CHAPTER 2

TRIPOLI BOULEVARD UNDERPASS PROJECT

CHAPTER 2

TRIPOLI BOULEVARD UNDERPASS PROJECT

2.1 PRESENT CONDITIONS AND PROBLEMS

Tripoli Boulevard is functioning as the primary arterial street and at the same time as an international highway. It passes through the Central Urban Area of Tripoli where through and local traffic is concentrated. The section from Halim Abu Azz El-Deen Roundabout to Bisar Street (hereinafter referred to as the Central Section) is the most critical section in the Study Area in terms of traffic congestion and air pollution.

Present condition of the said Section is shown in Figure 2.1-1 and summarized as follows:

Present Condition of the Central Section

Road width:	Dual 9.0 m carriageways with 4.0 m center median and 4.8 m sidewalk on both sides. Road right-of-way width is 42 m by the latest decree in 2001. It has 2 lanes with shoulder (or loading/unloading zone) on each direction.
Intersections:	There are 4 major intersections in the 775 m Section with an interval of 220 m to 295 m. Short interval between intersections is one of the causes of traffic congestion.
Traffic volume:	Tripoli Boulevard – 25,000 ~ 29,000 veh./day Intersecting Roads – 9,400 ~ 19,600 veh./day
On-street parking:	Shoulders on both sides are occupied by parked vehicles. One lane on each direction is frequently blocked by double parked vehicles, thus only one lane is effectively functioning as a travelway. Such condition is greatly reducing traffic capacity of the road.
Travel speed:	8 ~ 20 km / hour.
Level of service:	F which means capacity is exceeded by traffic volume and requires urgent measures.
Noise level:	100 ~ 105 dbA which is exceeded the standard of 72 dbA.

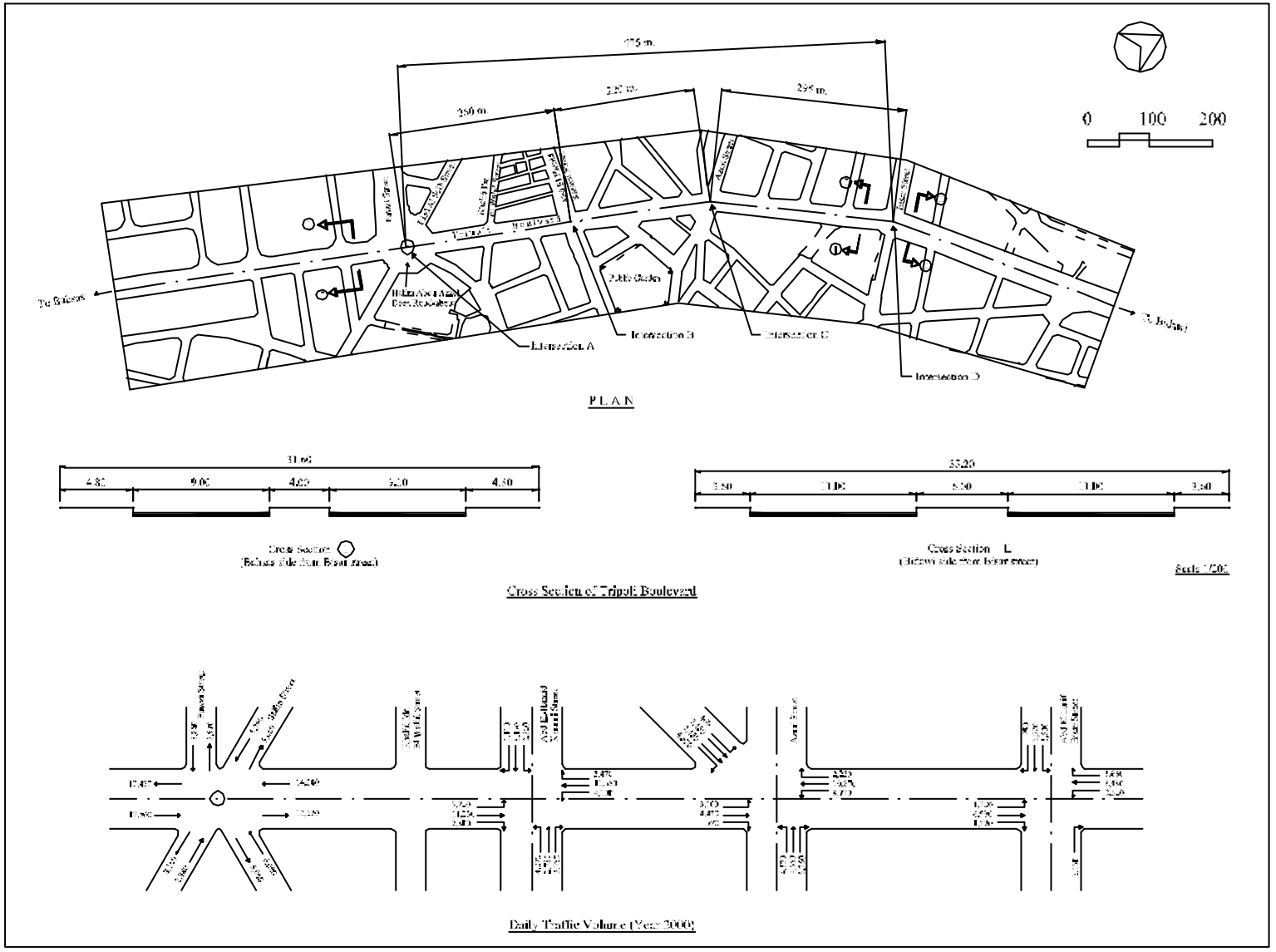


Figure 2.1-1 Present Condition of Tripoli Boulvard at Tripoli Central Area

2.2 ALTERNATIVES AND PLAN SELECTION

2.2.1 Needs of the Underpass

Along the Central Section of Tripoli Blvd., an underpass is needed due to the following:

1) Traffic volume exceeded road capacity along the section, causing heavy traffic jam throughout a day, very slow travel speed of less than 20 km/hour and noise and air pollution are recognized.
2) As shown in Figure 2.2-1, Tripoli Blvd. is the only wide road (4-lane road) for the North – South direction. No wide road in the North-South direction is available in New Tripoli and Downtown/Old town areas.
3) Tripoli West area is being developed. Tripoli North area is planned to be developed. Therefore, traffic demand in the North-South direction will continue to increase.
4) When East Ring Road, West Ring Road and Arab Highway are completed, through traffic from Beirut to Syria or vis-à-vis will be diverted to these roads, however, due to traffic demand of 3) above, traffic volume of Tripoli Blvd. will continue to grow (see Table 2.2-1).
5) According to the traffic assignment results shown in Table 2.2-1, traffic, which will utilize an underpass, will be about 27,000 pcu per day in 2005 and 34,000 pcu per day in 2020, even though two ring roads and Arab Highway are completed.
6) An underpass requires additional road right-of-way at tunnel approach sections. Areas along tunnel approach sections are not developed yet; therefore, additional road right-of-way should be acquired at the earliest time.

Table 2.2-1 Estimated Traffic Volumes On Tripoli Boulevard/Underpass

(pcu/day)

Section			*I*	*II*	*III*
2000			*28,447*	*26,734*	*24,551*
2005	*Do Nothing*		*38,272*	*34,265*	*33,725*
	With	*At-grade*	*31,849*	*33,662*	*30,843*
		Underpass	*26,985*		
		Total	*58,834*	*60,647*	*57,828*
2010	*Do Nothing*		*38,726*	*36,524*	*37,777*
	With	*At-grade*	*34,537*	*33,771*	*31,999*
		Underpass	*23,784*		
		Total	*58,321*	*57,555*	*55,783*
2020	*Do Nothing*		*39,594*	*40,773*	*41,090*
	With	*At-grade*	*37,661*	*35,958*	*33,612*
		Underpass	*33,918*		
		Total	*71,579*	*69,876*	*67,530*

Note: 1) East Ring Road, West Ring Road and Arab Highway assumed to be completed as scheduled.
2) Sections I, II & III are shown in Figure 2.3-1.

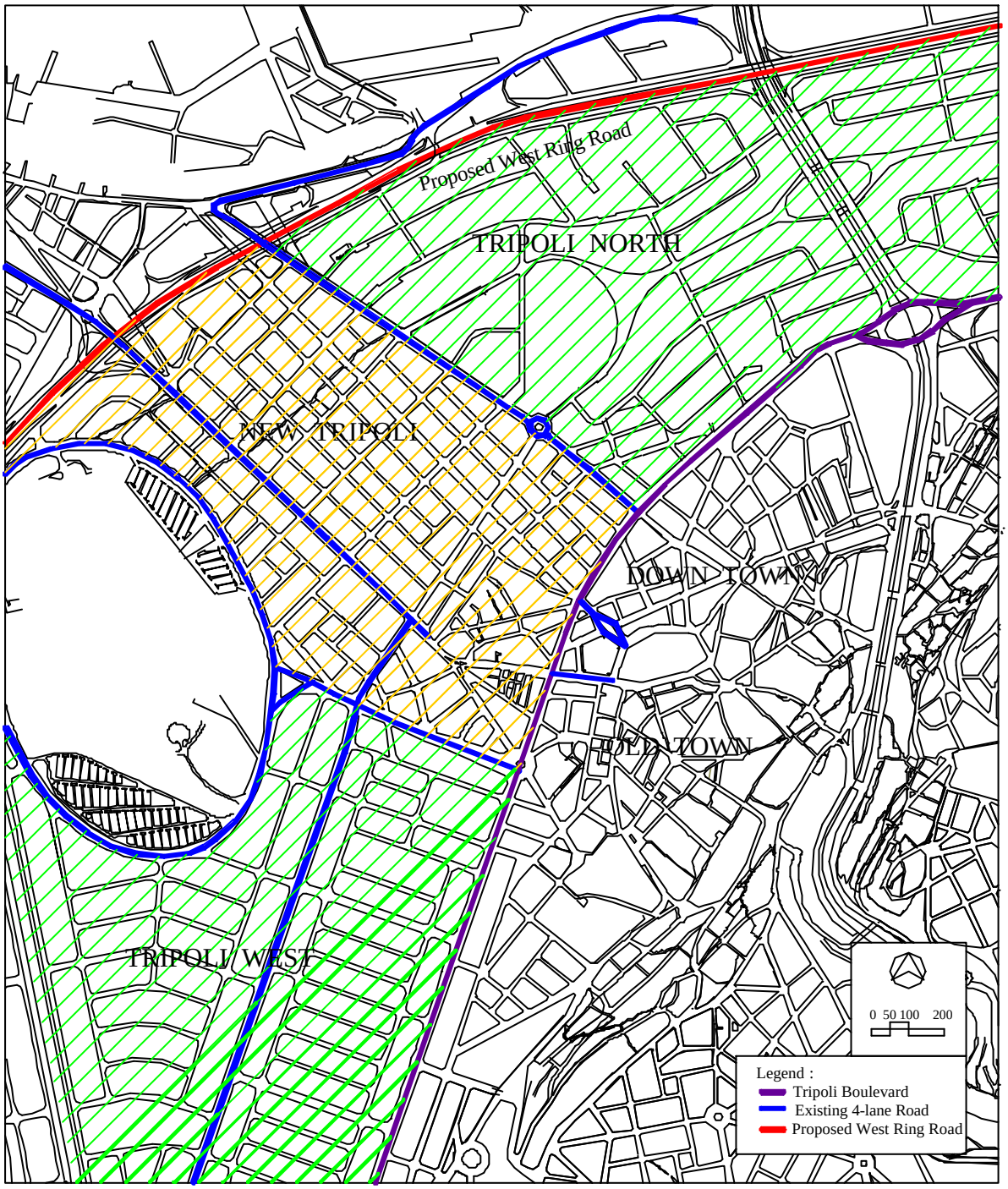


Figure 2.2-1 Road Network in Central Tripoli Area

2.2.2 Objectives of the Project

Objectives of the Project are as follows:

- To alleviate traffic congestion
- To provide anti–air pollution facility for improvement of environment and contribution to human health.

2.2.3 Alternatives Plans

Basically, a scheme of underpass is selected rather than overpass due to landscape and environmental considerations, as overpass schemes are opposed by all concerned authorities. Five alternatives are developed to select the optimum plan for implementation. Alternatives have dfferent lengths and number of intersections to be under-passed, which will affect the cost and efficiency of the underpass.

- Scheme-1: To provide an individual underpass for each intersection A, B, C & D.
- Scheme-2: To provide a continuous underpass for the most congested intersections of B & C.
- Scheme-3: To provide a continuous underpass for three congested intersections of B, C & D.
- Scheme-4: To provide a continuous underpass for 3 intersections A, B & C.
- Scheme-5: To provide a continuous underpass for all 4 intersections A, B, C & D.

Figure 2.2-2 shows these five scheme alignments and Table 2.2-2 shows the evaluation of these schemes.

As a result of the abovementioned evaluation, scheme 3 was selected as the best alternative for the construction of underpass along Tripoli Boulevard.

Table 2.2-2 Evaluation of Underpass Schemes

Scheme No.	**(1) Individual underpass for each intersection A, B, C & D**	**(2) Continuous underpass for intersections B & C**	**(3) Continuous underpass for intersection B, C & D**	**(4) Continuous underpass for intersection A, B & C**	**(5) Continuous underpass for all intersections.**
Advantages	- Can be carried out under phasing concept. - Implementation can be depend on available fund resources.	- Reasonable construction Cost. - Solve the traffic congestion at the most two important intersections along Tripoli Blvd. - Avoid the critical ROW at Behassas side	- Solve traffic congestion at three of the main four intersections along Tripoli Blvd. - Reasonable Construction Length - Avoid the critical ROW at Behassas side - The large area of the roundabout A can be utilized to solve at-grade geometrical alignmet of traffic circulation.	- Solve traffic congestion at three of the main four intersections along Tripoli Blvd. - Costruction cost is less than scheme no. 5	- Slove completely the traffic congestion along the all major intersections along Tripoli Blvd. - Underpass approaches will be costructed in the most wider cross sections.
Dis-advantages	- High construction cost. - Distance among intersections are too short to provide an individual underpasses. - ROW land aquision problem in Behassas side.	- Intersection A will be affected by the approach section of the underpass. - Underpass approach is too near to intersection D. - Traffic congestion will be solved at only two of the major four intersections.	- Underpass approach is too near to intersection A. - Traffic congestion will not be solved at one of the major intersections A.	- Underpass approach is too near to intersection D. - Traffic congestion will not be solved at one of the major intersections D. - Needs land acqusition in Behassas side.	- Almost non except it is the second highest construction cost after scheme no. 1. - Needs land acqusion in Behassas side.
Approach Sec. Length (m)	1,600	400	400	400	400
Tunnel Sec. Length (m)	480	275	585	760	1060
Cost (million US$)	26	13	19	23	30
Rank	**(5)**	**(4)**	**(1)**	**(3)**	**(2)**

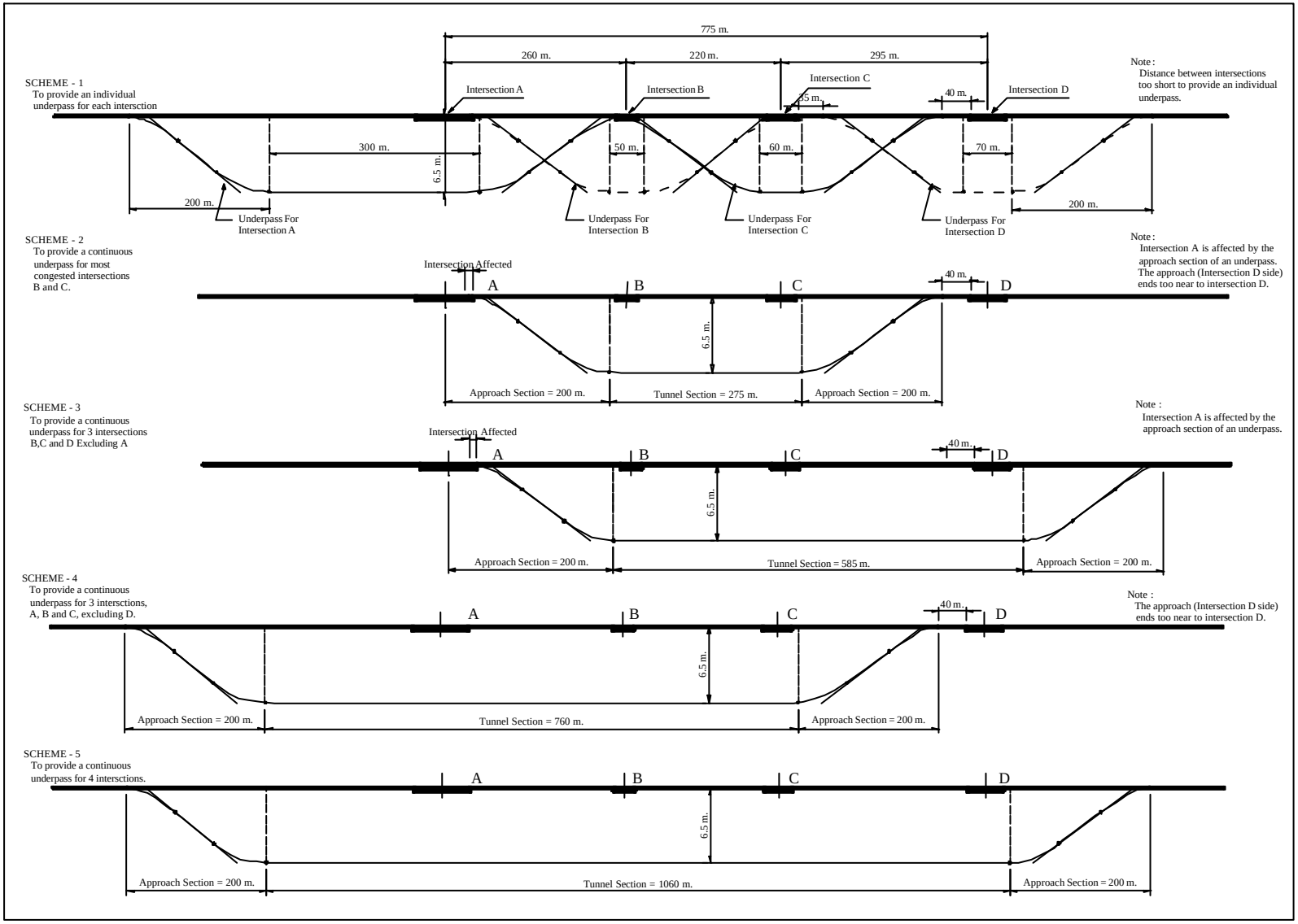


Figure 2.2-2 Alternatives of Tripoli Blvd. Underpass

2.3 PRELIMINARY DESIGN

2.3.1 Design Criteria

Design criteria adopted for the underpass based on standard in Lebanon were as follows:

Design speed	:	60 km/hr
Minimum radius of horizontal curve	:	200 m
Maximum vertical grade	:	5 %
Minimum radius of vertical curve	:	1,400 m
Lane width	:	3.5 m
Shoulder width	:	0.5 m
Vertical clearance	:	4.5 m
Live load for structural design		AASHTO HS 20 – 44

2.3.2 Preliminary Design

Plan and profile of the underpass is shown in Figure 2.3-1 and standard cross section is shown in Figure 2.3-2. Major features of the underpass is as follows:

Tunnel section length	585 m
Approach section length	2 x 200 =400 m
Transition section length	2 x 150 = 300 m
Total length	985 m
Tunnel size (Box-culvert type)	18.0 m x 4.7 m
Drainage	Pump up System
Tunnel ventilation system	Natural ventilation (See Figure 2.3-3)

At-grade section is proposed as follows:

- 4-lane divided street with loading/unloading zone of 2.5 m (or pay-parking).
- 5.3 m sidewalk on both directions, of which 1.5m is planned to be used for green-belt (or flower garden) for beautification of the Blvd.

2.4 CONSTRUCTION PLAN AND COST ESTIMATE

2.4.1 Construction Plan

As the project site is the most congested area with concentration of commercial and business activities, traffic flow and accessibility to the alongside area of the construction site must be maintained and construction period must be so short as possible. Possible detour roads and traffic circulation are shown in Figure 2.4-1. Construction needs to be undertaken by two steps; construction of one direction of underpass in the first step, then the other direction in the second step as shown in Figure 2.4-2. Construction should be done by segment. Possible segmentation will be as follows:

First Segment:	Behsass Side Approach and section between Intersections A & B (l = 455 m)
Second Segment:	Section between Intersections B & Bedaoui side Approach (l =530 m)

Construction period will be as follows

Mobilization	1.0 month
First segment	12.0 months
Second Segment	10.0 months
Demobilization	1.0 month
Total	24.0 months

2.4.2 Cost Estimate

1) Construction Cost:

Construction cost was estimated at 16.67 Million US $ (see Table 2.4-1).

2) Engineering Services Cost:

Detailed design cost was assumed to be about 4% of construction cost and estimated at 0.67 Million US$.
Construction supervision cost was assumed to be 8% of construction cost and estimated at 1.33 Million US$.

3) Right-of-way Acquisition Cost:

Area to be acquired for an additional road right-of-way is estimated to be about 1,750 sq. m.

Right-of-way acquisition cost was estimated as follows:

1,750 x 600 US$/$m^2$ = 1.0 million US$.

4) Project Cost:

Total project comprising construction cost, engineering services cost and right-of-way acquisition cost was estimated at 19.67 Million US$.

Construction Cost	16.67 Million US $ (24.9 Billion LL)
Engineering Services Cost	2.00 Million US $ (3.0 Billion LL)
Right-of-way Acquisition Cost	1.00 Million US $ (1.5 Billion LL)
Project Cost	19.67 Million US $ (29.4 Billion LL)

