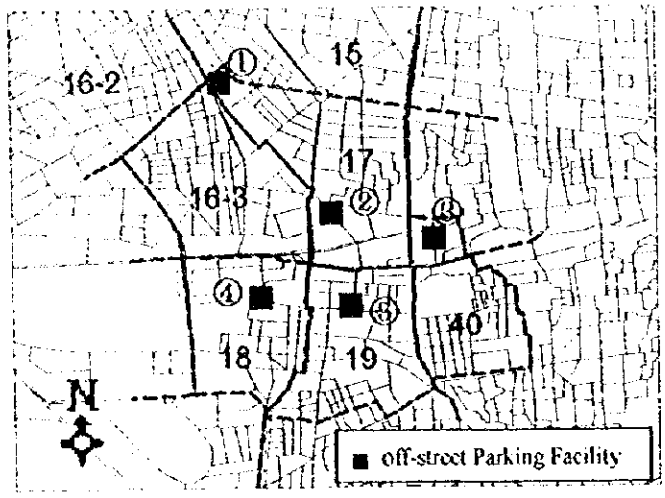


Figure 15.3.8 Future Off-Street Parking Facilities Locations in 2010

The capacity supplied by these 5 Off-street parking facilities shown in Table 15.3.2 is not sufficient to fill the gap of supply demand balance (Table 15.3.3). In this area priority should be given to provision of parking for shopping and business.

Table 15.3.3 Parking Supply-Demand Balance in Service Area (2010)

Parking Facilities & Supply							Demand			Supply-Demand
Off street Parking sites	Zone No	Capacity	In each Zone	(lots)	Road-Side	Total	Work, School	Business, Shopping	Total	Total
	15,16-2,43			150						
	16-3			140	666	806	1,335	241	1,576	-770
1. Amous Square	17	500		680	522	1,202	2,148	541	2,689	-1,487
2. Square near Azneh St.		400								
3. Souk Al Hal-Qadim		320								
4. Al Na'naa	18	200		200	628	828	3,582	589	4,171	-3,343
5. Al Nasr	19	240		240	303	543	4,051	843	4,894	-4,351
	40			160	412	572	3,243	1,045	4,288	-3,716
	43			90	-	-	-	-	-	-
Total		1,660		1,660	-	-	-	-	-	-
Zone	15,16-2, 43			240	-	-	-	-	-	-
Zone	16-3,17,18,19,40			1,420	2,531	3,951	14,359	3,259	17,618	-13,667

In order to cover the entire parking demand in 2010 it is necessary to shift most of the work purpose trips from the private vehicle to public transport modes. From the point of view of the necessity for measures to control demand, the vigorous construction of parking space in the city center area would be counterproductive. Such construction will also encourage commuting by car and that is not desirable. Therefore, the construction of parking spaces using public funds should be avoided, and regulations should be enacted to control the construction of public parking spaces by the private sector.

Among the five off-street parking sites mentioned above, Arnous Square is highly implementable and is therefore under consideration in the Feasibility Study for the possibility of employing BOT scheme.
There will be a review for the parking provision after 2010 by taking into consideration parking conditions and demands at that future time.

It is also required to make a policy for parking after 2010, using private lands and investment including private parking facilities. In order to support this policy, the following public aids are necessary for facilitating project implementation, and these are to be studied in detail at the next step.

- Subsidy for private parking management
- Incentives to interest rates of the fund for investment for parking
- Incentives for taxation

In addition, the existing regulation for compulsory parking space for new buildings seems insufficient and it should be revised adding a clause stipulating minimum number of parking space per floor area of building.

15.4 Traffic Safety Requirements and Pedestrianization

15.4.1 Channelization for Traffic Safety

Traffic safety requirement for channelization is considered for the following three items.

- Intersection Design
- Pavement Marking
- Traffic Signs

(1) Intersection Design

Many of the intersections in Damascus City are rotary type intersections. Along the ring road section from Umawyeen Sq. intersection to Al-Abbassiyeen Sq., 9 intersections of the existing 15 intersections, are rotary type intersections.

These intersections are large in areas and this creates traffic conflicts, which renders the intersections inefficient in terms of traffic flow. Furthermore at most intersections lane markings have almost disappeared creating conflicts in vehicular movement.

It is therefore necessary to prepare sufficient intersection design standards. In Syria, American, Russian and French design standards are all applied depending upon the implementing agency involved. This situation needs to be reviewed and standards should be specifically prepared for Syria. Standardization is especially important for compound intersections with many legs.

There are a number of basic considerations in the design of channelization. The key points to consider are:

a. Channels have to have an appropriate lane width. Too wide a channel will only encourage motor cycle and other small vehicles to run along side large vehicles. This will cause frequent side swipe accidents and create confusion in the use of the channels.

b. Islands must be of appropriate size and shape. Small islands can easily cause confusion among various traffic streams. It is preferable to have only a few large islands rather than a large number of small islands.

- The minimum size of an island is $5m^2$, but the preferable size is $10m^2$ and above.
- The side of any island should have sufficient length in channelization traffic. Triangular islands such as those used to control right turning traffic should not be cut abruptly along the curved sections. It should instead be followed through and extended to the end of the curves. Moreover, the two ends should preferably have extensions of 3-4m of guide marking. For rectangular islands, the length should be at least 5-6m long.

c. Diverging and merging traffic should not be made to converge at one point. Such a design would only create confusion among drivers.

d. Approaching vehicles must clearly and easily see islands. However, the start of an island must not be located at the crest of a slope or a curve. Besides the use of markings to indicate the start or end of an island, reflecting paint and lighting should be used for easy identification at night.

As a whole, the design of at-grade intersection has to reflect normal human movement behavior when designing such elements as pedestrian crossings, stopping lines, and channelization. Designs that create forced movement or behavior should always be avoided.

Figure 15.4.1 and Figure 15.4.2 shows standard channelization in the cases of a 4-branch intersection and a rotary intersection.

