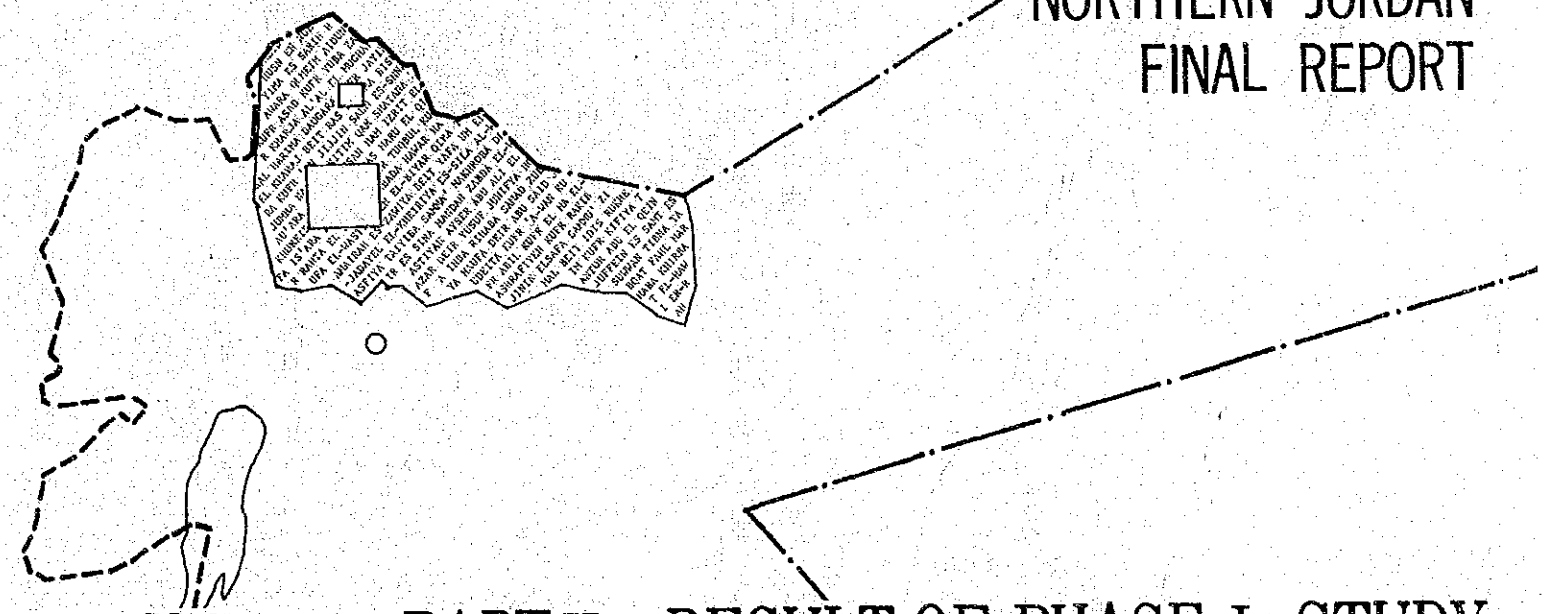
THE HASHEMITE KINGDOM OF
JORDAN

INTEGRATED REGIONAL DEVELOPMENT STUDY OF NORTHERN JORDAN
FINAL REPORT



Volume4: PART II, RESULT OF PHASE I STUDY
CHAPTERS X to XIII

March, 1980
JAPAN INTERNATIONAL COOPERATION AGENCY
TOKYO

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CHAPTER X

TRANSPORTATION

CHAPTER X

TRANSPORTATION

10.1 Modal Use in the Kingdom

10.001 Transportation system in the Country consists of roads, railways, two airports at Amman and Aqaba, and a seaport at Aqaba. In our Study Area, the Irbid Governorate, there are only two modes of transportation: roads and railways. It seems unrealistic to develop other modes in the future, since the rivers do not have enough water for the development of river transportation, and since the center of the Irbid Governorate, Irbid, is too close to Amman for the development of the air transportation. Accordingly, our efforts are mainly devoted to analysis of road and railway transportation.

10.1.1 International Transportation

10.002 The trends of the international transportation for people and goods are shown in Table 10.1 and Table 10.2 respectively. The international passenger travel is predominantly by roads, accounting for over 80 percent of the total for the past five years. The number of passengers by roads more than doubled during this period, corresponding to the increase of the total demand. The use of the railway transportation in 1972 was extremely little due to the aftermath of the civil war in the Country and the number of passengers by railways remained at a relatively low level since then.

10.003 With regard to the movements of international freight, including import, export and transient goods, the total movement of the goods increased by 83 percent during the year 1972 to 1976. The percentage of road transportation within the total freight steadily increased until 1975, but after that period dropped from 54.6 percent to 40.0 percent due to the sudden increase in the use of sea transportation owing to the increased handling capacity at the port of Aqaba. On the other hand, the contribution of the railway transportation steadily declined accounting for only 0.2 percent of the total goods movement in 1976.

10.1.2 Domestic Transportation

10.004 Statistical data on railway and air transportation are shown on Table 10.3 and Table 10.4, excluding domestic road

Table 10.1 Trends in International Passengers by Modes, East Bank, 1972 to 1976

(Unit: 1,000 Persons)

Year	Road	Railway	Air	Sea	Total
Number of Arrivals and Departures					
1972	1,124.3	0.7	173.4	1.2	1,299.6
1973	1,286.3	17.8	209.5	1.1	1,514.7
1974	1,839.3	30.1	313.2	1.2	2,183.8
1975	2,129.2	35.1	429.5	1.6	2,595.4
1976	2,753.7	30.9	550.8	3.5	3,338.9
Percentage to the Total					
1972	86.5	0.1	13.3	0.1	100.0
1973	84.9	1.2	13.8	0.1	100.0
1974	84.2	1.4	14.3	0.1	100.0
1975	82.0	1.4	16.5	0.1	100.0
1976	82.5	0.9	16.5	0.1	100.0
Index of Activity (1972 = 1.00)					
1972	1.00		1.00	1.00	1.00
1973	1.14	1.00 1/	1.21	0.92	1.17
1974	1.64	1.69	1.81	1.00	1.68
1975	1.89	1.97	2.48	1.33	2.00
1976	2.45	1.74	3.18	1.92	2.57

Source: Information reported by the Department of Statistics.

Note: 1/ Because of the unusual impact during 1971-1972, we referred 1973 as 1.00.

Table 10.2 Trends in International Freight Movement for Import, Export and Transient, East Bank, 1972 to 1976

(Unit: Million Tons)

Year	Road	Railway	Air	Sea	Total
International Freight Movement					
1972	1,088.0	52.9	9.0	1,165.7	2,315.6
1973	1,119.9	53.8	5.2	1,242.8	2,421.7
1974	1,643.9	81.6	50.4	1,492.6	3,268.5
1975	1,604.1	28.2	8.8	1,277.8	2,918.9
1976	1,696.5	10.5	11.1	2,526.2	4,244.3
Percentage to the Total					
1972	47.0	2.3	0.4	50.3	100.0
1973	48.4	2.2	0.2	49.2	100.0
1974	50.3	2.5	1.5	45.7	100.0
1975	54.6	1.0	0.3	44.1	100.0
1976	40.0	0.2	0.3	59.5	100.0
Index of Activity (1972 = 1.00)					
1972	1.00	1.00	1.00	1.00	1.00
1973	1.03	1.02	0.58	1.07	1.05
1974	1.51	1.54	5.60	1.28	1.41
1975	1.47	0.53	0.98	1.10	1.26
1976	1.56	0.20	1.23	2.17	1.83

Source: From the Department of Statistics.

transportation. The number of passengers increased steadily for both railway and air, but freight transportation by railway fluctuated widely over the past several years. This fluctuation is mainly due to the construction of a new line and the improvement of the existing facilities to Aqaba during the years 1973-1975 as will be discussed later. Until 1973,there were no railway services beyond Ras el Naqab, and the goods to Aqaba used to be transferred from the railway to trucks at this point. After the completion of the construction of a new line to Aqaba, the railway goods transportation rose steeply again in 1976.

Table 10.3 Trends in Domestic Person Travel by Mode, East Bank, 1971 to 1976

(Unit: 1,000 Persons)

Year	Railway	Air	Road
1971	2.0	56.1	
1972	0.3	78.2	
1973	15.4	112.3	n.a.
1974	50.0	138.8	
1975	58.4	243.8	
1976	65.7	332.2	

Sources: Department of Statistics, Statistical Yearbook, 1976.

Transport Statistics, 1976.

Table 10.4 Trends in Domestic Freight Transport by Mode, East Bank, 1971 to 1976

(Unit: 1,000 Persons)

Year	Railway	Air	Road
1971	82.1		
1972	172.1		
1973	121.0	n.a.	n.a.
1974	6.5		
1975	4.2		
1976	340.3		

Source: Department of Statistics, Statistical Yearbook, 1976

10.005 Although the domestic activity levels of railway and aviation grew during the past several years as mentioned, the road transportation seems to be still the major mode of transportation. The following Table 10.5 shows the trends in the motor vehicle registration. During the years from 1970 to 1976, the number of passenger vehicles increased by as much as 2.6 times and that of goods vehicles more than doubled. The average daily number of trips is said to be two or three times per vehicle. This suggests that the number of passengers by roads is at least 500 times more than that of railway passengers in 1976.

10.2 Road Transportation

10.2.1 General

10.006 The road network in the Country is classified as either national roads, administered by the Ministry of Public Works, or Municipality administered by the corresponding municipalities. National roads are classified into three categories, primary, secondary and village roads. From the functional aspect of classfication, primary and secondary roads are considered as arterial or collector roads, which will be called hereafter as trunk roads in this report. Village roads are all considered as feeder roads. City roads consist of trunk roads and feeder roads.

10.007 Trunk roads must have an adequate quality of services to satisfy the transportation demands from the functional viewpoint. On the other hand, for the feeder roads, the accessibility to the activity centers or the trunk roads is more crucial than the quality of services. Accordingly, several indicators on the quality of service for the trunk roads and the accessibility for the feeder roads were examined for the evaluation of the existing system and for the identification of the points to be improved.

10.008 Two aspects of the trunk roads will be evaluated. First, it will be examined whether the roads are above the level of standard in terms of structural conditions such as surface condition, width, horizontal or vertical alignments, etc."Tolerable standards" established in the Master Road Plan will be used for evaluation. These standards are meant to judge on a uniform basis, the relative conditions of the existing road system components. The roads which are considered inferior to these minimum acceptable standards should be improved. The other criterion is the comparison of the road capacity to the future traffic volume. The roads which are considered as having inadequate capacity for the current and future traffic volume are judged as requiring expansion.

10.009 With regard to the feeder roads, two indicators will be used for evaluation. First, it will be examined whether there was an access to the activity centers or the trunk roads from a village by the feeder roads. If trails are the only available access, feeder roads should be constructed to replace them.

Table 10.5 Trends in Motor Vehicle Registration, East Bank, 1970 to 1976

(Unit: Cars)

Year	Passenger Vehicles 1/ Number	Passenger Vehicles 1/ Percent Increase (Decrease)	Goods Vehicles Number	Goods Vehicles Percent Increase (Decrease)	Other Vehicles 2/ Number	Other Vehicles 2/ Percent Increase (Decrease)	Total Vehicles Number	Total Vehicles Percent Increase (Decrease)
1970	14,495	-	5,436	-	4,198	-	24,129	-
1971	15,521	7.1	5,766	6.1	4,482	6.8	25,769	6.8
1972	16,428	5.8	5,556	(3.6)	4,714	5.1	26,698	3.6
1973	19,829	15.8	5.777	4.0	6,008	27.5	30,814	15.4
1974	23,879	23.9	6,470	12.0	7,011	16.7	37,060	20.3
1975	29,293	24.2	8,378	29.5	9,383	33.8	47,054	27.0
1976 3/	37,323	27.4	10,988	31.2	11,145	18.8	59,457	26.4
Percent change 1970 - 76		157.5		102.1		165.5		146.4

Source: Department of Traffic and Ministry of Interior.

Notes: 1/ Includes private passenger cars, taxis, and buses.

2/ Includes government vehicles, motorcycles, tractors and vehicles registered by foreign governments and agencies.

3/ Figures for 1976 are preliminary.

Second, as another indicator, the surface conditions of roads will be examined. Taking account of needs at emergency cases, the roads to villages should give an access not only by jeeps but also by passenger cars.

10.2.2 Diagnosis of the Present Condition

a. Inventory

10.010 The total length of the national roads in the East Bank is 6,175.1 km as of 1977, and additional 157.0 km is now under construction (see Table 10.6). In the Irbid Governorate, the total length of the national roads is 1927.1 km,of which 30.8 percent is the primary road extending 592.8 km. The secondary road system is 202.3 km, accounting for 10.5 percent of the total length. The rest 1,132.0 km, comprises the village roads, making up 58.7 percent of the total.

Table 10.6 Total Length of National Road, March 1977

East Bank

(Unit: km)

Classification	Total	Asphalted	Not-Asphalted
Primary	1,703.8	1,693.8	10.0
Secondary	1,035.3	1,033.6	1.7
Village	3,593.0	2,097.3	1,495.7
Total	6,332.1	4,824.7	1,507.4

Irbid Governorate

Classification	Percent	Total	Asphalted	Not-Asphalted
Primary	30.8	592.8	512.8	10.0
Secondary	10.5	202.3	201.1	1.2
Village	58.7	1,132.0	585.0	547.0
Total	100.0	1,927.1	1,298.9	558.2

Sources: Information from the Ministry of Public Works, Master Road Plan.

10.011 The total length of the national roads in Irbid Governorate makes up about 30 percent of the East Bank total. Comparing this figure to the Governorate's share of the area and of the population in the East Bank, the road network in the Governorate can be said to be relatively well developed (see Table 10.7).

Table 10.7 Comparison of Irbid Governorate to East Bank, 1977

	Irbid Gov. (A)	East Bank (B)	(A)/(B)
Road Length (km)	1927.1	6332.1	30.4%
Area (km)	22,654	89,206	25.4%
Population in 1975 (Persons)	563,990	1,951,968	28.9%

Source: Department of Statistics

10.012 Figure 10.1 shows the network of primary and secondary roads in the Governorate, and Table 10.8 shows the length of roads by urban and rural.

(1) Primary Roads

There are 7 primary routes in the Irbid Governorate, Routes 5,11,15,16,20,30 and 45. As shown on Table 10.8, about 96 percent (569.0 km) of the primary road system is considered to be in the rural areas.

(2) Secondary Roads

As for the secondary road system, six routes, Routes 12,19,23,33,37 and 41 exist in the Governorate. Only 4.9 km of the secondary roads are in the urban areas.

(3) Village Roads

Village roads in the Irbid Governorate extend 1132 km of which about 52 percent is asphalted. The remaining non-asphalted village roads of 547.0 km are sometimes called agricultural roads.

(4) Municipality

No statistical information is available on municipality roads. According to the Municipality of Irbid, the total length of the municipality roads is approximately 120 km and the construction of the additional 80 km is

Figure 10.1 Primary & Secondary Roads in the Irbid Governorate

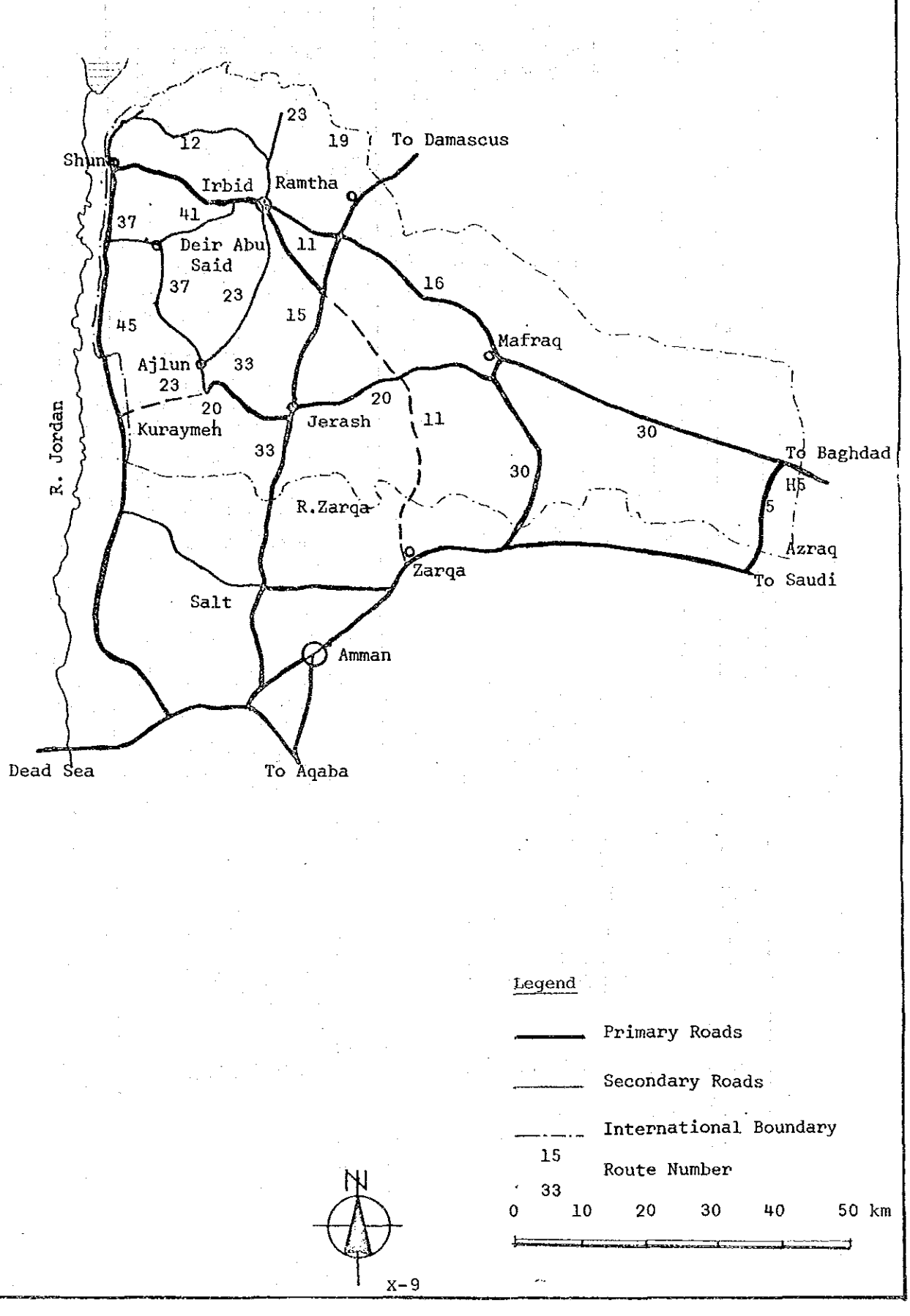


Table 10.8 Existing Primary and Secondary Roads in Irbid Governorate

(Unit: km)

Route Description			Length in the Irbid Governorate		
Route Number	From	To	Rural	Urban	Total
Primary Roads					
5	West of El Jafr	H5	10.4	0.0	10.4
11	Irbid	Zarqa	31.8	2.6	34.4
15	Syrian Border	Saudi Border	42.6	7.0	49.6
16	Mafraq	North Shuna	69.1	7.0	76.1
20	Mafraq	Kraymeh	63.6	2.6	66.2
30	Iraqi Border	Jordan River	290.5	3.4	293.9
45	West of Amman	North Shuna	61.0	0.0	61.0
Total			569.0	22.6	591.6
Secondary Roads					
12	North of Irbid	North Shuna	25.5	0.0	25.5
19	Ramtha	Dhuneiba	20.6	2.4	23.0
23	Anjara	Yarmouk River	55.6	2.0	57.6
33	Route 23	Salt	34.0	0.5	34.5
37	Ajlun	Route 45	40.2	0.0	40.2
41	West of Irbid	Deir Abu Said	17.8	0.0	17.8
Total			193.7	4.9	198.6

Source: Ministry of Public Works.

on schedule. About 20 km of the total is unpaved gravel roads. Most of the trunk roads in the Municipality of Irbid are a part of the national roads which pass through the city center of Irbid.

b. Present Road Condition

10.013 In general, roads in the Irbid Governorate are fairly well designed and maintained except for village roads. As shown on Table 10.6, only 1.4 percent (11.2 km) of the primary and secondary roads in the Governorate remains unpaved in 1977. It is reported that the unpaved parts which are on Route 30 and 45, are now being paved. On the other hand, the village roads have a considerable portion of unpaved surface in the Governorate. About 41.6 percent of the total are yet non-asphalted.