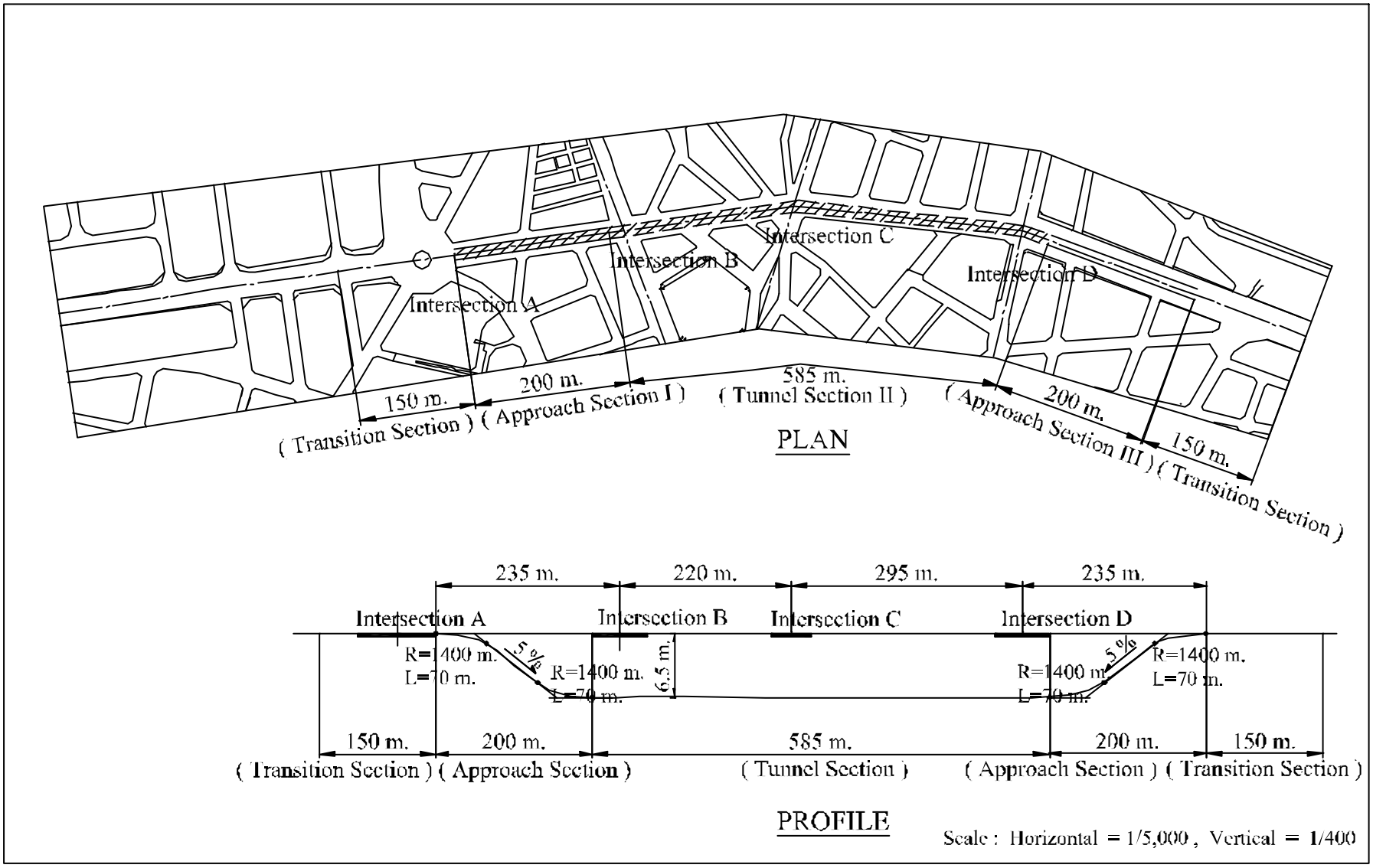


Figure 2.3-1 Tripoli Boulevard Underpass: Plan And Profile

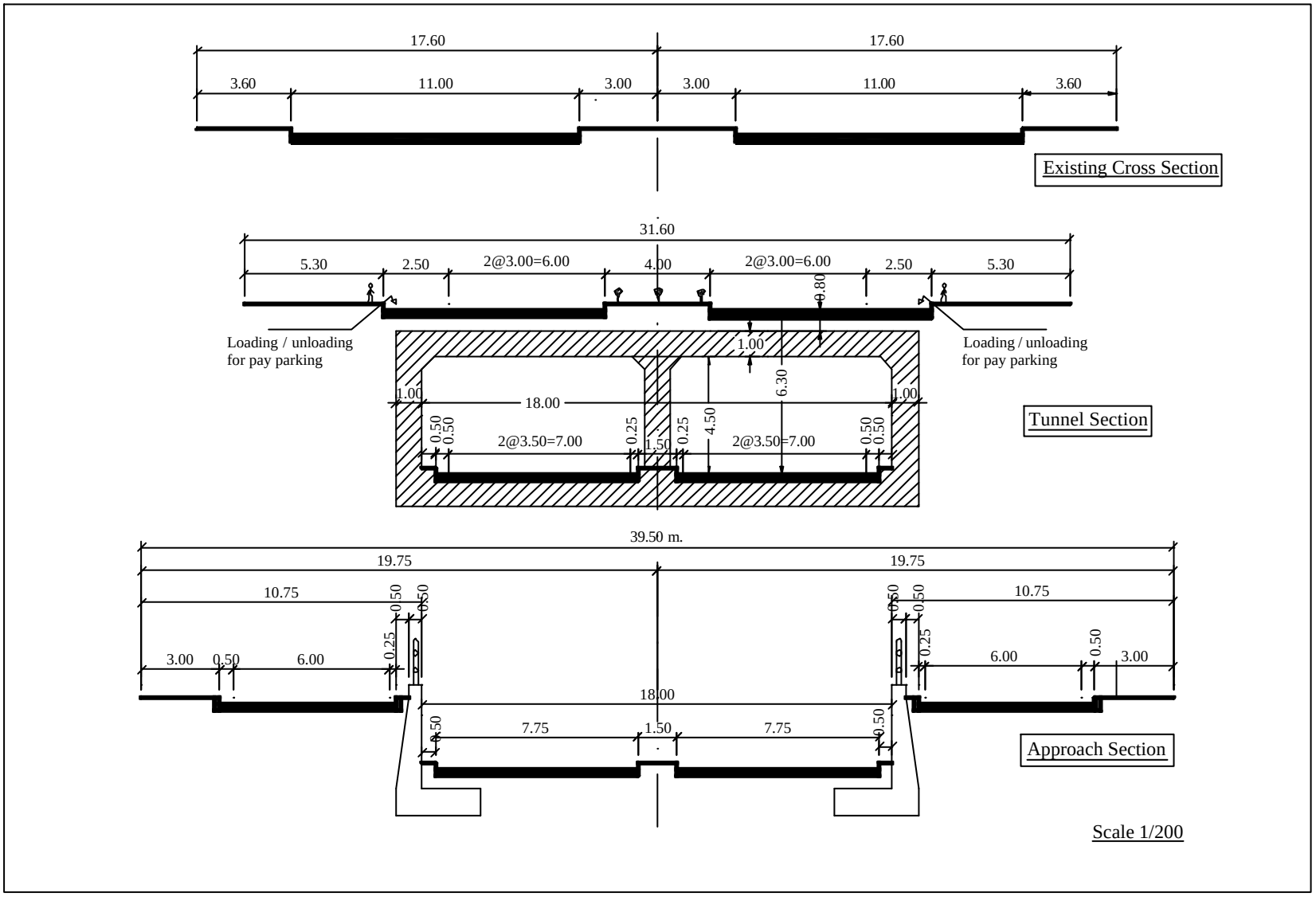


Figure 2.3-2 Proposed Cross Section Of Tripoli Blvd. Underpass

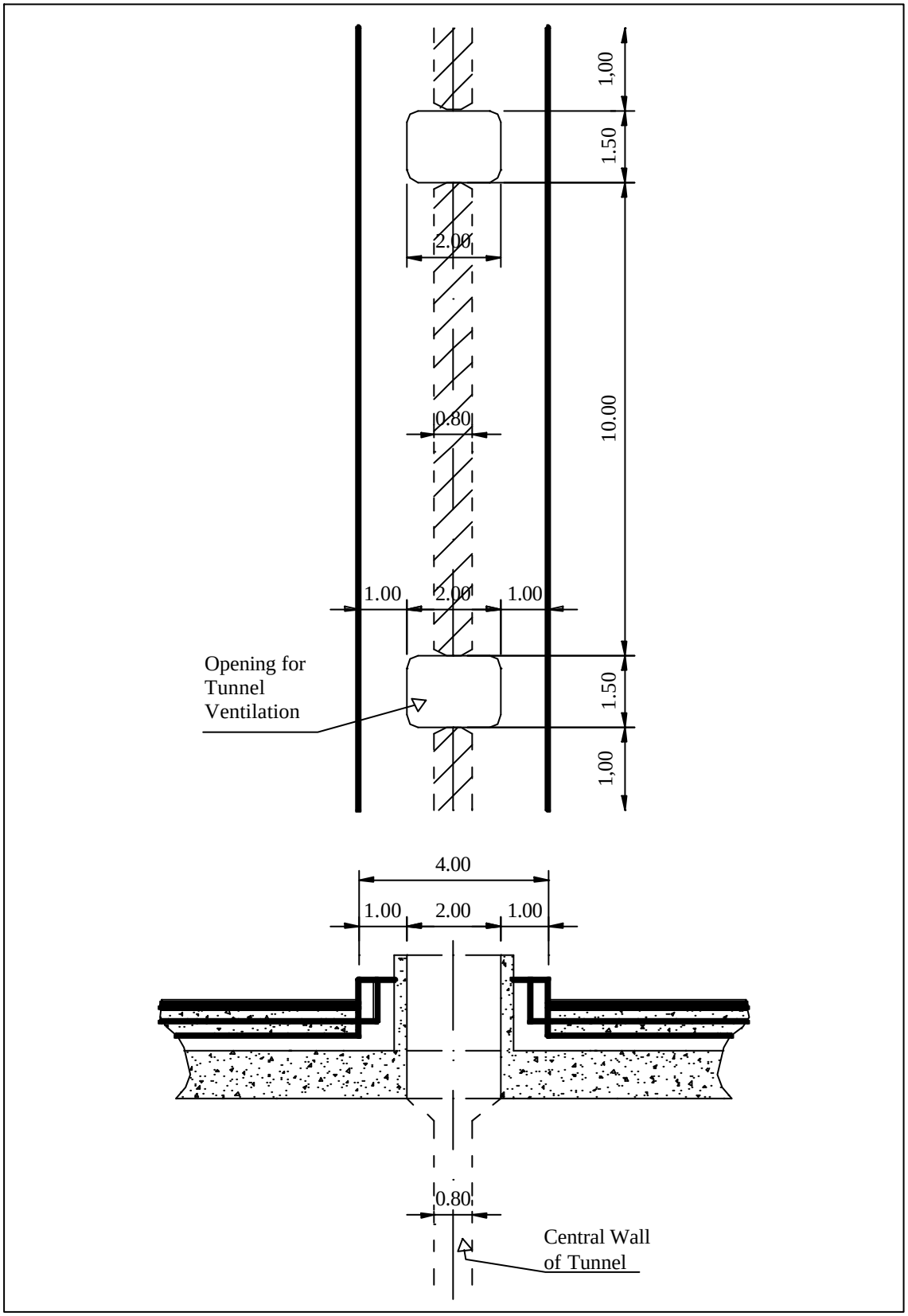


Figure 2.3-3 Opening for Tunnel Ventilation

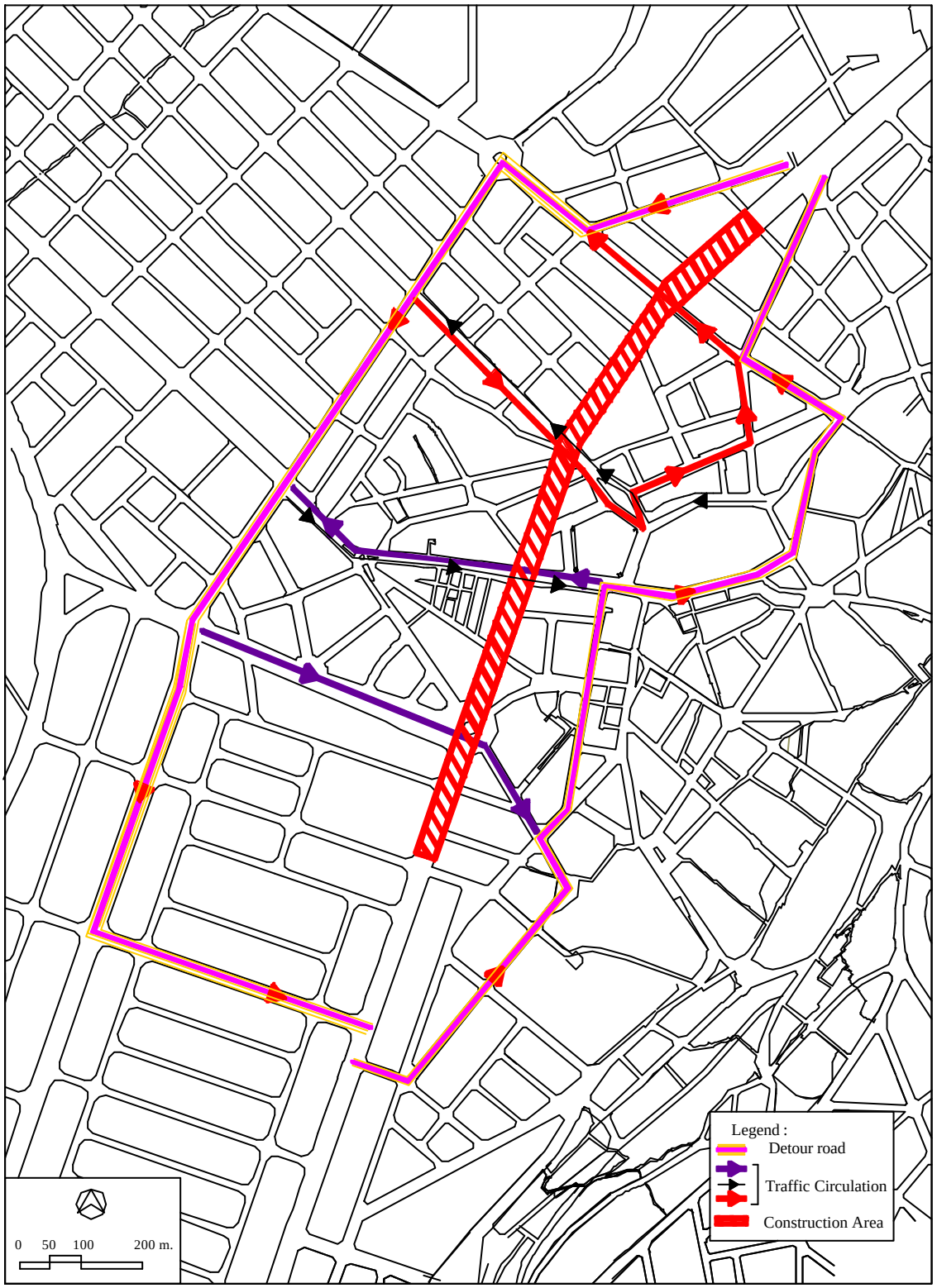


Figure 2.4-1 Detour Roads during Construction of Underpass

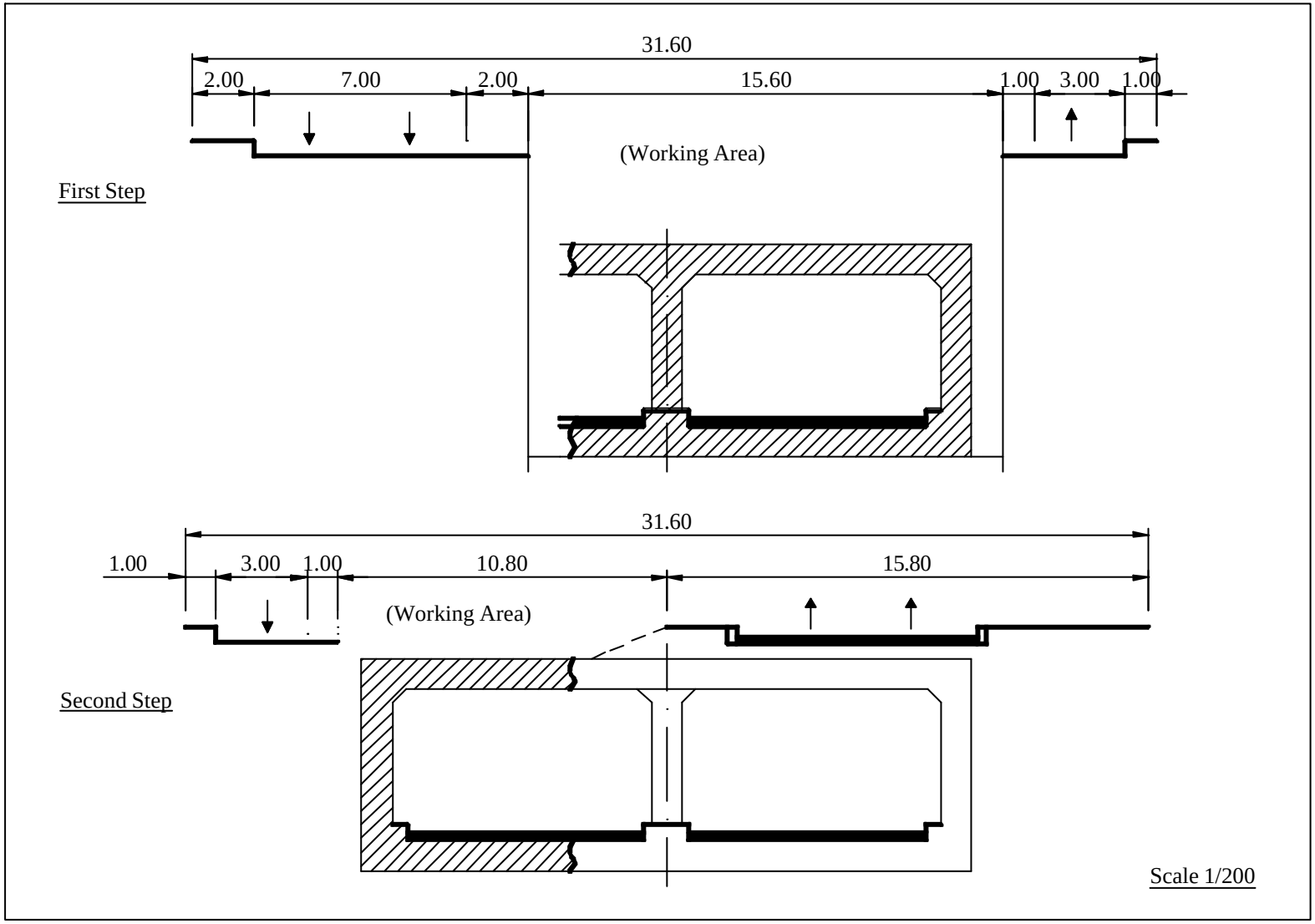


Figure 2.4-2 Construction Procedure

Table 2.4-1 Construction Cost Estimate

Description	Unit	Unit Price (US$)	Quantity	Cost (1,000 US$)
A. Earth Work				
• Removal of existing AC pavement	m^2	3.00	25,000	75
• Removal of existing sidewalk	m^2	2.50	13,400	33.5
• Excavation	m^3	7.00	225,000	1,575
B. Pavement Work				
• AC pavement	m^3	80.00	2,758	221
• Base course	m^3	16.00	6,895	110
• Sub base course	m^3	12.00	9,653	116
C. Structural Work				
• Structural concrete	m^3	120.00	54,497	6,539
• Reinforcing bar	Kg	0.60	5,449,700	3,269
• Structural steel and temporary work	Ton	2,500.00	590	1,476
D. Drainage Work			-	
• Water pump and its facilities	L.S.	150,000.00	1,970	
• Pipe culvert (600)	m	70.00		150
				138
E. Road Surface Works				
• Curb stone	m	12.00	3,940	
• Curb and gutter	m	18.00	3,940	47
• Sidewalk	m^2	20.00	12,280	70.6
• Street lighting	m	350.00	1,285	245
• Lighting for tunnel	m	150.00	985	449
• Traffic signal	Set	35,000.00	3	148
• Pavement markings	m^2	10.00	740	105
• Traffic signs/guide signs	L.S.	90,000.00	-	74
				90
F. Beautification Works				
• Tree planting	L.S.	20,000.00	-	20
• Flower boxes	L.S.	30,000.00	-	30
• Center median beautification	L.S.	10,000.00	-	10
H. Fire Fighting System	m	150.00	1,100	165
Sub-Total				15,156
Physical contingency (10% of above)				1,515
Total				**16,671 (LL 24.9 Million)**

2.5 IMPLEMENTING ORGANIZATION AND FUND PLAN

2.5.1 Implementing Organization

CDR is proposed as the implementing agency. CDR should organize a Project Management Team (PMT) under their responsibility and appoint a Project Manager, an engineer and an accountant or in-house consultant as the team member. Figure 2.5-1 shows the schematic and practical operation of the implementing organization.

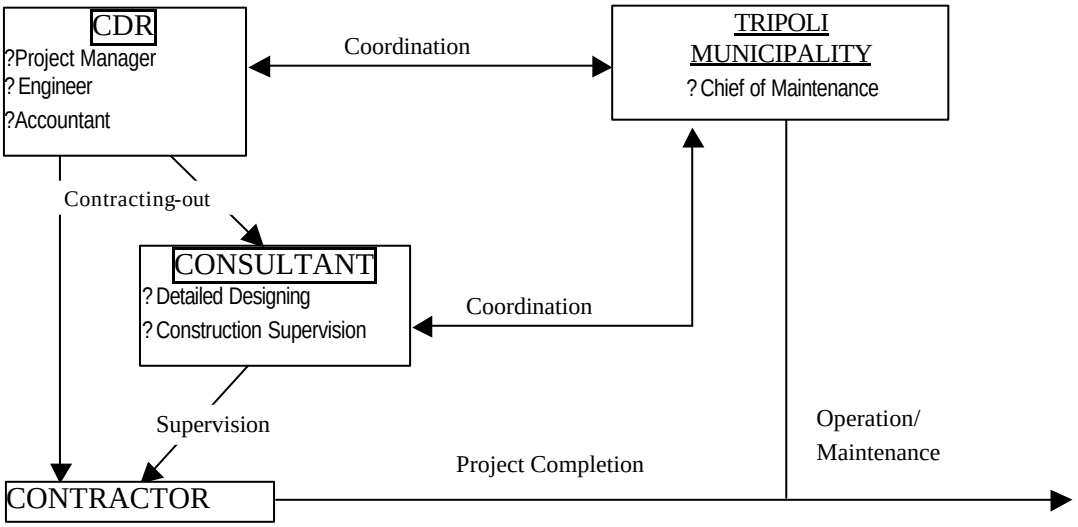


Figure 2.5-1 Project Management Team

In actual performance of the team, there are many relevant organization involved in the implementation of the project. Figure 2.5-2 shows the proposed project implementing organization to be established and its relation with other relevant organizations.

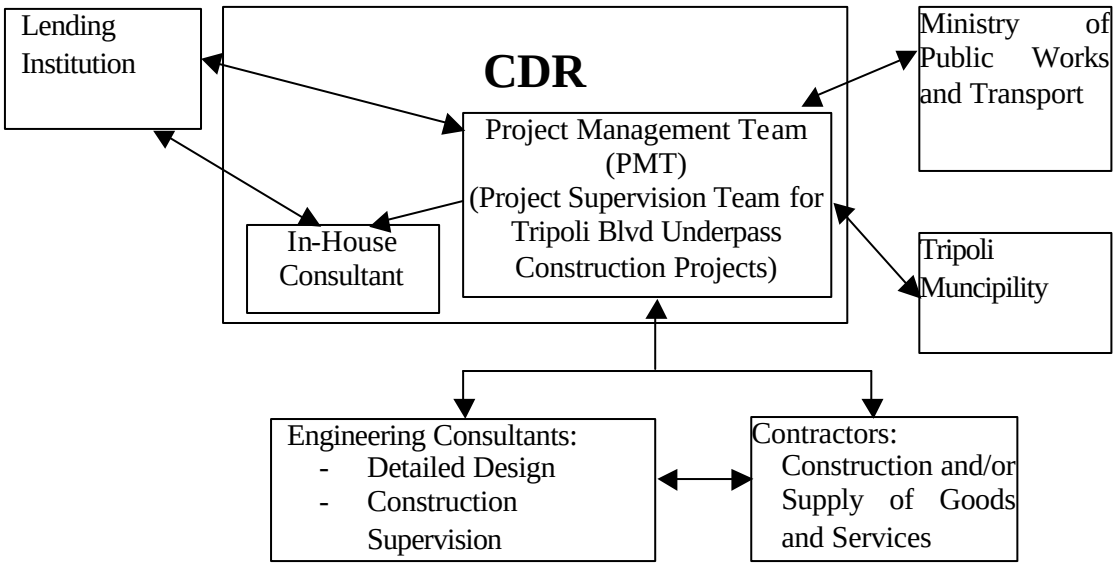


Figure 2.5-2 Proposed Implementing Organization and Relation with Other Organizations

2.5.2 Duty of CDR, Consultant, Contractor and Tripoli Municipality

Project Management Team (PMT) will coordinate with higher authorities of the Government, related Ministries and Tripoli Municipality and a lending institution. It will directly manage the smooth implementation of the Project with the assistance of in-house consultant(s) and advisor(s) who is well acquainted with administrative matters and procedures of a lending institution. CDR will hire an engineering consulting firm(s) for the detailed design and construction supervision. A contractor(s) will be selected through tendering. Table 2.5-1 shows the assigned tasks of each member of the Project Management Team.

Table 2.5-1 Tasks of Project Management Unit

Organization	Category	Duty/Tasks
CDR (PMT)	1) Contracting	(a) Preparation of Contents of Contract, Terms and conditions, Budget (b) Arrangemnt of Right of Way, Acquisition of Land (c) Authorization of performance for consultant
	2) Reporting	(a) Higher Authority (b) Financier
	3) Supervising of contracts	Supervising of consulting service contract, supply and/or construction contracts
Consultant	1) Detailed Designing	(a)Review on the preliminary study and design mentioned in the Feasibility Study (b) Preparation of Construction Plan and Drawing (c) Cost Estimation (d) Preparationof Construction Specifications (e) Tender Documents Preparation
	2) Construction Supervision	(a) Quality Control (b) Quantity Control (c) Schedule Control
Contractor	Construction	Construction and/or Supply of Goods and Services
TRIPOLI MUNICIPALITY	Management of O & M	(a) Operation (b) Maintenance

2.5.3 Fund Plan

Since this project does not have any income from the operation, the Municipal budget is not enough to spare for this project, and final financial burden should be covered by tax payer. The project should be implemented to have concessional loan from international aid agencies. Annual fund requirements are estimated as shown in Table 2.5-2.

Table 2.5-2 Required Annual Fund Unit: Billion L.L

Items	2002	2003	2004	2005	Total	%
Right of Way, Land Acquisition	0.30	1.20			1.50	5.1
Engineering	2.40	0.60			3.00	10.2
Construction		7.50	10.00	7.49	24.90	84.7
Total	2.70	9.30	10.00	7.49	29.40	100.0

Administraive cost for each implementing organization is not included. Financing cost such as payment of intrest and fees is also not included because the terms and conditions of the loan is unknown at this time.

Except engineering cost, all other cost is local cost. It should be reminded that some small amount of the local cost should be born by the project implementing organization because some international aid agencies can not finance some of the local cost such as land acquisition cost.

2.6 PROJECT EVALUATION

The project evaluation is derived from the different between "Do-nothing Project" and "With Project". The economic benefit is made for the following assumptions.

2.6.1 Assumptions

1) Time Frame (Analysis Period)
- Detailed design : 2002
- Construction : 2003-2004
- Operation (benefit generation) : 2005-2029 (25 years)

2) Cost
Economic cost is used, which is estimated by deducting the tax component from the financial cost as shown in Table 2.6-1.

Table 2.6-1 Project Cost Component

Unit: Billion L.L

Item	Economic Cost		Tax	Financial Cost
	Foreign	Local		
Construction Cost	15.44	8.26	1.30	24.90
Engineering Cost	1.80	1.04	0.16	3.00
Right-of-way	0.00	1.42	0.08	1.50
Total	17.24	10.72	1.54	29.40

3) Pavement Maintenance
AC overlay with a thickness of 5cm is applied as a rehabilitation work after 10 years of completion and maintenance cost shall be recurring throughout the analysis period.

4) Quantified Benefit
Traffic cost savings consisting of:
- Running cost
- Fixed cost
- Time cost

5) Discount Rate : 12% per year.

2.6.2 Results of Evaluation

1) Unit Traffic Cost and Project Benefits
Table 2.6-2 shows the unit traffic cost and project benefits are shown in Table 2.6-3. Comparison of pcu-km and pcu-hr shows that construction of underpass will lead to savings in vehicle operating costs and travel time cost ranging from L.L 10.34 billion in year 2005 to L.L 14.60 billion in year 2020.

Table 2.6-2 Unit Traffic Cost

Unit: L.L/km, L.L/hr

Vehicle Type / Speed	Passenger Car	Taxi	Bus	Truck
30	205	194	328	334
40	182	177	300	304
50	166	159	292	295
60	157	152	287	291
Fixed Cost / hr	505	642	2,091	2,678
Time Cost / hr	5,520	4,200	3,465	4,860

Table 2.6-3 Project Benefits

Item	2005		2010		2020	
	PCU-km	PCU-hr	PCU-km	PCU-hr	PCU-km	PCU-hr
Do-nothing Project/day	2,074,671	48,884	2,205,718	53,536	2,460,805	63,618
With Project/day	2,043,003	44,422	2,172,954	48,833	2,413,528	57,864
Savings/day	31,668	4,462	32,764	4,703	47,277	5,754
Annual Savings in Traffic Cost	2,804	7,535	3,011	8,155	4,463	10,140
Annual Benefit	L.L 10,340 Million		11,166		14,603	

2) Economic Indication

Table 2.6-4 shows the cost and benefit flow for construction of the proposed Tripoli Boulevard underpass project. Net Present Value (NPV) and Benefit-Cost Ratio (B/C) are calculated at L.L 51.39 billion and 3.15 for 25 years period. The corresponding values of the Economic Internal Rate of Return (EIRR) are calculated as 32.68.

Table 2.6-4 Cost and Benefit Flow

Unit : Billion L.L

Year	Cost				Benefit							Dis'd Cost	Dis'd Benefit
	D/D, C/S	Const.,	Maint	Total Cost	Running Cost, W/O	Fixed Cost, W/O	Time Cost, W/O	Running Cost, With	Fixed Cost, With	Time Cost, With	Total Benefit		
2002	1.2	-	-	1.2	-	-	-	-	-	-	-	1	-
2003	0.8	12.6	-	13.4	-	-	-	-	-	-	-	12	-
2004	0.8	12.6	-	13.4	-	-	-	-	-	-	-	11	-
2005	-	-	0.1	0.1	120	12	71	117	11	65	10	0	7
2006	-	-	0.1	0.1	122	12	73	119	11	66	11	0	7
2007	-	-	0.1	0.1	124	12	74	121	11	68	11	0	5
2008	-	-	0.1	0.1	126	12	76	123	11	69	11	0	5
2009	-	-	0.1	0.1	127	13	78	125	11	71	11	0	5
2010	-	-	0.1	0.1	129	13	79	126	12	72	11	0	5
2011	-	-	0.1	0.1	131	13	81	128	12	74	12	0	4
2012	-	-	0.1	0.1	133	13	83	130	12	75	12	0	4
2013	-	-	1.1	0.1	135	13	85	132	12	77	12	0	4
2014	-	-	0.1	0.1	137	14	86	134	12	79	13	0	3
2015	-	-	0.1	0.1	139	14	88	136	13	80	13	0	3
2016	-	-	0.1	0.1	141	14	90	137	13	82	13	0	3
2017	-	-	0.1	0.1	143	14	92	140	13	83	13	0	2
2018	-	-	0.1	0.1	145	14	93	141	13	85	13	0	2
2019	-	-	0.1	0.1	147	15	95	143	13	86	13	0	2
2020	-	-	0.1	0.1	149	15	97	145	14	88	14	0	2
2021	-	-	0.1	0.1	151	15	99	147	14	90	14	0	2
2022	-	-	0.1	0.1	153	15	100	149	14	91	14	0	2
2023	-	-	1.1	0.1	156	16	102	151	14	93	14	0	1
2024	-	-	0.1	0.1	158	16	104	153	14	95	14	0	1
2025	-	-	0.1	0.1	160	16	106	155	15	96	15	0	1
2026	-	-	0.1	0.1	162	16	108	157	15	98	15	0	1
2027	-	-	0.1	0.1	164	16	110	159	15	100	15	0	1
2028	-		0.1	0.1	166	17	112	161	15	102	15	0	1
2029		-11.2	0.1	-11.8	169	17	114	163	15	103	15	-0	1
Total	2.8	14.0	2.8	19.6	3,591	357	2,296	3,488	324	2,088	343	24	75

Economic Indicators	
B/C Rate	3.15
EIRR (%)	32.68
NPV (B L.L)	51.39

2.6.3 Sensitivity Analysis

A sensitivity analysis was conducted to take into account the uncertainty of assumptions for unexpected increase in construction costs or decrease in benefits. The cases considered in this analysis are:

Case 1: Cost + 10 % and Benefit 0 %
Case 2: Cost 0 % and Benefit - 10 %
Case 3: Cost + 10 % and Benefit - 10 %

The result of this sensitivity analysis is shown in Table 2.6-5.