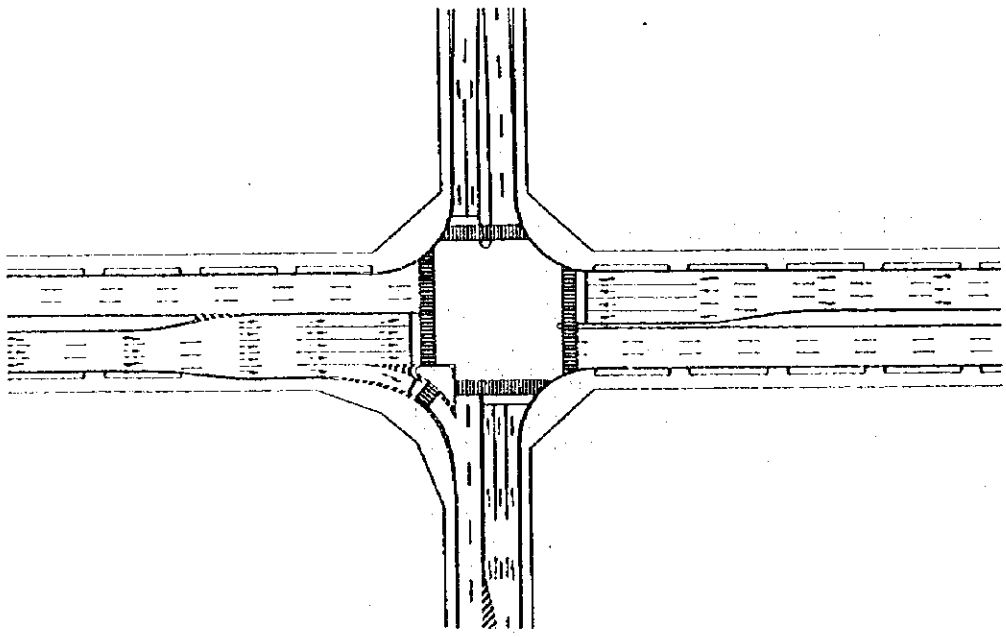


Figure 15.4.1 Channelization for Cross Intersection

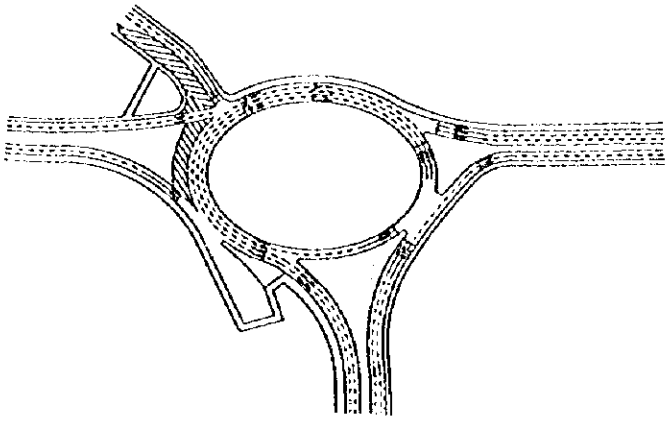


Figure 15.4.2 Channelization for the Four-way and Rotary Intersections

(2) Pavement Markings

In Damascus City pavement marking is poor in quality and coverage. Pavement markings perform various functions such as lane identification, guidance of driver's sight (mainly at the intersection), traffic safety, etc. It is therefore important to apply them on the main traffic arteries as identified in this Study.

The lane line, central line, traffic channelization markings, stop line, pedestrian crossing strips, parking area, traffic direction signs (straight, left and right turn), etc. are all types of pavement marking. Once applied, however, constant maintenance is required to keep them clearly visible. Figure 15.4.3 shows standard plans for the pavement marking.

At present, low resistance paint is used in marking pavement, and therefore annual application is required. Thermoplastic glass bead must be employed to improve their endurance as well as their visibility for night driving. This procedure will be necessary once every 4 to 5 years in general.