10.014 The following Table 10.9 shows the width and number of lanes of the primary and secondary roads. Most of the primary and secondary roads have a width of 4.0 - 7.2 meters and two lanes. The width of the primary roads is a little wider than the secondary, and about 1.4 percent of them have 4 lanes. According to the tolerable standards of the Master Road Plan, the required widths for the primary and the secondary roads with 2 lanes are 6.6 meters and 5.4 meters, respectively. Therefore, about 50 percent of the trunk roads do not have the required width, particularly shoulder width.

10.015 The horizontal and vertical alignment of the roads also affect the quality of traffic service and therefore the safety of the motor vehicle operations. Table 10.10 shows the number of curves by various design speeds and the distribution of the vertical alignments of roads in the Irbid Governorate. Tolerable standards define that the design speed must be at least 50 km/hour for the primary and 40 km/hour for the secondary roads. Therefore, 19 percent (approximately 2.7 km) of the primary roads should be improved, keeping the gradient to 9 degrees at maximum. In the similar vein, 12 percent of 2.2 km of the secondary roads will have to be upgraded to meet the tolerable standards. The exact location of the parts which require upgrading will be indicated in the subsequent paragraphs.

c. Ongoing Projects

10.016 The current Five Year Plan lists 28 projects in this sub-sector of roads. Among these, the followings are projects either located in or closely related to the Irbid Governorate (see Figure 10.2).

(1) Yarmouk-Dead Sea road:

Construction of the primary road connecting North Shuna and the Dead Sea to link the Jordan Valley to the primary road network.

Table 10.9 Road Length by Surface Width and Number of Lanes, Irbid Governorate

(Unit: km)

	Primary Roads		Secondary Roads		Total	
	km	%	km	%	km	%
Width						
Less Than 4.0 m	11.8	2.0	32.6	16.6	44.4	5.6
4.0 m " 6.0 m	154.8	26.1	132.6	66.8	287.4	36.4
6.0 m " 7.2 m	346.9	58.6	28.7	14.5	375.6	47.5
7.3 m " 14.4 m	71.8	12.1	4.7	2.4	76.5	9.7
More Than 14.4 m	6.7	1.1	0.0	0.0	6.7	0.8
Total	591.6	100.0	198.6	100.0	790.2	100.0
Number of Lanes						
2	582.9	98.5	198.6	100.0	781.5	98.9
3	0.0	0.0	0.0	0.0	0.0	0.0
4	0.2	0.0	0.0	0.0	0.2	0.0
4 (divided)	8.5	1.4	0.0	0.0	8.5	1.1
6	0.0	0.0	0.0	0.0	0.0	0.0
6 (divided)	0.0	0.0	0.0	0.0	0.0	0.0
Over 6	0.0	0.0	0.0	0.0	0.0	0.0
Total	591.6	100.0	198.0	100.0	790.2	100.0

Source: Ministry of Public Works.

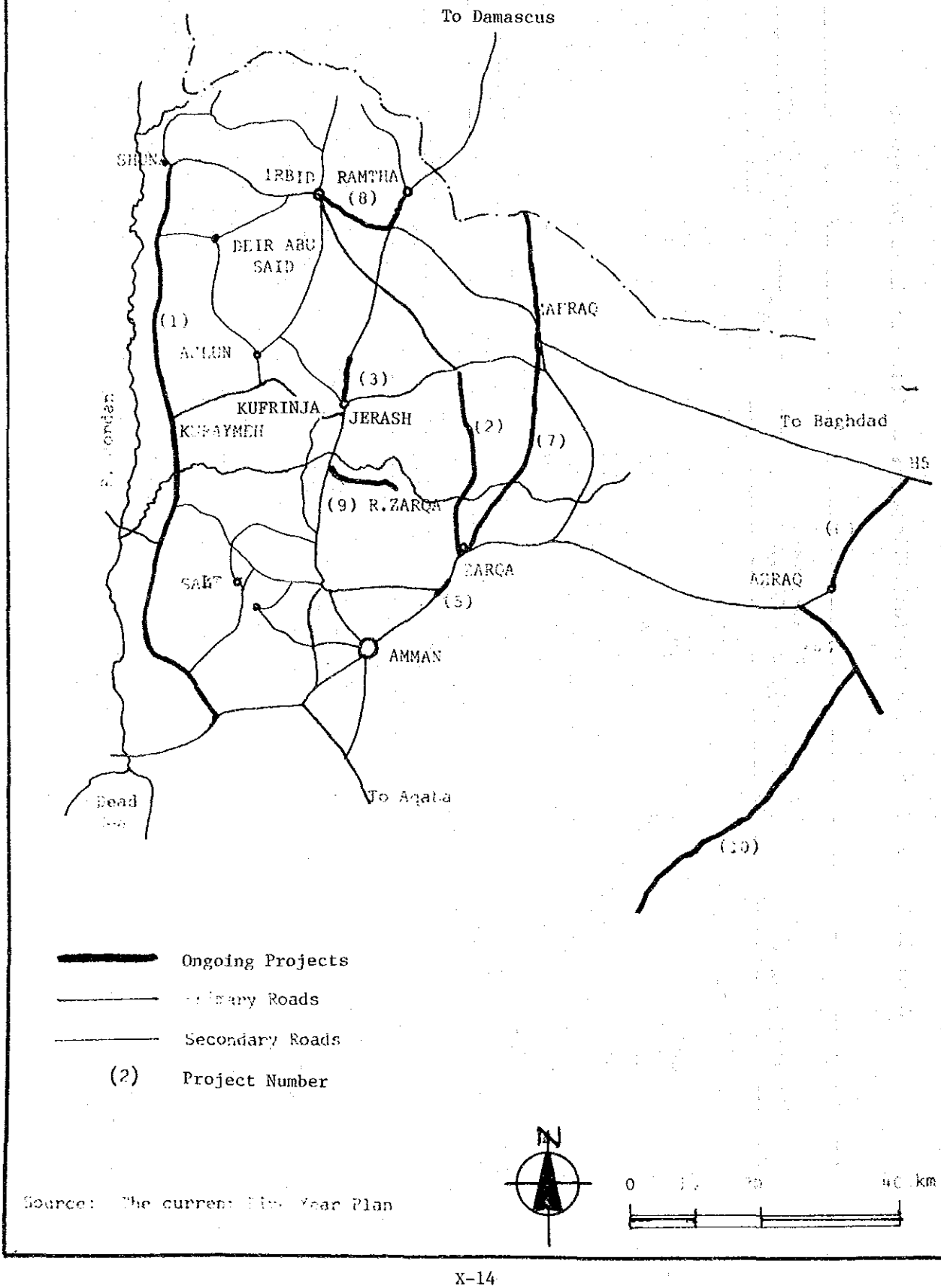
Table 10.10 Horizontal and Vertical Alignments of Roads in Irbid Governorate

Design Speeds	Primary Roads		Secondary Roads	
	Number of Curves	%	Number of Curves	%
40 km/hr	126	18.9	442	60.5
50	134	20.1	142	19.4
60	116	13.4	81	11.1
70	104	15.6	51	7.0
80	111	16.7	14	1.9
90	57	8.5	1	0.0
100	19	2.8	0	0.0
110	0	0.0	0	0.0
Total	667	100.0	731	100.0

Gradients	Primary Roads		Secondary Road	
	km	%	km	%
3	377.5	66.4	71.0	36.7
" 4	69.2	12.2	21.7	10.9
4 " 5	60.3	10.6	21.1	10.9
5 " 6	30.7	5.4	16.9	8.7
6 " 7	13.6	2.4	23.4	12.1
7 " 8	8.2	1.4	10.0	5.2
8 " 9	6.7	1.2	11.1	5.7
9 " 10	2.2	0.4	8.8	4.5
10 " 11	0.5	0.1	5.3	2.7
11 " 12	0.0	0.0	2.2	1.1
12	0.0	0.0	2.2	1.1

Source: Ministry of Public Works.

Figure 10.2 Ongoing Projects, Irbid Governorate



Source: The current Five Year Plan

(2) Rihaba -Zanieh-Hashimiya road:

New link of the Jordan Refinery, the Hussein Central Thermal Power Station and the Municipality of Zarqa to the Mafraq Mutserfieh.

(3) Jerash-Thaghrat 'Asfur road:

Improvement of the alignment of the primary roads between Jerash and Thaghrat 'Asfur.

(4) Azraq-Saudi Border road:

Construction of the primary road (Route 50) from Azraq to the Saudi Border.

(5) Overpasses at the intersection of Amman/Zarqa road and the railway.

(6) Azraq-H5-Iraq: Border road:

Construction of a new road from Azraq to the Iraqi Border via H5.

(7) Zarqa-Mafraq-Syrian Border road:

Construction of a new road from Zarqa to the Syrian Border via Mafraq.

(8) Irbid-Ramtha Triangle road:

Upgrading the existing 16 km road from a subsidiary road into a main one.

(9) Sukneh-Jerash road:

Construction of a new road for the development of the agricultural area along the Zarqa River.

(10) Azraq-Bayer-Jafer road:

Construction of a road from Azraq via Jafer to Ma'an, i.e. completion of Route 5.

10.017 In addition, the current Five-Year Plan projects the upgrading of the 800 km of the primary and the secondary roads, and the construction and asphalting of the 550 km of the village roads.

10.018 According to the annual report of 1976 and information from the Ministry of Public Works, the projects (1), (4) and (8) above, has already been completed. The project (5) has been started recently. The projects (2) and (6) are reported to be also under construction. The rest of the ten projects listed above are still under study or

at the stage of designing. As for the other major road projects, the road between Kufrinja and the Ghor on Route 20 is now under construction. With regard to village roads, the following roads are to be asphalted or partly completed:

(1) Jubba-Deir Alkahf road,

(2) Almukaifa-Baldat Qasem road,

(3) 'Anjara-Rajib road,

(4) Sakib-El Huseiniyat road,

(5) Aidun Bani Hasan-Yayan El Mushref road,

(6) Main Road-Yayan El Gharbi road,

(7) Burma-El Sheibeh road,

(8) Main Road-Deir Alkahf road, and

(9) Al Mukaifa-Um Algntum road.

10.019 In 1976, about 13 km was constructed and 31.5 km was asphalted in the Irbid Governorate, including the above roads.

d. Traffic

i. Growth of the Traffic Volume

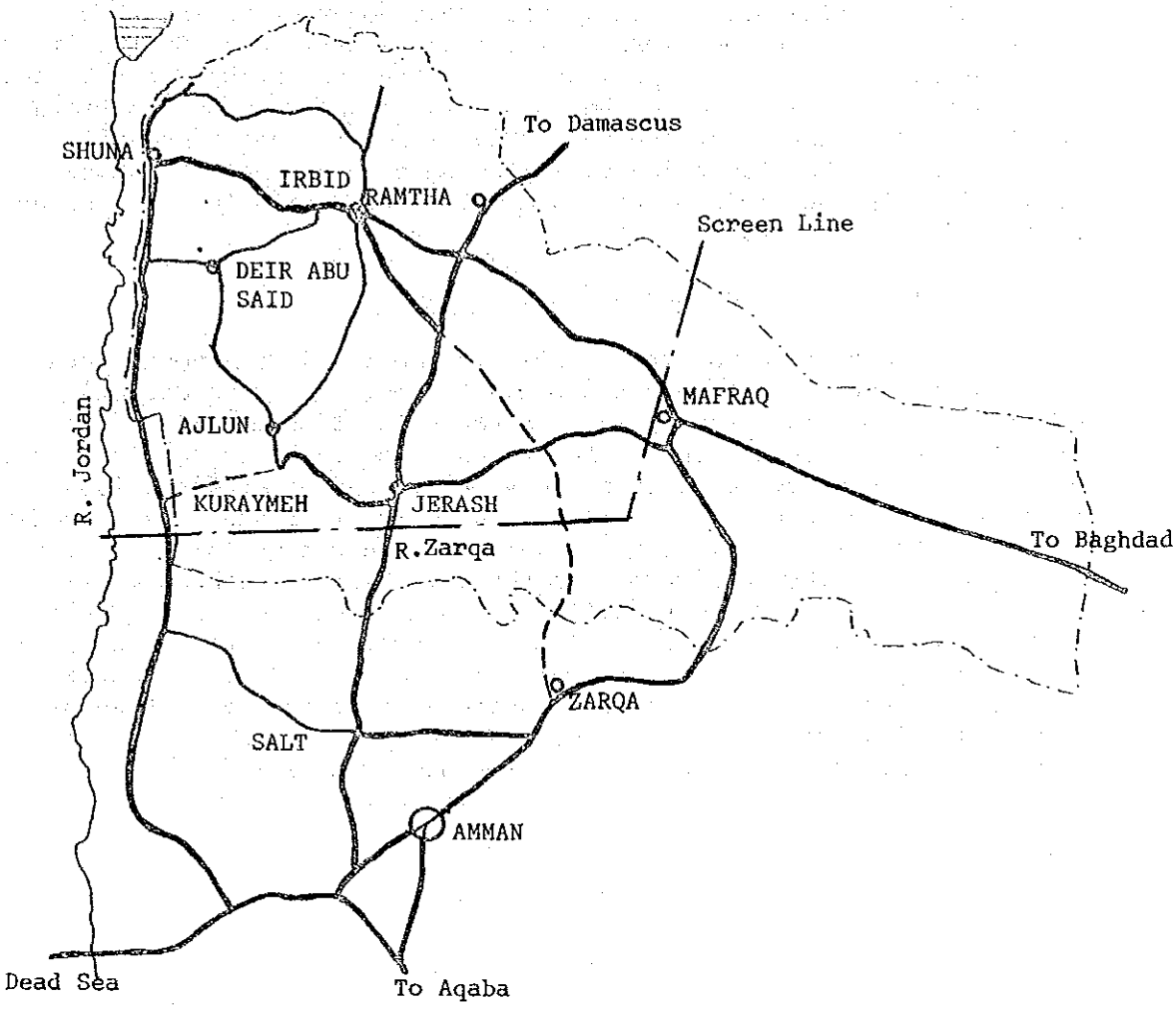
10.020 The growth of the traffic volume is examined by setting a screen line between the Irbid Governorate and the Amman Governorate as shown on Figure 10.3. The following table indicates that the traffic volume steadily increased and almost doubled during the five years from 1972 to 1976.

Growth of the Traffic Volume at Screen Line

Year	Vehicles per day	Index (1972=100)
1972	5,953	100
1973	6,948	117
1974	8,370	141
1975	8,812	148
1976	11,524	194

Source: Master Road Plan.

Figure 10.3 Screen Line for Traffic Count



Legend

- Screen Line
- Primary Roads
- Secondary Roads
- International Boundary

Source: Master Road Plan.