Table 2.6-5 Sensitivity Analysis

Parameter	Base Case	Sensitivity Analysis		
		Case 1	Case 2	Case 3
B/C Ratio	3.15	2.86	2.83	2.57
EIRR (%)	32.68	30.21	29.96	27.68
NPV (B L.L)	51.39	48.99	43.85	41.46

CHAPTER 3

CENTRAL TRIPOLI TRANSPORT MANAGEMENT PROJECT

CHAPTER 3

CENTRAL TRIPOLI TRANSPORT MANAGEMENT PROJECT

3.1 PRESENT CONDITION AND PROBLEMS

Central Tripoli which consists of Central Business District (CBD) and extended to cover all the near surrounding main commercial streets, touristics area, old town market area and shopping area along Abou-Ali River. New Tripoli is the busiest area in the Study Area with concentration of commercial and business activites as well as cultural and historical spots. Accordingly people are concentrated and high volume of traffic is generated and attracted in the area. Present condition and problems are as follows as shown in Figure 3.1-1.

a) Road Network and Road Space Utilization
- Roads are mostly narrow and road network is like a maze, particularly downtown and old city areas.
- Road space is not fully used for traffic purpose due to heavy on-street parking.
- There is no room for road widening or construction of new road due to high density roadside development.

b) Inter-City Buses
- There is no off-street inter-city bus terminal, but existing roads are used as the inter-city bus terminal (or on-street inter-city bus terminal).
- Inter-city buses wait for passengers on a road until enough passengers boared on it, thus traffic is severely disturbed.
- On-street inter-city bus terminals are concentrated along the busiest roads.

c) Taxis
- There is no off-street taxi terminal stand. Taxis are parking on streets to get 4 or 5 passengers.
- Over-supply of taxi service is obvious. Many taxis can not get passengers, but park on a street all day long.
- Taxis are concentrated at Public Garden and J. Abd El-Nasser Square areas.

d) On-Street Parking
- Many vehicles park along streets, narrowing a road space for travel way.

e) One-way Traffic Operation
- One-way traffic operation is being extensively adopted in the most of areas, this system is successful, but there are some areas where this system needs to be improved.

f) Environmental Condition
- Due to concentration of traffic, its slow moving conditions, and many old-age vehicles, air quality is seriously deteriorated.

g) Factors afecting Tourism Development
- Historical and cultural heritages are concentrated in the old city area. Proper parking areas, improvement of sidewalks and pedestrian roads and beatificution of area are needed to attract more tourists.

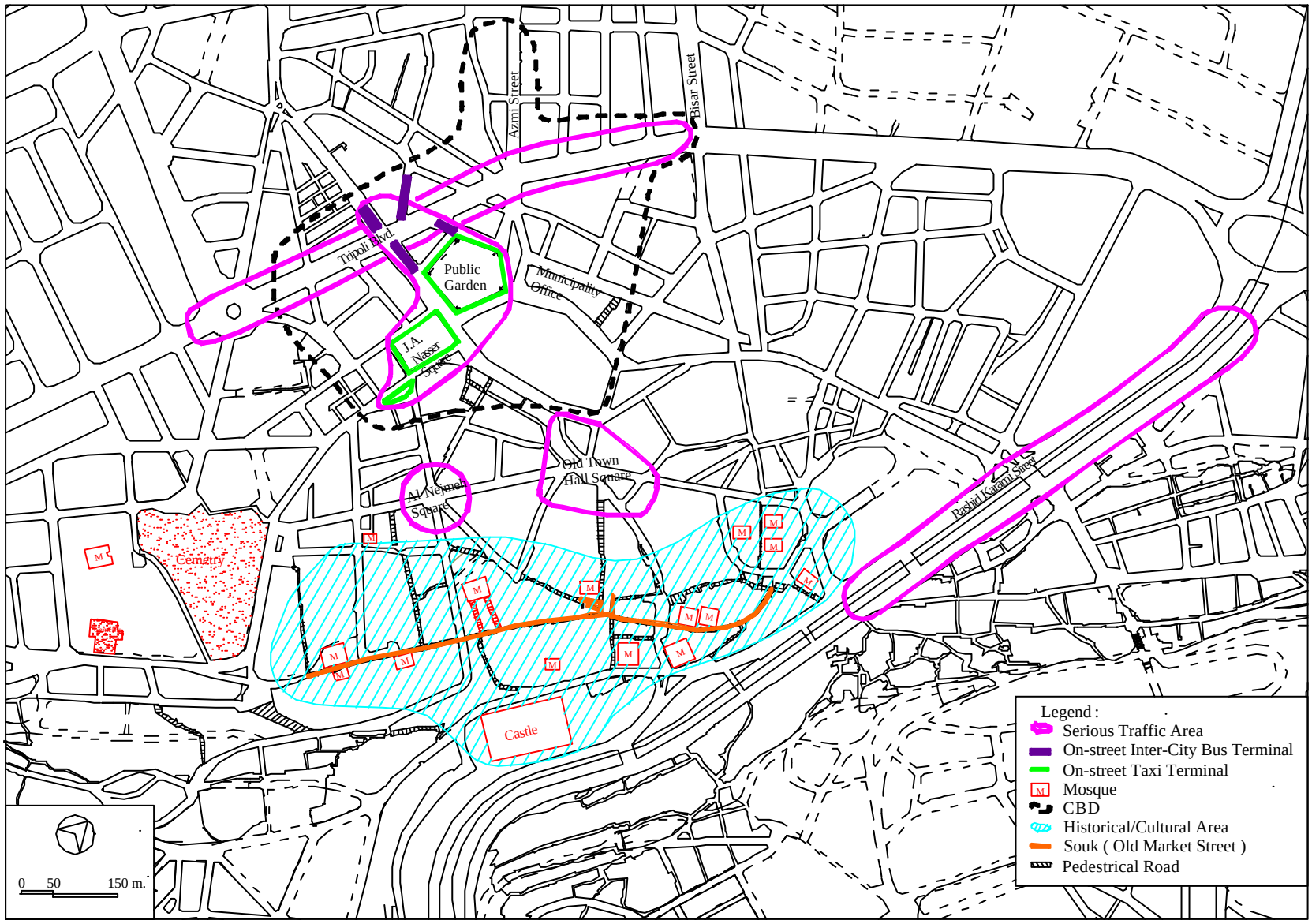


Figure 3.1-1 Present Condition of Central Tripoli Area

3.2 PROJECT COMPONENTS

In order to solve traffic congestion and environmental problems in the Central Tripoli Area, integrated approach is needed. The following project components should be integrally implemented.

Poject Component

1) Improvement of Bus/Taxi Service and Designation or Construction of New Terminals.
2) Improvement of One-way Traffic System.
3) Restricted On-Street Parking and Provision of Off-Street Parking Area.
4) Intersection Geometry Improvement and Installation of Traffic Signal.
5) Installation of Trafic Safety Facilities.
6) Installation of Traffinc Signs and Pavement Markings.

3.3 BUS/TAXI SERVICE SYSTEM AND TERMINALS

3.3.1 Proposed Bus/Taxi Service System and Terminals

Bus/Taxi Srvice System needs to be planned in relation to provision of terminals. In the Master Plan, the following are recommended:

- Introduction of City Bus (Short term: 2001-2005).
- Construction of Behsass Terminal (Short term: 2001-2005).
- Construction of Bedaoui Terminal (Medium term: 2006-2010)

In line with above recommendations, bus/taxi service system improvement schemes were studied as shown in Table 3.3-1.

Improvement of Present System (Short-term Measure)

- System to be implemented immediately until such time that the Behsass Terminal is completed. Major proposed improvement is as follows:
    - Existing on-street inter-city bus terminals are transferred to the designated temporary, terminal located near the present on-street terminals.
    - Taxi service and taxi terminals remain the same as present, however, control measure of over-supply of taxi service be implemented.

Designed Terminal System (1) (Medium-term Measure)

- One of the schemes to be considered when new (Behsass) Terminal is completed.
- Function of short-term bus terminal is transferred to new terminal.
- Bus/taxi service system is the same as the short-term measure.

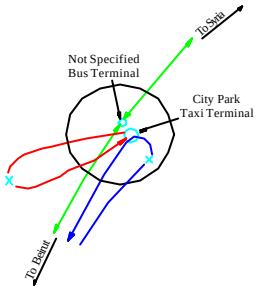
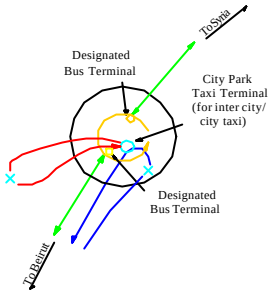
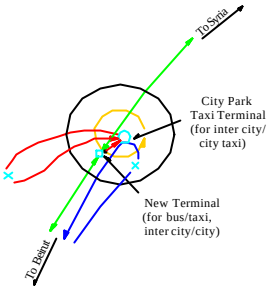
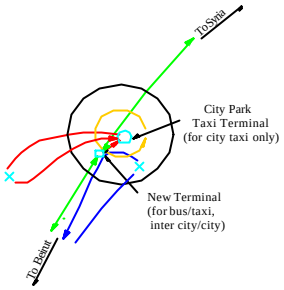
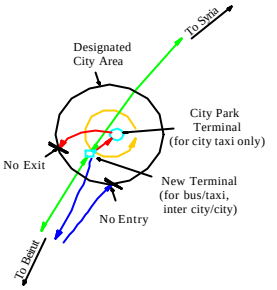
Designated Terminal System (2) (Medium-term Measure)

- Same as Designated Terminal System (1), except inter-city taxis are prohibited to park at the City Park Taxi Terminal in order to reduce traffic congestion at the City Park Area.

Taxi Area Service System (Meduim-term Measure)

- City taxis are allowed to operate only within the designated city area, and allowed to park at the City Park Terminal.
- Inter-city taxis are allowed to load and unload only at the new terminal, and operation within the designated city area is prohibited.

Table 3.3-1 Bus/Taxi Service System Improvement Schemes

	Present System	Improvement of Present System (Short Term Measure)	Designated Terminal System (1) (Medium Term Measure)	Designated Terminal System (2) (Medium Term Measure)	Taxi Area Service System (Medium Term Measures)
Schematic Diagram **LEGEND:** Inter City Bus City Bus Inter City Taxi City Taxi Loading/unloading Unloading Designated terminal New Terminal					
System	- Intercity Bus: Loading and unloading at the city center, parking on a road. - City Bus: Are not yet in service. - Inter City Taxi: Unloading almost at passanger's final destination and loading almost at city center. - City Taxi: There is no classification between city and intercity taxi, that means city taxi can move from inside and outside the city boundary.	- Intercity Bus: Loading and unloading at designated bus terminal. - City Bus: Connect the city center with the designated bus/taxi terminals and other city destinations. - Inter City Taxi: Unloading at passanger's destination and loading at city center terminal. - City Taxi: Loading from the city center, unloading at passenger's destiantion and also can go outside the city boundary. - Provision of designated bus terminal.	- Intercity Bus: Loading and unloading at the new terminal. - City Bus: Connect the different city origins and destinations with the terminal locations. - Inter City Taxi: Unloading at passanger's destination and loading at the city park terminal. - City Taxi: Loading at the city park terminal and unloading at passenger's destiantion, connect the city park terminal with the new terminal and can also go outside the city boundary. - Construction of a new terminal.	- Intercity Bus: Loading and unloading at the new terminal. - City Bus: Connect the different city origins and destinations with the terminal locations. - Inter City Taxi: Unloading at the passanger's destination and loading at the new terminal. - City Taxi: Loading and unloading can be at the city park terminal and also connect the city park terminal with the new terminal and also go outside the boundary of the city. - Construction of a new terminal.	- Intercity Bus: Loading and unloading at the new terminal. - City Bus: Loading and unloading at origins and destinations and connect the city park terminal with the new terminal. - Inter City Taxi: Loading and unloading only at the new terminal and not allowed to enter the city boundry. - City Taxi: Move only within the city boundary and can make loading and unloading at the city park terminal and new terminal. - Construction of new terminal.
Advantage	Very conveniant and confortable for the passangers, but hampering social activities and city environment.	- Mitigate the congested traffic condition at the city center because of designated bus terminals. - Intercity bus will not enter to the city center that can improve the congested traffic condition at the city center.	- Intercity bus will load / unload at a new terminal therefore, bus congestion at city center will be mitigated.	- Congestion at the city park terminal will be minimized , because inter city taxi can not load at city park terminal.	- Recognizable improvement in the reduction of traffic congestion at the city center.
Disadvantage	- There is no functional classification of the city intercity taxi/bus. - There is not enough parking space at the city center and city park terminal which are over congested. - Taxi waits for a long time since the number of passenger is few. (taxi service supply is greater than passenger demand).	- Almost same as the current condition unless the following measures will be implemented: • Commencement of city bus services. • Enforcement of recommended traffic regulation. • Traffic flow improvement especially near the old city. • Intersection improvement including traffic flow and geometry.	- Congestion at city park terminal may be almost remain as present system unless the recommended measures will be implemented. - Recommended measures same as " Improvement of present system.	- City taxi shall be destinguished with city ID card to park at city park terminal. - Enforcement to prohibit intercity taxi from loading at the city park terminal.	- Difficult to define the city boundry limits because administrative legislation on service area of taxi is required to be determined at national level. - Dificult to prohibit a city taxi to go out of, and an inter city taxi to go in the city boundary.
Evaluation	Not acceptable in terms of hampered social activities and city environment.	Practical as short term maesure with recommended measures.	Not acceptable as medium term measure because of congestion at city park terminal.	Practical.	Not implementable because of required legislation at national level.

Among medium term measures, Designated Termimal System (2) is recommended for implementation.

Candidate locations of temporary inter-city bus terminals are shown in Figure 3.3-1. Land for temporary inter-city bus terminal will be leased from a land owner to the Tripoli Municipality Government.

3.3.2 Control Measure of Over-Supply Taxi Service

The following legislation or regulation are recommened to be formulated and strictly enforced to control over-supply of taxi service:

a) To Prohibit old model taxis. Business permit or renewal of such of old taxis should be canceled or not be issued.

b) To introduce odd-even plate number system for example:

- Even number plate taxis: operation is allowed on Mondays, Wednesdays, Fridays to Sundays.
- Odd number plate taxis: operation is alowed on Tuesdays ,Thursdays and Fridays to Sundays.

Number of taxis can be reduced to one half from Monday to Thursday of a week.

Due to over-supply of taxi service, most taxi drivers have less chances to catch passengers. Therefore, even if this odd-even plate number system is introduced, drivers income will not be reduced.

c) To apply parking fee

3.4 ONE-WAY TRAFFIC SYSTEM

3.4.1 Present One-Way Traffic System

Present one-way traffic system is shown in Figure 3.4-1, which is generally well planned and functioning except in the areas A and B. Present one-way traffic system and traffic volume in the area A is shown in Figure 3.4-2(a). Problem exists at Approach 5 where traffic of 3,910 veh./day has to maneuver to make left turn to merge with traffic of 7,270 veh./day which comes from the opposite direction and makes a queue which extends up to the intersection, resulting in heavy traffic condition at the intersection.

Present one-way system of the area B is shown in Figure 3.4-3(a). In this area, taxis are concentrated and parked along Public Garden and J.A.Nasser Square. Present system does not allow access from (A) to (B). At (C), traffic direction of ordinary vehicles is different from that of taxis. Circulation along J.A.Nasser Square can not be made.

3.4.2 Proposed One-Way Traffic System

Proposed one-way traffic system is shown in Figure 3.4-4. Modification of the system is proposed at areas A and B. Detailed traffic flow for areas A and B is shown in Figures 3.4-2(b) and 3.4-3(b), respectively.

This modification can be easily done without physical improvement, however, it is recommended that intersection geometry be improved as shown in section 3.6 of this chapter and traffic signals be installed.

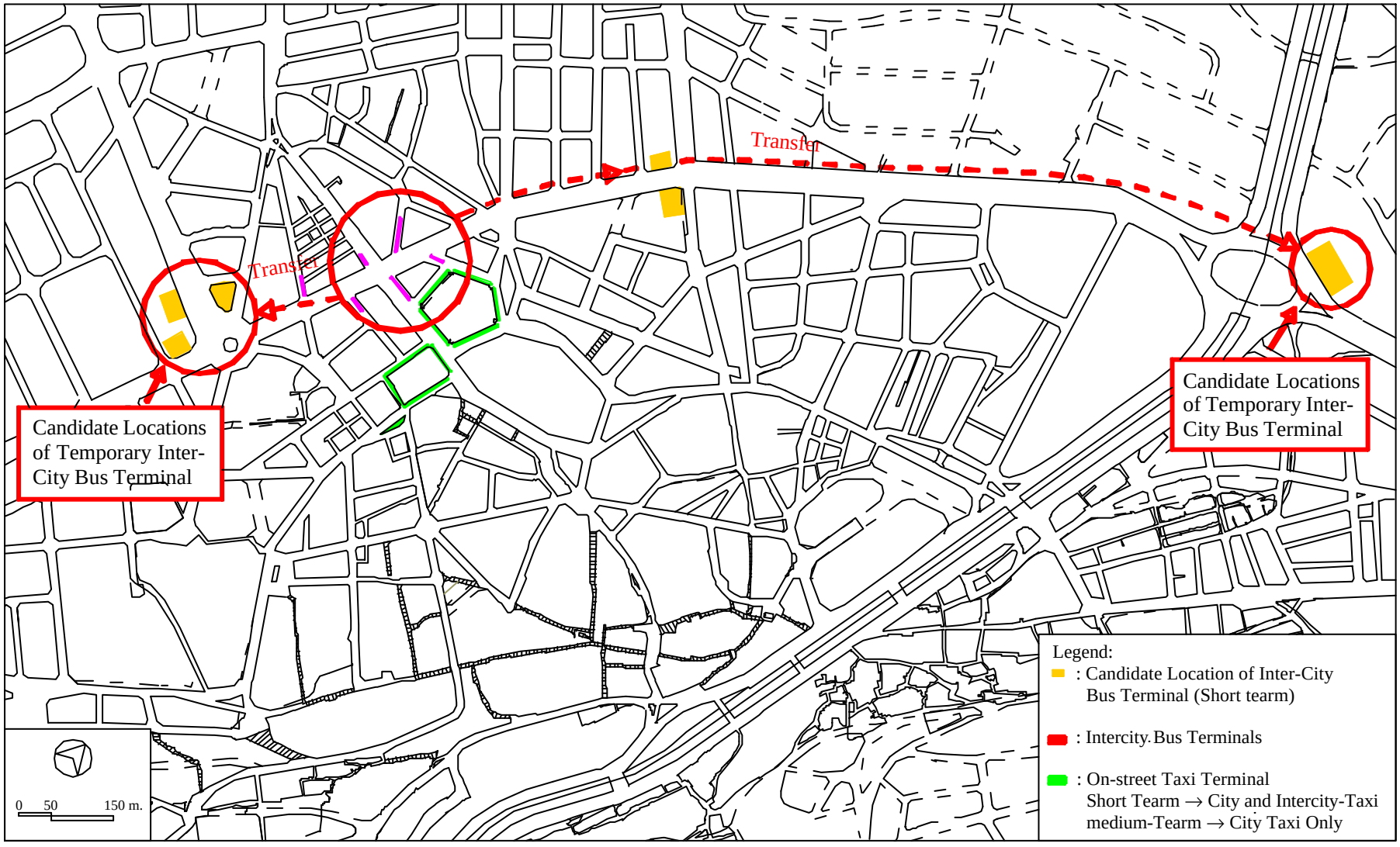


Figure 3.3-1 Candidate Location of Intercity Bus Terminals

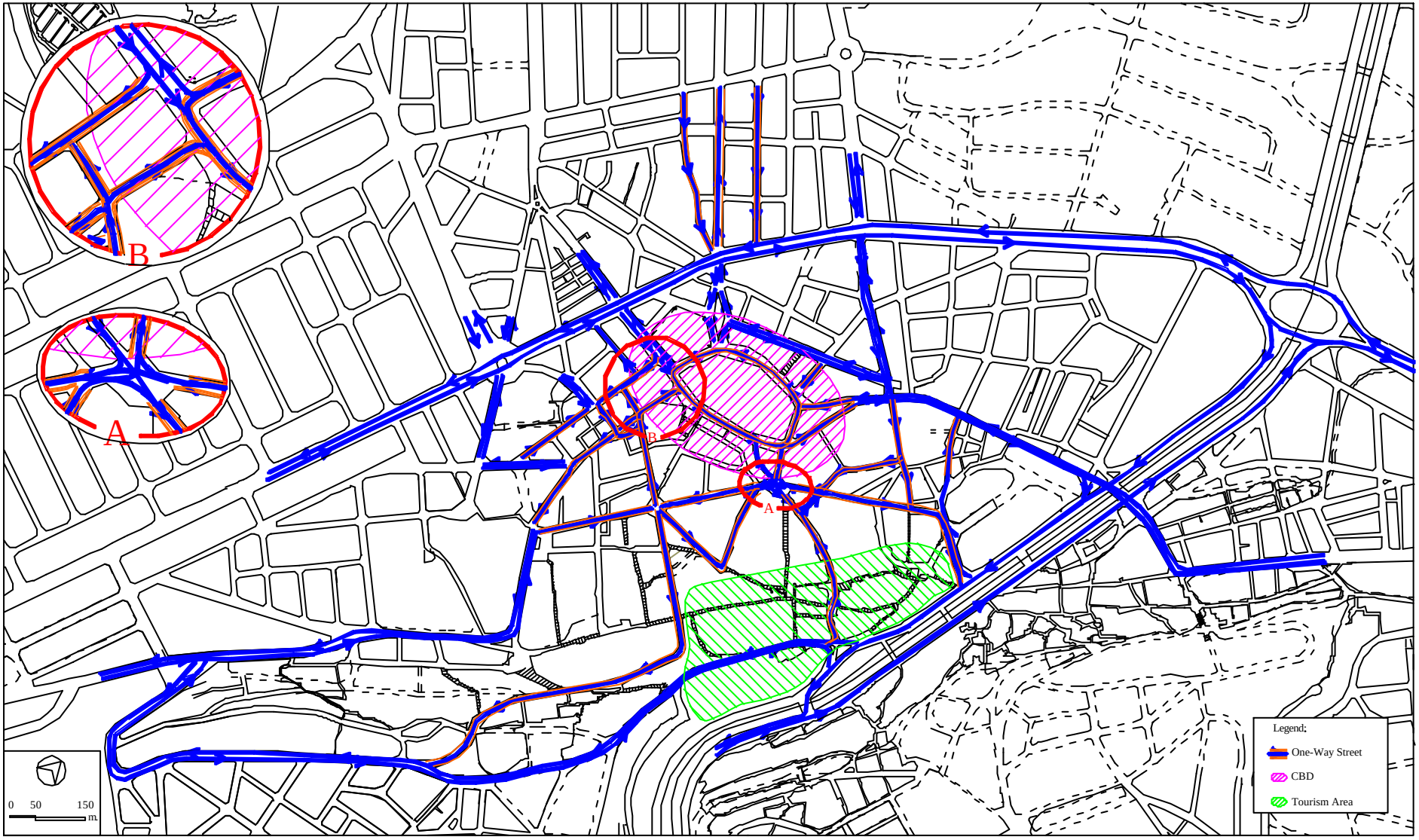


Figure 3.4-1 Present One-Way System

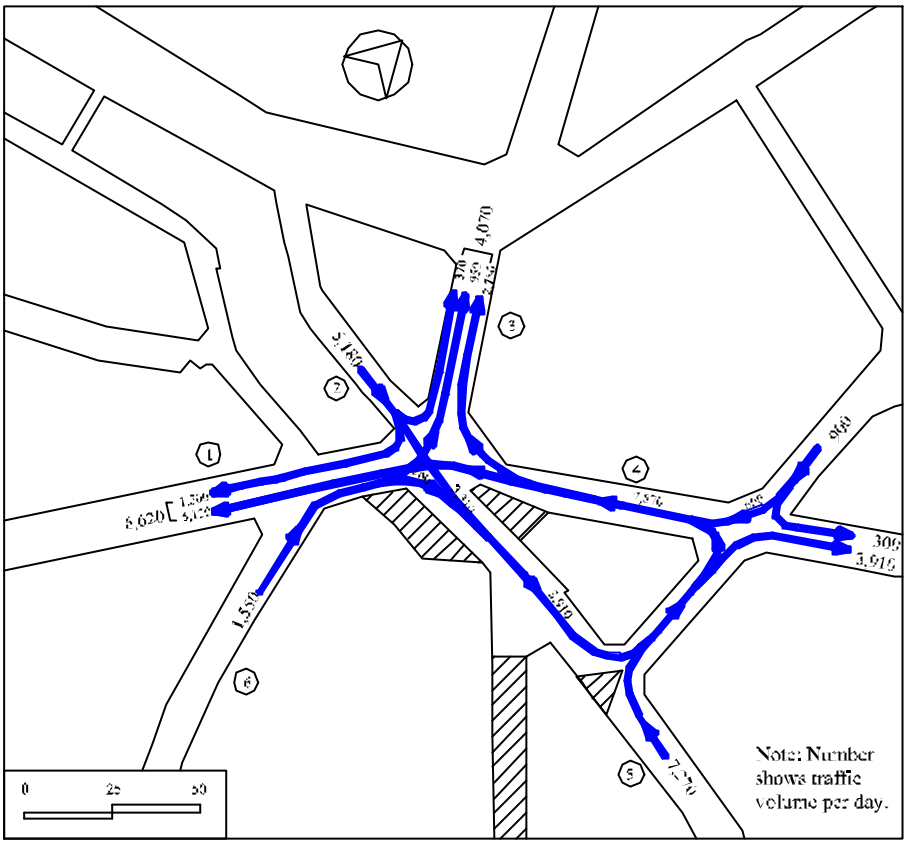


Figure: 3.4-2(a) Area A : Present One-Way System

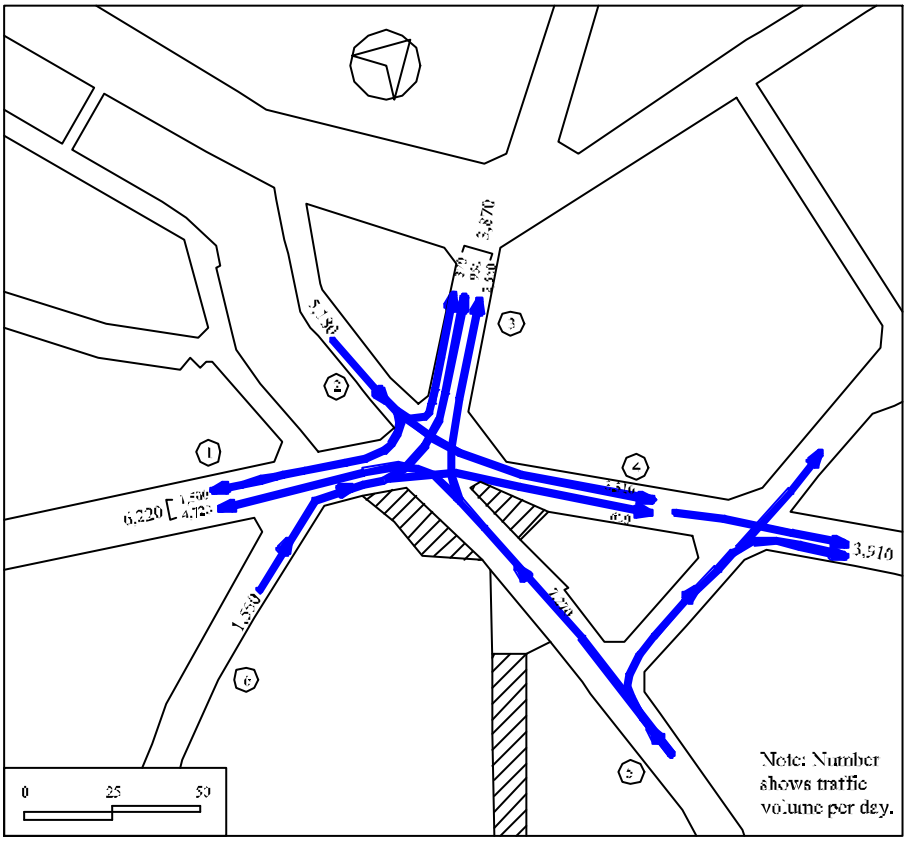


Figure: 3.4-2(b) Area A : Proposed One-Way System

Figur 3.4-2(a) & Figure 3.4-2(b)