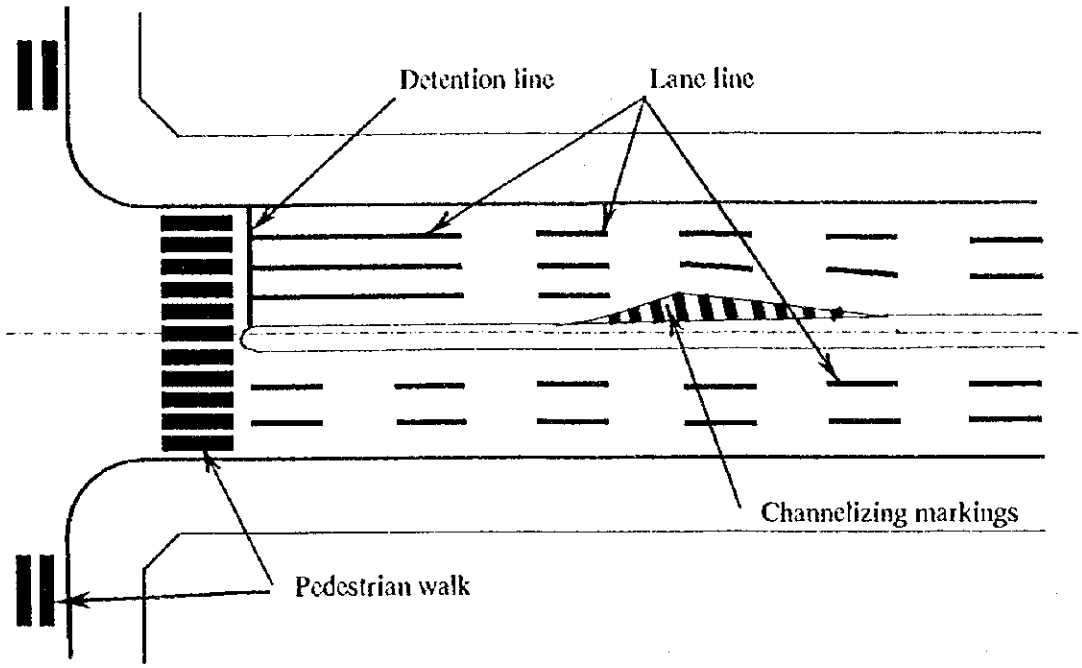


Figure 15.4.3 Typical Plans for Intersection Marking

Table 15.4.1 Typical Plans for Intersection Markings

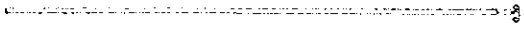
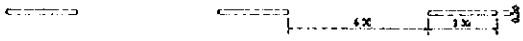
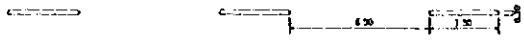
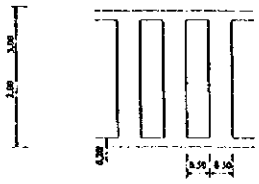
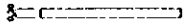
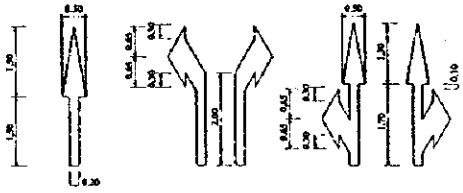
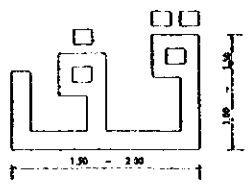
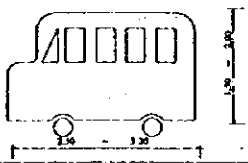
Types	Location	
Street Central Line	Street Center	(More than 4 Lanes)  (2 Lanes) 
Lane Line	Lane Limit	(No Lane Changing Section)  (Lane Changing Section) 
Pedestrian Crossing	Areas to orientate Pedestrian Crossing	
Stop Line	At the intersections Where temporary detention or stop light detention must be done (2m before the pedestrian Crossing).	
On road Parking Area	Streets werw parking is allowed	(Passenger Car) 
Traffic direction	At the intersections before reaching the intersections & where the lane number increases or decreases.	
Temporary detention "stop"	Before the stop line of non preferencial intersections without stop light.	
Bus Preferencial Sign	At the bus exclusive lane. one for each block.	

Table 15.4.1 shows the types of pavement marking, the main functions of which are described as follows:

a. Lane Lines:
Marking indicating prohibition to change lanes is applied mainly near the intersection. Marking should start 30m before the stop line.

b. Pedestrian Crossings:
Pedestrian crossing marking should be applied for arteries within the central business district. Although the width of the pedestrian strip depends on the volume of pedestrians, it is generally established at 2.0m for all arteries (taking into consideration that streets are narrow) and 3.0m in case of preferential streets for pedestrian traffic.

c. Stop Line:
When marking the stop line, the clear visibility of the signal at the intersection is very important.

d. Parking Place
Each parking area shall be 2.5m x 5m.

e. Traffic Direction Sign
Most streets within the central area are one way; therefore, marking must be applied in order to avoid traffic accidents.

f. "STOP" Marking
This is located at the entrance of a non-signalized intersection for a non-preferential artery.

(3) Traffic Signs

Traffic sings are classified as follows: regulatory signs, warning sings, and guide signs. Regulatory signs indicate those rules that drivers must follow such as "no through way," "no parking," "maximum speed," etc. Warning signs indicate the proximity to danger areas for drivers, such as intersections, curves, etc. Guide sings indicate information such as the name of the place, the sign that directs drivers to a determined area, or other useful information for road users. Regulatory and warning signs which are established in Damascus City are established in the right place and attentive awakening are given to drivers. Informative signs mainly show the direction, the area concerning arterial road.

Traffic sings should be established at intersections and every 200 to 300 meters along roads.

15.4.2 Pedestrianization and Sidewalks

(1) Pedestrian Streets

From the pedestrian movement point of view, the characteristics of Damascus can be generalized as follows:

- Existence of many antiquities and historical monuments
- Barada River which is expected to return to its role after the completion of a waste water management project
- Narrow streets in most of the commercial and populated areas
- Centralization of commercial markets and activities in the city center

According to these characteristics and taking advantage of available socio-economic activities in the city within its historical and traditional frame, the policy established for pedestrian movement is based on providing main pedestrian corridors between the main centers attracting pedestrian movement in the city. Such corridors may be composed of:

a. Streets exclusively for the use of pedestrian movement, which may include:
   - Streets for shopping, such as Gamal Abdul Naser Street.
   - Streets serving a promenade purpose and might be near or neighboring Barada River.
   - Streets for exploring antiquities and monuments.

b. Streets with priority movement for pedestrian, which should have:
   - Wide width of pavement and passage
   - Connection with public transport stops and different attraction centers
   - Sidewalks free from obstacles, such as advertisement signs, bookstalls, etc.

Table 15.4.2 and Table 15.4.3 present the proposed pedestrian corridors for the two types of pedestrianization.

Table 15.4.2 Pedestrian Exclusive Streets

No.	Street Name	Length (m)	Width (m)	Function	Zone No.
1	Gamal Abdul Naser	650	12	Shopping	16 - 17
2	King Faisal	400	10 - 15	Building Materials & purchasing	19 - 40
3	Old city	1400	~9	Shopping & Tourism	40 - 45
4	Al Qassa'a	200	~10	Shopping	54
5	Above railways	1200	~15	Strolls	18

Table 15.4.3 Pedestrian Priority Streets

No.	Street Name	Length (m)	Width (m)	Function	Zone No.
6	Shukri Al Quatli	3000	~40	Promenade	9-10-16-18
7	Al Assad Bridge	800	30	Student's Promenade	18
8	Al Jabiri-Hijaz	500	30	Business	16-17-18-19
9	Al Naser	500	40	Shopping & Business	19
10	Al Midan	2800	12 - 16	Shopping	27-28-29-30-33-38
11	King Faisal	1100	12 - 25	Shopping	43-44-45
12	Al Qassa'a	750	~12	Shopping	54

Through the pedestrianization of these corridors, pedestrians can move freely in the city center from east to west and from north to south for shopping, promenading and exploring antiquities. These axis will provide convenient and civilised access to tourism, commercial and recreational destinations. The pedestrianization scheme in the central areas of Damascus City is shown in Figure 15.4.4. Following is a description for the proposed streets for the two types of pedestrianization schemes.

1) Pedestrian Exclusive Streets

- Gamal Abdul Naser street

At present, a section of about 300m long of this street is actually executed as a commercial street for pedestrians exclusively. It should be developed and extended to reach Yousef Al Azmeh Square keeping the same function of its entity, which is commercial area for shopping purpose.

- King Faisal and Al Shuhada streets
  This area is very crowded with people all day as it is a central market for food and other products. Vehicles passing in these streets form a real burden on pedestrian movement and it is convenient to develop a model for pedestrianization in area.

- Old City streets
  Pedestrian movement in the Old City is currently concentrated in Souk Al Hamidiya. It should expand to cover and surround the Omayyad Mosque and pass across some antique locations to reach Bab Sharki area from the east, then to the planned pedestrian yard near Damascus Castle from the west. This corridor will help visitors and tourists to access and enjoy the ancient sites and shopping in the Old City without obstacles.

- Kassaa street
  This street is currently characterized by only pedestrian evening movement and shopping. Pedestraizing this street for picnic and shopping purposes will increase the commercial activity all the time round.

- Above-Railway Street
  This street is currently unusable as it is designated originally for the train railway towards summer resorts west of Damascus City. The railway is planned to run in an underground tunnel to facilitate the movement of regular commuter train service in the tunnel and at-grade vehicular movement simultaneously. The street over the railway tunnel will have a positive environmental impact in the area especially it is located near university and schools with about 40,000 students.