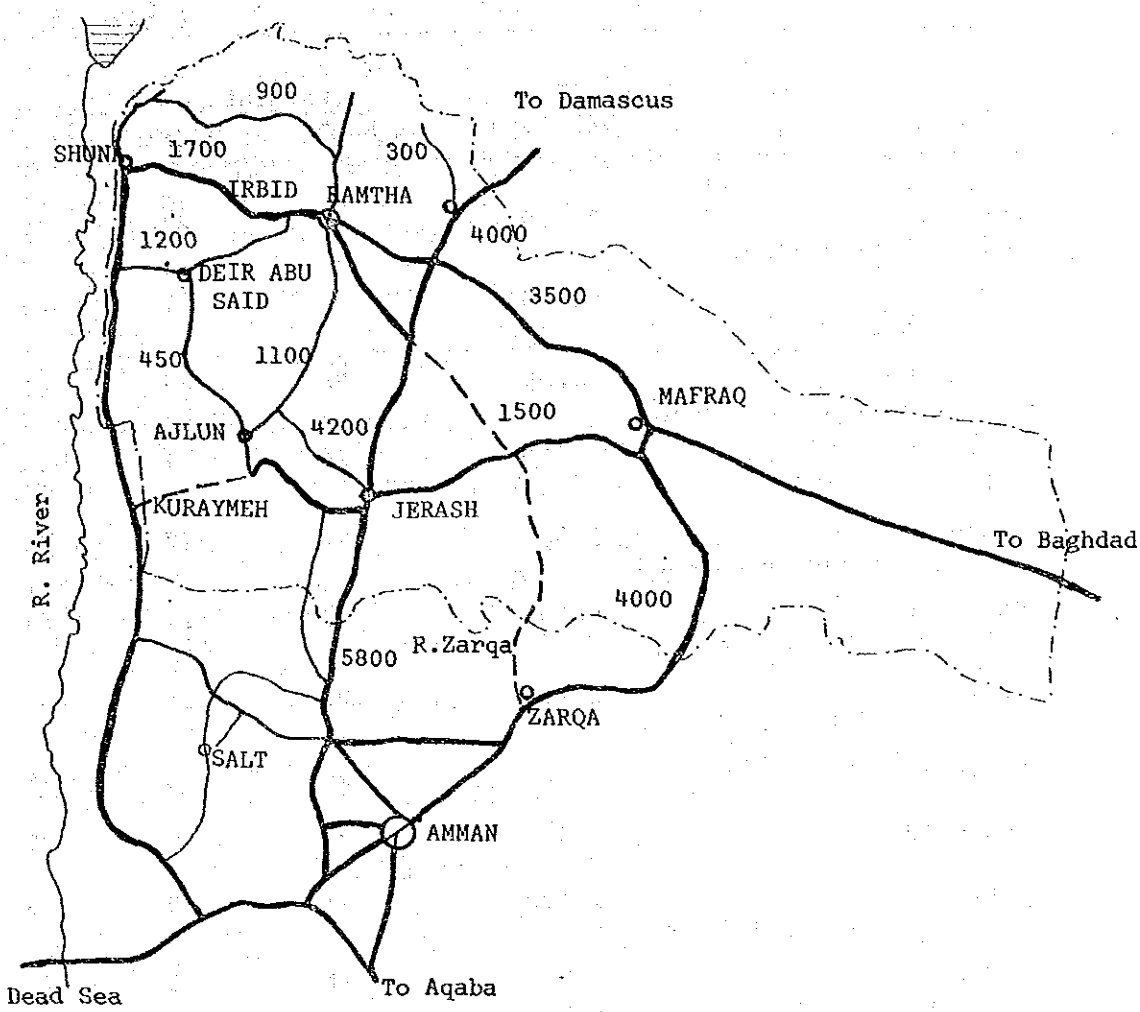
0 10 20 30 40 50 km

This steady growth reflects the increase in the number of motor vehicles already shown in Table 10.5. Out of the total private cars excluding taxies and buses approximately 7,000 vehicles (23.7 percent) are owned by the people in the Irbid Governorate in 1976. There are thus 0.012 vehicles per person in the Irbid Governorate and this figure is lower than the average of the whole East Bank, 0.015. It is observed in other developing countries that the number of vehicles increases exponentially once the household income reaches a certain level, and that the lower the ownership ratio is the higher will its growth rate be. Accordingly, it is anticipated that the number of vehicles in the Irbid Governorate will increase faster than other regions in the future.

ii. Traffic Volumes on Trunk Roads

10.021 The traffic volumes in 1976 in the Irbid Governorate are shown on Figure 10.4. According to the figure, the major direction of traffic flows is north-south, and Route 15 and Route 30,connecting the Irbid Governorate and Amman, have the largest traffic volume of about 4,000-6,000 vehicles per day. As to the other directions, recorded volumes were much smaller . Table 10.11 presents percentages of the daily traffic of trucks at various observation points indicated on Figure 10.4. The traffic on the roads to Mafraq contains many trucks, accounting over one half of the daily traffic volume. This is because Mafraq is located at the inter-section of the trunk roads to Damascus, Baghdad and Amman, which are major origins and destinations for trucks. The table also indicates that the percentage of trucks would decrease in roads located close to cities, where inter-regional traffic mainly consist of passenger vehicles.

Figure 10.4 ADT in 1976 at the Main Points in the Irbid Governorate



Legend

1100: Average Daily Traffic Volume

Primary Road

Secondary Road

International Boundary

0 10 20 30 40 50 km

Table 10.11 Percentages of Trucks within ADT, Irbid Governorate

(Unit: %)

Route	ADT (Veh/Day)	Percentage of Trucks		
		Light	Heavy	Total
Route 15 (North of Ramtha)	4,000	11	33	44
Route 15 (North of Jerash)	4,200	16	7	23
Route 16 (Between Mafraq-Irbid)	3,500	28	23	51
Route 16 (West of Irbid)	1,700	30	9	39
Route 20 (Between Jerash-Mafraq)	1,500	48	17	65
Route 30 (Between Mafraq-Zarqa)	4,000	30	27	57
Route 45 (South of N.Shuna)	1,200	30	10	40
Route 12	900	20	5	25
Route 19	300	21	6	27
Route 23 (Between Ajlun-Irbid)	1,100	21	5	26
Route 37 (Between Ajlun-Deir Abu Said)	450	15	5	20

Source: Master Road Plan.

iii. Interregional Traffic Flows

10.022 Interregional traffic flows are illustrated in the following several figures based on the Origin-Destination Survey conducted by the Ministry of Public Works in 1976.

10.023 The Figures 10.5 and 10.6 represent the traffic flows between the Irbid Governorate and the other regions in terms of the daily volumes of passenger vehicles and trucks respectively. Both flows show a similar pattern; the Governorate is most closely related as shown by heavy traffic, with the Amman Governorate, particularly Amman and Zarqa followed by Syria and the Balqa Governorate.

10.024 The traffic flows between the districts in the Irbid Governorate are shown on Figures 10.7 and 10.8. These figures clearly indicate that the city of Irbid is the center of activity in the Governorate, since most of the trips are originated in or destined to Irbid for both passenger vehicles and trucks. One distinguishing characteristic of the truck flow from the passenger vehicle flow is its large volume between the Ghor and Irbid.

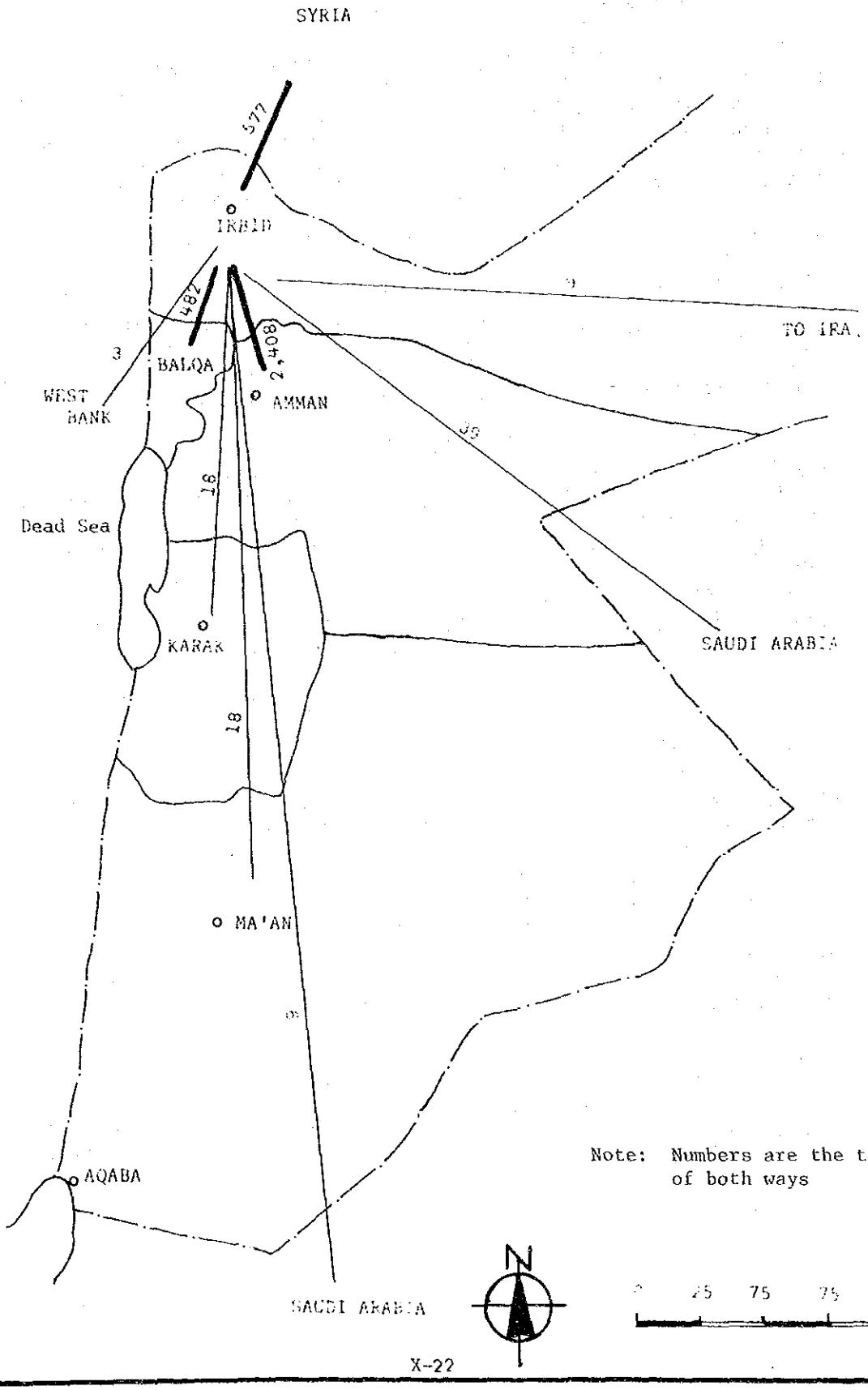
10.025 The through traffic in the Governorate are shown on Figures 10.9 and 10.10. As to the passenger vehicles, the main flows passing through the Governorate are those between Syria and Amman and between Syria and Saudi Arabia. The through traffic of trucks are somewhat more varied in their origins and destinations, but the flows from Syria to Amman, or to Saudi Arabia are also predominant. It is notable that the volume of through traffic between Syria and Amman, or to Saudi Arabia in the north-south direction amounts to over 2,200 vehicles per day.

iv. Urban Traffic in the Municipality of Irbid

10.026 With regard to the urban traffic in the Study Area, there is no data available. Considering that the traffic volume in a city is obviously larger than that in a rural area, it is necessary to estimate the urban traffic volume for the development of municipality roads. Therefore, a traffic survey was made by the Study Team at 8 stations in the city of Irbid, the largest municipality in the Study Area on two days of August 21 (Monday) and August 22(Tuesday), 1978. The stations selected were mainly located on the major roads as shown in Figure 10.11. The traffic volume at each station was counted for each direction. The station No. 7 has two observation points for two one-way roads running in opposite direction.

10.027 The results of the survey are presented in Table 10.12 and Table 10.13. The largest traffic volume was observed at the station No. 5, which is located at the CBD on Route 16. A short period of traffic congestion was observed at such points as No. 4, No. 5 and No. 7, at CBD. The hourly variation of traffic volume was little at all the stations, with minor peaking from 9:00 to 10:00 a.m. and from 13.00 to 14.00 p.m.

Figure 10.5 Interregional Flows (Trucks)



Note: Numbers are the total of both ways

Figure 10.6 Interregional Flows(Passenger Cars,Buses & Taxis)

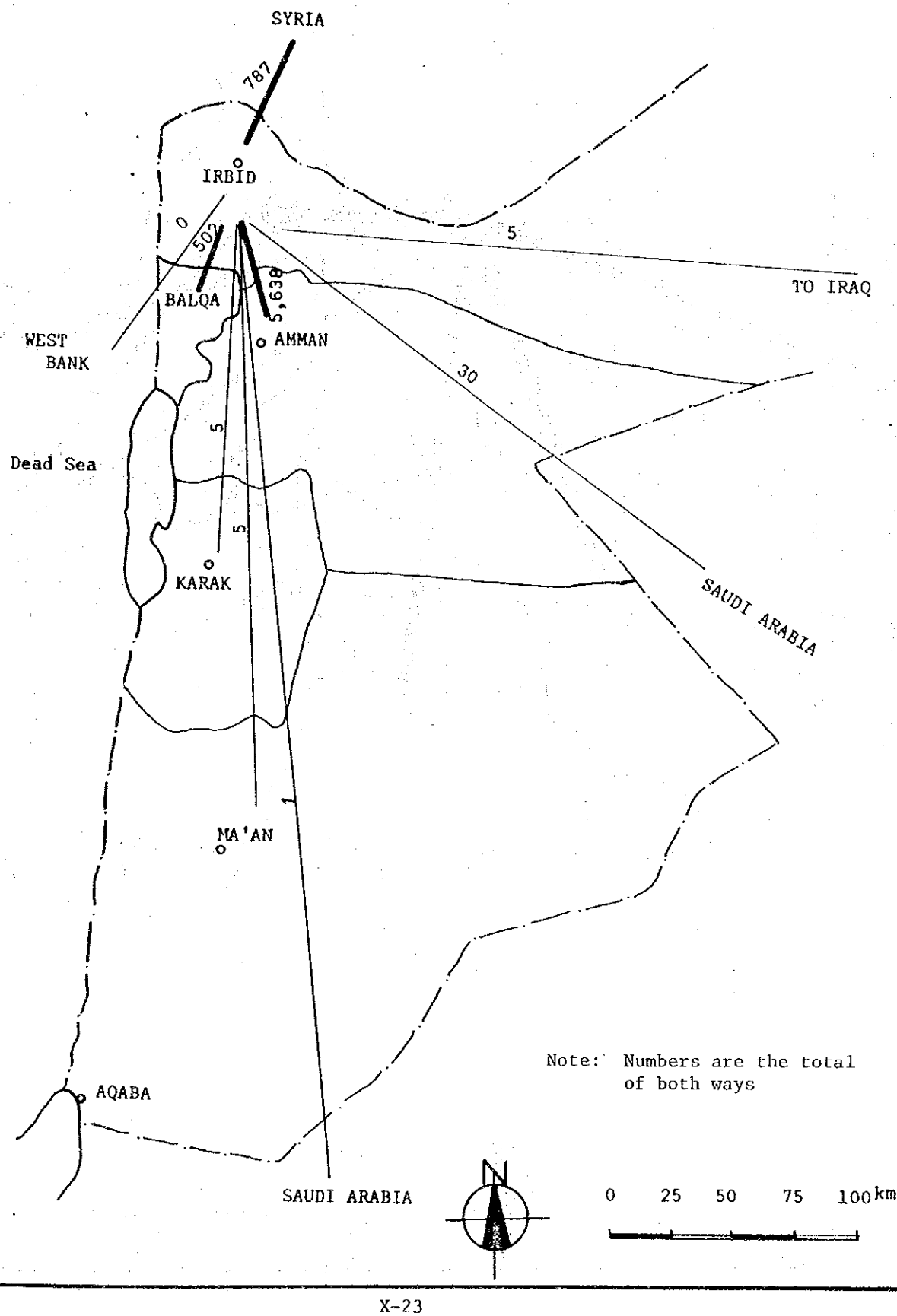


Figure 10.7 Traffic Flows in Irbid Governorate
(Passenger Vehicles per Day)

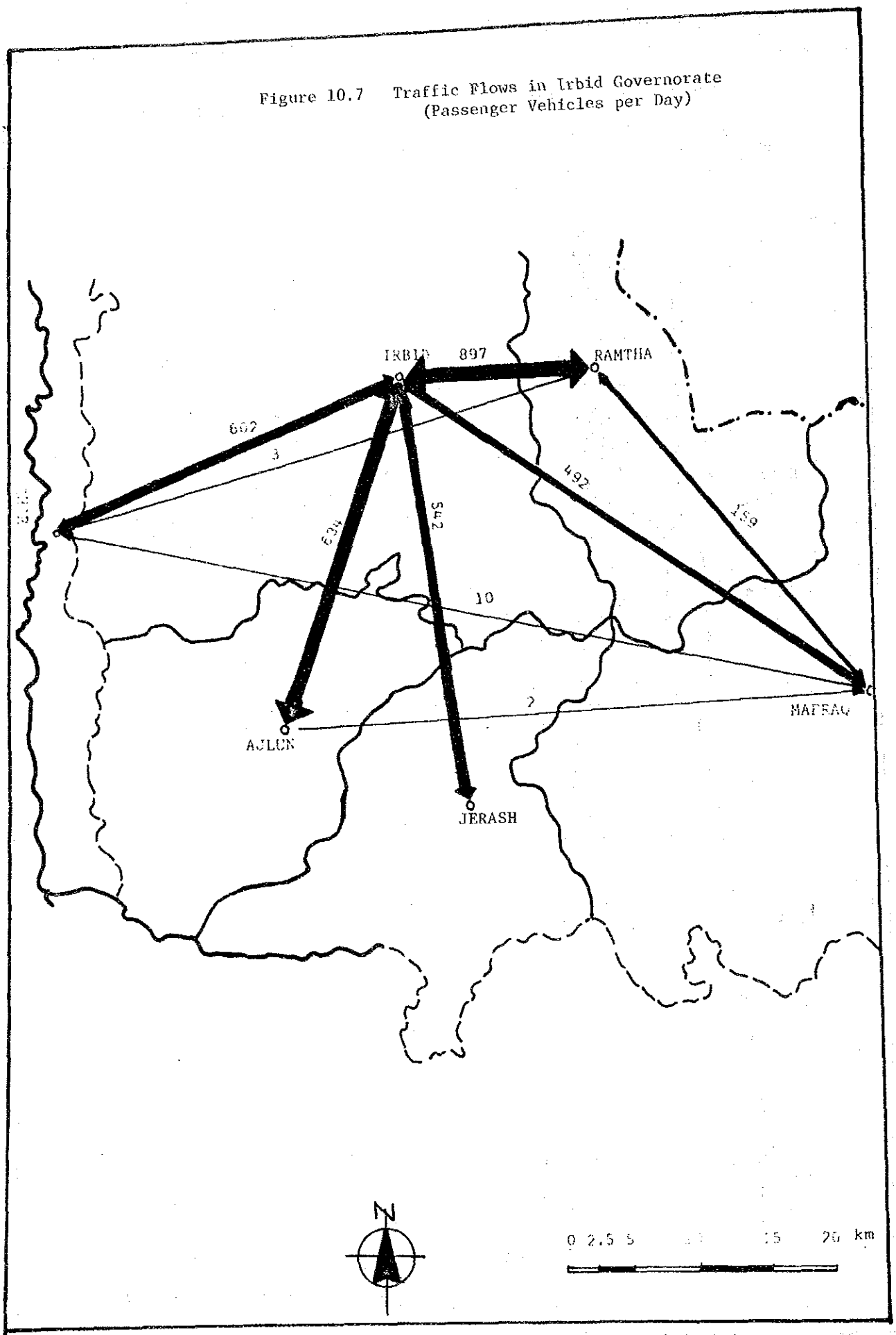


Figure 10.8 Traffic Flows in Irbid Governorate
(Trucks per Day)