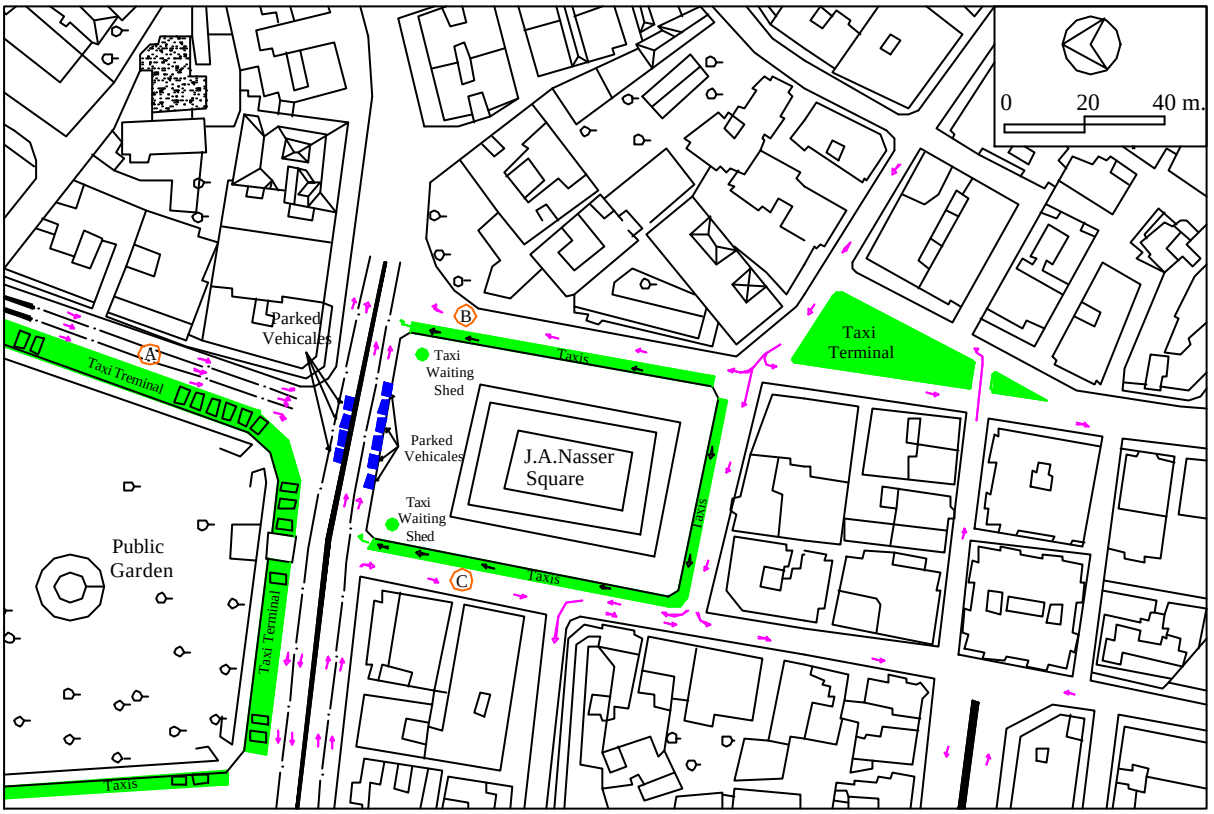


Figure: 3.4-3(a) Area B : Present One-Way System

Figure: 3.4-3(b) Area B : Proposed One-Way System

Figure 3.4-3(a) & Figure 3.4-3(b)

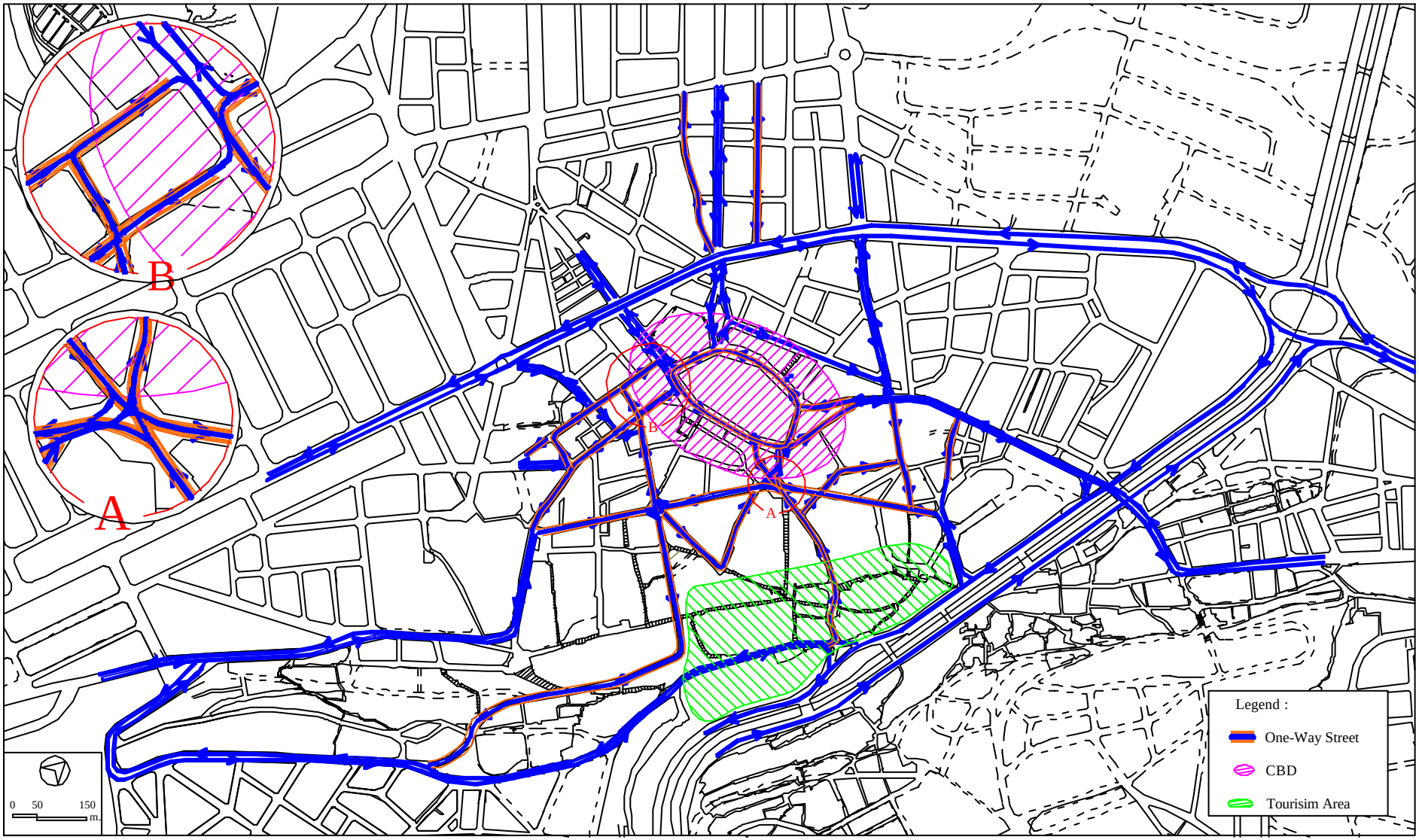


Figure 3.4-4 Proposed One-Way System

3.5 ON-STREET AND OFF-STREET PARKING

The present conditionds of on-street and off-street parking and future requirements have been investigated for the whole of the Study Area and presented before in Technical Report-4.

For the purpose of traffic management in the downtown area a parking survey at second stage was carried out in June 2001 to highlight the finding of the survey of the first stage that was carried out in Nov. 2000. In the second survey all the locations for off-street parking area within the downtown area are considered. These locations are presented in Figure 3.5-1.

Concerning the on-street parking, the second survey covers all the major corridors within the downtown area. These corridors are presented in Figure 3.5-2.

For both on- and off-street parking surveys, the duration of vehicles parking times are measured. Hereafter, the results and finding for on- and off-street parking on the downtown area are described.

3.5.1 On-Street Parking

a) Present Demand and Supply

Table 3.5-1 shows the results of the parking survey for the major corridors. The total number of vehicles parked during the working day from 8 A.M to 3 P.M. is 4,753 vehicles. The ratio of vehicles parked on sidewalk is 10% while the ratio of double parking is 15%. Table 3.5-2 shows a summary of these main findings.

Table 3.5-1 Present On-Street Parking Demand

Location	Number of Parked Vehicles	Double Parking	Sidewalk Parking
Ia	75	1	9
Ib	39	8	-
Ic	16	1	-
Id	23	1	-
IIa	182	30	8
IIb	189	29	4
IIIa	159	19	11
IIIb	171	24	9
IVa	127	24	19
IVb	98	19	10
Va	77	2	12
Vb	74	10	9
VIa	211	44	90
VIb	203	15	65
VIIa	194	33	5
VIIb	202	36	2
VIIIa	154	41	3
VIIIb	120	22	1
IX	375	48	61
Xa	196	13	5
Xb	181	16	7
XIa	161	60	3
XIb	176	56	1
XIIa	176	13	2
XIIb	163	19	5
XIIIa	238	18	8
XIIIb	272	10	8
XIV	306	46	3
XV	195	63	102
Total	**4753**	**721**	**462**

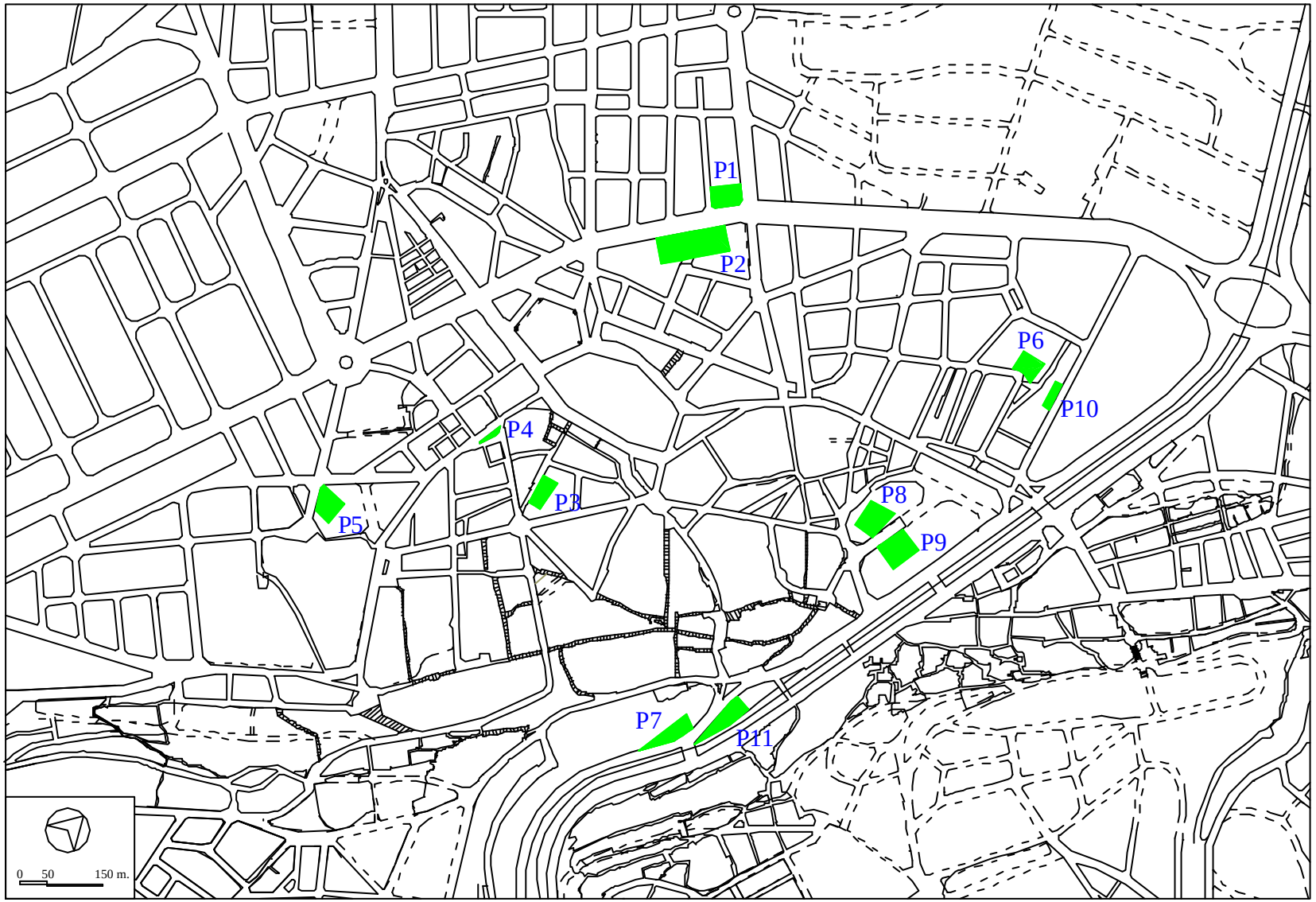


Figure 3.5-1 Locations of Off-Street Parking Areas

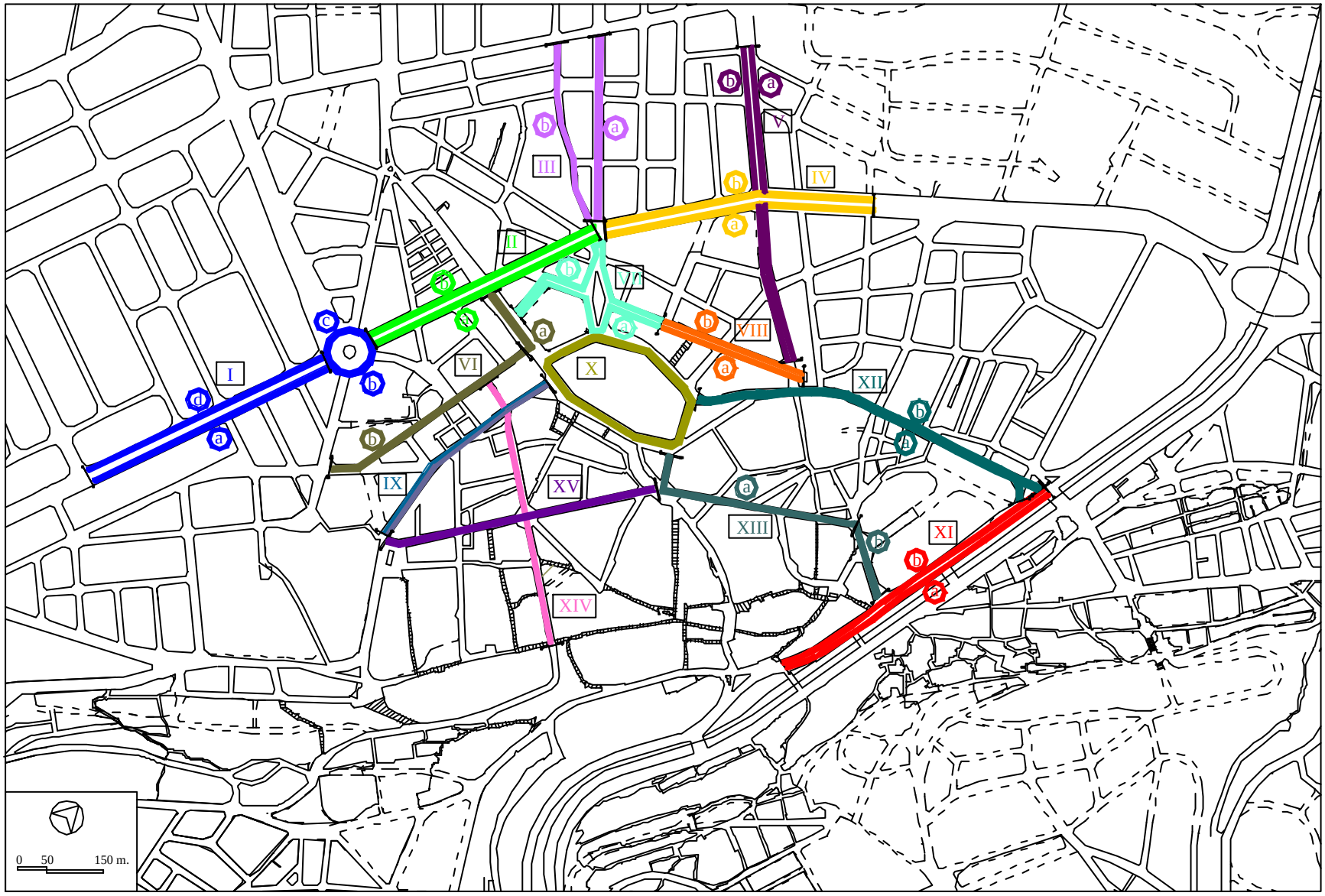


Figure 3.5-2 Locations of On-Street Parking Survey

Table 3.5-2 Assessment of On-Street Parking Demand

Category	Number of Parked Vehicles	Ratio
On-street parking	4,753	100
Single side	3,570	75
Double side	721	15
On sidewalk	462	10

The street inventory survey shows that the on-street parking supply is about 2,000 spaces. The presently parking condition based on the street inventory survey is shown in Figure 3.5-3.

Figure 3.5-4 shows the locations where double parking and parking on sidewalk are frequently or often observed. Based on this figure the following locations are highlighted as the locations with high demand.

- Sahet El-Taal
- El-Saraya El-Kadimah
- El-Nejma Square
- Tripoli Boulvard
- Around Tripoli Municipality
- Azmi Street
- El-Mitain Street
- Abou Ali River Near to the Old Market

Under the Master Plan Study the total present demand was estimated as 3,000 spaces. As mentioned, currently the on-street supply is about 2,000 spaces. That means under the current condition the central area needs at least additional 1,000 spaces without prohibtion of the on-street parking. When the on-street parking will be prohibted the central area will require 3,000 parking stalls. However, there are presently about 500 over supply off-street parking stalls which mean that the central area will be in need for an additional 2,500 stalls to manage the complete prohibtion of on-street parking.

b) Estimated Future Demand and Required Supply

The estimation of future parking demand on the downtown area based on the natural population growth and car ownership was carried out as shown before in Technical Report-4. The results are shown hereafter in Table 3.5-3.

Table 3.5-3 Estimated Future On-Street Parking Demand in the Downtown Area

Year	Demand (Number of Parking Stalls)
2001	3,000
2005	3,250
2010	3,500
2020	4,125

As the off- street parking analysis shows that presently there are about 500 over supply stalls as will be shown later, the current and future off-street parking supply can be estimated as shown in Table 3.5-4.

Table 3.5-4 Required Off-Street Parking Supply to Prohibt On-Street Parking

Up to Year	Number of Required Parking Stalls
2005	2,750
2010	250
2020	625

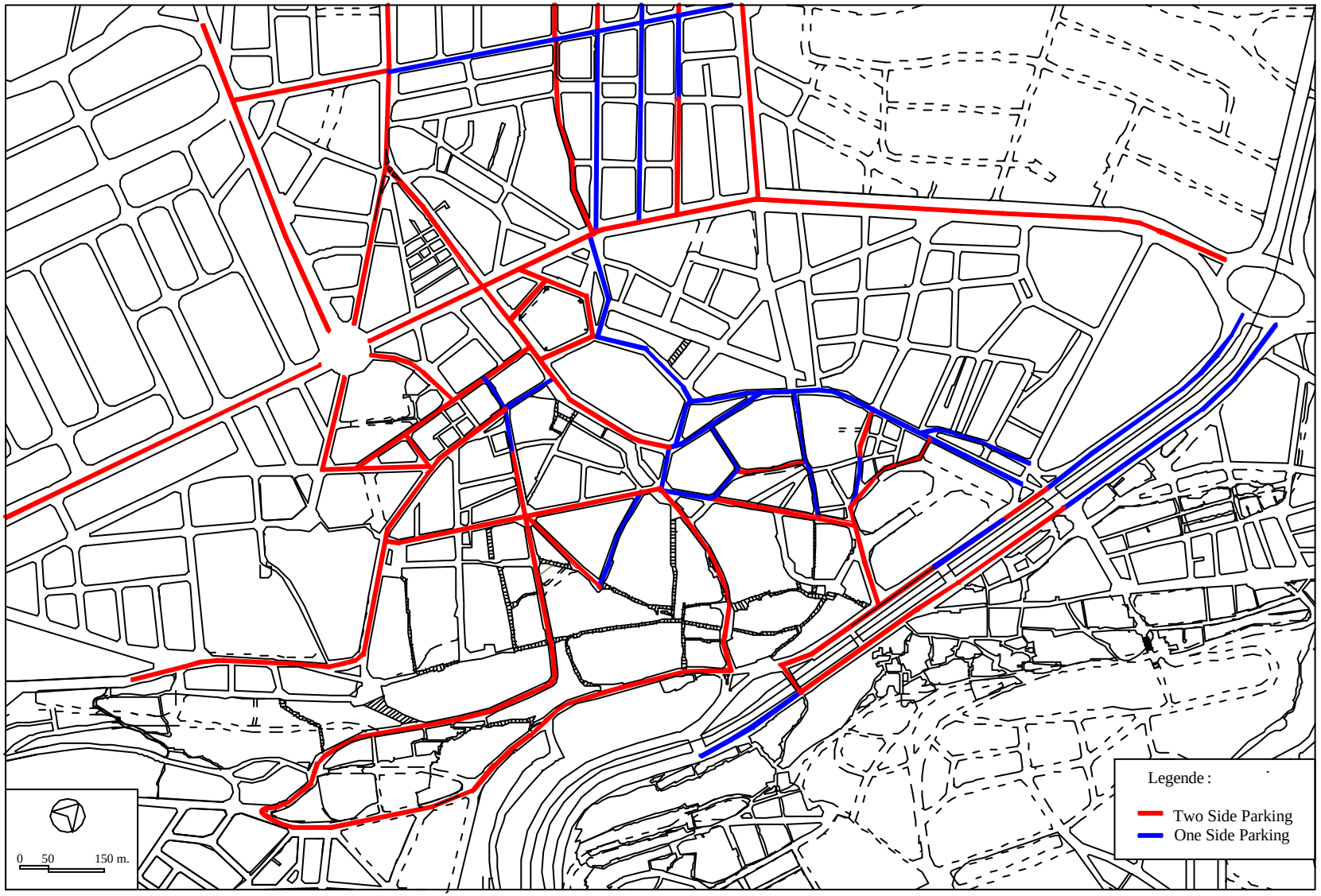


Figure 3.5-3 Present On-Street Parking Conditions

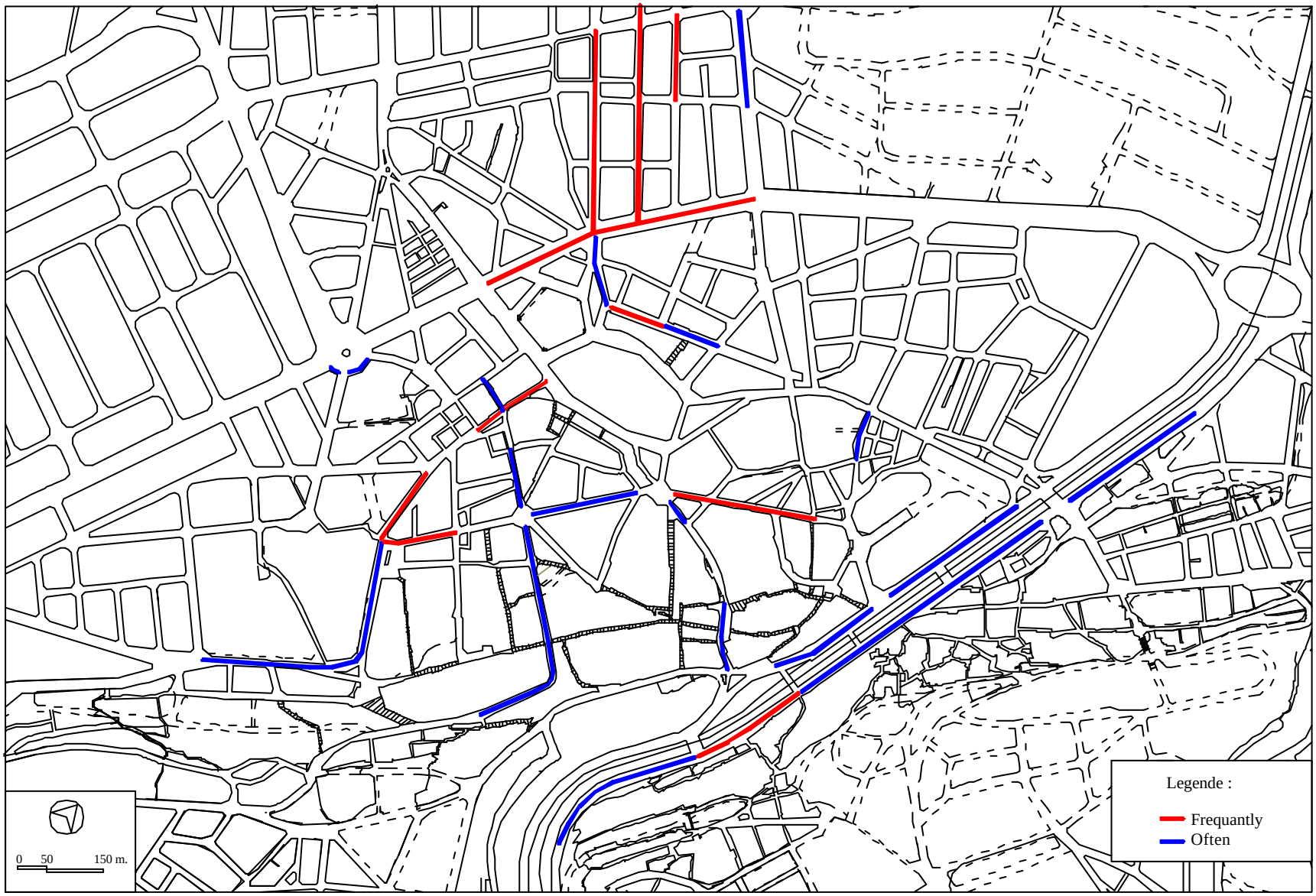


Figure 3.5-4 Locations Characterized by Double and Sidewalk Parking

c) Analysis of Parking Duration

From the results of the second stage parking survey, the investigation of the on-street parking duration was investigated. The result is shown in Figure 3.5-5.