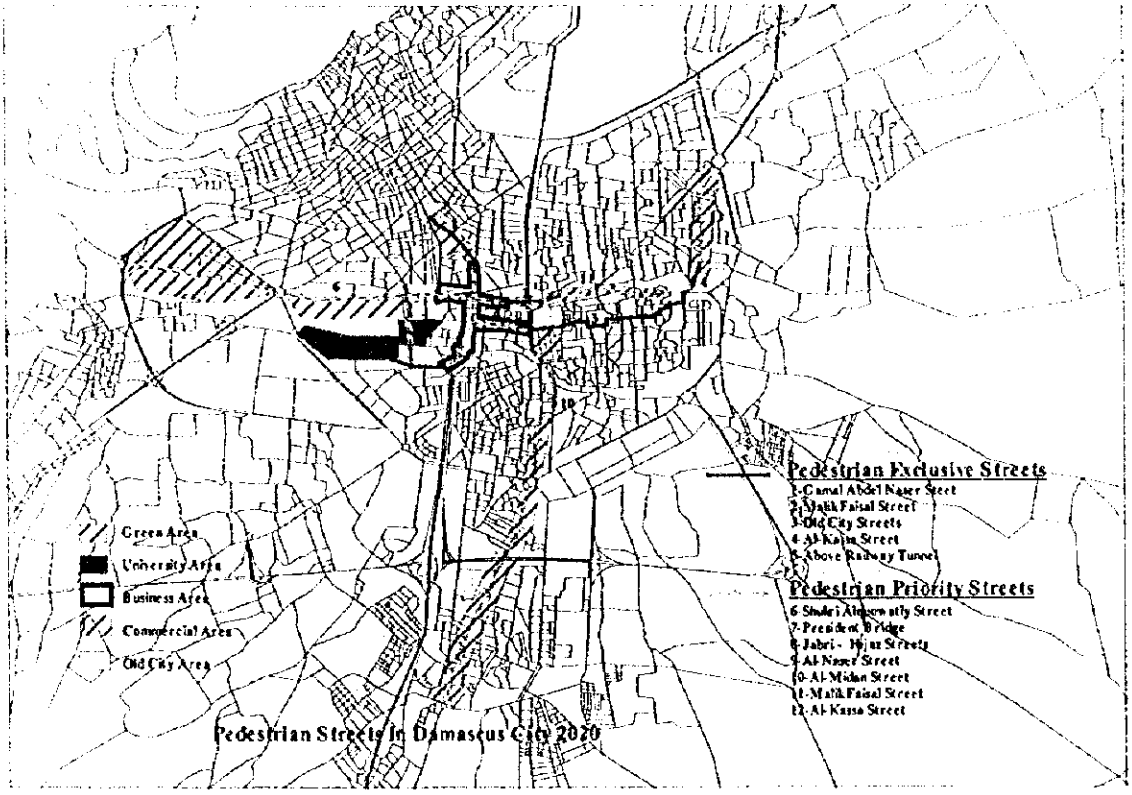


Figure 15.4.4 Pedestrian Streets in Damascus 2020

2) Pedestrian Priority Streets

- Shukri Al Quwatli street
  It is surrounded on both sides by a wide sidewalk from Omayyad Square till Victoria Bridge with relatively long distance in addition to the fact that it is a riverside street of one of the widest branches of Barada River on its left bank.

- Al Assad Bridge
  This bridge is currently connecting between the two banks of Barada River and it is a conflict point for pedestrian and vehicles movements. It has a wide carriageway and sidewalks but it is crowded with people all day as it is very close to many faculties of Damascus University.

- Al Hijaz and Al Jabiri streets
  These two streets are located in the city center and accommodate many offices, clinics, establishments, ministries, and other public authorities. Therefore the pedestrian movement is dense and rapid and it needs a kind of protection and priority taking into account that sidewalks and carriageway are wide enough.

- Al Nassr Street
  It is considered as an extension for the previous streets, which are characterized by public activities. Its end is at Souk Al Hamidiya entrance near Damascus citadel.

- Al Midan Street

It is a traditional commercial street characterized by a dense pedestrian movement, which need to be separated from vehicles by developing the street and giving priority to pedestrians.

- King Faisal Street
  It is a supplementary section that specified for pedestrians by giving them priority for safety considerations and to separate pedestrian movement from vehicular movement.

- Kassaa Street
  Its end is connected with Al Abbassiyeen Square and its beginning section is specified for pedestrians. It is characterized as a commercial activity street with heavy pedestrian movement, which should be separated from vehicular movement for safety and to promote the commercial activity.

(2) Pedestrian Crossing Passages

At present, the pedestrian crossing passages in the central areas of the city are located at the following squares and streets:

- Overpass:	- Shukri Al Qwuatli	2
	-Victoria	2
	- Port Said	1
	- Al Naser	1
	- Uthman Iben Affan	1
	- Ath Thawra	2
	- 6 October	1
	- Bab Sharki	1
- Underpass:	- 8th March	1
	- Al Thawra	2
	- Aal Al Bait	1
	- 6th October	1

At other places, at-grade pedestrian crossing passages are provided. Outside the city central areas, there are some underpasses in Ruken Addin, Mezzeh, south bypass entrance, etc.

Considering the social, geographic and climatic of the city, prioritization criteria for the selection of the type of pedestrian crossing passages is established as follows:

- First priority is given to at-grade pedestrian crossing facilities through zebra-line crossing passages provided with stopping lines, signs and pedestrian signals at intervals of 150-200m on main streets and at commercial areas.
- Second priority is for pedestrian underpasses that should be provided directly under the road surface near attraction and other socioeconomic activity centers. They should have lightning vents of 2.20-2.50m height and a minimum of 5.0m width, connected with surface by fixed stairs or electric escalators and be provided with ramps for bicycles and carriages. These underpasses are used in case of impossibility of providing at-grade-crossing facility at the required place due to the high vehicular traffic volumes or the need to increase the phase of the signals. They may accommodate commercial activities, and their entrances and exits should be studied in accordance with the pedestrian movement.
- Third priority is given to pedestrian overpasses, which can be adapted in case of showing more viability than providing underpass. They should not cause visual distortion of the landscape of the city or increase the pedestrian burden or obstruct the movement on sidewalks.