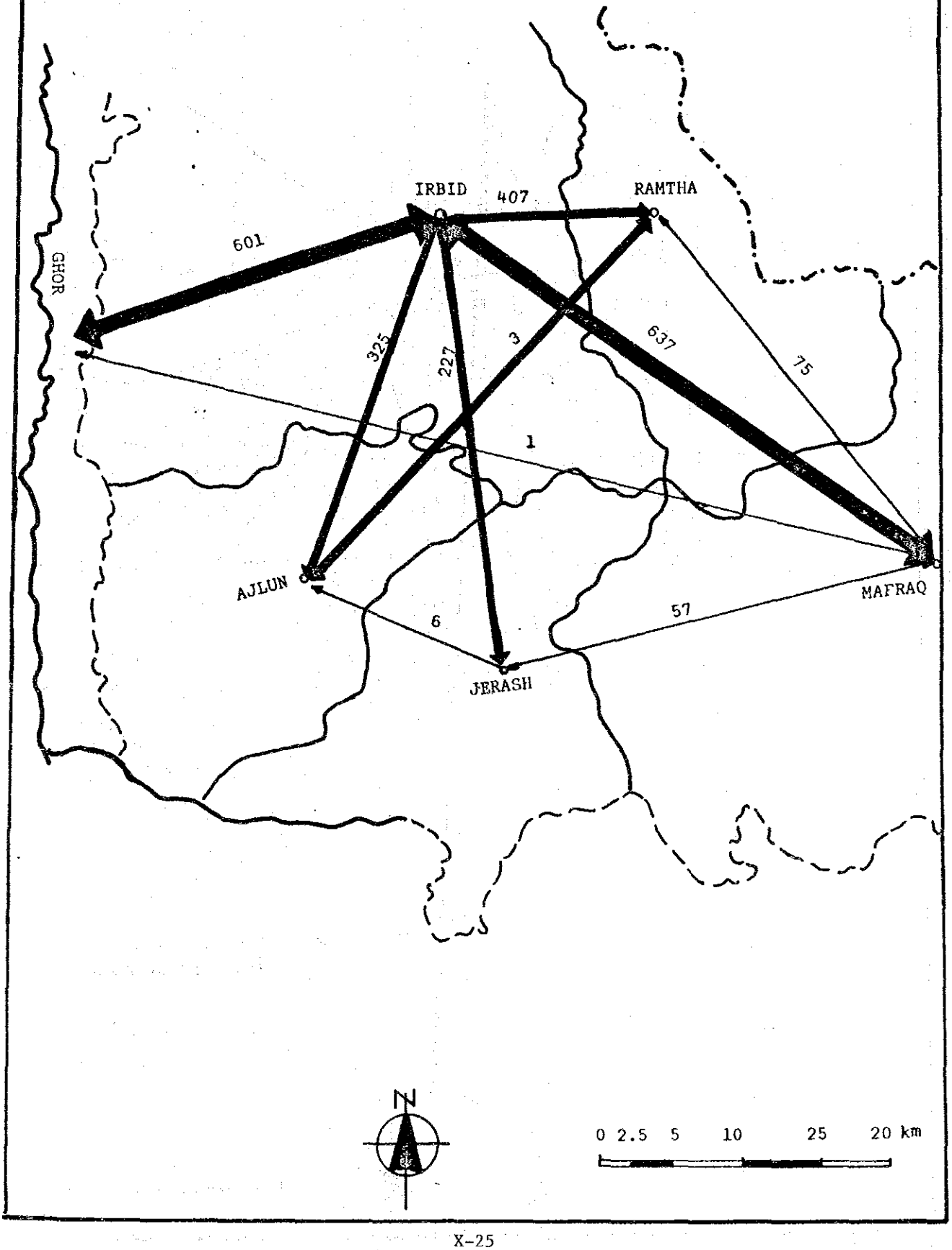
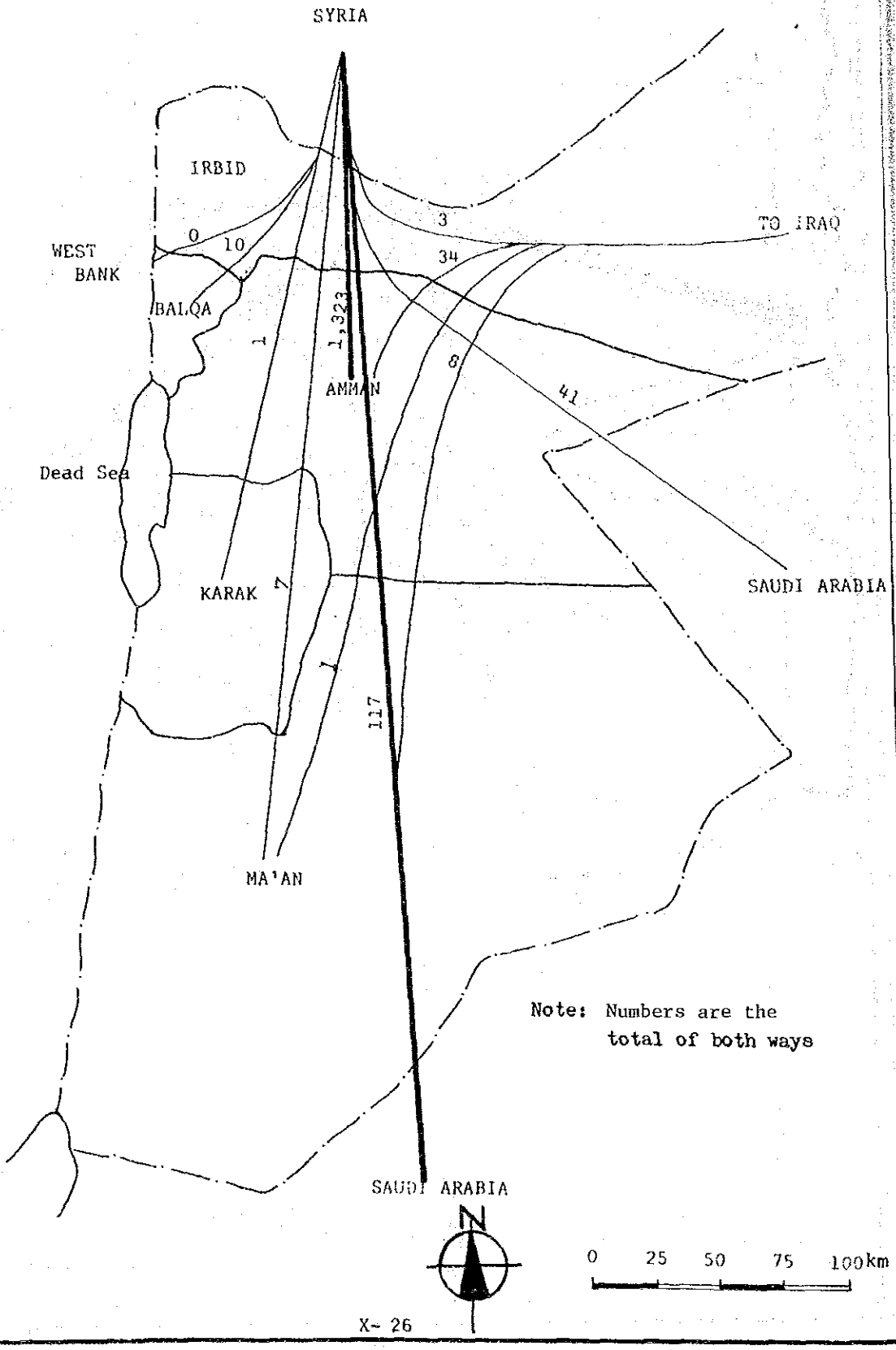
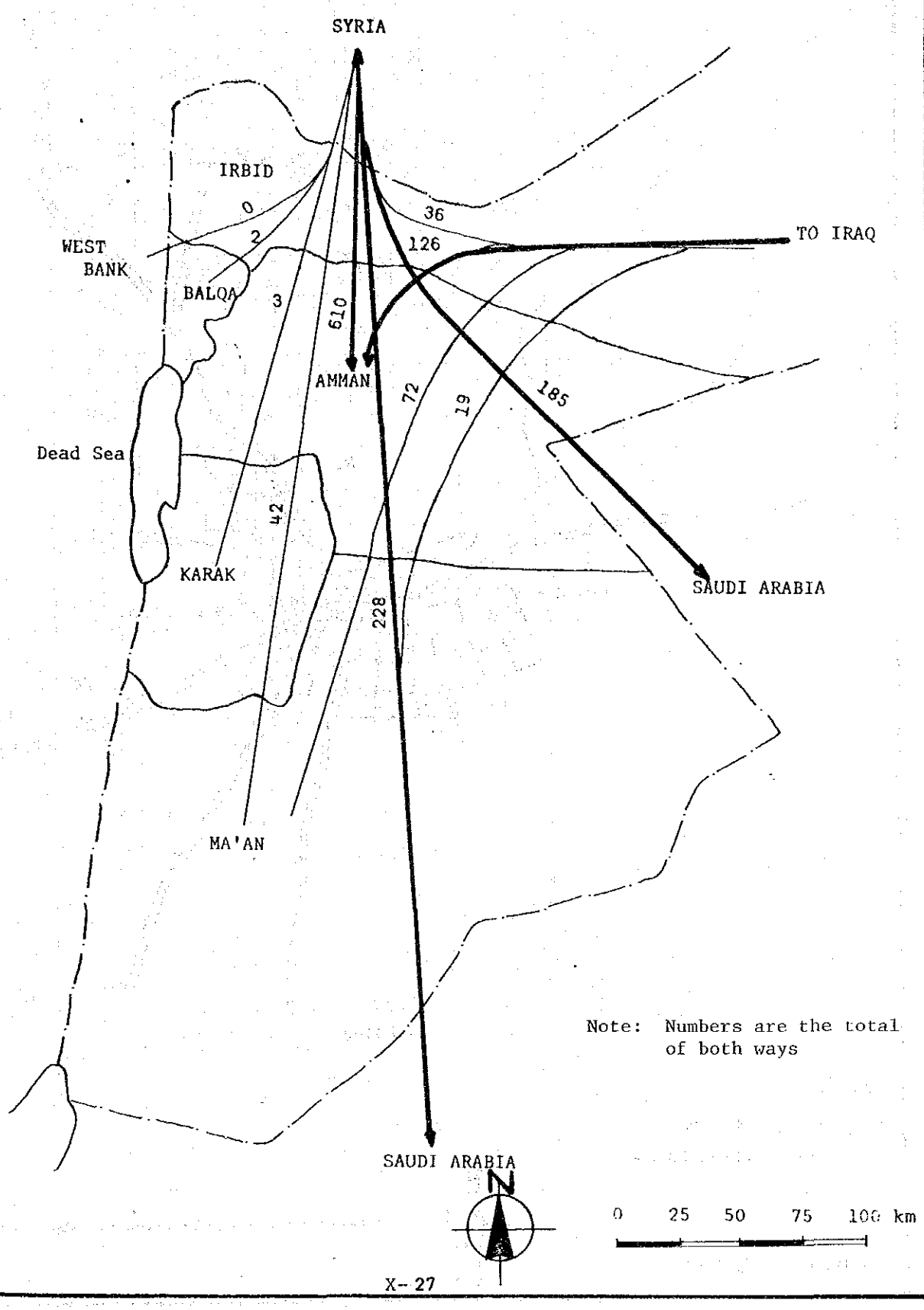


Figure 10.9 Through Traffics (Passenger Cars, Buses & Taxis)



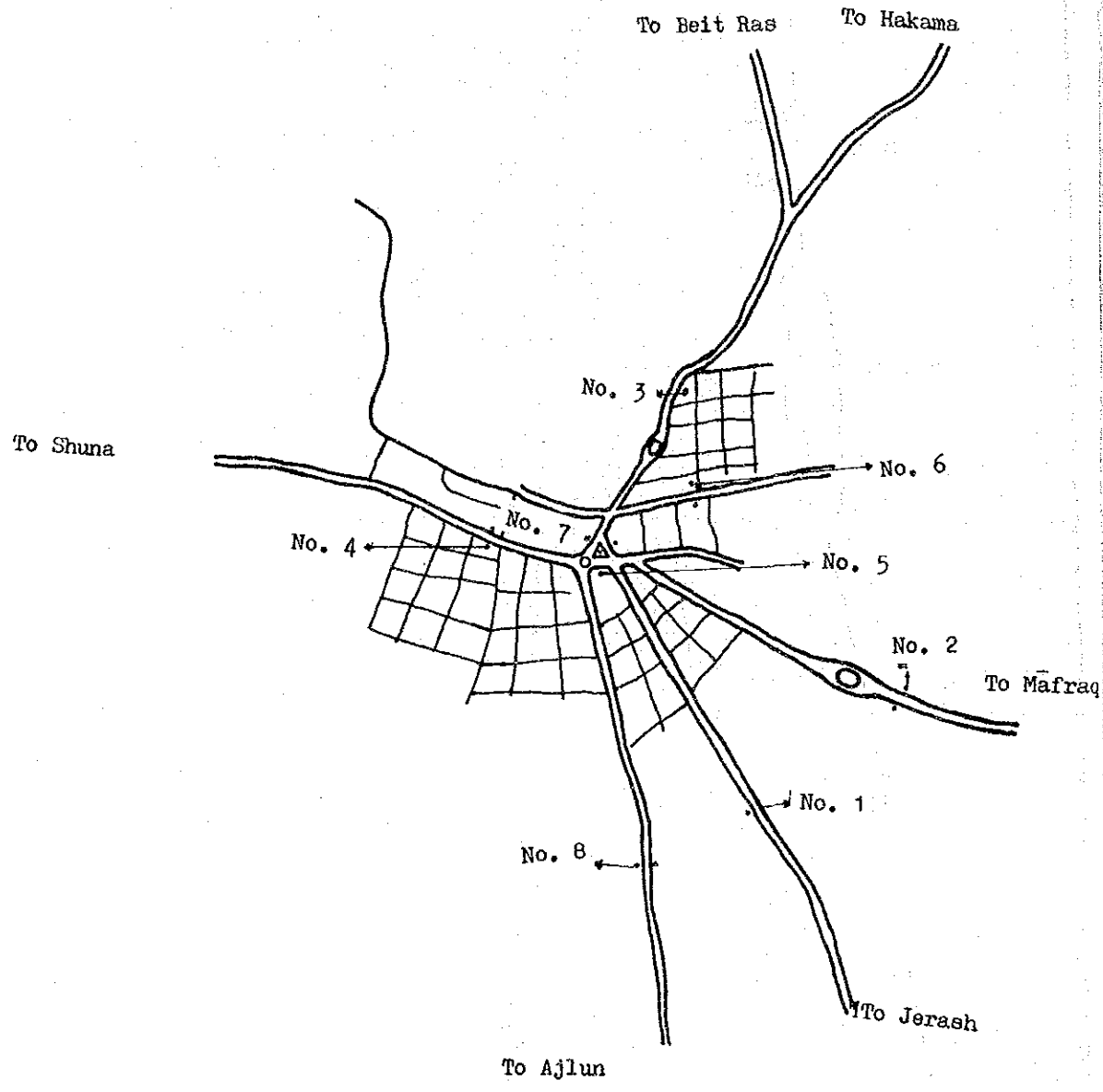
Note: Numbers are the total of both ways

Figure 10.10 Trough Traffics (Trucks)



Note: Numbers are the total of both ways

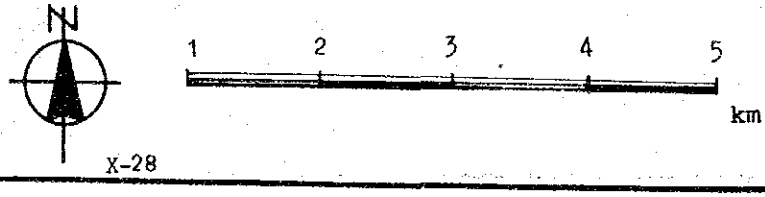
Figure 10.11 Trafic Count Stations, Irbid Municipality, 1978



Legend

No 3 Count Station

• Observation Point



Source: Study Team

Table 10.12 Hourly Traffic Volume in the City of Irbid

(Unit: Vehicles)

Hour	Observation Station							
	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No.8
7-8	692	788	1,004	1,152	840	692	916	370
8-9	564	802	838	950	984	678	1,054	470
9-10	636	842	808	954	1,180	772	1,064	400
10-11	606	896	694	946	1,124	722	1,032	414
11-12	600	868	831	1,057	1,093	812	1,327	401
12-13	644	804	966	1,044	1,026	816	1,282	474
13-14	712	876	968	1,036	1,110	674	1,176	452
14-15	712	688	982	1,082	956	600	1,026	416
15-16	606	570	990	1,008	996	628	1,164	416
16-17	570	550	849	992	964	562	1,132	324
17-18	492	544	762	936	1,114	804	1,090	230
Total	6,834	8,208	9,692	11,157	11,387	7,760	12,263	4,361
Estimated ADT	10,000	12,000	13,500	15,500	16,000	11,000	18,000	6,500

Source: Estimated by Study Team based on O-D Survey.