As be noticed from the figure about 60% of the vehicles parking time duration is less than or equal 2 hours. In the downtown area always the problem come due to the long time parking because the vehicles make the long time parking almost come early and occupy the available spaces. In such case, the time limit policy is the best alternative to eliminate this long time parking and to give the parking priority in the downtown area for the short time parking.

The results of the compairson between the on-street supply and demand depending on the working day parking time duration of 7 hours from 8 A.M. to 3 P.M. for the major corridors in the downtown shows that the total demand is about 11,575 parking hours. The corrsponding supply is 2,000 x 7 = 14,000 parking hours.

This supply in hourly bases can cover the required demand. However, in the absent of time limit this can not be achieved.

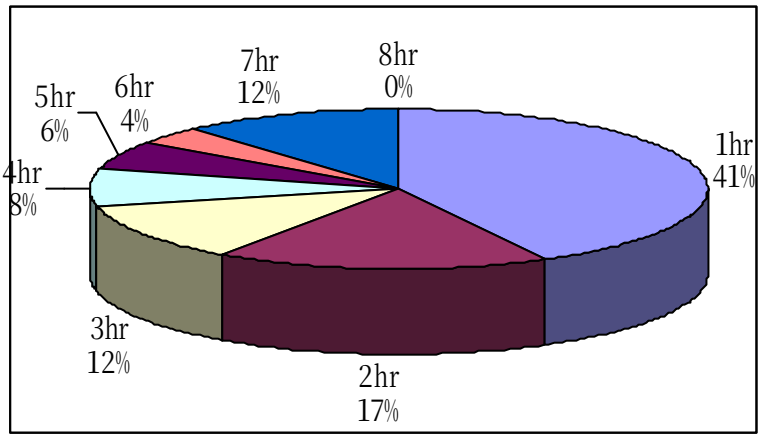


Figure 3.5-5 Distribution of On-Street Parking Duration

d) Parking Policy

In the Short-term Plan direct prohibting of all on-street parking is non-feasible. Prohibtion must be applied gradually as the off-street parking supply can be increased and the required enforcement to prohibt illegall on-street parking can be prepared. However, by the end of the Short-Term (year 2005) the on-street parking must be almost prohibted in all major corridors.

Figure 3.5-6 shows the on-street parking short term plan based on the results obtained from measured traffic volumes and street inventory.

- In the downtown area the cost of the land price is maximum and it is unlogical to offer the land use for parking spaces free of charge. Offering the parking spaces free of charge incourage the long-time parking. Long-time parking decreases the chance of short-time parking. Therefore, application of parking fee with the time limit must be considered in the Short-Term Plan. One hour limit zone in the location of very high parking demand concentration and two hour limit zone on the location of high demand concentration are recommended. On the selection of these two zones, the first one is considered in the locations of frequently double parking areas. The second zone is considered in the locations of often double parking areas. The third zone where no parking time limit will be applied is the rest of the downtown area excluding zone 1 and zone 2.

- Concerning the parking fee and based on the rates proposed for the parking meter by CDR the reasonable rates are listed in Table 3.5-5.

Table 3.5-5 Parking Time Limit Zones and Fees

Zone Number	Time Limit	Fee (LL)
1	1	1,500
2	2	1,000/1 hr.
3	no limit	500/1 hr.

The classification of corridors under each zone is presented in Figure 3.5-7.

As mentioned early in Technical Report-4, it is expected that the parking demand in the downtown area will not increase since this area is almost at the saturation level. However, in the future the traffic volume will be increased and the on-street parking must be prohibted on all of the major corridors. To ban the on-street parking the off-street parking supply must be provided. The vacent lands are available and the municipality can use these vacant lands on a rental base from their owners. For the Plan success, up to the year 2005 it is estimated that about 2,750 off-street parking stalls will be required.

3.5.2 Off-Street Parking

a) Existing Demand and Supply

The second stage survey for the all off-street parking areas within the downtown study area shows that there are 11 locations. The survey was carried out to estimate the supply on each location. The locations are shown in Figure 3.5-1. The capacity of each location and the total off-street parking capacity are shown in Table 3.5-6.

Table 3.5-6 Off-Street Parking Capacities

Location	Area m^2	Capacity Space
P1	3,400	136
P2	5,400	216
P3	800	32
P4	650	26
P5	950	38
P6	1,300	52
P7	1,200	48
P8	3,100	124
P9	800	32
P10	900	36
P11	1,300	52
Total	19,800	792

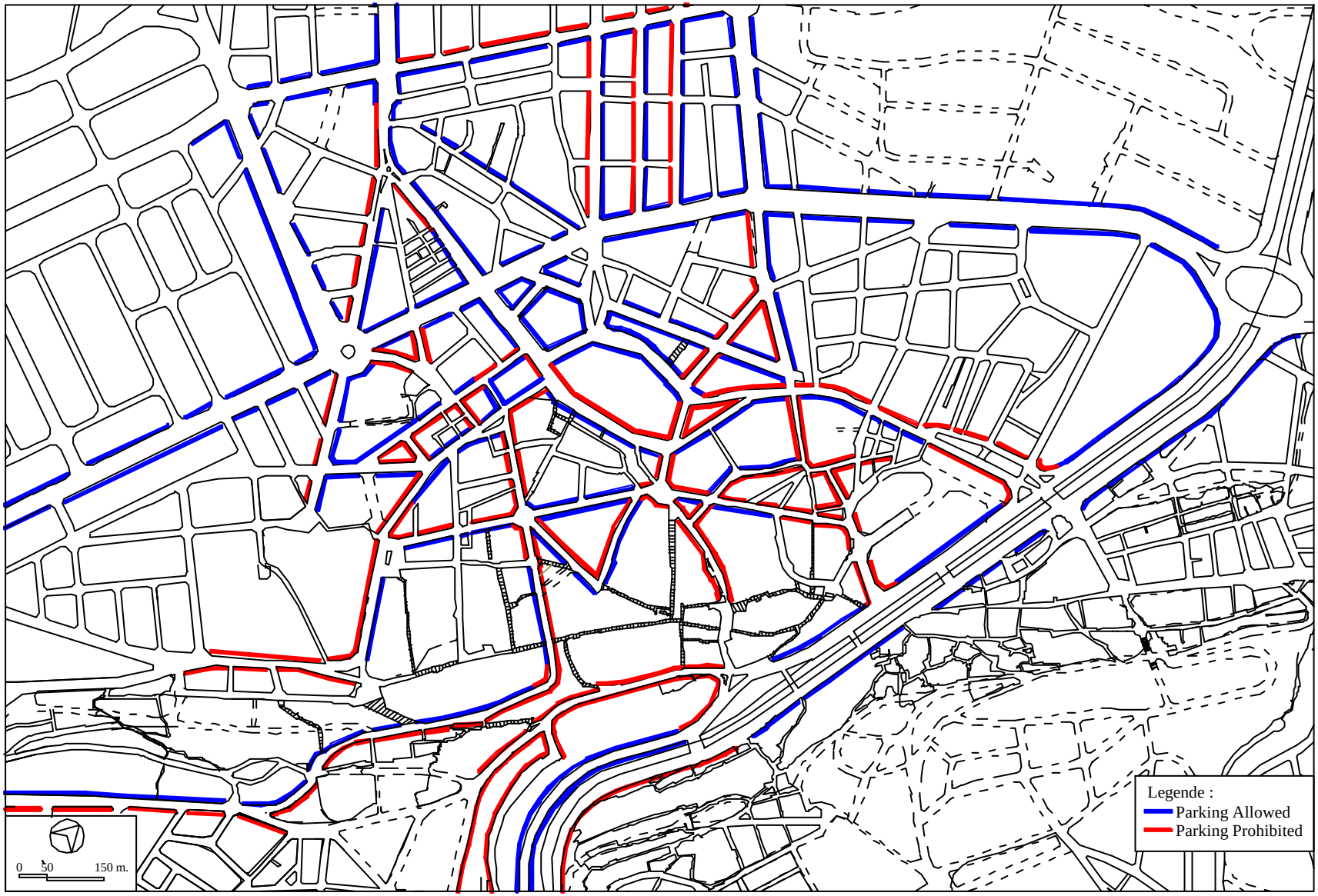


Figure 3.5-6 On-Street Parking Short Term Plan

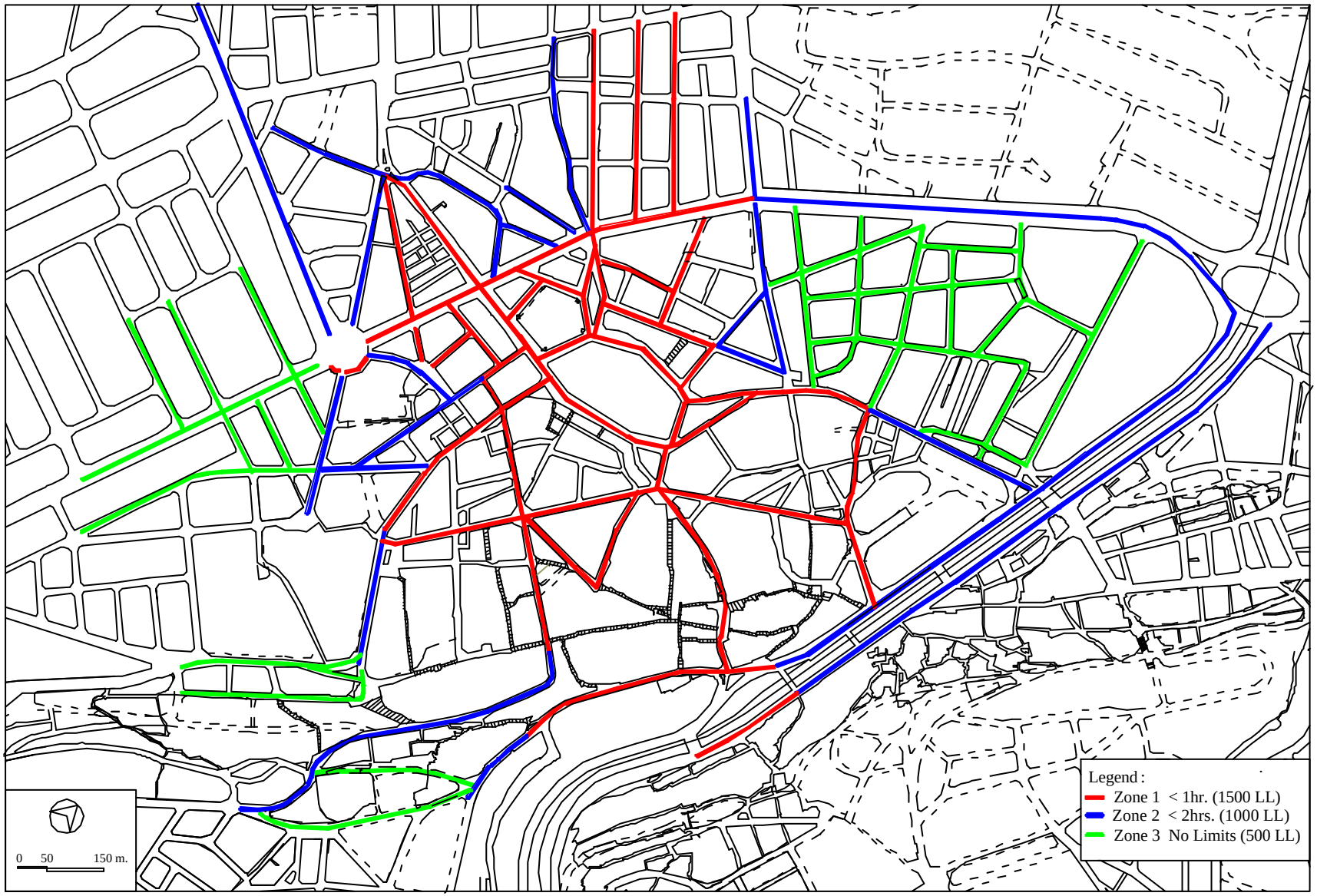


Figure 3.5-7 Time Limit Zones

The current demand is less than the supply in most of areas as can be noticed from Table 3.5-7. The comparison between supply and demand in each location is carried out based on the duration of vehicle parking during the working day for the surveyed locations. The working day is considered by 7 hours from 8 A.M. to 3 P.M.

Table 3.5-7 Comparison of Supply and Demand for Surveyed Off-Street Parking (hourly estimation)

Location	Supply Parking Hour	Demand Parking Hour	Difference
P1	952	124.63	827.37
P2	1,512	440.18	1,071.82
P3	224	133.15	90.85
P4	182	127.58	54.42
P5	266	132.76	133.24
P6	364	130.23	233.77
P7	336	166.62	169.38
P8	868	257.76	610.24
Total	4,704	1,512.91	3,191.09
Corresponding number of stalls	672	216	455
Ratio	100%	32%	68%
Over supply off-street parking = $\frac{792 \times 68}{100}$ = 500 stalls			

b) Estimated Future Demand and Required Supply

The investigation shows that in the downtown area the existing supply is about 792 spaces. The demand was estimated as 216 spaces during the working day. In future the on-street parking must be prohibited to allow for the main corridors to accommodate the increase in traffic volumes. Therefore, the required number of off-street parking estimated as shown before in Table 3.5-7. As the off-street supply will be increased the on-street parking prohibition must be managed.

c) Analysis of Parking Time Duration

By the date obtained by the second stage survey, the duration of vehicle parking times in the off-street parking area was investigated and final results is presented in Figure 3.5-8.

The figure shows that about 54% of the total vehicles are parked for time less than or equal 2 hours. This result is coinside with the expected trend of parking in the central area and support the recommendation to give the parking priority in the central area of the downtown to the short time parking. Off-street parking can accommodate the long time parking. In case of long time parking driver must accept longer walking distance up to his final destination.

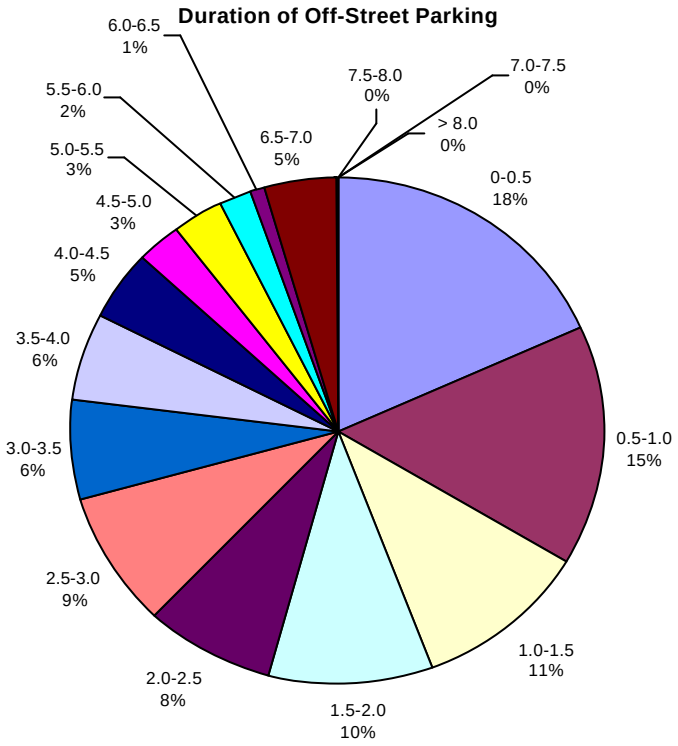


Figure 3.5-8 Off-Street Parking Duration

3.5.3 Parking Policy

In the Short-term Plan the present off-street parking areas are enough if the on-street parking will not be prohibited. Gradually, as the on-street parking will be prohibited new off-street parking areas will be required.

For the existing areas improvement of pavement condition and geometrical design are required. Many locations are unpaved and have no or very poor geometry.

Additional off-street areas will be required as the on-street parking will be prohibited due to the present on-street over demand and expected increase in the traffic volumes. By the end of year 2005, the on-street parking must be completely prohibited and to fulfill this target the required additional off-street supply is estimated to be about 2,750 spaces.

Finally the parking policy for on-street and off-street can be summarized as shown in Table 3.5-8. The table shows the present condition, the requirements during the Short-Term Plan, and the targets by its end. The advantages and disadvantages are assessed.

3.5.4 Standard of Parking Stalls

The survey of the on- and off-street shows that the city suffer from the absent of the standard geometrical design for the parking stalls. The standard requirements for parking stalls in case of on-street parking are shown in Figure 3.5-9.

Table 3.5-8 Plan of Parking Regulation

Present System	During Short-Term	End of Short-Term (2005)
On-Street		
-Demand greater than supply -No regulation -Lack of enforcement -Very poor geometric planning	-Application of time limit concept to give priority for short term parking -Improve parking regulation system -Improve geomentrical design -Strength enforcement -Creat off-street parking and gradually prohibit on-street one	-Almost all on-street parking will be prohibited except for very short time interval of maximum 30 min. in front or near to very important locations
Off-Street		
-Supply greater than demand -No regulation -Poor geometric planning	-Utilize the off-street parking area more efficiently especially for long term parking -Improve parking regulation -Improve geometric planning -Creat additional areas	-Fully utilize off-street parking area due to the prohibition of on-street parking
Advantages		
-Non, just free system every driver do whatever he like to do	-Improve on-street parking regulation to reduce traffic congestion -Utilize off-street parking more efficiently -Almost prohibit the on-street parking in future	-Improve the road network operating conditions speeds and travel times -Improve the city environmental conditions -Incourage investment on off-street parking areas projects
Disadvantages		
-Double parking -Parking on sidewalk -Block corridors, increase pollution -Off-street not full utilized and reduce travel -Priority for long term parking speed	-On-street parking is allowed during the short-term plan duration, that can reduce the capacity of major corridor -Cost for installation of time limit zones	-Need very efficient management procedure and technique to achieve this plan. -Need very efficient education programs and enforcement facilities
Evaluation		
Very bad	Best during the short term plan	Excellent if can be correctly implemented

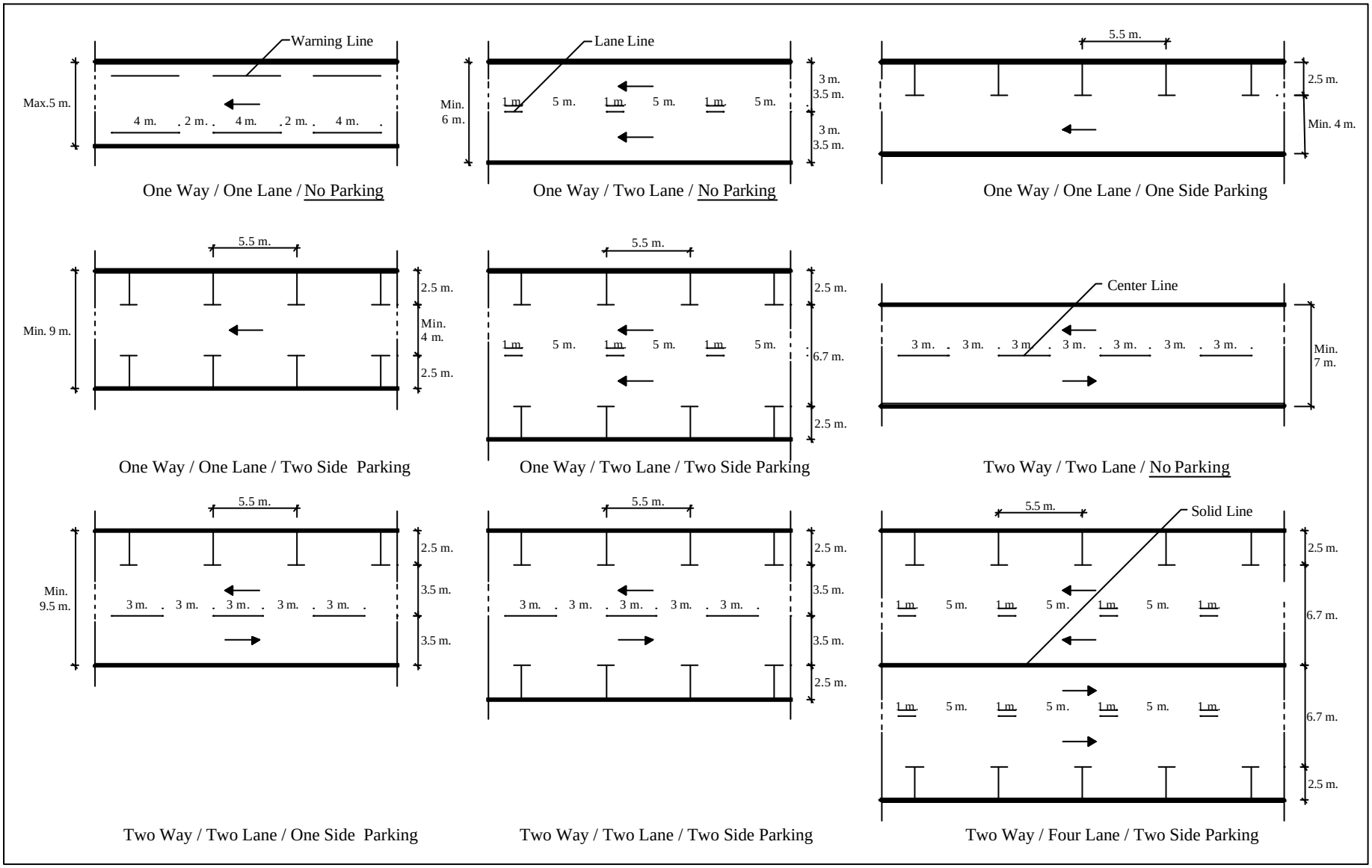


Figure 3.5-9 Standard of Parking Stalls

3.6 INTERSECTION IMPROVEMENT AND TRAFFIC SIGNALS

3.6.1 Evaluation of Existing Conditionds

Present traffic circulation is shown early in Figure 3.4-1. The investigation highlighted two areas where traffic rerouting is required. The traffic circulation on the downtown area after the required rerouting is shown in Figure 3.4-4.

Due to this rerouting and construction of the Tripoli Boulvard underpass the intersections where improvements and traffic signals will be required during the Short-term Plan were selected as shown in Figure 3.6-1. There are eight locations where geometrical improvement and traffic signals will be required. Three of these locations are along the Tripoli Boulvard which are intersections numbers 16, 20 and 22. These three locations are already included in the traffic signal plan of the CDR. Concerning the improvements cost of these three intersections it will be included with the required cost for the constraction of the underpass.

From the other five locations, there are three already included in the traffic signal plan by the CDR which are intersection numbers 14, 17 and 23. However, only intersection number 17 is included in phase I of CDR plan. The others 14 and 23 are included in phase II. Therefore, these two intersections plus the intersections at Sahet El-Taal and Al Saraya Al Kadima must be considered in the phase I of CDR traffic signal plan.

3.6.2 At Grade Network Analysis

For the detail investigation of the road network and intersections in the downtown area a second stage survey was carried out in June 2001. In this survey, a complete street inventory survey for the all major links was done. Figure 3.6-2 shows the location map of street inventory survey. A second stage traffic counting survey was carried out at 30 locations during the peak hours traffic volumes. Figure 3.6-3 shows locations of the surveyed corridors within the downtown area where the estimated maximum hourly traffic volumes in pcu/ hr. were also shown.

The collected data is utilized to investigate the major road network in the downtown area for four cases as:

- Case 1: Year 2001, Without traffic management and underpass
- Case 2: Year 2005, Without traffic management and with underpass
- Case 3: Year 2005, With traffic management and without underpass
- Case 4: Year 2005, With traffic management and underpass

The volume/capacity (V/C) ratios under these four cases are estimated and presented graphically as shown in Figure 3.6-4. This figure shows the importance to consider the both traffic management and underpass to mitigate the traffic congestion in the downtown area and consequently improve the environmental conditions. If these projects will not be carried out many corridors in the downtown area will be characterized by a congestion index v/c greater than 1 as can be noticed in Figure 3.6-4 case 2. Case 2 will be the most servere case for the ciy environment.