Based on the above presented policy, pedestrian facility projects on different levels at either intersections or interchanges are included in the plan of this study mainly as at-grade pedestrian crossing passages at most of the intersections. On the other hand, some of the existing overpasses and underpasses are preferred to be replaced by at-grade facilities, as they are not efficiently performing their assumed function. In this regard, more detailed studies are required on the pedestrian movement altogether with reorganizing the vehicular traffic movement in such areas and streets of Victoria, Al Thawra, Al Naser, 8th March, Uthman Bin Affan and Bab Sharki. In addition, many of the grade-separation schemes in this plan will provide more space for pedestrian movement and crossing in such a way to cancel the need to construct underpasses or overpasses in such areas of Al Hamidiyeh, Al Hijaz, Al Salehiyeh and SANA.

Other areas that have high concentration of pedestrian crossing movements and require underpasses to be provided are shown as follows:

- Shukri Al Quatli Street — 2 underpasses
- Al Itihad Street — 1 underpass
- Bab Sharki — 1 underpass
- Hassan Al Kharat — 1 underpass

Figure 15.4.5 presents the existing and planned pedestrian facilities in the central areas of the city.

Figure 15.4.5 Pedestrian Facilities Proposal for Downtown and Surrounding Area, 2020

15.5 Education and Organization

15.5.1 Education

The education plan deals with the strengthening of traffic safety and observance of traffic rules and focuses on the three elements of general public, vehicle drivers and traffic management personnel.

(1) General Citizens

A rush to cross at intersections and streets and ignoring traffic signals by the general public is observed at present. Moreover the interference of vehicular traffic with citizens getting on and off buses at bus stops is also observed.

Not only improvement at intersections and proper road marking, but also education and guidance of citizens are required in order to ensure their safe crossing and strengthen their observance of the traffic rules. Therefore the following educational and guidance items are required. Implementation may be through teaching at schools and other educational institutions, and media campaigns by the police and municipal authorities.

- Teaching traffic regulations directed at pedestrian crossing at schools
- Diffusion of information on traffic safety and regulations through media campaigns
- Strengthening consciousness and understanding of traffic safety through such activities as traffic safety week campaigns.

The traffic regulations should be reviewed and the following items highlighted:

- Basic road traffic rules
- Road crossing
- Night time pedestrian rules
- Careful watch over children in the streets
- Getting in and out of vehicles
- Considerations for the physically handicapped and senior citizens, etc.

(2) Vehicle Drivers

One of the traffic problems in Damascus City is lack of strict observance of traffic regulations on the part of drivers. Another problem is illegal parking. In order to settle these problems it is necessary to ensure applicants understand traffic regulations at the time of issuing them driving licenses, revoke the driving license in case of report or severe traffic regulation offenders, and strengthening of the enforcement of punishments in case of traffic violations.

At present there are 6 types of driving licenses issued in Damascus Governorate. In 1997 a total of 28,000 persons acquired driving licenses. Compared to the respective figure of 21,000 in 1994 an annual increase rate of 11% is observed.

Training for obtaining driving license is conducted at three private training offices in the city, and the average hours spent in training before acquiring the license is about 15 hours. The examination applicants must pass consists of three tests: theoretical, practical and medical. The theoretical test is easy and covers standard traffic signs only. Persons 18 years and above can take the examination. In order to obtain a public license, such as for taxis it is necessary to apply at least three years after acquiring the private license. Once a license is obtained new test for renewal is required, other than a simple medical test every 8 years.

However, in order that proposals adopted in this transportation master plan for traffic facilities improvement projects, such as intersection improvement, marking, and traffic signs are effective an education and training plan is also necessary. Education and training targeted at vehicle drivers are as follows;

- Knowledge of safer driving: Understanding the car mechanical systems, efficient driving method, and the influence of speeding
- Tips for driving: Starting the car safely, basic driving rules, watching out for pedestrians, maintaining safe speeds and distances between vehicles, lane changing, overtaking, crossing intersections, parking and stopping, and action in dangerous situations
- Driving on highways: Caution in entering the highway, maintaining highway speeds and driving on the right hand side lane
- Signals and signs: Traffic signals, different types of signs

In order to implement the above plan it is necessary not only to prepare thorough traffic regulations and enforcement system, but also a safe vehicle driving center should be established where proper driving license issuance procedures are applied.

Furthermore the traffic police should strictly enforce the traffic regulations and penalties, introduce driving license revoking system, maintain traffic accident statistics, implement periodic traffic surveys and renew traffic data base, amongst others.

(3) Traffic Police

The manual operation of traffic signals at intersections by the traffic police is a problem. The police change the traffic lights according to the traffic conditions at the intersection approaches. This does not necessarily lead to efficient traffic flow at the intersection, but is rather spot control without taking into consideration overall traffic flow conditions along streets leading into the intersections. This is the reason why there are too often traffic congestion is observed at such intersections.

This master plan recommends improvement of signalization system at the major intersections and introduction of area traffic control system. This will reduce the manual control of traffic signals but it will require implementation of training programs to ensure efficient operation of the system by the traffic police.

Of particular importance is training the traffic police in maintaining and analyzing traffic data needed to operate the system. The present curriculums studied at the police academies should therefore be adjusted to reflect this requirement. The items that should be covered under the revised curriculum include;

- Traffic regulations and rules
- Basic of traffic flow
- Traffic data collection and analysis; traffic volumes, accidents, etc.
- Area traffic control system; operation method, management parameters
- Traffic safety countermeasures; countermeasures in emergency cases
- Traffic flow countermeasures; standards for applying regulations concerning one-way traffic system and parking, and the management of these regulations

15.5.2 Organization

In the context of Damascus traffic conditions, there are three organizational suggestions that aim at more efficient operation of traffic control.

1) Build up Planning Capability: Establishment of Road Traffic Planning Department

Comprehensive planning of roads and traffic will lead to an improvement of traffic conditions in Damascus City and its surrounding areas and enable roads to be used more efficiently. As a result, it will contribute to the development of Syria as a whole.

In Damascus City, Traffic police and Governorate separately but efficiently manage traffic and roads. However, there is a lack of coordination between them, which is creating inefficiency in many parts of the city. As a solution to this problem, it is suggested that one agency above these organizations be established and take responsibility for comprehensive planning.

This new agency would take a large role in planning for roads, traffic measures, and new transportation technology. It would also supervise on-going plans and projects of the existing transportation-related departments and attempt to untangle the rigid organizational structures from multi-dimensional perspectives.

2) Increase Traffic Technology Operation Capability

Damascus has been employing high-standard technology in building new roads and paving main roads. However, at the city center in particular, drivers and pedestrians experience inconvenient and unsafe aspects of roads and intersections. That results from a lack of technology in traffic operation. Although drivers and pedestrians need to be educated more, it is necessary for the city to provide an environment where its citizens can safely use such transportation facilities and thus to establish design standards for roads and intersections.