Note: Figures are the total volume of two ways.

Table 10.13 Composition of Vehicles

(Unit: Vehicles)

Station		Passenger Cars	Bus Taxi	Light Truck	Heavy Truck	Total
No. 1	No.	2,985	2,280	1,363	206	6,834
	%	(43.6)	(33.4)	(19.9)	(3.0)	(100.0)
No. 2	No.	3,887	2,709	1,315	597	8,208
	%	(43.7)	(33.0)	(16.0)	(7.3)	(100.0)
No. 3	No.	3,472	4,461	1,366	393	9,692
	%	(35.8)	(46.0)	(14.1)	(4.1)	(100.0)
No. 4	No.	4,564	3,406	2,323	864	11,157
	%	(40.9)	(30.5)	(20.8)	(7.7)	(100.0)
No. 5	No.	6,175	1,959	2,477	776	11,387
	%	(54.2)	(17.2)	(21.8)	(6.8)	(100.0)
No. 6	No.	4,581	1,723	1,233	223	7,760
	%	(59.0)	(22.2)	(15.9)	(2.9)	(100.0)
No. 7	No.	7,391	2,505	2,171	191	12,263
	%	(60.3)	(20.4)	(17.7)	(1.6)	(100.0)
No. 8	No.	1,916	1,691	543	211	4,361
	%	(43.9)	(38.8)	(12.5)	(4.8)	(100.0)

Source: Estimated by Study Team based on O-D Survey.

Note: Figures in parentheses show percents.

10.028 Unfortunately, the survey was made during Ramadan, and accordingly the results may not represent the typical traffic patterns. But they do not differ very much from those on normal days in terms of the total daily traffic volume. The average daily traffic volume (ADT) was estimated with an assumption that the traffic volume at the peak hour makes up 7.5 percent of ADT. This percentage was derived from a traffic survey conducted in Amman.

10.029 Table 10.13 shows the share of trucks within the traffic volumes obtained from the survey. In general, the share of trucks is lower in the city than outside the city. However, it is noted that the high proportion of trucks was observed at such points as No. 4 and No. 5 at CBD. This seems to be due to the through traffic northward from Irbid, or toward Amman or Mafraq.

10.030 It is also noted that the share of taxis within the total traffic volumes is extremely high, e.g., taxis observed at No, 3 numbered nearly a half of the total traffic. This is because intra-city person trips are heavily dependent on service taxis due to the inadequacy of bus services in Irbid.

e. Major Issues

i. *Improvement of Trunk Roads*

10.031 As stated earlier (Section 10.2.1), trunk roads are evaluated from the two viewpoints, by "tolerable standards" and by adequacy or inadequacy of the capacity vis-a-vis the current and future traffic volume. From the first viewpoint, the following sections of the national roads in the Governorate are considered to be sub-standard.

(1) Route 15

There is a section of 900 m with no shoulders near Jerash. Moreover, between Jerash and the Zarqa River there are many curves without adequate width.

(2) Route 16

With regard to the section between Irbid and Mafraq, the road is fairly wide at over 9 meters and has 2 lanes except for the section of 3.5 km near Irbid. However, the surface condition is very poor, well over 50 percent having inadequate pavement.

As to the section between Irbid and Shuna, 25.4 km of the road has less than 6 m of width. There are many curves with small radius and an up-downs with a gradient of over 9 degrees near Shuna.

(3) Route 20

About 10 km of the road between Jerash and 'Anjara has a narrow width of less than 6 m, and the pavement is also in a poor condition.

(4) Routes 30 and 45

These roads used to have many structural deficiencies, which, however, seem to have been improved already by the projects mentioned already.

(5) Route 12

This road also has about 5.4 km of less than 4.0 m in its width, which is sub-standard as a secondary road.

(6) Route 23

There exists about 2 km of very narrow width and about 5 km in a poor surface condition between Irbid and Ajlun.

(7) Route 33

About a half of this road between Jerash and Dibbin does not have the adequate width, i.e., it is difficult to pass simultaneously in both directions. In addition, most of the road surface are not well maintained.

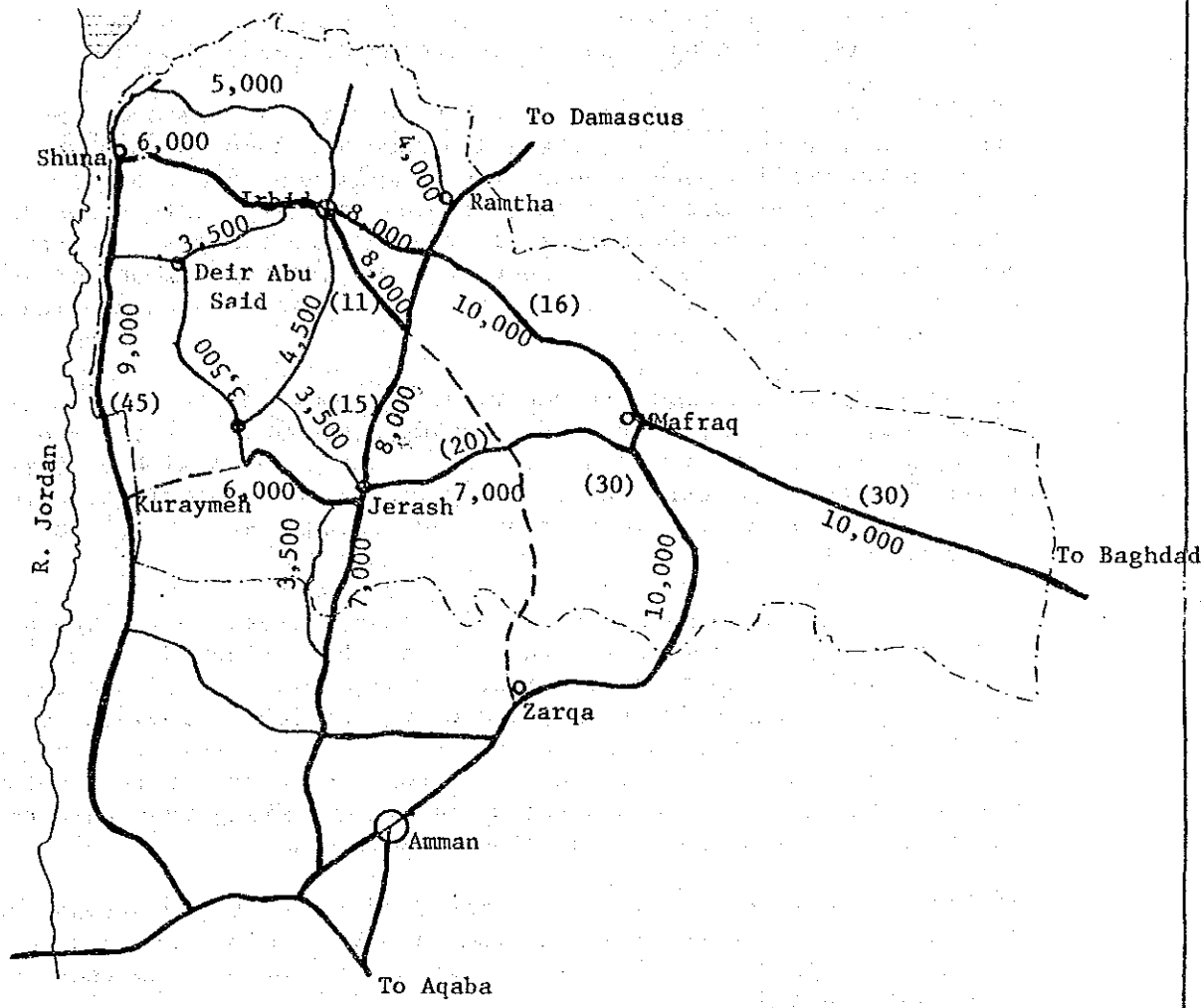
(8) Route 37

About 10 km of this road between Ajlun and Deir Abu Said is sub-standard in terms of both width and surface condition. Moreover, the section between Deir Abu Said and Route 45 is in an even poorer condition, with a width of about 3 meters, many sharp curves and a steep slope with a gradient of over 12 degrees.

10.032 In order to examine the adequacy of the capacity vis-a-vis the traffic volume, the road capacity was calculated following the Highway Capacity Manual. According to the Manual, the capacity of roads can be determined by the level of service offered by the roads, which ranges from the level of service A (free flowing traffic with little or no delay caused by other cars) to the level of service E (forced flow with maximum volume, occasionally congestion occurs).

10.033 In this report, the capacity was calculated at the level of service E assuming that the volume during peak hours accounts for 20 percent of ADT based on the information from the Ministry of Public Works. The results are shown on Figure 10.12. With regard to the inter-regional trunk roads, there is no section where the

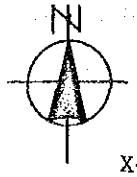
Figure 10.12 Capacity of Roads



Legend

( ) : Route Number

5,000: Traffic capacity per day



traffic volume is exceeding the capacity at present. However, the traffic volume on the trunk roads running north to south is expected to reach their full capacity in the near future because the transport demand has been increasing exponentially in the recent years.

ii. Construction and Upgrading of Feeder Roads

10.034 The village roads of 1,132 km cover most areas of the Irbid Governorate. However, there are some villages which have only narrow trails. Inhabitants of such villages have a difficulty to transport agricultural products to the activity centers, or daily consuming goods from the market. They often use donkeys to carry goods along the trails to the nearest roads. Taking account of an emergency case such as a sudden attack of illness, roads are indispensable for any villages.

10.035 In this report, feeder roads are examined in two aspects. First, how long the feeder roads should be extended, if all the villages are to be connected with the existing roads without passing trails. Second, how long the existing feeder roads should be paved, if all the villages are to be connected through paved roads to activity centers.

10.036 There are 374 municipalities and villages in the Irbid Governorate, according to the Water Master Plan studied in 1975 by a German Team. Based on the Master Plan, locations of all the villages were exhaustively examined on the road map provided by the Ministry of Public Works, although about 5 percent of them could not be found on the map. Table 10.14 shows the names of the isolated villages and the minimum distances from the existing road network. The total road length to be developed is 67.0 km.

10.037 The names of villages connected only by unpaved roads to the existing road network are listed in Table 10.15. The total length to be paved is 175.5 km in addition to the 67.0 km that is to be constructed.

10.2.3 Estimated Future Traffic Demand

a. General

10.038 As discussed earlier, the roads and railway of the Governorate have to meet the transport demand and support the social and economic development of the area. For this purpose, it is essential to find bottlenecks on the roads and identify projects which should be consistent with the short and long-term development strategy. In this section, therefore, the projection of the traffic volume in 1985 will be made, and then, the perspective traffic growth toward the year 2000 will be discussed.

10.039 In the Study Area, there are some big projects for the social and economic development, which might have significant effects on the volume of traffic demand. They are the Yarmouk

Table 10.14 Village Roads to be Constructed

Mutserfieh	Name of Village	Population (1975)	Distance from Existing Road (km)
Irbid	Zabada Ferkuh	419	2.0
	Qira	n.a.	1.0
	Tamairah	n.a.	2.0
	Es-Sila	n.a.	2.0
Kura	Zimal	1,444	2.0
	Es-Suwwan	86	2.0
	Er-Riqqa	138	3.0
	Deir El-Asal	n.a.	4.0
Jerash	Kh Esh-Shawahid	n.a.	2.0
	Uneiba	n.a.	3.0
	Khsheiba	285	2.0
	El-Rahmuniya	208	0.5
	'Asfur	286	1.0
Mafraq	Tell Er-Rimah	201	5.0
	En-Nuzha	95	1.0
Ajlun	El-Hanash	n.a.	4.0
	Khirbet Es-Sag	47	1.0
	Es-Safineh	209	4.0
	Lash'ath	n.a.	2.0
	Deir El-Birak	n.a.	1.0
	Bir Ed-Daliya	3	0.5
	Ras al-'Agra'	n.a.	1.0
	Ez-Zeitun	21	2.0
	Um Er-Ramel	46	4.0
	Khillet Es-Samra	n.a.	4.0
Ghor Esh-Sham -aliya	Marajam	n.a.	2.0
	Tell El-Arba'in	655	1.5
	Buseila	260	1.0
	Waqqass	3,265	0.5
	Es-Beira	566	3.0
	Himmat Ghor El-Arba'in	n.a.	1.0
	Es-Sukhneh	173	2.0
Total Length			67.0

Source: Estimated on the basis of the informations from the Ministry of Public Works.

Table 10.15 Village Roads to be Paved

Mutserfieh	Name of Village	Population (1975)	Distance from Existing Road (km)
Irbid	Kufr An	1,035	0.5
	Kufar Harta	447	3.0
Kura	Mukheim	97	4.5
	Abo El-Qein	180	5.0
	Tabgat Fahl	233	8.0
	Tantur	n.a.	10.0
	Khirbat El-Hawi	96	4.0
Bani Kinana	Barashta	88	2.0
	Yarmouk	170	4.0
Jerash	El-Kufeir	414	4.0
	El-Mant	159	1.2
Mafraq	El-Ashrafiya	351	0.5
	El-Manara	234	0.5
	Er-Rafa'iyat	956	9.0
	Abu Lufart	259	1.0
	Khisha' Sleitin	471	4.0
	Zumlat Ed Dibs	334	0.8
	Rodet El-Jimal	532	1.0
	Hileiwat El-Masariha	140	2.0
	Qom Er-Raf	523	6.0
	Rasm Elhisan	87	2.5
	Manshiet Bani Hasan	2,089	3.0
	Surra	98	3.0
	Nadira	502	4.0
	Ileimet	53	3.0
	Deir El-Qin	189	15.0
Balama	El-Kh'an	n.a.	4.0
	En-Nimra	104	4.0
Ramtha	El-Maheirfeh	100	14.0
	El-Akider	140	12.0
Ajlun	Esh-Shikara	368	2.0
	Rajib	135	5.0
	Bilass	376	6.0
	Ez-Zira's	206	4.0
	Es-Sarabis	n.a.	4.0
	El-Hizar	n.a.	2.0

(to be cont'd)

Mutserfieh	Name of Village	Population (1975)	Distance from Existing Road (km)
Ghor	El-Midraj	312	5.0
	El Mirza	281	3.0
	Abu Ziyad	n.a.	8.0
Total Length			175.5

Source: Estimated on the basis of the informations from the Ministry of Public Works.

University and the Industrial Free Zone on the Syrian Border. Although the number of students will reach close to its full scale by mid-1980s, the construction of the Yarmouk University will be continued until 1990 and its full operation will start around 1990. About the half of the Industrial Free Zone is expected to be completed by 1985 but its full-size operation will not take place before 1990. These projects will have some effects on traffic demands expected in mid-1980s, but it is difficult to qualify the magnitude of the effects. So, it is assumed that these projects would not give much influence on the traffic pattern by the end of 1985. Also assuming that there will be no drastic change on the international relationships, particularly with the neighbouring countries, the traffic demand in 1985 in the Irbid Governorate will be estimated on the basis of the present traffic pattern.

b. Estimation of Traffic Demands

i. Interregional Traffic Flow

10.040 For the purpose of estimating traffic volume in the future, the East Bank was divided into 53 zones, of which 44 zones are located in the Irbid Governorate (see Figure 10.13). This zoning follows the Master Road Plan to utilize its O-D survey conducted in 1976. Five additional zones for the international traffic were defined outside the East Bank. They are zones to the south of the Saudi Arabian Border to the south-east of the Saudi Arabian Border to the east of Iraqi Border to the west of the Syrian Border, and of the West Bank.

10.041 In our estimation of traffic volumes in 1985, at first the total trip ends and the total volume of traffic generated in and attracted to the zones were estimated. Next, the traffic flows were predicted by utilizing the data from the Origin-Destination Table of 1976.