3.6.3 Review of On-Going Traffic Signal Plan

The final on-going traffic signal plan was shown in Figure 6.1-1 in Technical Report-4. The plan consists of two phase where the first phase include 13 traffic signals, one stop sign and one location with stop/ giveway signs. As mentioned early this plan is depended on judgment and field observation without considering for the traffic volumes, traffic circulation, physical geometrical condition pedestrians and linking of signals. The plan was revised under the present traffic circulation

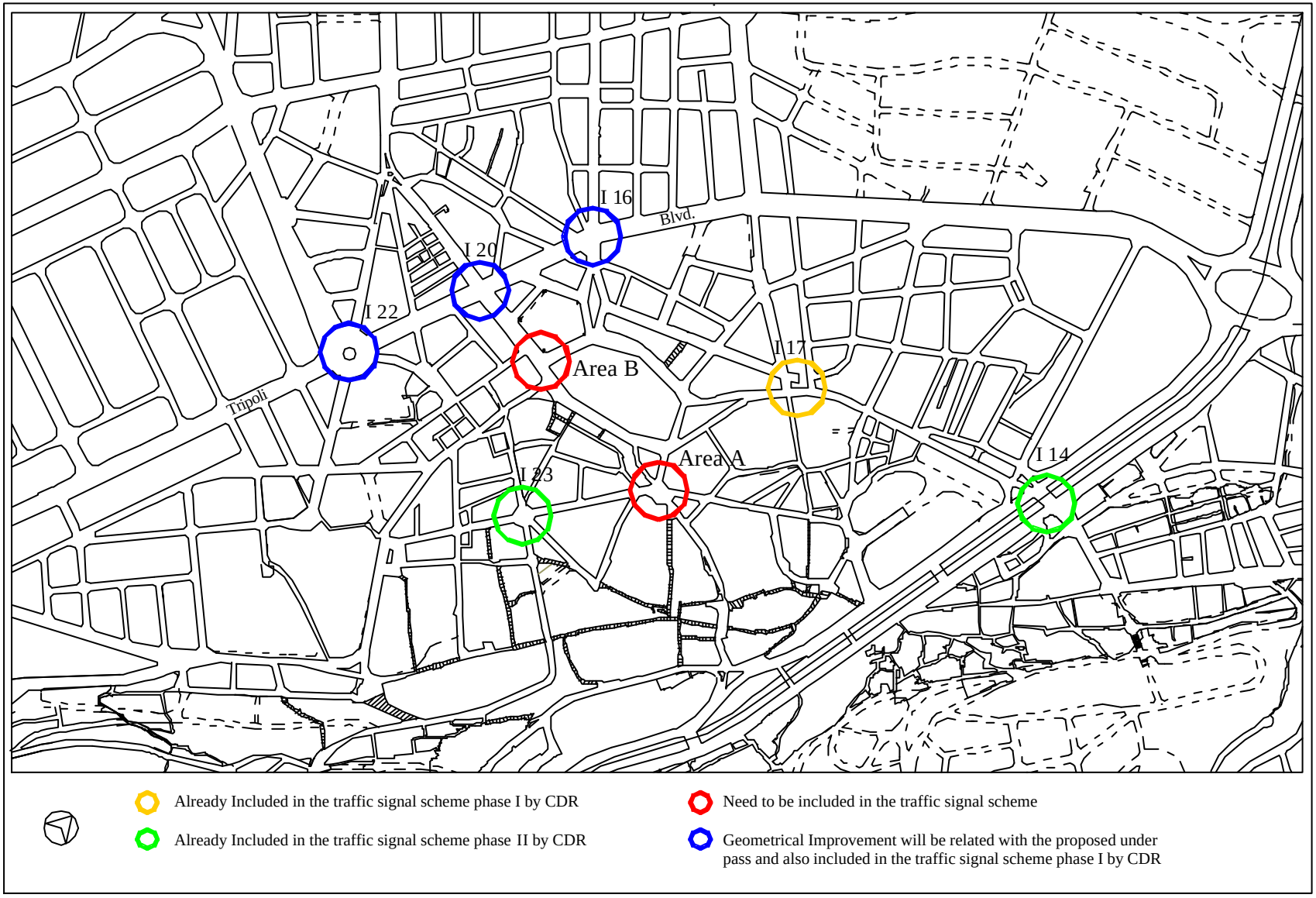


Figure 3.6-1 Main Location of Geometric Improvement

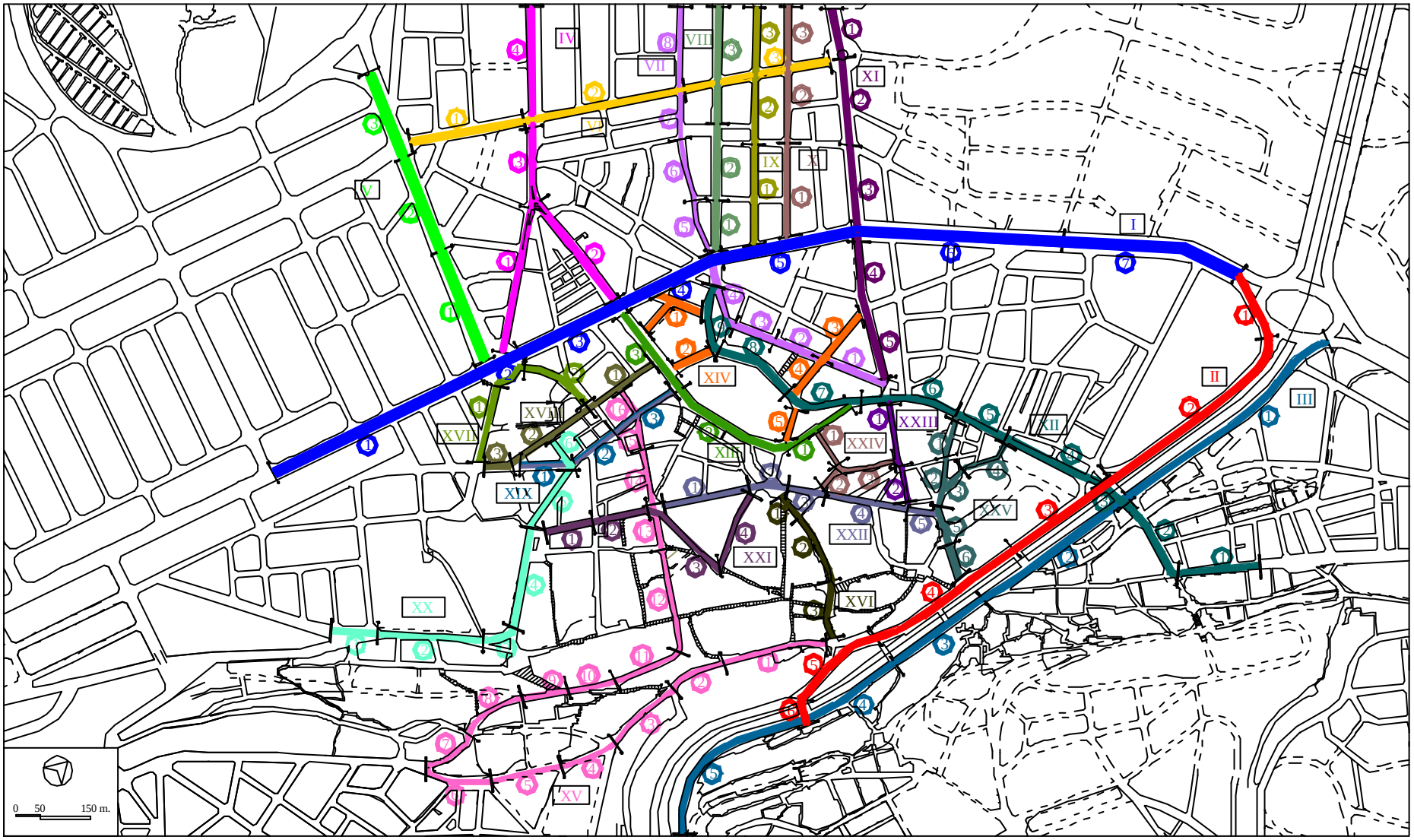


Figure 3.6-2 Location Map of Street Inventory Survey

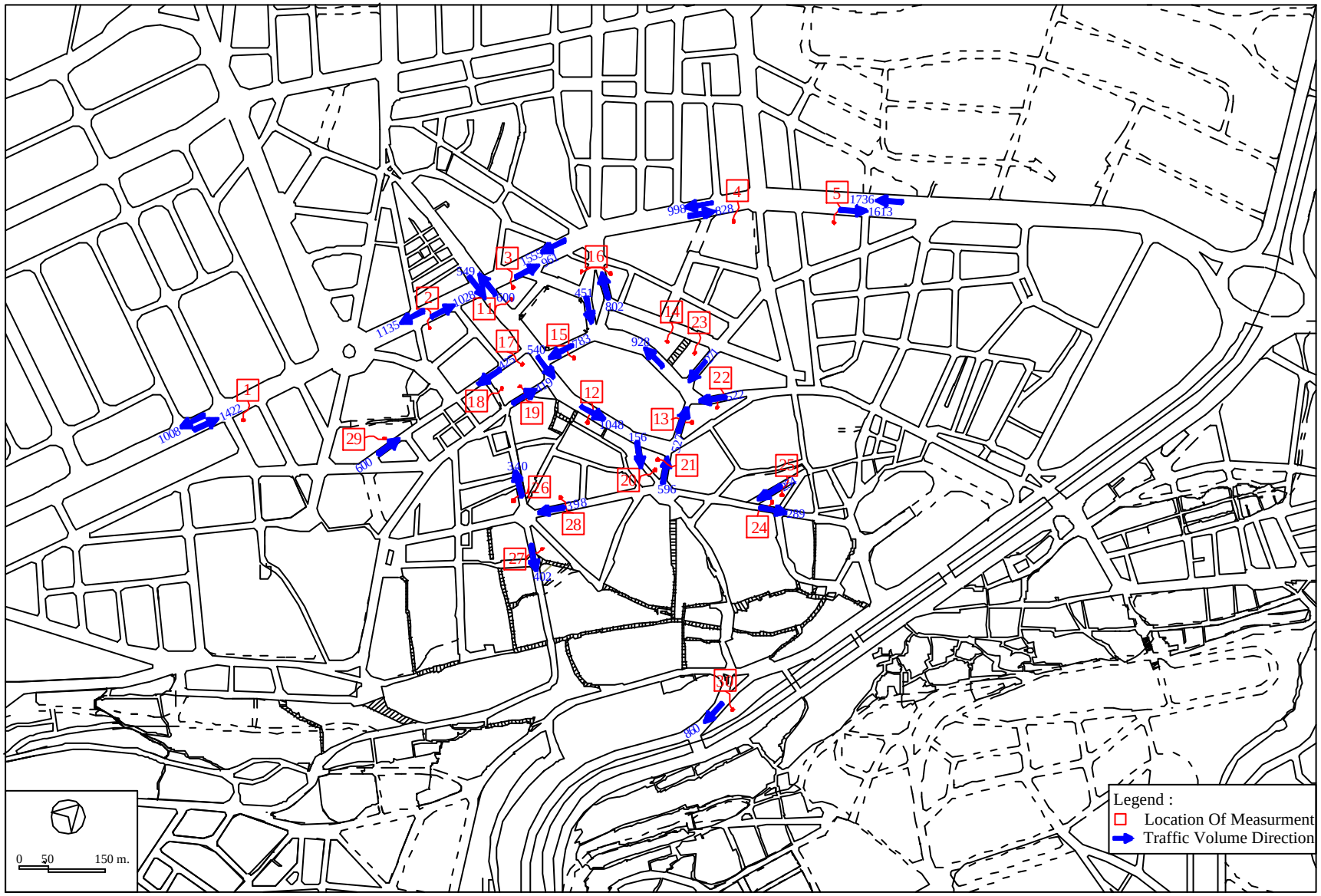


Figure 3.6-3 Maximum Hourly Traffic Volumes

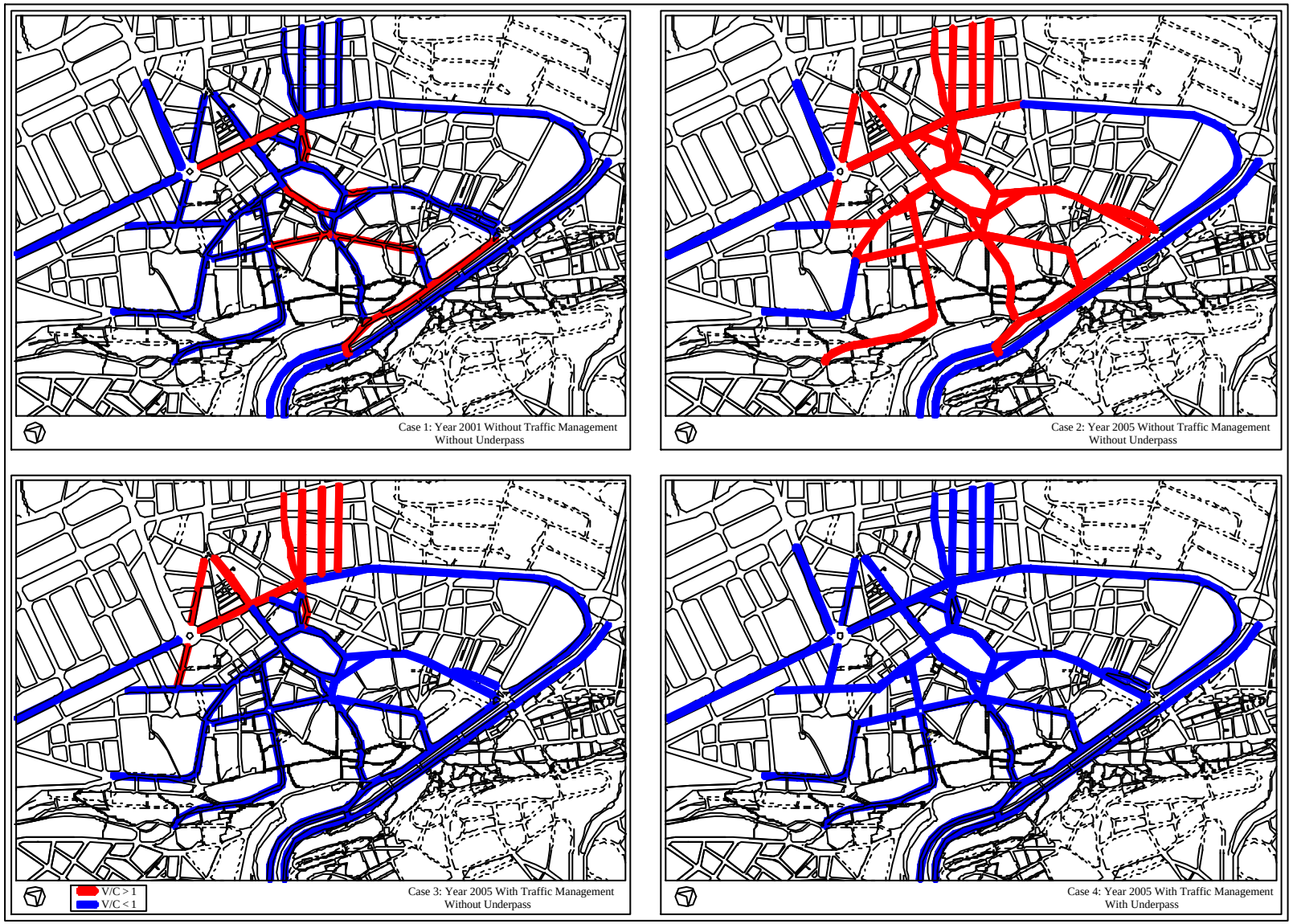


Figure 3.6-4 Congestion of Major Corridors

and a proposed for the revision of current implemented plan was shown in Technical Report-4 in Figure 2.2-1. This revised plan take into consideration all the neglected itmes in the on-going implemented plan. However, under the feasibilty study for the traffic management in the Tripoli downtown area the present one-way system must be re-routed in some corridors as mentioned early and shown graphically in Figure 3.6-1. Therefore, the revised plan taking into consideration the traffic re-routing in the downtown area, for the current traffic signals plan is shown in Figure 3.6-5. Figure 3.6-5 can be consider as the Short-term Plan. This Short-term Plan must be considered as phase I of the on-going traffic signal project.

Phase II of traffic signal project will representing the Meduim-term Plan (2006-2010). Phase II is shown also on the same figure by the green circles.

In the Short-term Plan, the intersections numbers 14, 23 ALSaraya Al-Kadimah and Sahat El-Taal are included in Phase I. Intersectiors number 16, 20 and 22 will be considered with the underpass project. The intersection at Sahat Al-Taal and Al Saraya Al kadima will be considered instead of intersection numbers 18 and 21 where these locations do not actually need a traffic signals. This scheme will minmize the cost that will be required to revise the current on-going plan. Concerning the phasing system for the new proposed intersections and their geometrical design this will be illustrated hereafter.

3.6.4 Intersection Improvement and Traffic Signals

During the Short-term Plan improvement of eight intersections have to be considered. There are three intersections will be related to the underpass project. For the other five intersections that their locations are shown in Figure 3.6-1 the geometrical improvement plan and traffic phasing system are shown in Figure 3.6-6 to 3.6-11. At Sahat El-Taal two alternatives have been considered as shown in Figure 3.6-10 and 3.6-11. The first one is much better for the smooth traffic circulation but it needs to cut and add some sidewalk areas. There is no problem with this plan. However, if the Tripoli Authorits dislike to carry out this modification, the second alternative can be used.

In the geometrical planning the traffic re-routing was taken into consideration. The traffic circulations in these intersections are based on the proposed one way system plan shown in Figure 3.4-4.