Although there are staff and workshops for TMD, the city is lacking in human resources for technology improvements and researches for new technology. It is suggested, therefore, that an agency or department be established to undertake a research for current traffic problems on a daily basis and attempt to find solutions to such problems.

3) Strengthen Statistical Department

Good planning and operation of roads and traffic requires an understanding of current conditions. Accurate data and analyses based on such data are absolute necessity for this.

In addition, data help implement the first two suggestions in this section and improve technology, and formulate an effective plan. It is costly to undertake investigations and studies, but the accumulation of such efforts would pay in the long run. Therefore, it is suggested that a department that manages data be established.

- Traffic volume data
- Traffic accident data
- Geometric design data
- Other socioeconomic data

15.6 Cost Estimate

The cost estimate of Traffic Management Projects is shown in Table 15.6.1.

Table 15.6.1 Traffic Management Planning Cost

Project Plan	Component of Plan	Project size		Cost SP(x1000)
		unit	SP	
D	ATC System (Including Channelization)			
	Stage-1	intersections	67	620,200
	Stage-2	intersections	63	524,000
				1,144,200
E	On Street parking Facility			
	Parking Meter Zone	m	1,500	64,000
				64,000
F	Off Street parking Facility			
	Arnous Square	lots	500	346,000
	Al Na'naa	lots	200	87,000
	Sq. near Azmeh	lots	200	175,000
	Souk Al Hal-Qadim	lots	320	140,000
	Under Naser St	lots	240	105,000
				853,000
	Pedestrian safety Facilities			
G	Pedestrian exclusive streets	streets	5	
	1. Gamal Abdeul Nuser	m	650	16,250
	2. King Faisal	m	400	10,000
	3. Old city	m	1,400	35,000
	4. Al Qassa'a	m	200	5,000
	5. Above railway	m	1,200	30,000
				96,250
H	Pedestrian priority streets	streets	7	
	6. Shkri Al Quatli	m	3,000	30,000
	7. Al Assad Bridge	m	800	8,000
	8. Al Jabri-Hijaz	m	500	5,000
	9. Al Naser	m	500	5,000
	10. Al Midan	m	2,800	28,000
	11. King Faisal	m	1,100	11,000
	12.Al Qassa'a	m	750	7,500
				94,500
I	Pedestrian crossing Facilities			
	1. Pedestrian Passage	sites	5	50,000
	2. Surface Pedestrian Passage	sites	85	25,000
				75,000
				2,326,950

15.7 Traffic Management Projects Implementation Schedule

The implementation plan of traffic management is shown in Table 15.7.1. The projects of traffic management vary in kinds. As most of those are of small scale and their project cost is not so large, early implementation at improvement priority location is recommended and the implementation area should be expanded gradually rather than selecting specific projects.

The implementation plan is classified into the following;

- ATC-System Project

Parking Facilities Project

- Safety Facility Project

(1) ATC-System Project

The priority is given to alleviation of traffic congestion in the central area. The project area should be expanded from the central area to the peripheral areas. At the same time as the traffic signal control in the congested crossings in the central area, channelization will be implemented to strengthen the effect.

In case that the capacity is not sufficient for the demand with the above measures, grade-separation should be implemented. However it will take time to prepare the grade-separation, phasing plan is proposed applying traffic signal control and channelization until the completion of grade-separation.

Two steps will be taken in Stage 1 of the ATC-system project. During this stage management, control and operation technique of urban traffic flow should be studied to establish proper traffic signal control system meeting the traffic characteristics of Damascus.

(2) Parking Facility Project

The parking facility project was planned based on the policy that on-street parking should be basically prohibited as it disturbs smooth traffic flow and safety. The following measures will be taken, considering that relevant off-street parking should be prepared in order to exclude on-street parking.

a. Five off-street parking facilities will be provided in high parking demand areas by 2010 with BOT system.
b. No-parking areas will be clearly marked on the trunk roads
c. On-street parking lots will be prepared on the parts where there are rooms giving no negative influence to traffic flow.
d. Parking meters will be installed on the parts of the on-street parking lots where the parking demand and the turnover are high

The planned off-street parking facilities are selected for the short-term (5-10 years) projects but it will not reach the demand. Therefore the measures of (b) to (d) are indispensable and they should be implemented in the central area with high parking demand, expanding step by step. On-street parking should be gradually controlled increasing use of off-street parking facilities and in future part of the trips to the central area are to be shifted to public transport.

Provision of off-street parking should be started in the central business district, and expanding to the residential areas. However it would be difficult to meet the parking demand. Therefore priority should be given to parking for shopping and business rather than parking for commuters to offices or schools. To support it, it is necessary to promote private parking facilities and BOT system. Subsidies for private investment for parking and taxation incentives should be materialized.

(3) Safety Facility Project

Separation of pedestrians and vehicles shall be made providing clear and proper marking on the crossings and the surrounding roads, which is packaged with the channelization of intersection mentioned in 1). This is not only for safety but also for smooth traffic flow increasing the traffic capacity at intersection.

At the next step, pedestrian priority streets and pedestrian exclusive streets or malls should be prepared for safe and pleasant walk.

The first project sites will be selected in the important points where traffic volume and number of pedestrians are large and a lot of crossings of pedestrians and vehicles occur. In addition it is required to educate and instruct traffic moral. Instruction to drivers and education to students should be started as early as possible.

Table 15.7.1 Implementation Schedule

Project ID	Traffic Management Project	Project Size		Year
		unit	SP	2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020
D	ATC-System			
D01	1. ATC stage1-1 (F/S Project)	intersections	28	
D02	2. ATC stage1-2 (F/S Project)	intersections	39	
D03	3. ATC stage2	intersections	63	
E	On Street Parking Facility			
E01	1. Parking area installed parking meter	m	1,500	
F	Off Street Parking Facility			
F01	1. Amous (12) (F/S project)	500 lots	1	
F02	2. Al Na'naa (6)	200 lots	1	
F03	3. Sq. near Azmeh (10)	200 lots	1	
F04	4. Souk Al Hal-Qadim (15)	320 lots	1	
F05	5. Under Naser St. (4)	240 lots	1	
G	Pedestrian safety Facilities (Pedestrian exclusive streets)	streets	5	
G01	1. Gamal Abdeul Nuser	m	650	
G02	2. King Faisal	m	400	
G03	3. Old city	m	1,400	
G04	4. Al Qassa'a	m	200	
G05	5. Above railway	m	1,200	
H	Pedestrian priority streets	streets	7	
H06	6. Shkri Al Quatli	m	3,000	
H07	7. Al Assad Bridge	m	800	
H08	8. Al Jabri-Hijaz	m	500	
H09	9. Al Naser	m	500	
H10	10. Al Midan	m	2,800	
H11	11. King Faisal	m	1,100	
H12	12.Al Qassa'a	m	750	
I	Pedestrian crossing Facilities			
I01	1. Pedestrian Passage	sites	5	
I02	2. Surface Pedestrian Passage	sites	85	
	Other Proposed Items		-	
	1.Education for Drivers,Pedestrians, Policemen		-	
	2.On Street Parking Reguration		-	
	3.Establishment of New-3-Traffic Departments		-	