(a) Domestic Flows of Traffic

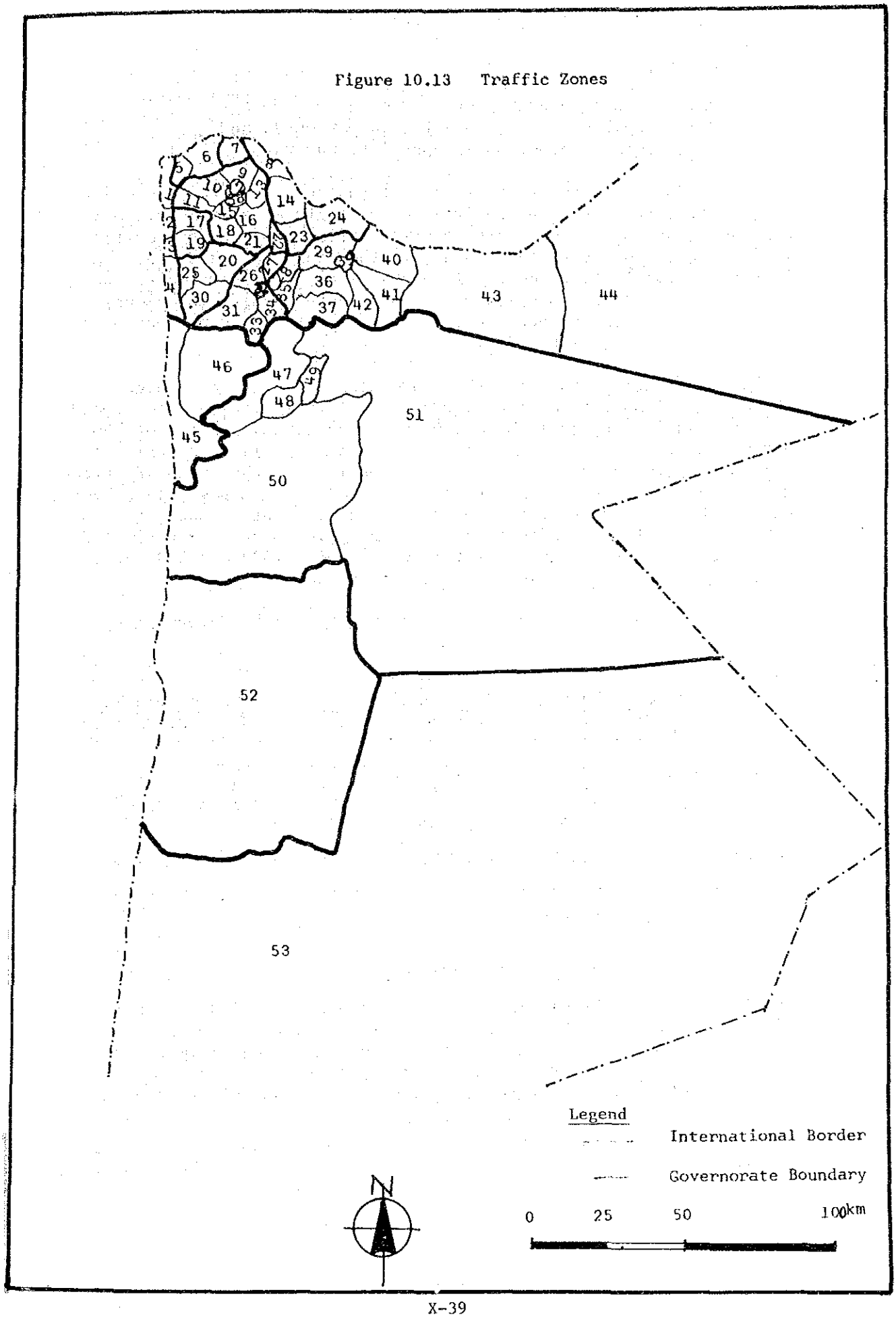
10.042 In order to predict the traffic volume in 1985, the correlation between the trip ends in 1976 and various socio-economic variables in each zone were examined by type of vehicle. This correlation was first studied for zones in the Irbid Governorate. For the other governorates, another separate correlation analysis will be made as discussed in the later paragraph. In the Irbid Governorate, the population and the total production were found to be most significantly relevant variables of all. And, their relationships to traffic volumes of passenger vehicles and trucks are as follows:

$Qi = 114.3Pi - 756$ (passenger vehicles)

where,

Qi: passenger vehicles generated or attracted in zone i,and
Pi: population in zone i (1,000 persons)

Figure 10.13 Traffic Zones



$Qi = 38.6Pi + 3.8\ Vi - 187$ (Trucks)

where,

Qi: trucks generated or attracted in zone i,
Pi: population in zone i (1,000 persons), and
Vi: total production in zone i (1,000 tons).

10.043 These two equations were employed only for the prediction of the total trip ends in the Irbid Governorate as a whole but not for each zone, since the correlation co-efficients were not sufficiently high, i.e., both less than 0.7. The zonal trip ends were estimated by distributing the total to each zone in proportion to the present pattern. This procedure does not cause significant amount of error, since the planned large-scale projects would not reach their full operations by 1985.

10.044 Likewise, for the other governorates in the East Bank, the correlations between the trip ends in 1976 and the various socio-economic variables for each zone were investigated. Inspite of the effort, however, no satisfactory results were obtained in terms of the correlation co-efficients. The reason is that the ratio of intra-zonal traffic volume to the inter-zonal traffic varies widely by zones due to the difference in size of the zones. For this reason, growth rate of the future traffic demand of each governorate was estimated separately, by utilizing the estimates made for 1982 and 2000 by the Master Road Plan. The results are shown in Table 10.16.

Table 10.16 Trip Ends and Growth Rate by Governorate

(Unit: Vehicles)

	No.of Passenger Car & Taxi			No. of Trucks		
	1976	1985	Growth rate	1976	1985	Growth rate
Irbid	33,666	50,400	1.50	17,197	22,500	1.31
Balqa	7,938	11,700	1.47	2,974	4,300	1.44
Amman	94,749	144,000	1.82	37,444	53,200	1.42
Karaq	652	1,100	1.68	627	1,000	1.62
Ma'an	633	1,000	1.64	1,753	2,800	1.59

Source: Master Road Plan.

(b) International Flows of Traffic

10.045 As for the passenger traffic, the number of arrivals in 1985 is estimated to be approximately at 1,294,000, according to data from the tourism sector. The passenger traffic volume at each entry/exit point in 1985 was estimated by applying the constant growth rate of 22 percent for the time period from 1976 to 1985.

10.046 Freight traffic consists of import, export and transient. The international goods movement for 1976, taken from the Master Road Plan, is shown in Table 10.17. The gross weight of imports, exports, and transient for 1985 were estimated by applying the past trends to the simple linear regression equations. Those projections are illustrated on Figures 10.14, 10.15 and 10.16.

10.047 The goods movements for 1985 at each entry/exit point could be estimated by multiplying the volume in 1976 by the growth rates for imports, exports, and transient. The growth rates of traffic during the period from 1976 to 1985 at each point are presented in the last column of Table 10.18.

ii. Inter-Zonal Traffic Flow

10.048 The traffic flows between the zones in 1985, shown in Table 10.19 and Table 10.20 were predicted by the calculation based on the O-D Table for 1976. To simplify the calculation, the traffic zones were aggregated into 16 zones as shown on Figure 10.17. The estimated volumes do not differ so much from the estimates made by the Master Road Plan.

iii. Traffic Volume by Road

10.049 The traffic volume on each road in 1985 was estimated by allocating the predicted traffic demand taken from the 1985 O-D Table. The result for the average daily traffic volume is shown in Figure 10.18.

10.050 The volume on the section between Jerash and Ramtha on Route 11 is estimated to grow rapidly from about 4,000 in 1976 to over 10,000 vehicles in 1985, after the completion of the Route 11 between Zarqa and Rihab. This traffic volume is larger than the capacity of Route 11. The volume on the section between Mafraq and Zarqa of Route 30 is anticipated to decrease, since most of the traffic between Amman and Baghdad will be diverted to the route via Azraq, and since most of the traffic between Amman and Irbid, Damascus will shift from Route 30 to Route 11.

10.051 In the year 2000, the traffic volume on each road is predicted to grow at least 1.8 times the 1985 volume, assuming that the annual growth rate after 1985 would be similar to that of the period 1976-1985.

iv. Road Sections to Be Improved

10.052 By comparing the future traffic volume in 1985 and 2000 with capacity, sections to be improved or to be newly constructed can be identified. The sections where the traffic volume exceeds the capacity are shown on Figure 10.19 assuming that the existing road network remains as it is without any further improvement. In conclusion, we can assume that the present road capacity will be inadequate to the traffic demand of 1985 on Route 15 between

Table 10.17 International Goods Movement by Roads, East Bank, 1976

(Unit: Tons per Day)

Point of Entry/Exit	Tons per Day		
	Imports	Exports	Transient
Route 15 at Syrian Border	647	344	1,595
Route 30 at Iraqi Border	27	773	1,091
Route 50 at Saudi Arabian Border	55	336	2,037
Route 36 at Jordan River	369	-	-
Route 48 at Jordan River	334	-	-
Route 53 at Saudi Arabian Border	15	214	27
Route 15 at Saudi Arabian Border	-	274	2,154
Total	1,447	1,941	6,904
Inland Transport from/to Port of Aqaba	2,708	3,287	686

Source: Master Road Plan.

Figure 10.14 Gross Weight of Imports

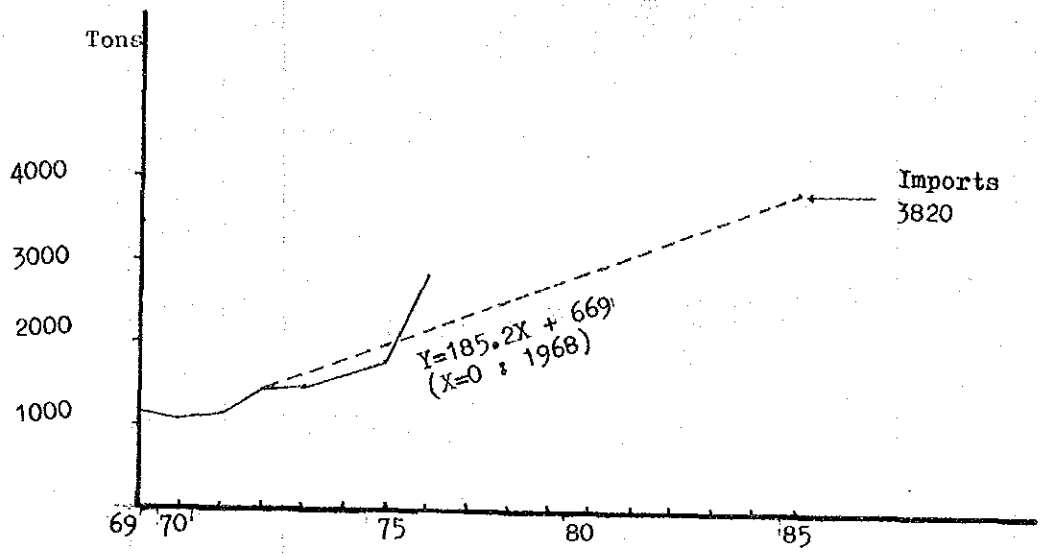


Figure 10.15 Exports by Trucks and Ships

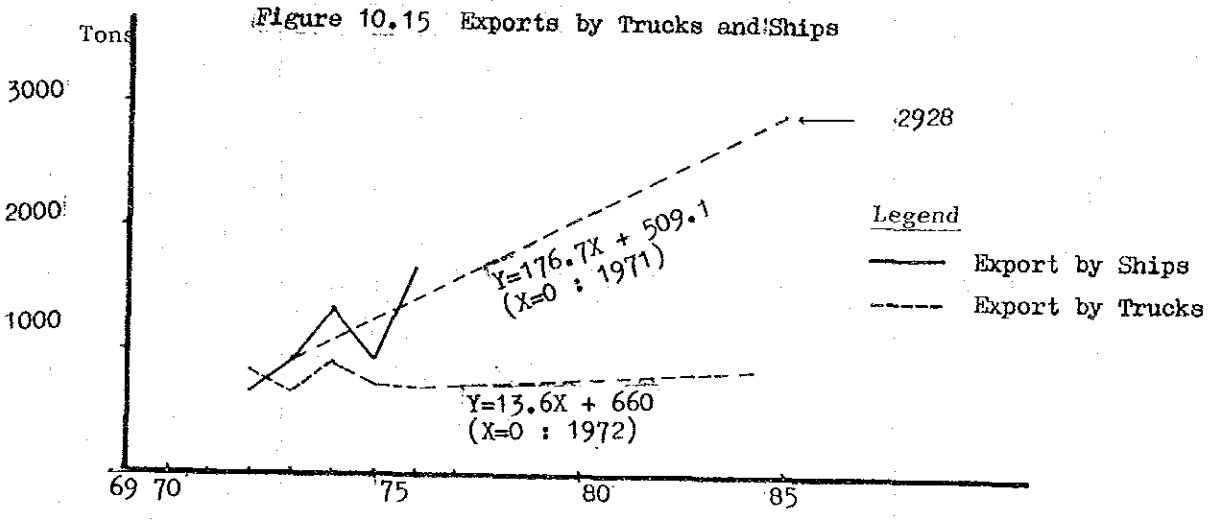


Figure 10.16 Transient Goods

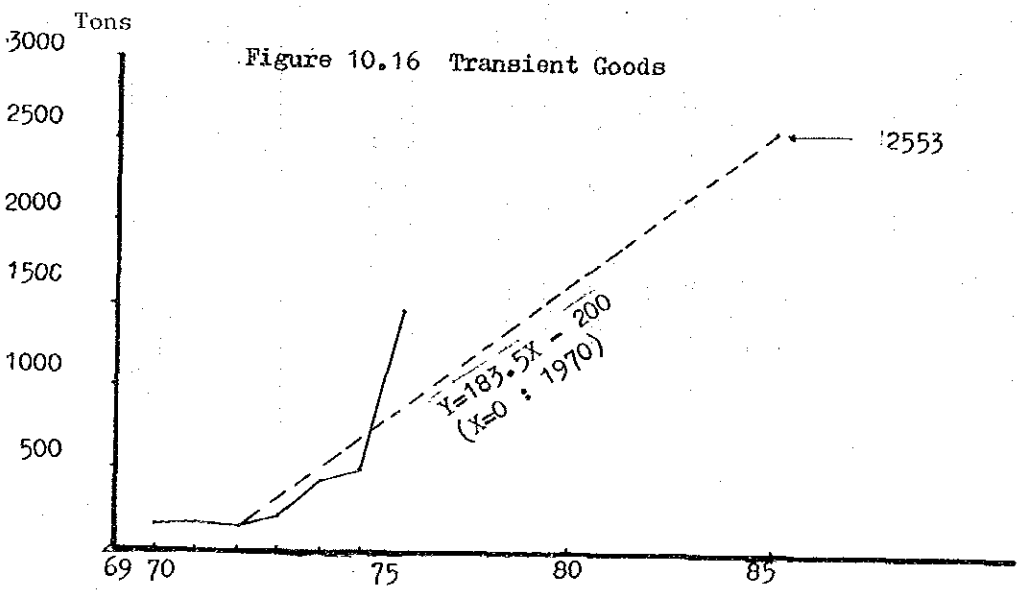


Table 10.18 Estimated International Goods Movement by Roads in 1985

(Unit: Tons per Day)

Point of Entry/Exit and Mode	Imports	Exports	Transient	Growth Rate of Traffic 85/76
Roads				
Route 15 at Syrian Border	906	406	2,935	1.55
Route 30 at Iraqi Border	38	912	2,007	1.45
Route 50 at Saudi Border	77	396	3,748	1.66
Route 36 at Jordan River	517	-	-	1.40
Route 48 at Jordan River	239	-	-	1.40
Route 53 at Saudi Border	21	253	50	1.23
Route 15 at Saudi Border	-	323	3,963	1.71
Inland Transport by Road from/to Port of Aqaba	3,504	4,200	1,262	1.32

Table 10.19 Passenger Cars and Taxis in 1985

(Unit: Vehicles)

Origin Zone \ Destination Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
1		423	3	2		15		245	68								756
2	480	13,914	668	477	381	396	9	83	2,220	2	3		15	3	242		18,893
3	2	678				153		5	194			2	6		380		1,420
4	2					2			230								708
5		432			50	66	2	8	692								1,250
6		342	86	2	77	537	141	2	951						2		2,140
7		5		2		168			14								189
8	275	123			19	2		568	4,512						8	41	5,548
9	70	166	166	283	923	602	6	5,380	60,727	515	313	63	75	29	886	8	72,173
10		2				5			493		9						509
11		2			4				381	15	89	51			8		550
12									52		36		3	10	106		207
13		10	2			3			50						41		106
14		3			2				19		2				2		28
15		160	283		8	13		6	903	2	3	37	10	3			1,430
16								24	5								29
Total	829	18,695	1,208	766	1464	1,962	160	6,321	71,511	534	455	153	109	45	1,675	49	105,936

Source: Study Team.

Table 10.20 Light Trucks and Heavy Trucks in 1985

Origin Zone \ Destination Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Total
1		353			2			227	161						4		747
2	304	4,968	288	214	197	541	21	33	762	15	8		13		30	2	7,396
3		245		4		81	2	9	10			4	16	2	570		1,003
4		212						9	77								298
5		101		8	35	51		6	240	3	2						446
6	2	294	19		24	443	247	4	332			2			3		1,370
7	12					197			17								226
8	349	23	2		6			353	1,622	12	3				3		2,373
9	22	707	44	100	331	396	19	1,226	21,527	321	709	50	67	77	279	253	26,128
10		5			4			2	224		272					5	512
11	2	10	7				2		924	104	147	89	15	67	35		1,402
12			8						73		87		5		14	127	314
13		9	16						97		2					124	248
14		10	4						120		50	17				10	211
15		66	90			5			580		28		205	140	42		1,156
16	4								282								286
Total	679	7,019	478	326	599	1,714	291	1,869	27,108	455	1,308	367	256	202	1,190	255	44,116

Source: Study Team.