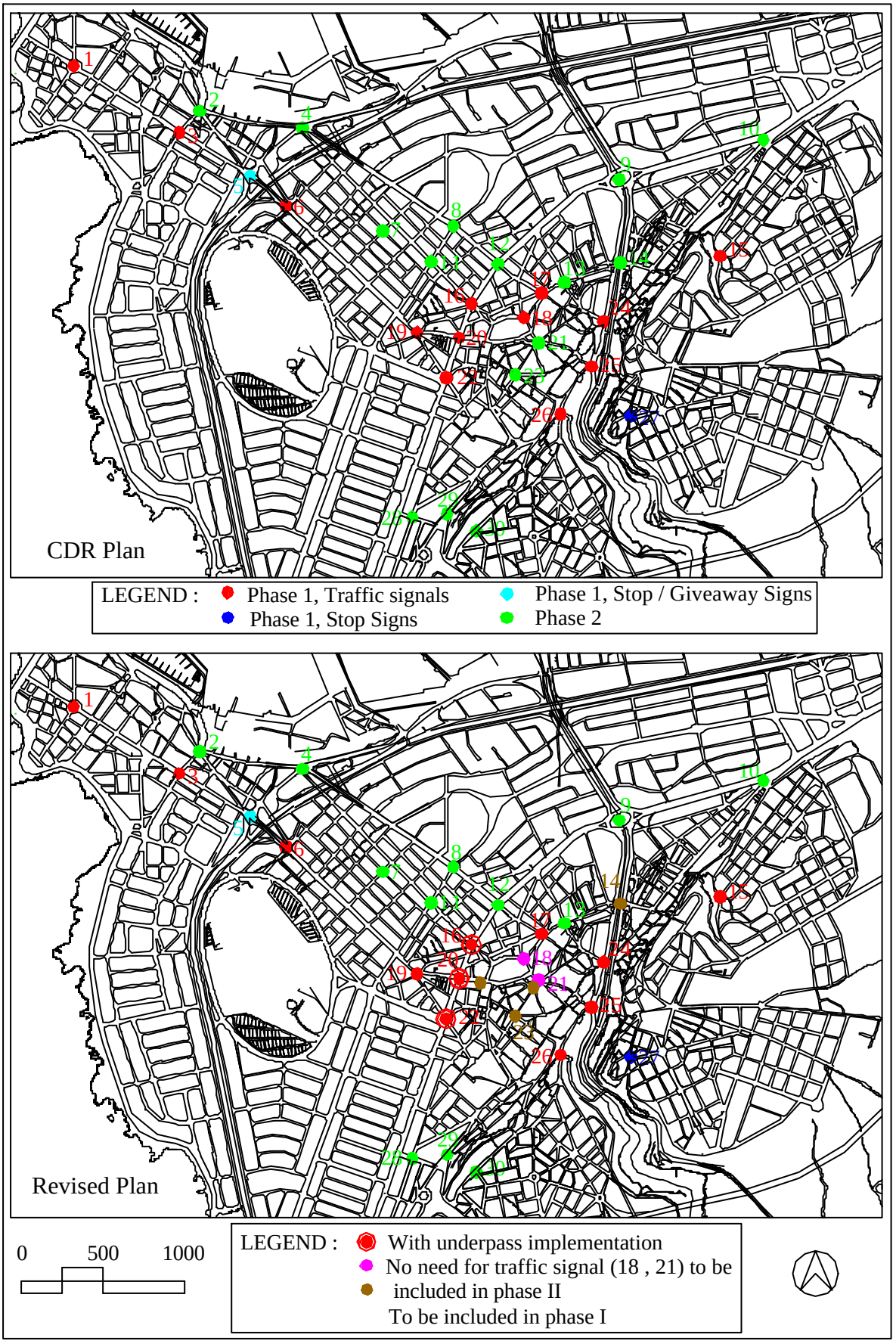


Figure 3.6-5 Review of On-Going Traffic Signal Plan

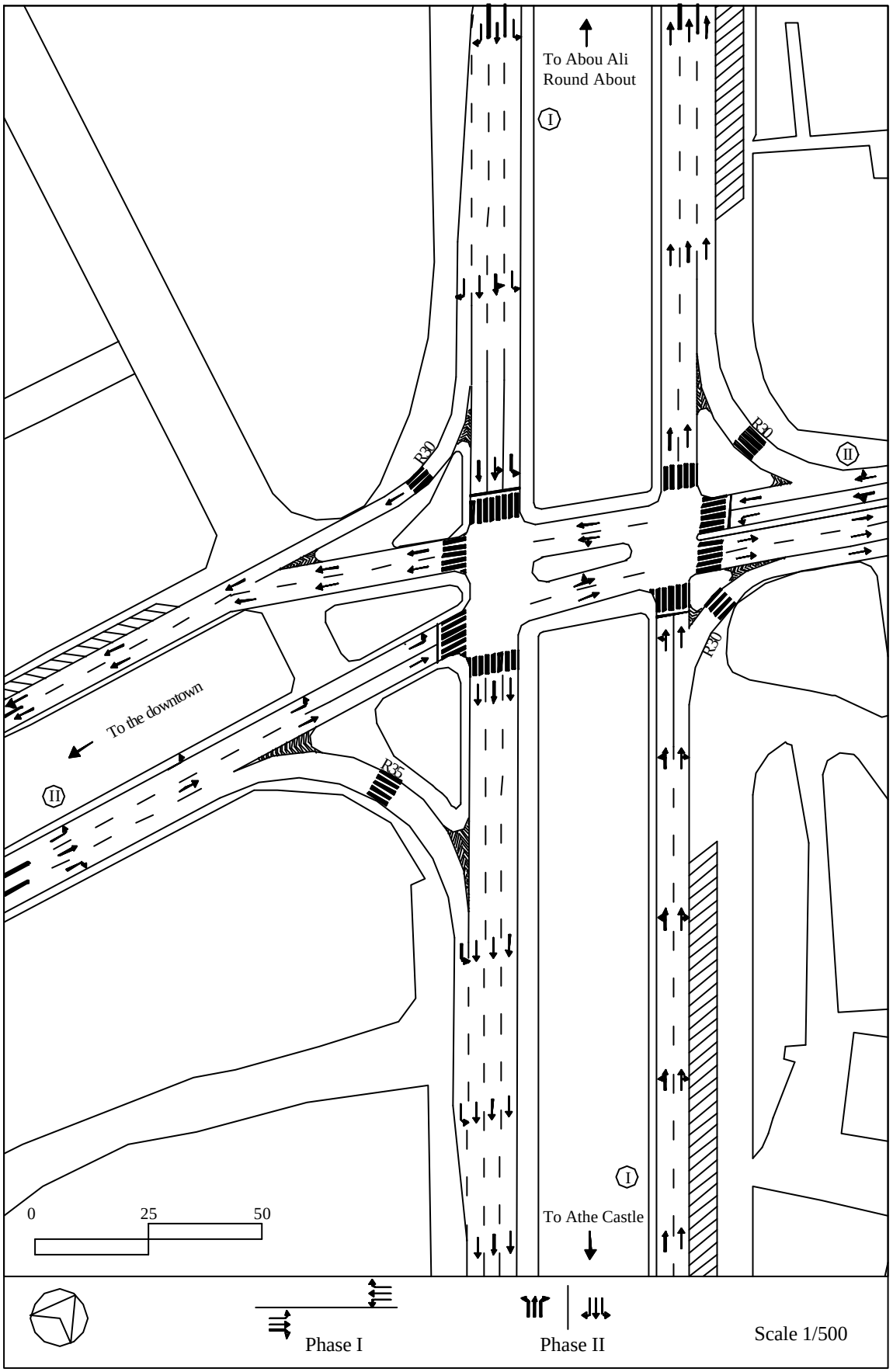


Figure 3.6-6 Geometrical Improvement and Signal Phasing for Intersection No.14

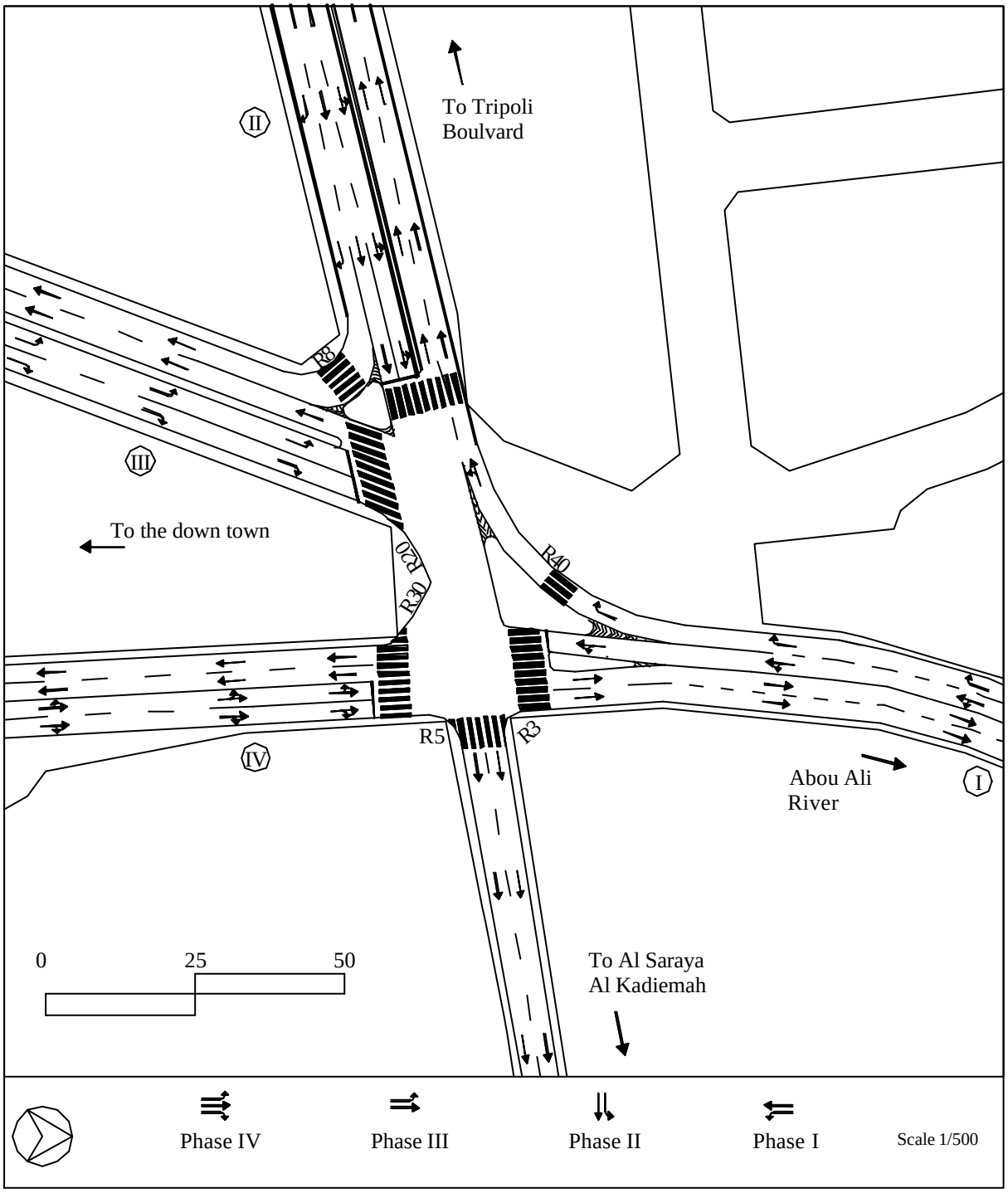


Figure 3.6-7 Geometrical Improvement and Signal Phasing for Intersection No.17

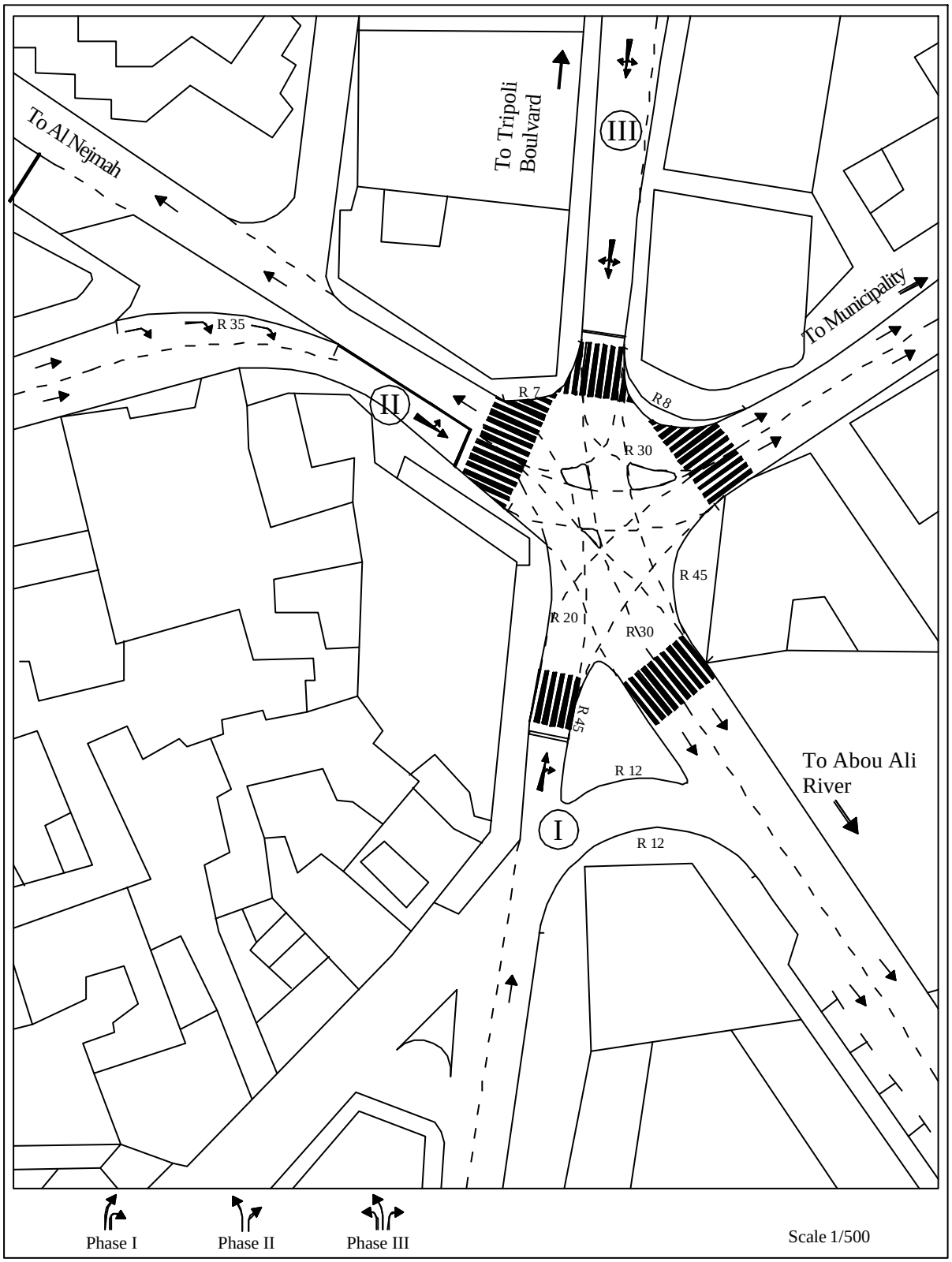


Figure 3.6-8 Geometrical Improvement and Signal Phasing for Intersection (Al Saraya Al Kadima)

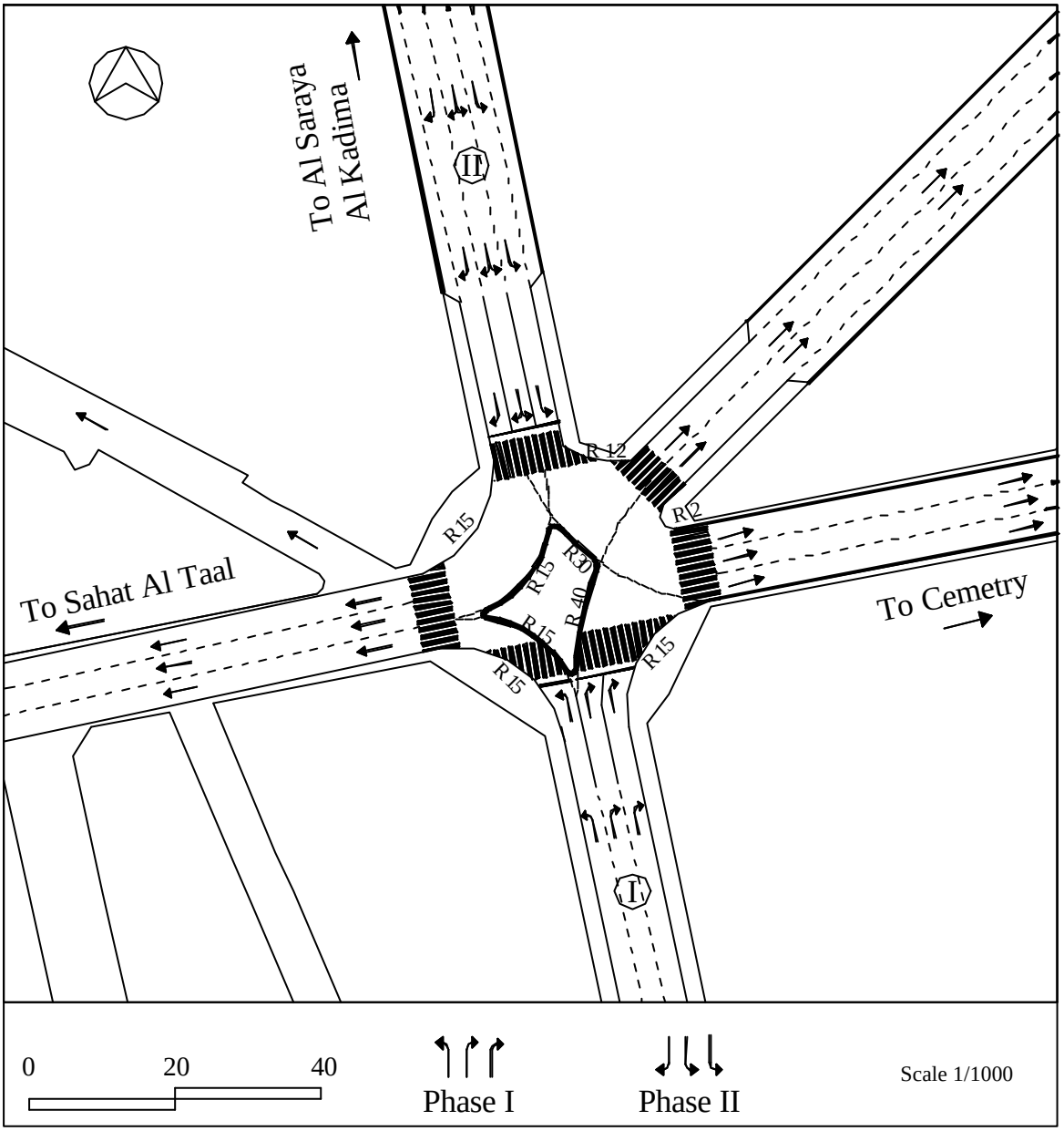


Figure 3.6-9 Geometrical Improvement and Signal Phasing for Intersection No.23 (Al-Nejmeh Square)

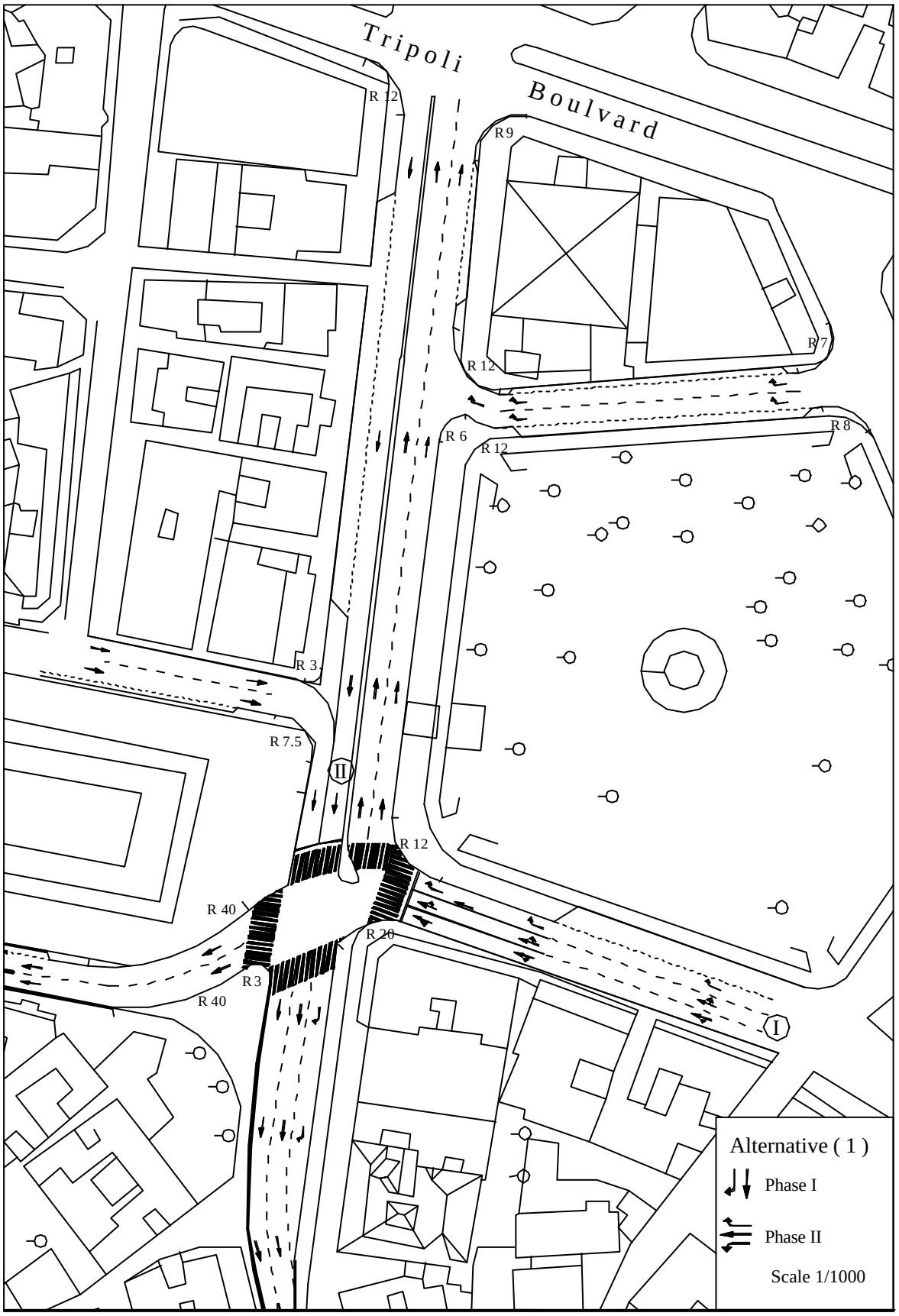


Figure 3.6-10 Geometrical Improvement and Signal Phasing at Sahat Al-Taal

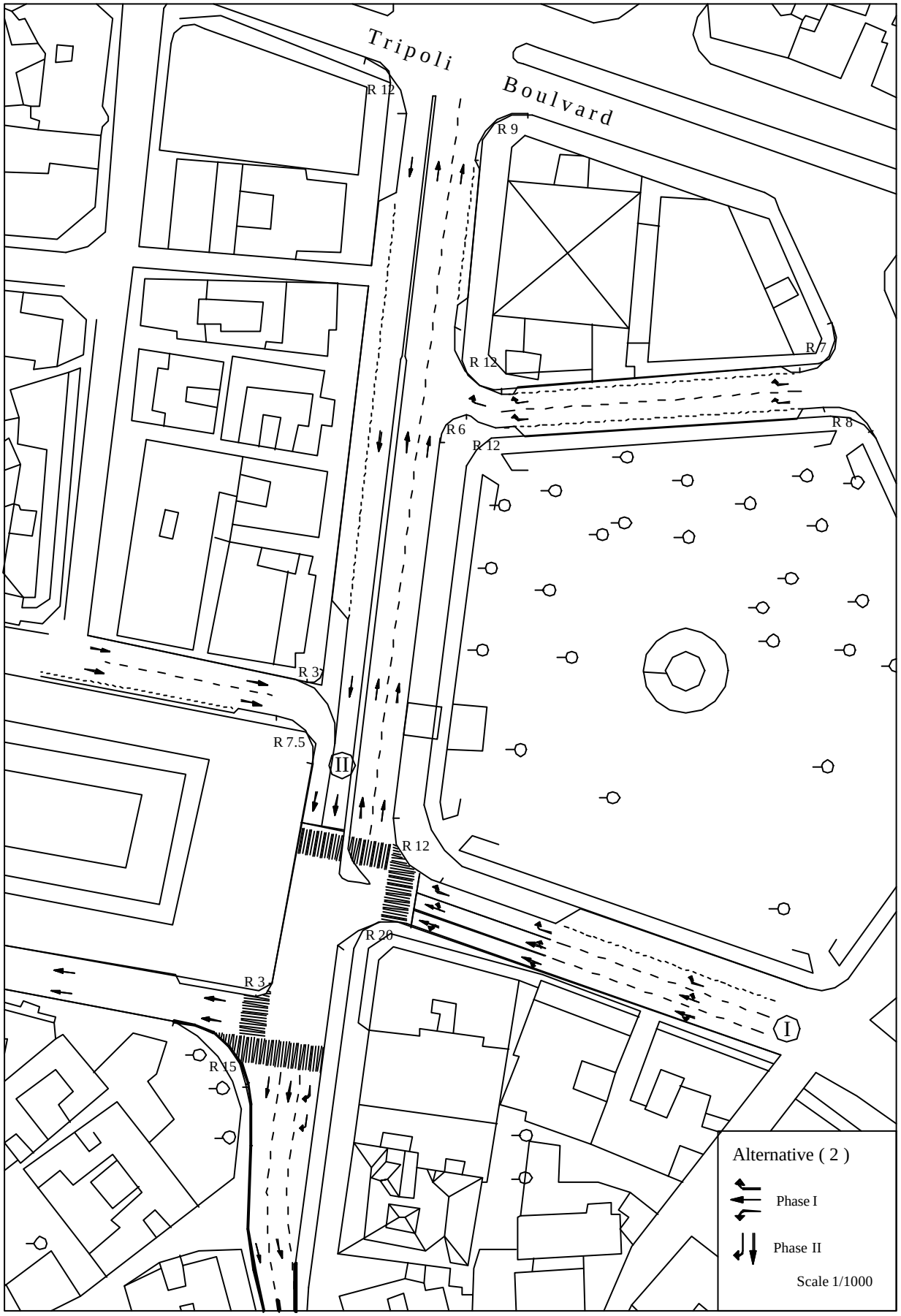


Figure 3.6-11 Geometrical Improvement and Signal Phasing at Sahat Al-Taal

3.7 TRAFFIC SAFETY FACILITIES

3.7.1 Present Condition

Traffic safety must protect the road users including both vechile drivers and pedestrians. Recently Tripoli City suffer a considerable shortage in the traffic safety facilities such as pedestrain signals, guard rails, pedestrain over and under pass, and bad condition of sidewalk. The pavement condition can consider also under the saftey facilities since the bad pavement conditions are reduceing the control abilty of drivers. The bad pavement condition is preventing the application of the road marking that can severly affected the safety.

The survey for the pedestrain traffic volumes was carried out at 5 main locations that are characterized with a heavy pedestrain movements. The sidewalk widths were surveyed under the street inventory survey. These five locations are shown in Figure 3.7-1 with the measured pedestrain volumes in person/min. Table 3.7-1 shows comparison between the sidewalk capacity and pedestrain volumes. As can be noticed from the table in the present condition the sidewalk widths are enough to accommodate the pedestrain traffic volumes in general but in the old city area the widths are critical.

Table 3.7-1 Assessment of Predestrian Volume and Sidewalk Capacity

Location	Pedestrain max. volume p/min.	Sidewalk width (m)	Capacity p/min.	V/C
1a	22	2	40	0.55
1b	26	2.6	64	0.40
2a	26	3.9	116	0.22
2b	29	4.7	148	0.2
3a	13	2	40	0.33
3b	18	1.5	20	0.9
4a	20	2	40	0.5
4b	22	2	40	0.55
5a	26	2	40	0.65
5b	21	1.8	32	0.97

During the street inventory survey the sidewalk conditionds were investigated. The results obtained from the survey are presented in Figure 3.7-2. The results considering the sidewalk widths and lengths can be classified among good, fair and bad conditions as shown in Table 3.7-2.

Table 3.7-2 Sidewalk Conditions

Condition	Area (m^2)	Ratio
Good	8,000	10 %
Fair	32,000	40 %
Bad	40,000	50 %

As mentioned, the pavement conditions has a recognizable effect on the safety of vehicle users. The present pavement conditions were investigated during the inventory survey and the results are presented graphically in Figure 3.7-3. Table 3.7-3 shows the result of the assessment of the present pavement condition.

Table 3.7-3 Pavement Conditions

Condition	Area m^2	Ratio %
Good	30,000	7.5
Fair	360,000	90.0
Bad	10,000	2.5

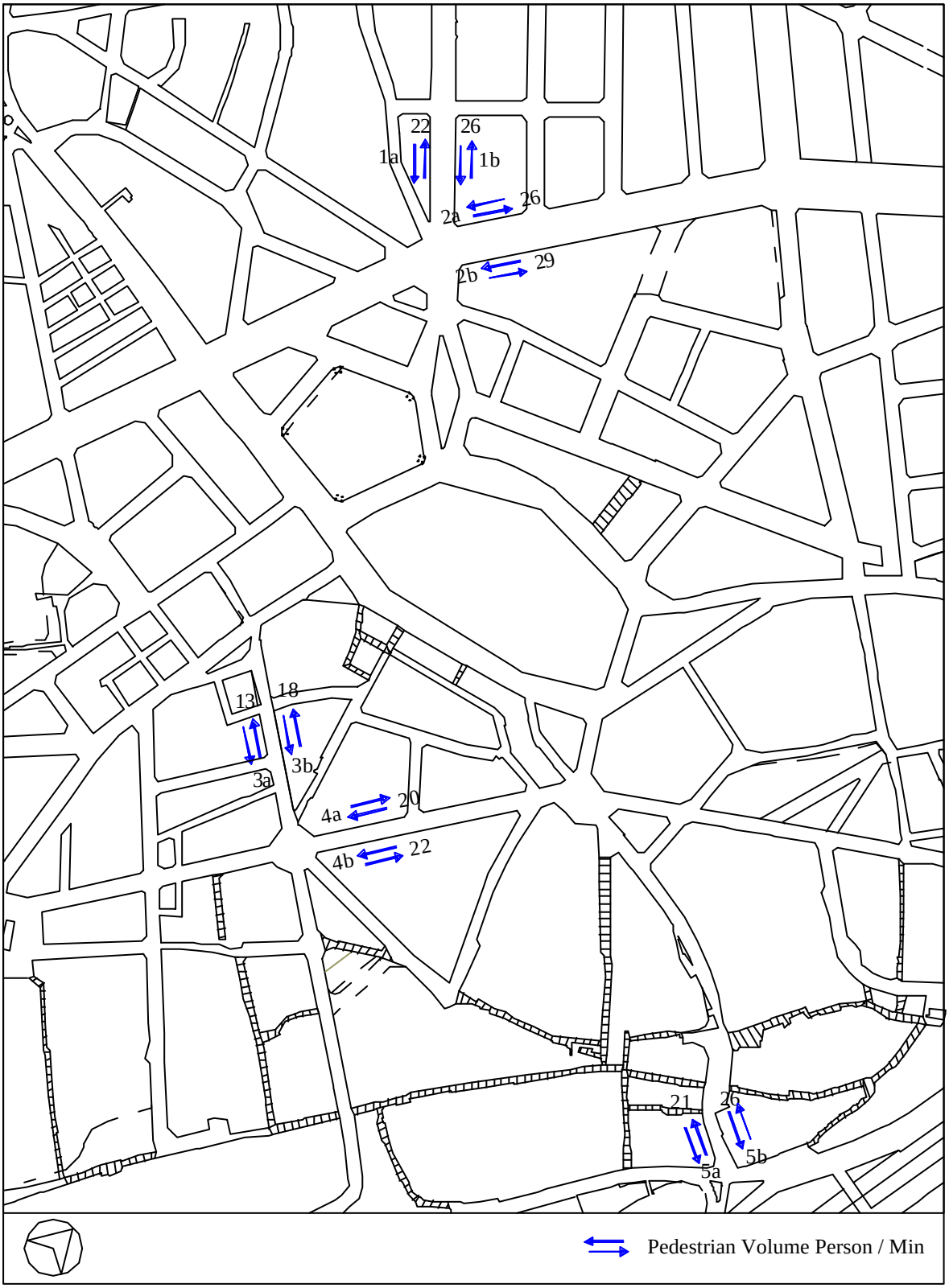


Figure 3.7-1 Location of Pedestrian Volume Survey and Surveyed Volumes

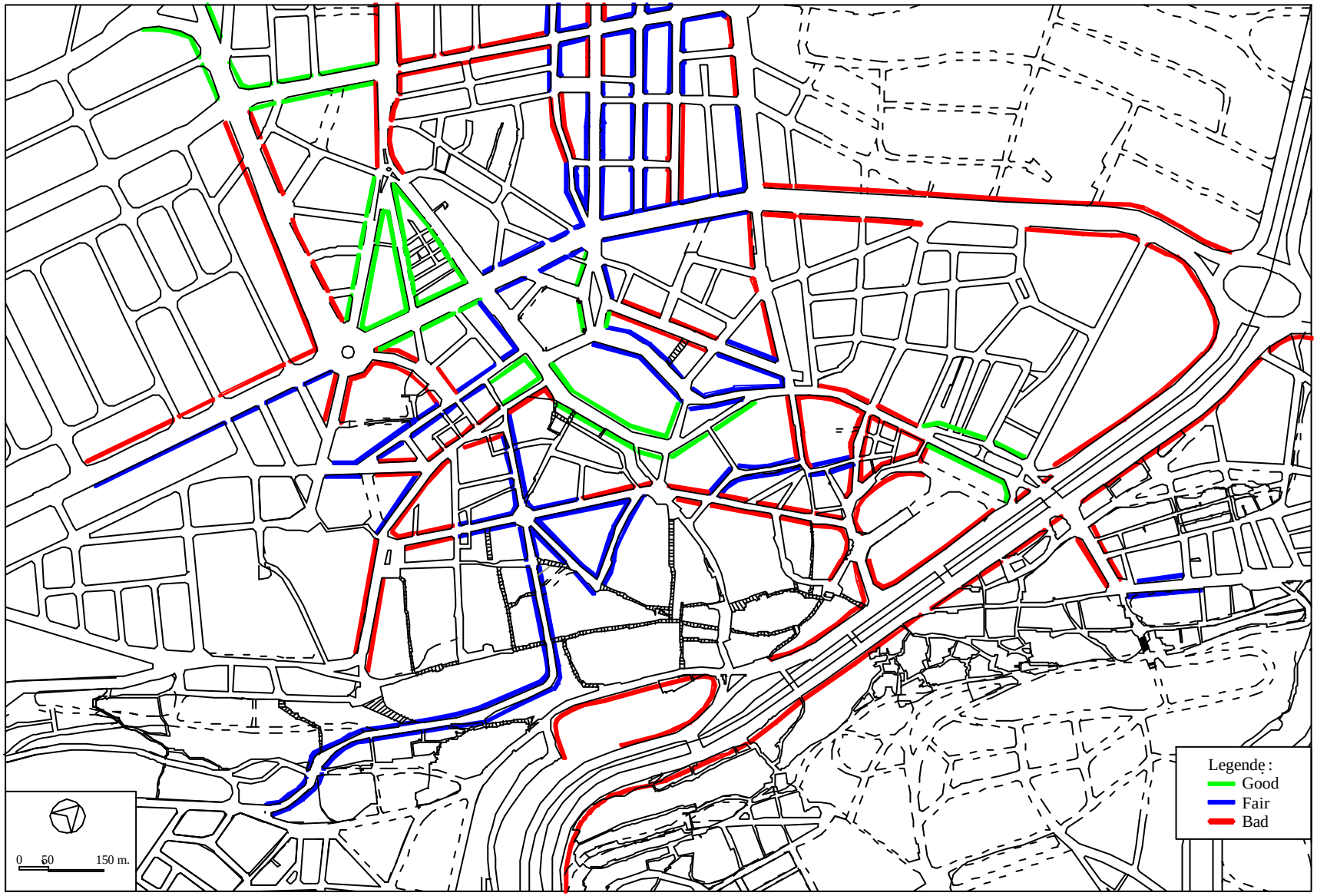


Figure 3.7-2 Present Sidewalk Conditions

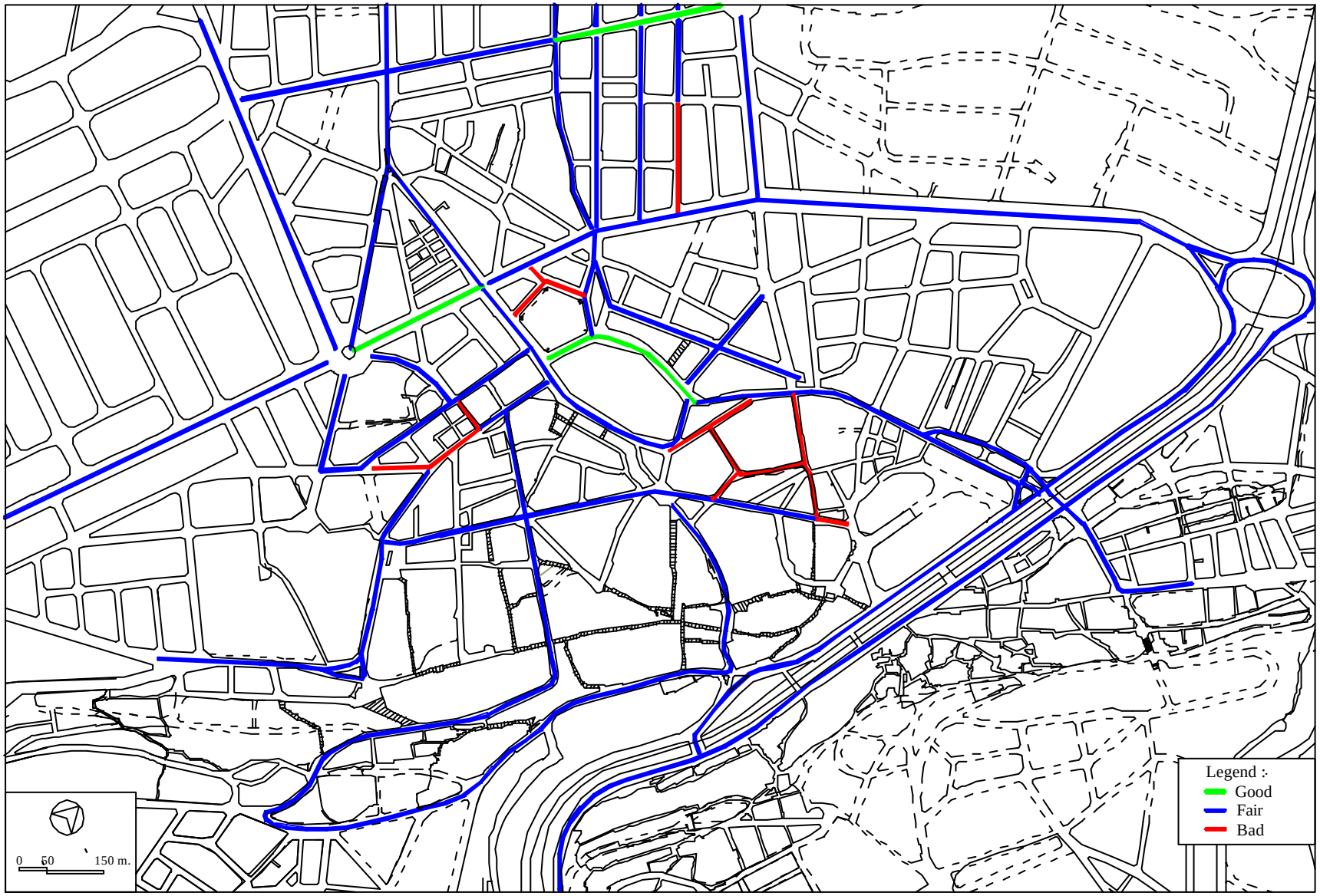


Figure 3.7-3 Present Pavement Conditions

3.7.2 Improvement Plan

The investigation of present condition shows that the city is in need for the safety facilities improvement in the short and meduim plans.