Chapter 16. INITIAL ENVIRONMENTAL EXAMINATION

16.1 Introduction

The Initial Environmental Examination (IEE) was carried out for the urban transport master plan of Damascus City in order to make a preliminary identification of negative and adverse environmental impacts.

The master plan includes various types of transport improvement projects that comprise not only physical improvement but also institutional improvement, especially parking control. The project types are as follows:

- Roads Improvement
- Intersections Improvement
- Trunk Bus System
- Signalization Improvement
- Parking Control and Facility Improvement

All the projects were subjected to IEE utilizing screening and scoping methods.

16.2 Projects in the Master Plan

The master plan projects have been classified according to four categories of development features as shown in Table 16.2.1. There are four transport development categories; road and intersection improvement, public transport, facility development and institutional development. Further categories for examination shall be considered after identifying the impact.

Table 16.2.1 Project Categories by Feature

Category / Proposed Projects	Urban Roads and Intersections Improvement	Public Transport Improvement	Facility Development	Institutional Development
1.Road Improvement	O			
2. Intersection Improvement	O			
3. Trunk Bus System		O		
4. Signalization			O	
5. Parking Control and Facility			O	O

16.3 Screening and Scoping of Proposed Plans

Screening and scoping were carried out using existing data and information in order to identify items that should be examined in more detail in the coming stage of further environmental impact analysis, based on rational impact prediction charts shown in Figure 16.3.1. The screening and scoping results are as follows:

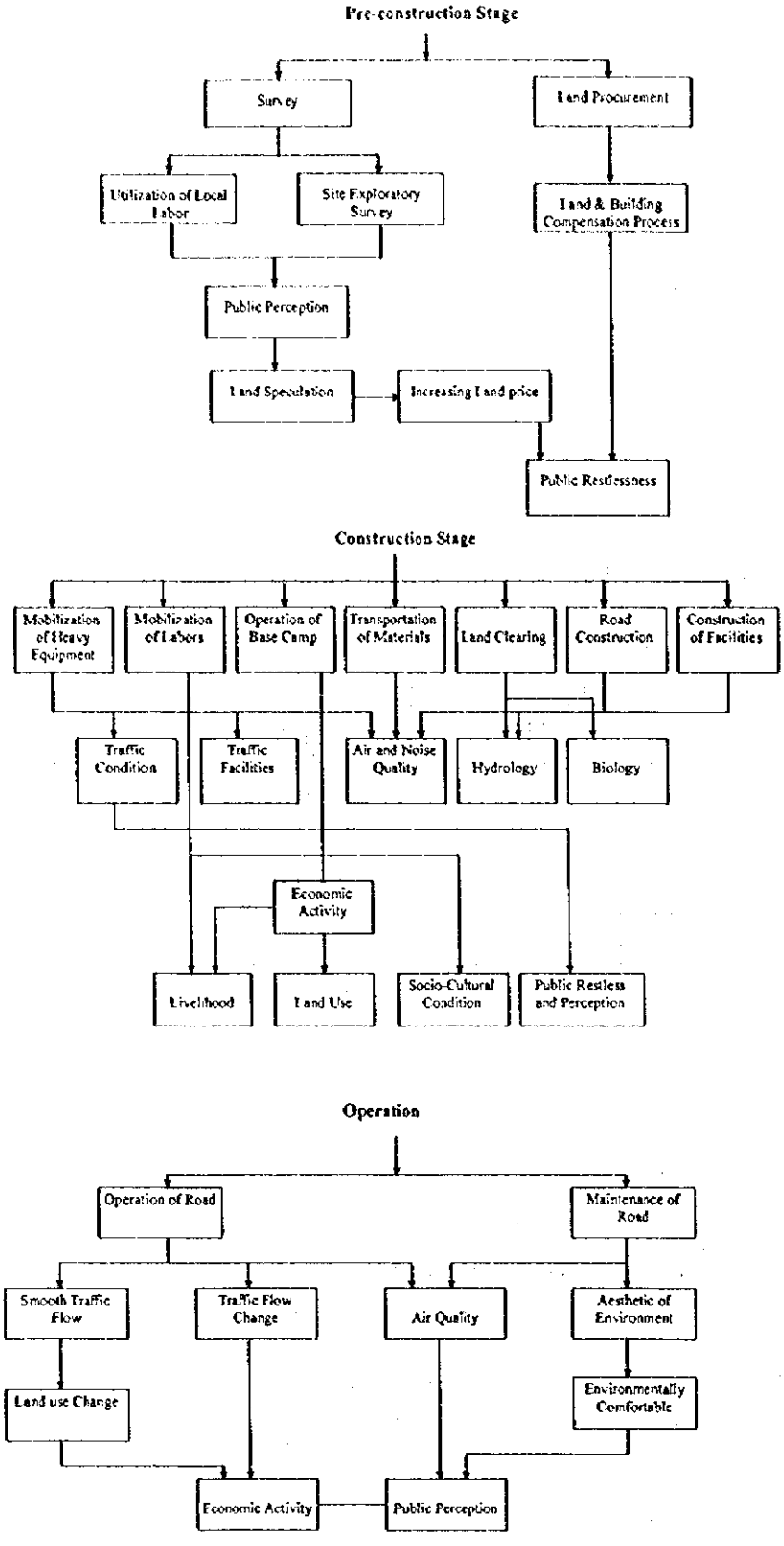


Figure 16.3.1 Impact Identification Flow by Phases

16.3.1 Screening and Scoping

(1) Screening

As a result of screening, further environmental examination is required. Detail by each factor is shown in following table.