Figure 10.17 Aggregated Traffic Zones

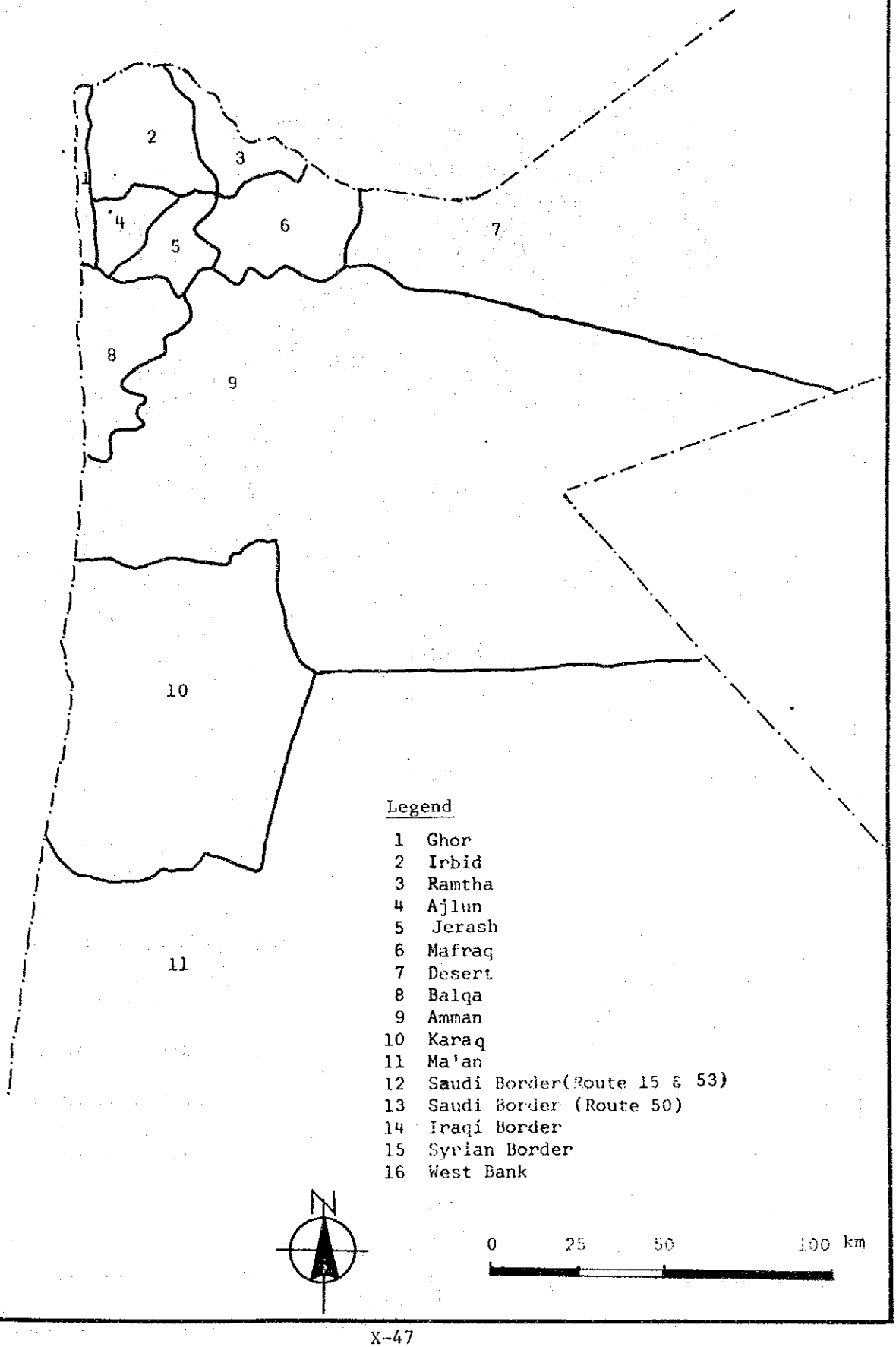
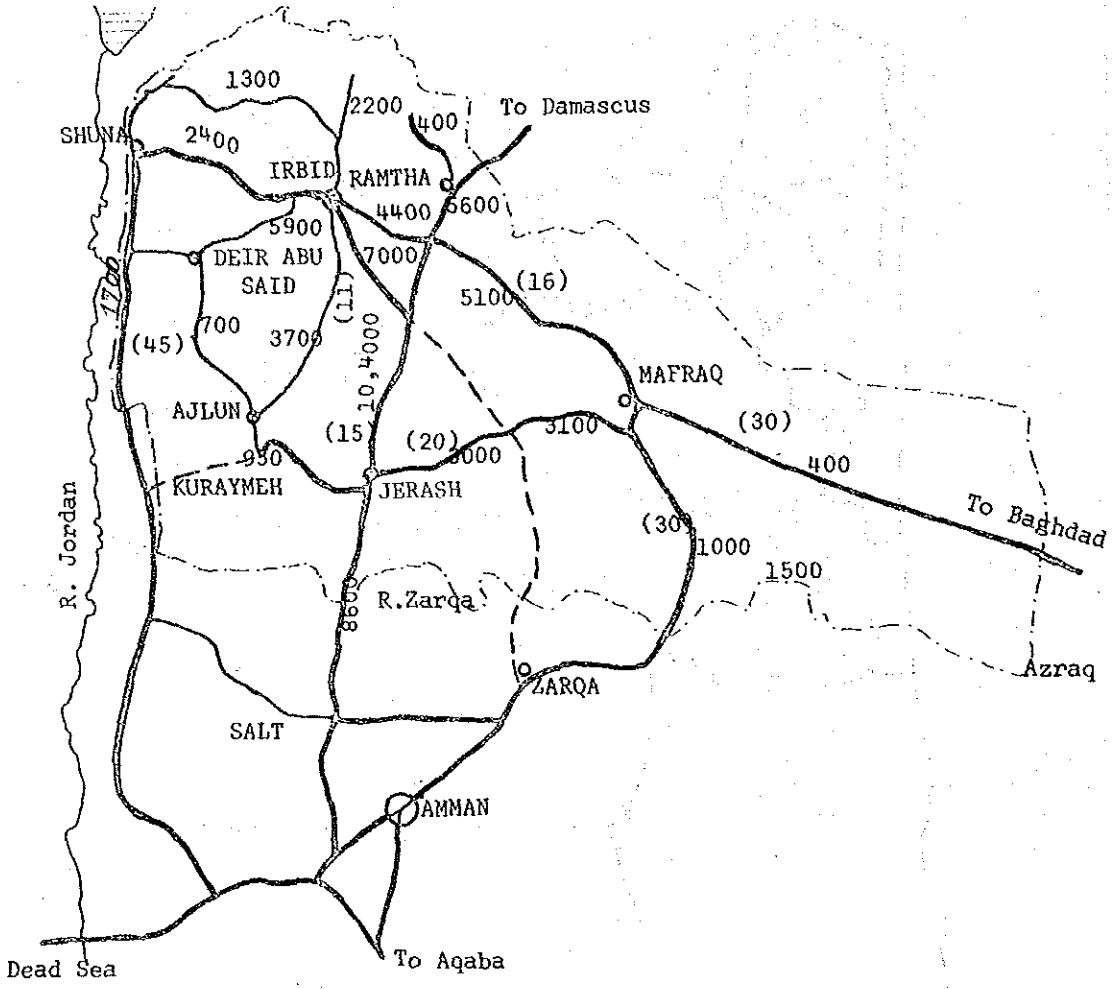


Figure 10.18 Estimated Traffic Volume in 1981



Legend

950 Estimated Traffic Volume 1981

Primary Road

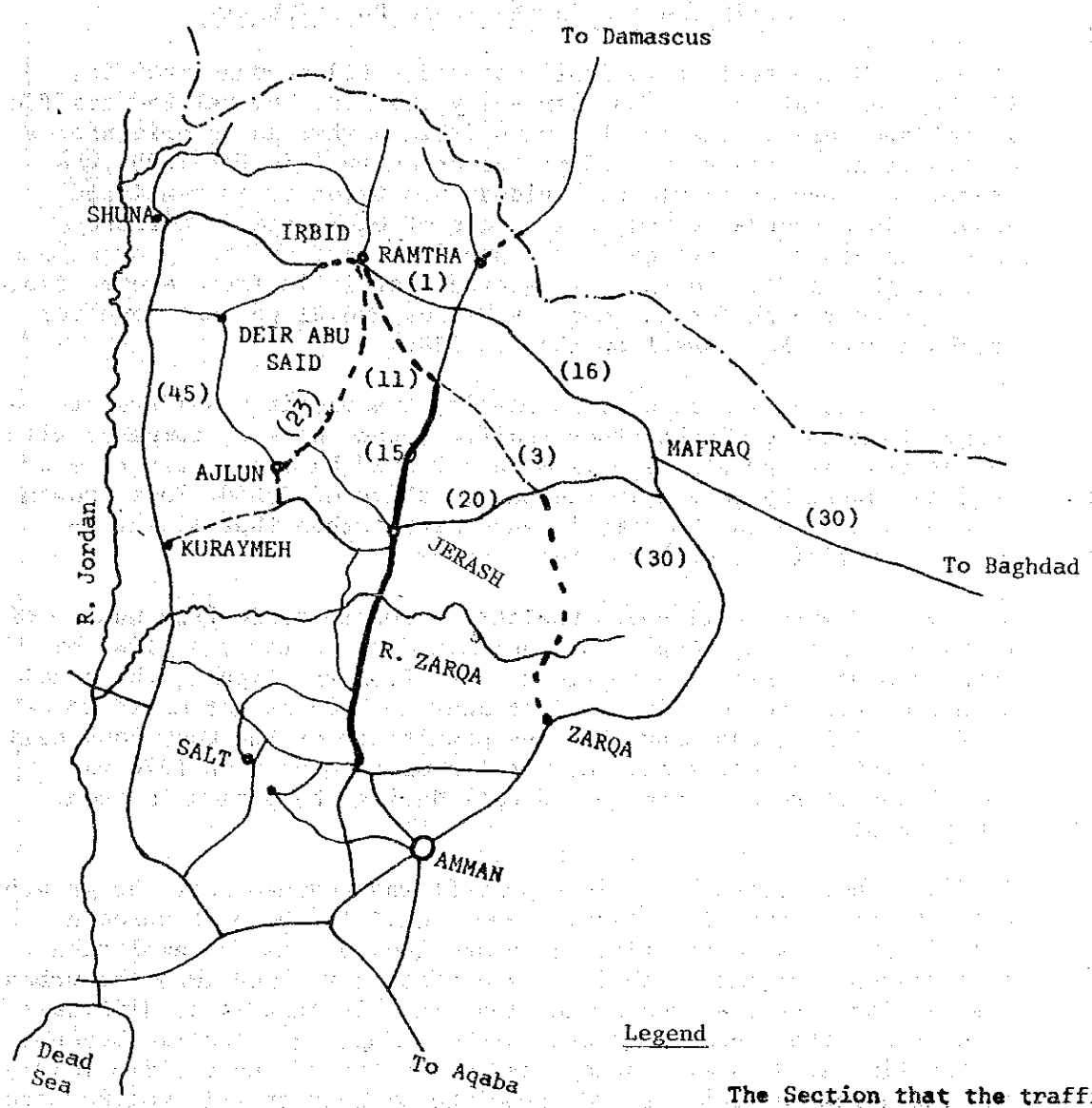
Secondary Road

International Boundary

(15) Route Number

0 10 20 30 40 50 km

Figure 10.19 Road Sections to be improved



Legend

The Section that the traffic volume will exceed the capacity by 1985

The Section that the traffic volume exceeds the capacity by 2000

(15) Route number

N

0 10 20 40 km

Amman and Irbid. The traffic demand would also exceed the capacity after 1985 on Route 11 and Route 23 between Irbid and Ajlun, Route 16 to the west of Irbid, and Route 15 between Ramtha and Syrian Border.

v. Urban Traffic in the Irbid Municipality

10.053 Urban traffic in Irbid comprises (1) through traffic, (2) related traffic and (3) intra-city traffic. The related traffic is defined here as the traffic with Irbid either as an origin or a destination. In order to predict the urban traffic for 1985, the traffic at present should be divided into three types mentioned above, since generally the growth rate of each type is different from each other. As stated in the previous section, the growth rate of through traffic and that of related traffic in Irbid are estimated as 50 percent each for passenger vehicles and 31 percent each for trucks during the years from 1976 to 1985.

10.054 The growth rate of intra-city traffic is considered to be larger than those of the other traffic types, because compared with the others, its growth rate is much affected by the growth rate of vehicles owned by people in the Municipality of Irbid. This growth rate of vehicles in the city is much higher than that of inter-regional traffic as will be stated below.

10.055 Figure 10.20 shows the car ownership ratio (the number of private cars per 1,000 persons) estimated up to the year 1985 by using the past trends in the East Bank. From the figure, the total number of private cars in the East Bank in 1985 is estimated to be 99,700 vehicles, assuming that the population of the East Bank will be 2,740,000 at that time. The total number of cars in 1976 was 29,478 and therefore, the growth rate during the period is about 240 percent.

10.056 Nontheless, in this report it was assumed that the growth rates of the intra-city traffic are equal to those of through traffic and related traffic. There are two reasons for employing this assumption: one is that it is difficult to break down the urban traffic into three elements, and the other is that it is difficult to estimate the accurate growth rate of intracity traffic because of the limited data available. The estimation of the traffic volume at each point in 1985 was made from the present traffic volumes and growth rates by vehicle type. The results are given on Figure 10.21. In the figure, the lowest estimates are given because of the above reason. Those estimates indicate that the traffic volumes in the Municipality will exceed the capacity of roads by 1985 and traffic congestion will occur in the CBD particularly at such spots as No 3. No. 4. No. 5. and No. 7 on Figure 10.11. It seems to be difficult, however, to widen the roads at these spots because they are lined with numerous buildings on both sides. To cope with this problem, the construction of a ring road, the operation of buses and others should be taken as countermeasures.

Figure 10.20 Car Ownership Ratio

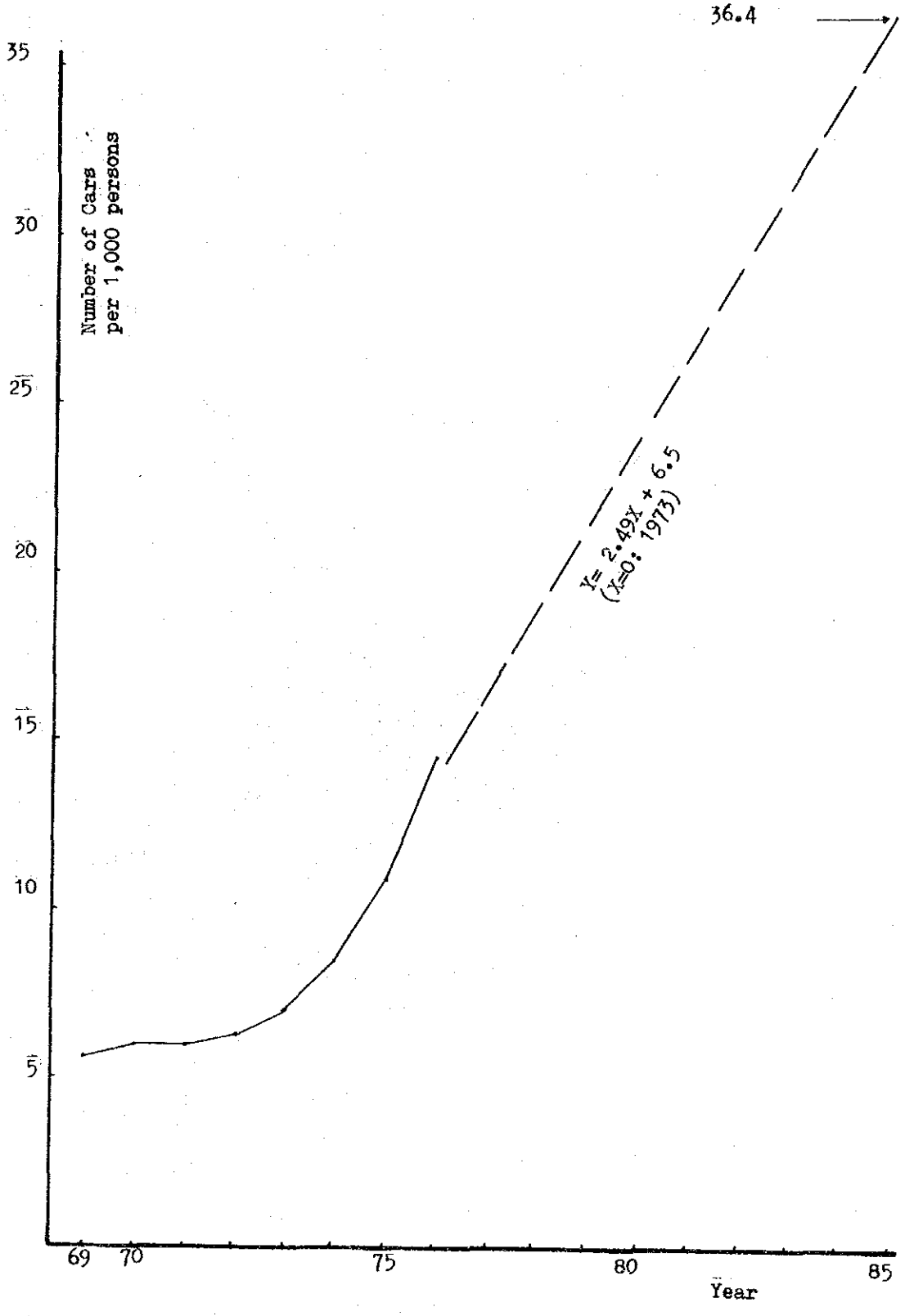
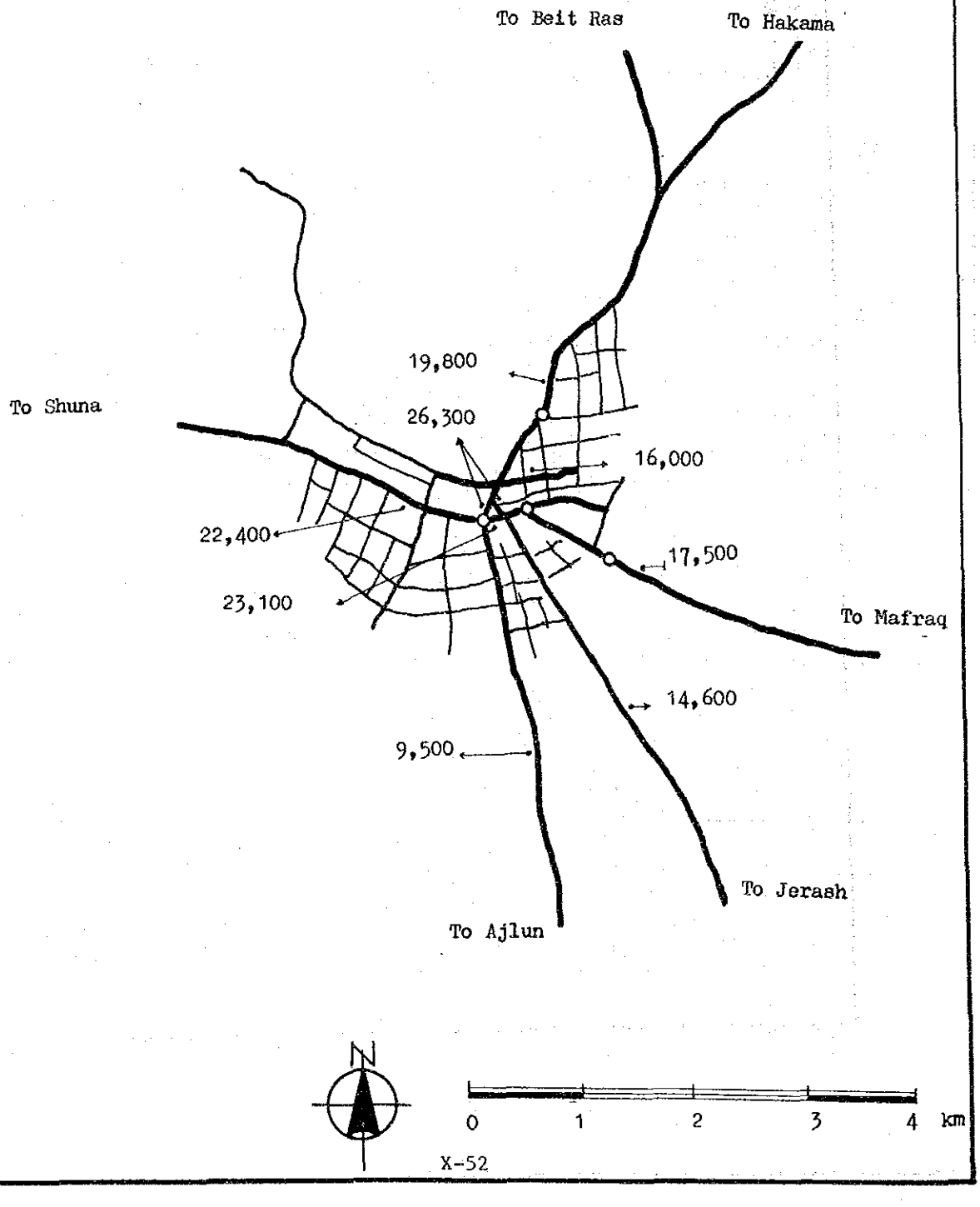


Figure 10.21 Estimated Traffic Volumes in 1985
(Vehicles per Day)



10.2.4 Project Formulation and Recommendations

a. General

10.057 In this section, firstly, the projects/programs to be implemented by the year 1985 will be pointed out, and secondly, the long-term perspective on the road development will be discussed. The proposed projects will be formulated mainly on the basis of the traffic demand estimated in the previous section. However, the projects discussed below include not only the roads themselves but those related to improvements of road transportation system.