The improvement for the city as a whole was clarified before under the Master Plan Study in Technical Report-4. For the downtown area the city will need to consider the following facilities during the Short-Term Plan:

- Sidewalk Improvement
- Pavement Improvement
- Guard Rails

Table 3.7-4 shows the details of the required improvement plan.

Table 3.7-4 Improvement Plan of Safety Facilities

Items	Short-Term
Sidewalk	72,000 m^2
Pavement	370,000 m^2
Guard Rail	40,000 m

3.8 TRAFFIC SIGNS AND PAVEMENT MARKING

3.8.1 Present Conditions

As mentioned under the Master Plan Study and through the inventory survey carried out in the Tripoli downtown area, the city is really out of any standard of road marking and suffering recognizable shortage in the traffic signs. In Tripoli Muncipality, they mentioned that they follow the 3M standard that is belong to a famous company in the field of traffic signs and road marking. However, the survey shows that there is no marking and only few warning and regulatory signs are fixed near to the CBD area. Therefore, the existing conditions means that traffic signs and road marking in the city have to be considered as it will be start from scratch.

Concerning the standard for road marking and signs the investigation carried out by the JICA study team shows that there is a standard on act since 1999 issued by the "Isstitut De Normes Libanaises–Libnor". This Lebaneese Standard for road signs and marking consist of:

- Lebaneese Norm NL 130-1: Road Sign and Marking, Introduction-Annex.
- Lebaneese Norm NL 130-2: Road Sign and Marking, Introduction-General.
- Lebaneese Norm NL 130-3: Road Sign and Marking, Part I: Marking.
- Lebaneese Norm NL 130-4: Road Sign and Marking, Part II: Signs.
- Lebaneese Norm NL 130-5: Road Sign and Marking, Part III: Safety Devices.
- Lebaneese Norm NL 130-6: Road Sign and Marking, Part IV: Traffic Signals.

This standard is in act now and therefore, it must be followed in all of the new implemented projects in Greater Tripoli. However, the arabic version of this standard and also the english one are not availble yet. It is only availble in French.

3.8.2 Traffic Signs

Warning, Regulatory and Informatory are the three major traffic sign types that must be considered. The inventory survey shows that the system of traffic signs not only in Tripoli downtown area but in Greater Tripoli is too poor and the implementation to provide the city with the necessary required signs will start basically as from begining.

For the downtown area under the traffic management project the estimated numbers of required signs during the Short-Term Plan are shown in Table 3.8-1.

Table 3.8-1 Traffic Signs Requirements

Sign Type	Required Number
Warning	240
Regulatory	120
Informatory	240

3.8.3 Pavement Marking

There is no marking in all of the downtown area. In the field of the pavement marking the following marking types have been considered:

- Lane marking.
- Cross-walk marking.
- On-street parking.
- Off-street parking.
- Channelization.

Table 3.8-2 Shows the estimated required marking during the Short-term Plan to provide the downtown with the required marking. However, for the off-street parking and channelization the marking cost will be overloaded upon the construction cost therefore, they are not included in cost estimate.

Table 3.8-2 Road Marking Requirements

Type of Marking	Area (m^2)
Lane	4000
Cross-walk	3000
Edge	4000
On-street	4800

Figure 3.8-1 shows a typical example of the pavement marking, edge marking and intersection marking. It is mentioned on the figure the case when each type of this pavement marking has to be used. As mentioned before, presently there is a standard in Lebanon and it is recommended to follow this standard in the all new implemented projects.

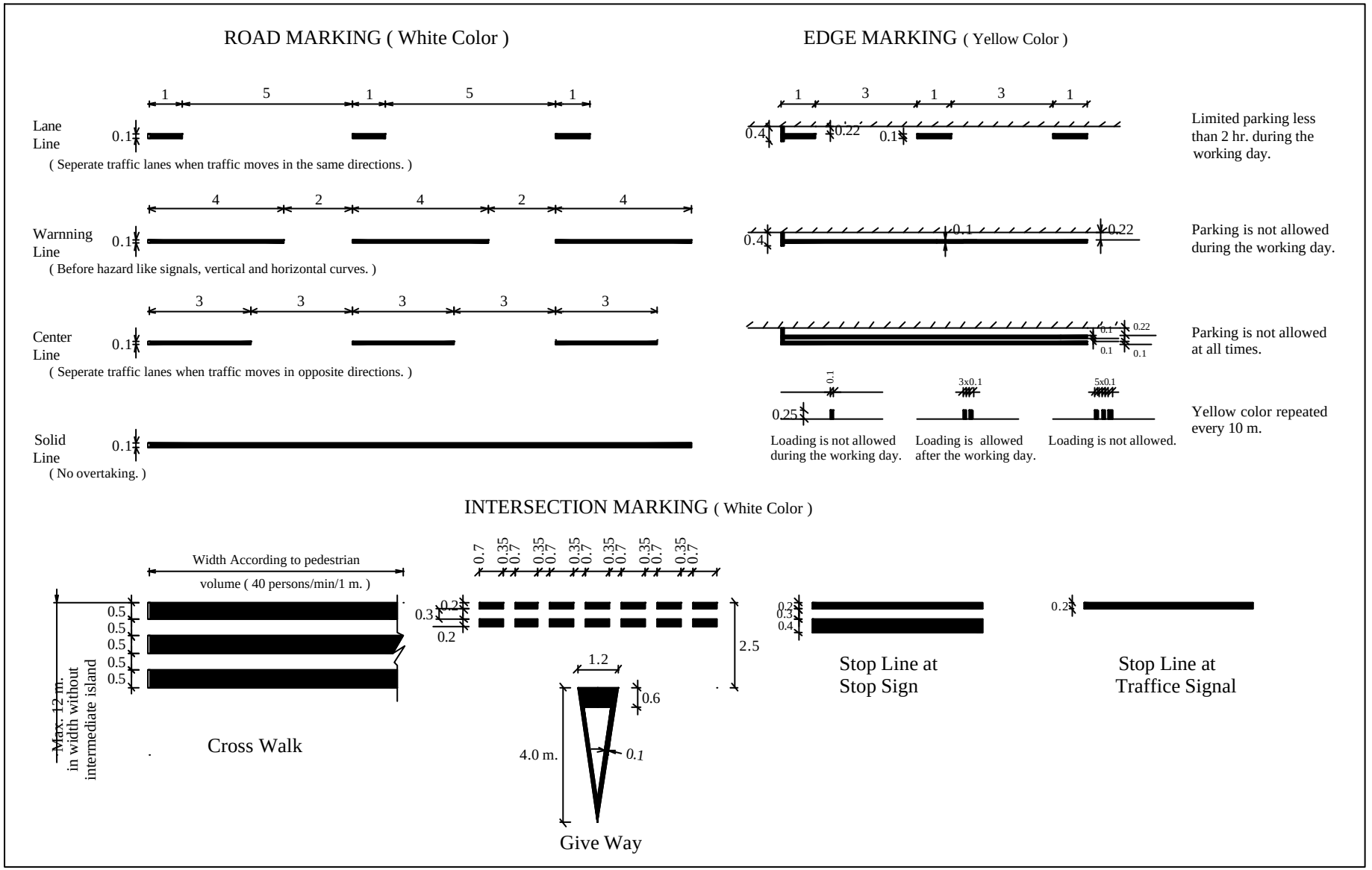


Figure 3.8-1 Typical Example of Pavement Marking

3.9 COST ESTIMATE

The main components of the Central Triploi Transport Management Project under the Short Term Improvement Plan includes six main tasks which are:

1) Bus/Taxi Terminal
2) One-Way Traffic System
3) On-Street and Off-Street Parking
4) Intersection Improvement and Traffic Signals
5) Traffic Safety Facilities
6) Traffic Signs and Road Marking

The required cost estimation was carried out based on the prevailing rates of the most recent similar projects. The estimated costs are presented in Table 3.9-1.

Table 3.9-1 Cost Estimate of Central Tripoli Transport Management Project

Components	Unit	Unit Price US$	Quantity	Cost US$	Remarks
1) Bus/Taxi Terminal					
- Designated Intercity Bus Terminals	m^2	5$/year	8,800	44,000	Rent & Preparing Cost.
- Taxi Central Park Terminal (Preparing)	m^2	2$/$m^2$	3,900	7,800	Land Belong to Municipality.
2) One Way Traffic System	Cost will be included within traffic signs & road marking				
3) On-Street & Off-Street Parking					
- On-Street Parking (parking meter)	space	200	2,000	400,000	Marking Included within Road Marking.
- Off-Street Parking					
Rent	space	50$/year	2,750	137,500	
Preparing	m^2	2$	68,750	137,500	
4) Intersection Improvement					
- Geometrical Design	1-Xn.	15,000	5	75,000	
- Traffic Signals	1-Xn.	35,000	5	175,000	
5) Traffic Safety Facilities					
- Sidewalk	m^2	20	72,000	1,440,000	
- Pavement Overlayers	m^3	70	1,000	70,000	
- Guard-Rail	m	45	40,000	800,000	
6) Traffic Signs & Road Marking					
- Signs					
Warning	1	120	240	28,800	
Regulatory	1	120	120	14,400	
Informatory	1	300	240	72,000	
- Marking					
Lane	m^2	10	4,000	40,000	
Cross-Walk	m^2	10	3,000	30,000	
Edge	m^2	10	4,000	40,000	
On-Street Parking	m^2	10	4,800	48,000	
Subtotal				3,560,000	
Physical Contingency (10%)				356,000	
Sub-Total				3,916,000	
Engineering Services (12%)				470,000	
Total				**4,386,000**	

Total project cost including engineering services will be LL 6.57 billion. (4.39 milion US$)

3.10 IMPLEMENTATION AND FUND PLAN

3.10.1 Implementation Organization

Project Components and implementation Organization, its Management Organization, and the enforcement Organization in the Greater Tripoli area are shown in Table 3.10-1.

Table 3.10-1 Project Component and Implementation Organization

Project Component	Implementing Organization	Management Organization	Enforcement Organization
Bus Terminals	MPWT	MOPWT	Municipality Police Force
Bus Service System	Bus Company (Private)		
Taxi Stand	Tripoli Municipality	Tripoli Municipality	
Taxi Service System	Taxi owner/companies (Private)		
One-Way Traffic System	Tripoli Municipality		
On-Street Parking	Meters - CDR Systems - Municipality		
Off-Street Parking	Private Company/Investor (BOT)		
Intersection Improvement and Traffic Signals	CDR		
Traffic Safety Facilities	Tripoli Municipality		
Traffic Signs and Pavement Marking			

Except private company or investor, the implementation organization should be as shown in Figure 3.10-1.

Project Manager's Task is as described in Table 3.10.2. He/she will perform his/her duties with help or advise of in-house consuultant or legal advisor.

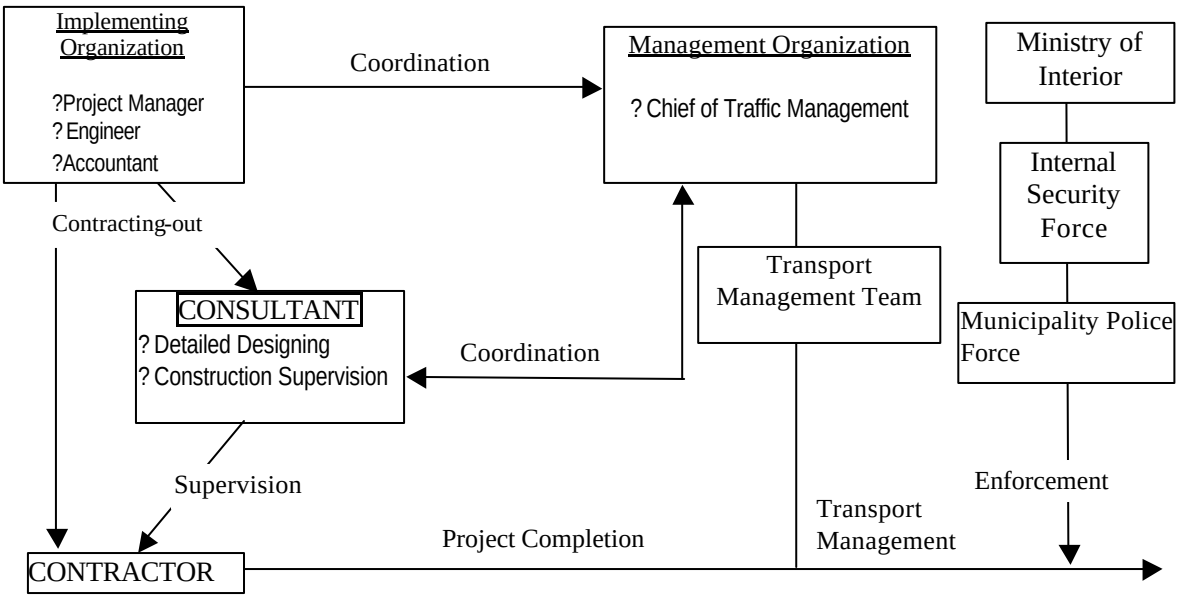


Figure 3.10-1 Implementation Organization

3.10.2 Duty of Implementing Organization, Consultant, Contractor and Tripoli Municipality

The Study proposes the duties and tasks of the implementing organization as following Table 3.10-2.

Except in the case of private participation (BOT) projects, Project Management Team (PMT) will coordinate with higher authorities of the Government, related Ministries and Tripoli Municipality and a lending institution. It will directly manage the smooth implementation of the Project with the assistance of in-house consultant(s) and advisor(s) who is well acquainted with administrative matters and procedures of a lending institution. Project Manager will hire an engineering consulting firm(s) for the detailed design and construction supervision. A contractor(s) will be selected through tendering.

Table 3.10-2 Duty and Tasks

Organization	Category	Duty/Tasks
PMT (CDR, MOPWT & The Municipality)	1) Contracting	(a) Preparation of Contents of Contract, Terms and conditions, Budget (b) Arrangemnt of Right of Way, Acquisition of Land (c) Authorization of performance for consultant
	2) Reporting	(a) Higher Authority (b) Financier
	3) Supervising of contracts	Supervising of consulting service contract, supply and/or construction contracts
Consultant	1) Detailed Designing	(a)Review on the preliminary study and design mentioned in the Feasibility Study (b) Preparation of Construction Plan and Drawing (c) Cost Estimation (d) Preparationof Construction Specifications (e) Tender Documents Preparation
	2) Construction Supervision	(a) Quality Control (b) Quantity Control (c) Schedule Control
Contractor	Construction	Construction and/or Supply of Goods and Services
TRIPOLI MUNICIPALITY(*)	Management of O & M, and Enforcement	a) Operation b) Maintenance c) Enforcement

Remarks: (*)

1) Management; Mayor and the Director General of Engineer with the help of legal advisor, and engineers of relevant expertise.
2) Maintenance; Facility maintenance will be managed by Chief of Maintenance.
3) Enforcement; Tripoli Municipality Police Force with the support of Internal Security Force and Ministry of Interior.

3.10.3 Fund Plan

The Study envisages the final financial burden sharing and the finance for intial cost for each component in the project should be as following Table 3.10-3.

As for the BOT projects, financial requirements, user's fare rate, period of investment, and other related matters are decided by or between the authorities concerned and the investor(s). The Study does not proposed anything on these points. However, the investment climate in Lebanon is very unfavorable compared to other surrounded countries, it is recommended to consider the situation and farer and favorable terms and conditions should be provided.

Table 3.10-3 Financial Resources and Finance for Initial Cost

Project Component	Implementing Organization	Final Financial resourses shared by:		Finance for Initial cost
		Initial cost	O & M cost	
Bus Terminals	MPWT	BOT (Bus users/ Tenants	Bus users/ Tenants	BOT
Bus Service System	Bus Company (Private)	BOT (Bus users/ Tenants	Bus users/ Tenants	BOT
Taxi Stand	Tripoli Municipality	Taxpayer	Taxpayer	Loan
Taxi Service System	Private taxi owner/ companies	Private taxi owner or companies (User)	User	Private taxi owner/companies
One-Way Traffic System	Tripoli Municipality	Taxpayer	Taxpayer	General Revenue
On-Street Parking	Meters - CDR Systems - Municipality	User	User	Loan
Off-Street Parking	Private Company/Investor (BOT)	BOT (User)	User	BOT
Intersection Improvement and Traffic Signals	CDR	Tapayer	Taxpayer	Loan
Traffic Safety Facilities	Tripoli Municipality	Taxpayer	Taxpayer	Loan
Traffic Signs and Pavement Marking		Taxpayer	Taxpayer	Loan

As for the other sub-projects proposed, these projects do not have any income from the operation, the Municipal budget is not enough to spare for these project, and final financial burden should be shared by tax payer. Touchy matters such as increase of tax rate and introduction of specific purpose tax is ommited.

The Study recommend this project for which loan is proposed should be implemented to have concessional loan from international aid agencies.

Annual fund requirements are estimated as Table 3.10-4.

Table 3.10-4 Annual Fund Requirements for the Project

Unit: 1,000 US$

Items	2002	2003	2004	2005	Total	%
Right of Way Acquisition	-	-	-	-	-	-
Engineering	235.0	235.0	-	-	470.0	10.7
Construction		1,174.8	1,174.8	1,566.4	3,916	89.3
Total	235.0	1,409.8	1,174.8	1,566.4	4,386.0	100.0

Administraive cost for each implementing organization is not included. Right of Way and land acquision cost is not included due to project owner's premises and for the BOT projects, it will be decided by the negotiation with project implementing organizations. Financing cost such as payment of intrest and fees is also not included because the terms and conditions of the loan is unknown at this time.

Except engineering cost, all other cost is local cost. It should be reminded that some small amount of the local cost should be born by the project implementing organization because some international aid agencies can not finance some of the local cost such as land acquisition cost.

3.11 PROJECT EVALUATION

Traffic management will improve traffic operations in the corridor and will reduce traffic congestion in the central area. These benefits on transportation investments with low cost could be achieved through proper law enforcement procedures and control measures of on-street parking. The economic benefit is made for the following assumptions.

3.11.1 Assumptions

1) Time Frame (Analysis Period)
- Detailed design : 2002 - 2003
- Construction & Installation : 2003 - 2005
- Operation (benefit generation) : 2005 - 2014 (10 years)

2) Cost
Economic cost is used, which is estimated by deducting the tax component from the financial cost as shown in Table 3.11-1.

Table 3.11-1 Project Investment Cost Component Unit: Million L.L

Item	Economic Cost		Tax	Financial Cost
	Foreign	Local		
Traffic Management	3,520	2,040	310	5,860
Engineering Cost	420	250	40	710
Total	3,940	2,290	350	6,570

3) Maintenance
Maintenance is needed to keep a given asset in good physical condition and assume continued operation and safety of the facilities. Cost for Signing and marking work shall be recurring throughout the analysis period.

4) Quantified Benefit
Traffic cost savings consisting of:
- Running cost
- Fixed cost
- Time cost

5) Discount Rate : 12% per year.

3.11.2 Results of Evaluation

1) Unit Traffic Cost and Project Benefits
Vehicle operating cost is used for various speeds based on vehicle characteristics and travel time cost is used for car driver or car passenger of all trips based on average annual income as shown in Table 3.11-2. The improvement in traffic control facilities and in traffic management have positive impacts on the user's travel time and saving of vehicle operating cost as shown in Table 3.11-3.

Table 3.11-2 Unit Traffic Cost Unit : L.L/km, L.L/hr

Vehicle Type / Speed	Passenger Car	Taxi	Bus	Truck
40	182	177	300	304
50	166	159	292	295
Fixed Cost / hr	505	642	2,091	2,678
Time Cost / hr	5,520	4,200	3,465	4,860

Table 3.11-3 Project Benefits

Item	2005		2010	
	PCU-km	PCU-hr	PCU-km	PCU-hr
Do-nothing Project/day	2,074,671	48,884	2,205,718	53,536
With Project/day	2,070,623	47,274	2,201,498	52,167
Savings/day	4,048	1,610	4,220	1,369
Annual Savings in Traffic Cost	284	1,718	640	1,614
Annual Benefit	L.L 2,001 Million		2,253	

2) Economic Indication

The economic analysis of the traffic management in showed an EIRR of % as shown in Table 3.11-4. Net Present Value (NPV) and Benefit-Cost Ratio (B/C) are calculated at Billon 4.30 L.L and 1.78 for 10 years period. The Economic Internal Rate of Return is calculated as 28.49.

Table 3.11-4 Cost and Benefit Flow Unit : Billion L.L

Year	Cost				Benefit							Dis'd Cost	Dis'd Benefit
	D/D, C/S	Const.. Installat-ion .	Maint.	Total Cost	Running Cost, W/O	Fixed Cost, W/O	Time Cost, W/O	Running Cost, With	Fixed Cost, With	Time Cost, With	Total Benefit		
2002	0.3	-	-	0.3	-	-	-	-	-	-	-	0.3	-
2003	0.2	1.8	-	2.0	-	-	-	-	-	-	-	1.8	-
2004	0.1	1.9	-	2.0	-	-	-	-	-	-	-	1.6	-
2005	0.1	1.9	0.1	2.1	120	12	71	120	11	70	2.0	1.5	1.4
2006	-	-	0.1	0.1	122	12	73	122	12	72	2.1	0	1.3
2007	-	-	0.1	0.1	124	12	74	123	12	73	2.1	0	1.2
2008	-	-	0.1	0.1	126	12	76	125	12	75	2.2	0	1.1
2009	-	-	0.1	0.1	127	13	78	127	12	76	2.2	0	1.0
2010	-	-	0.1	0.1	129	13	79	129	12	78	2.3	0	0.9
2011	-	-	0.1	0.1	131	13	81	131	13	80	2.3	0	0.8
2012	-	-	0.1	0.1	133	13	83	133	13	82	2.3	0	0.7
2013	-	-	0.1	0.1	135	13	85	135	13	83	2.4	0	0.7
2014	-	-	0.1	0.1	137	14	86	136	13	85	2.4	0	0.6
Total	0.7	5.6	1.0	7.3	1,286	126	786	1,280	123	773	22.1	5.5	9.8

Economic Indicators	
B/C Ratio	1.78
NPV (B L.L)	4.30
EIRR (%)	28.49

3.11.3 Sensitivity Analysis

A sensitivity analysis was conducted to take into account the uncertainty of assumptions for unexpected increase in project costs or decrease in benefits as shown in Table 3.11-5. The cases considered in this analysis are:

Case 1: Cost + 10 % and Benefit 0 %
Case 2: Cost 0 % and Benefit - 10 %
Case 3: Cost + 10 % and Benefit - 10 %

Table 3.11-5 Sensitivity Analysis

Parameter	Base Case	Sensitivity Analysis		
		Case 1	Case 2	Case 3
B/C Ratio	1.78	1.62	1.60	1.46
EIRR (%)	28.49	25.41	25.09	22.19
NPV (B L.L)	4.30	3.75	3.32	2.77

3.12 IMPLEMENTATION PLAN

The implementation schedual for the components of Central Tripoli Transport Management Project is presented in Table 3.12-1.

Table 3.12-1 Implementation Plan of Central Tripoli Transport Management Project

Task	2002						2003						2004						2005					
Fund Allocation																								
Consultant Selection																								
Detail Design																								
Tendering																								
Contractor Selection																								
Construction																								

Under the detail design, tendering and construction the following must be considered:

1. Designated Intercity Bus Terminals
2. Taxi Central Park Termin
3. One-Way Traffic Re-Routing
4. On-Street Parking
5. Off-Street Parking
6. Intersection Improvement including geometrical planning and traffic signals
7. Sidewalk Improvement
8. Pavement Rehabiltation
9. Guarde-Rail
10. Traffic Signs
11. Road Marking

It is expected to start the project by the begining of 2002. About one year will be required to prepair the detail design and tendering documents. The construction stage will required about 30 months that will be shared by the above mentioned management components.