Table 16.3.1 Screening of Master Plan

No.	Environmental Items	Description	Evaluation	Remarks (reason)
Social Environment				
1.	Resettlement	Resettlement by occupancy of proposed land	Yes	Residence are living in project areas
2.	Economic Activities	Loss of productive opportunity such as land	Yes	Various economic activities exist
3.	Traffic and Public Facilities	Influence of existing traffic such as congestion	Yes	Public facilities exist in the project area
4.	Split of Communities	Split of Communities by obstruction of traffic	Yes	Some access controlled roads may create split
5.	Cultural Property	Loss of cultural property and falling of values	Yes	Cultural heritage buildings exits in most parts of the city area
6.	Water Rights and Rights of Common	Obstruction of fishing rights, water rights, and common rights of forest	Unknown	Rivers and canals for agriculture exist
7.	Public Health Condition	Deterioration of a hygienic environment by production of refuse and noxiousness	No	Large refuse amount will not be produced
8.	Waste	Occurrence of waste dumps and solid waste	Yes	Some construction waste of dumps will be produced
9.	Hazards (Risk)	Increase of possibility of danger of landslide and accident	No	Low possibility
Natural Environment				
10.	Topography and Geology	Change of valuable topography and geology by excavation or filling works	No	No large scale structure or earth work
11.	Soil Erosion	Surface soil erosion by rainwater after land development (vegetation removal)	No	Subjected area is developed already
12.	Ground Water	Change of distribution of ground water by large scale excavation	Unknown	Main work is Filling
13.	Hydrological Situation	Change of river discharge and riverbed condition due to landfill and drainage	No	No structure will be built on the rivers
14.	Coastal Zone	Coastal erosion and sedimentation due to landfill or change in marine condition	No	Project area is on land
15.	Flora and Fauna	Obstruction of breeding and extinction of spices due to change of habitat condition	No	Urbanized and developed area
16.	Meteorology	Change of temperature, precipitation, wind ,etc., due to large-scale devmt.	No	There are no large scale development
17.	Landscape	Change of topography and vegetation by land development and harmonious obstruction by structural objects	Yes	Landscape will be changed
Pollution				
18.	Air Pollution	Pollution caused by exhaust gas or toxic gas from vehicles and factories	Yes	Impact by exhaust gas from increasing traffic
19.	Water Pollution	Pollution by inflow of silt, and effluent into rivers and ground water	Unknown	Less impact by road facilities
20.	Soil Contamination	Contamination of soil by dust and chemicals	No	No chemical activities for soil
21.	Noise and Vibration	Noise and vibration generated by vehicles	Yes	During construction and operation
22.	Land Subsidence	Deformation of land and land subsidence due to the lowering of ground water	No	Sensitive lands do not exist in the subject area
23.	Offensive Odor	Generation of exhaust gas and offensive odor by facilities and operation	No	No factor
Overall evaluation		Environmental Impact Assessment (EIA) is required or not	From the results of the evaluation, EIA is required.	

(2) Scoping

Based on examination of screening discussed in the previous section, scoping for further examination was carried out and the results were as follows.

Table 16.3.2 Scoping of Master Plan

No.	Environmental Items	Evaluation	Remarks (reason)
	Social Environment		
1.	Resettlement	A	Resettlement will occur due to construction of new roads and improvement of existing roads especially in the urbanized area
2.	Economic Activities	B	Large change of economic activities will not occur
3.	Traffic and Public Facilities	B	It is necessary to consider impacts on schools, hospitals and public facilities in the project area
4.	Split of Communities	D	Non-access controlled roads will not create split
5.	Cultural Property	A	There are may cultural properties along some of the planned roads
6.	Water Rights and Rights of Common	D	No rivers and canals for agriculture exist
7.	Public Health Condition	D	Large amount of refuse will not be generated
8.	Waste	B	A little amount of waste will be produced by construction
9.	Hazards (Risk)	D	Low possibility for natural disasters to occur
	Natural Environment		
10.	Topography and Geology	D	Large land development is not included
11.	Soil Erosion	D	Large scale of soil erosion has not been identified
12.	Ground Water	D	There is no large scale underground structure planned
13.	Hydrological Situation	D	No large scale excavation will be included
14.	Coastal Zone	D	Project area is on land
15.	Flora and Fauna	D	There is no valuable flora and fauna, but there is reserved land in the project area. It is important for the ecosystem.
16.	Meteorology	D	Large scale felling and construction of high building is not planned
17.	Landscape	B	It is necessary to harmonize with the urban landscape
	Pollution		
18.	Air Pollution	B	There is impact on air quality by increasing traffic volume during operation stage
19.	Water Pollution	C	There is less impact on water quality by road project, however road facilities might have impacts.
20.	Soil Contamination	D	There is no action that would create soil contamination
21.	Noise and Vibration	B	There is impact on noise and vibration by increasing traffic volume during operation stage
22.	Land Subsidence	D	No sensitive lands exist in the project area
23.	Offensive Odor	D	There is no concern regarding offensive odor

Note1: Evaluation categories:
- A: Serious impact is predicted
- B: Some impact is predicted
- C: Extent of impact is unknown (Examination is needed. Impact may become clear as study progresses)
- D: No impact is predicted. EIA is not necessary

Note 2: The evaluation should be made with reference to the Explanation of Item.

Table 16.3.3 Matrix for Scoping Classified by Project

Environmental Factors \ Major facilities, activities which may cause impacts			Facilities/ Construction					
			Overall Evaluation	Before Operation		After Operation		
				Reclamation and spatial occupancy	Operation of construction equipment	Occupancy of land	Operation of Roads	Accumulation of people and goods
Social Environment	1.	Resettlement	XX	XX				
	2.	Economic Activities	X	X				
	3.	Traffic and Public Facilities	X		X			
	4.	Split of Communities						
	5.	Cultural Property	XX	XX			X	
	6.	Water Rights and Rights of Common						
	7.	Public Health Condition						
	8.	Waste	X		X			
	9.	Hazards (Risk)						
Natural Environment	10.	Topography and Geology						
	11.	Soil Erosion						
	12.	Ground Water						
	13.	Hydrological Situation						
	14.	Coastal Zone						
	15.	Flora and Fauna						
	16.	Meteorology						
	17.	Landscape	X			X		
Pollution	18.	Air Pollution	X		X		X	
	19.	Water Pollution	X		X			
	20.	Soil Contamination						
	21.	Noise and Vibration	X		X		X	
	22.	Land Subsidence						
	23.	Offensive Odor						

Note: XX: The environmental items to which special attention has to be paid. They might be serious impacts that may affect the project formulation depending on the magnitude of the impacts and the possibility of the measures.

X: The environmental items that may have a significant impact depending on the scale of the project and site condition

No mark: The environmental items requiring no impact assessment since the anticipated impacts are, in general, not significant.