10.058 Some of the projects proposed in this report are included in the current Five Year Plan or the Master Road Plan, but their evaluation was made irrespective to whether or not they were listed in those plans.

b. Recommended Projects for the Period until 1985

i. Improvement of Existing Roads

10.059 As stated earlier, the trunk roads should satisfy the tolerable standards, and consequently many minor improvements on various roads are required. Among them a widening of 3 km near Irbid and re-surfacing of about 20 km between Irbid-Mafraq on Route 16 and a widening of the curve portions near Jarash on Route 15 are the most important projects. The improvement cost is estimated to be JD 0.5 million at 1977 prices for both of them.

ii. Development of the Village Roads

10.060 It was found that there are many villages isolated from other villages or activity centers. There are at least 32 of those villages in the Irbid Governorate as listed in Table 10.14. By constructing roads of 67.0 km in the total length, those villages are connected with activity centers. The construction cost of the roads without pavement is estimated as JD 1.1 million.

10.061 In addition to this, 38 villages are connected only by dirt roads. The pavement of those roads are also important, especially when emergency needs, such as ambulance service, are considered. The total length of roads to be paved is 175.5 km in addition to the 67.0 km to be newly constructed. The pavement cost amounts to JD 1.5 million.

iii. Construction of the New Road Between Zarqa and Irbid

10.062 The traffic demands between Amman region and Irbid region will exceed the maximum capacity of roads by 1985. This project aims to increase the capacity and to develop closer connection between the two regions by constructing a new 2-lane road between Zarqa and Irbid via Rihaba.

10.063 The section of the road between Irbid and Route 16 has been already opened for traffic, and the section between Zarqa and Rihaba is now under construction and expected to be completed in 1978. As to the rest of the road between Rihaba and Route 16, its detailed design is not yet completed, though the Ministry of Public Works ranked it among the top priority projects. The construction cost of this road with 18 km in length is estimated to be about JD 1.4 million.

iv. Construction of a New Road Bypassing Jerash

10.064 For the purpose of tourism development in Jerash, a new road bypassing Jerash is proposed. The existing road through Jerash is the main trunk road connecting Irbid and Amman, and it has heavy traffic of over 5,000 vehicles per day at present. Such a large volume of traffic may cause an annoyance to the tourists.

10.065 By the construction of the new road between Irbid and Zarqa, most of the existing traffic are expected to divert to the new road, but still some of them will remain on this route. Accordingly, it is proposed that the portion of the road in the city could be used only for the traffic related to Jerash, after the construction of the bypass of approximately 10 km in length. The by-pass should be aligned at the west side of Jerash, taking account of the magnificent view from the top of the hill. The construction cost is estimated JD 1.1 million. The recommended projects are marked on Figure 10.22.

v. Construction of a Ring Road Around Irbid

10.066 In the previous section, it was found that the traffic volume on main roads would exceed the capacity of roads in the CBD in the Municipality of Irbid in 1985. Thus it is anticipated that many traffic congestions, similar to what are now seen in the city of Amman at present, will take place. In order to mitigate the anticipated congestions and to make use of road network more effectively, a study on the master road plan in the Municipality should be undertaken. The study should include the city planning of Irbid, taking account of the future expansion of the Municipality and also an urban renewal.

10.066 As one of the countermeasures to the anticipated congestions, construction of a ring road is proposed (see Figure 10.23). The Municipality of Irbid has already made its plan with its location on the city boundary, which is a circle with a radius of about 3 km. The present built-up area is concentrated within 1.5 km from the center and the east part of the Municipality is more active than the west in terms of building construction. Hence, the ring road proposed in this report is a half-ring road at a distance of 1.5 km from the center, which would connect Route 23 in the north, Route 16, Route 11 and Route 23 in the south. By constructing the ring road, at least the through traffic, which accounts for 30 percent of the total, will be diverted from the CBD area of Irbid.

Figure 10.22 Recommended Projects

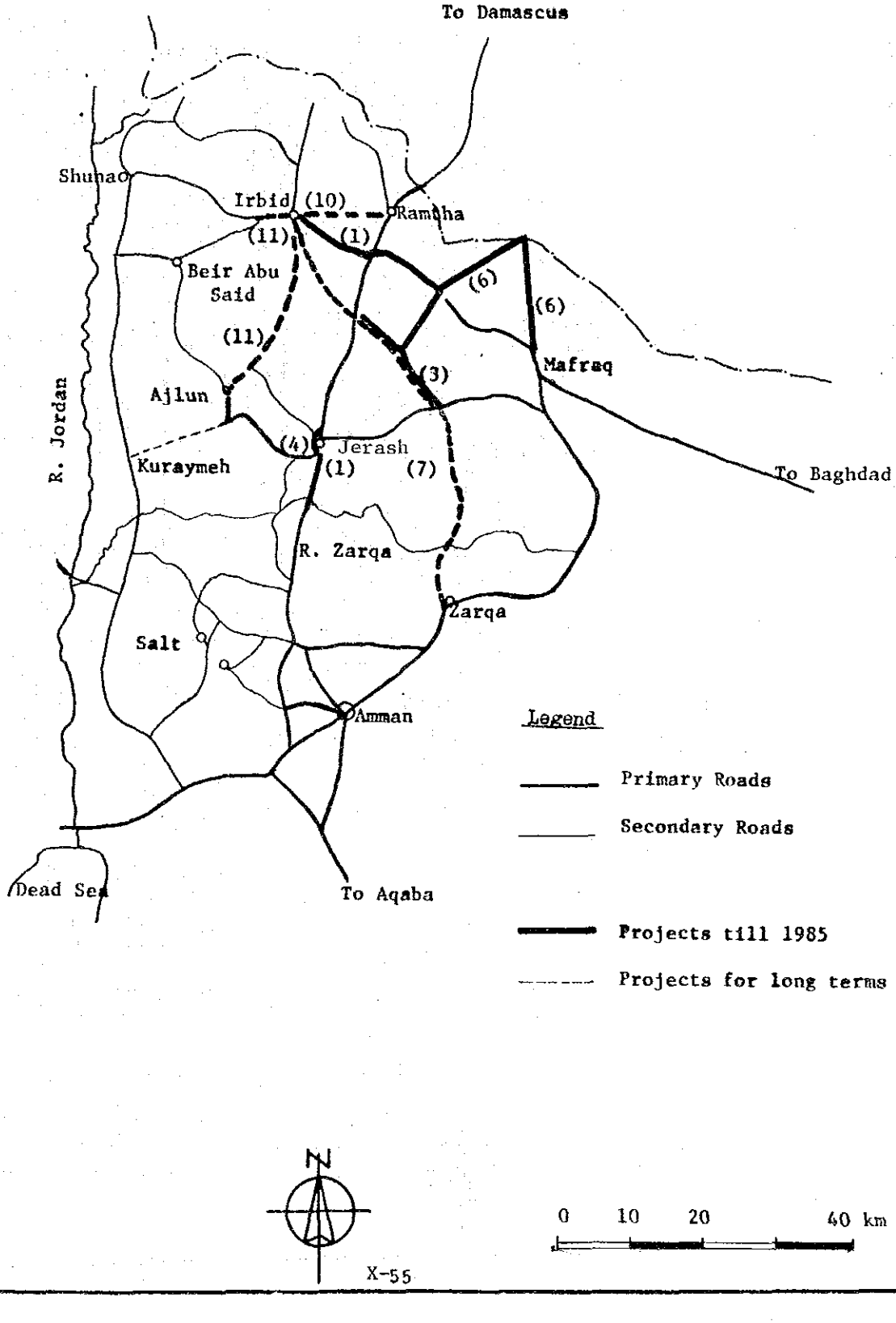
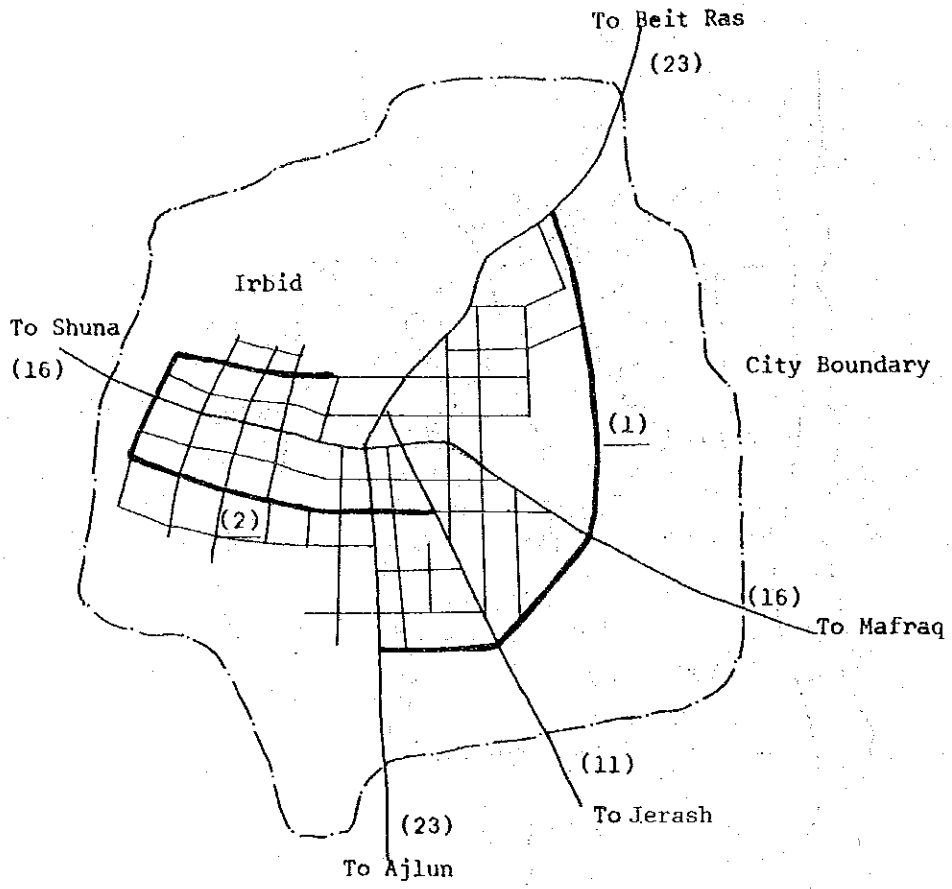


Figure 10.23 Recommended Projects in Irbid



Legend

(1) Ring Road Project till 1985

(2) Widening of Streets till 1985

(16) Route Number

The length of this half ring would be about 3.5 km and the existing roads can be utilized as part of the ring by improving them. The construction cost is estimated at JD 0.45 million, which includes the land cost of JD 25,000.

10.068 With regard to the west part of the Municipality, it is recommended to broaden the present narrow streets, which run parallel to Route 16, as illustrated on Figure 10.23. Because many houses are standing along these streets, the widening project would need a housing program for compensation.

vi. Construction of a New Road Connecting Route 11 and the Industrial Free Zone

10.069 The Industrial Free Zone project at the Syrian Border is going on at present and its partial operation is planned to start before 1985. Thus, the construction of a new road connecting the Industrial Free Zone to the existing trunk roads is proposed. The road between the Industrial Free Zone and Damascus is already completed and called "Autostrada". Therefore, the new road would become a part of Autostrada: an arterial road between Lebanon, Syria and Jordan when completed. It was found in the previous section that the capacity of road between Syria and Ramtha will become inadequate relative to the traffic demand expected in 2000, but by constructing this new road, there would be no need to raise its capacity.

10.070 There are two routing alternatives for this new road: one is from the Free Zone to Mafraq and connecting to Route 16, and the other is from the Free Zone to Route 11 which is planned to be widened to four lanes by the Ministry of Public Works. For the first alternative, the length would be about 22 km with the construction cost estimated to be JD 1.5 million. The second alternative would extend longer at 27 km, and the topographic condition is less favourable. However, it is expected that it would greatly contribute to the development of the Yarmouk University complex. Since we are recommending a regional development strategy which emphasizes the development of the Yarmouk University complex as well as the Irbid area, the second alternative is recommended for this Autostrada. The construction cost is estimated to be JD 2.0 million.

c. Project Priorities

10.071 Among the six projects mentioned above, the construction of the two new roads, the one between Zarqa and Irbid and the Jordan part of Autostrada are most urgently needed because the capacity of the roads between Amman and Irbid is too small to withstand the traffic demand expected in 1985 and also because the operation of the Free Zone will start before 1985.

10.072 The second priority should be placed on such projects as improvement of the existing roads, construction of a ring road around the Municipality of Irbid and development of village roads.

10.073 The third priority would be the bypass road of Jerash, which is an important project for the development of tourism, even though the economic feasibility seems to be low.

d. Projects for the Long Term Strategy

i. Expansion of the New Road Between Amman and Irbid

10.074 After the completion of the construction of the highway between Amman and Irbid, i.e., Route 11, this project will aim to raise the capacity of this road by additional two lanes. The length will be 65 km with an estimated construction cost of JD 5.5 million.

ii. Construction of a New Road Between Irbid and Ramtha

10.075 In order to develop the greater Irbid area, it is important to directly connect the two largest cities in this area: Irbid and Ramtha. The length between Irbid and Ramtha is about 12 km, the estimated construction cost is JD 800 thousand.

iii. Construction of Distribution Center

10.076 At present there are two distribution centers in the Municipality of Irbid, from which goods are distributed to adjacent cities and villages. But they are located near the CBD and are of small scale. They handle exclusively domestic trade, since goods from abroad, mainly Syria, are cleared for their customs at Ramtha. In order to mitigate the problems of heavy trucks passing through the center of Irbid, and to make its function more effective, the construction of a large distribution center in Yarmouk complex area seems to be necessary. The Yarmouk complex area is the best location for the distribution center, because it will be close to the anticipated two custom clearing points at Ramtha and at the Industrial Free Zone. The distribution center should include a truck terminal, warehouses, grain silos and cold storages. Assuming there would be 4 ha of truck terminal, 0.2 ha of silos and cold storages and 4 ha of warehouse, the total construction cost would be JD 4.0 million.

iv. Construction of the Second Ring Road Around Irbid

10.077 This is a project to construct an outer ring road at the Municipality boundary of Irbid. The Municipality boundary is about 3.0 km from the city center. The land use plan of Irbid should be made by setting this ring road as a frame. The total length of the ring road is about 25 km. The construction cost is estimated at JD 1.8 million.

v. Improvement of the Existing Roads

10.078 The section between Irbid and Route 20 on Route 23 and the section of about 6 km in length to the west of Irbid on Route 16 should be widened, since the traffic volumes are expected to exceed their capacities by 2000 as seen on Figure 10.19. The improvement cost is estimated to be JD 1.2 million for both of them.

e. Recommended Studies

i. Basic Social and Economic Survey

10.079 Statistics on socio-economic indicators at the village level is prerequisite to make any plan. Therefore, those basic data such as population and agricultural and industrial output at the village level should be compiled periodically.

ii. Traffic Survey

10.080 The Ministry of Public Works is conducting a traffic survey on the national roads. However, the traffic data on municipality roads are seldom found. Therefore, it is recommended to have a traffic survey on municipality roads at least once a year. In addition, the origin-destination survey in the Municipality of Irbid is also recommended.

f. Recommendations on Institutional Arrangement

i. Establishment of Bus Corporation in Irbid

10.081 In Irbid, there are only two bus companies which operate a few buses without any regular time schedule, and therefore, the public transportation in the Municipality is exclusively dependent on taxis. The percentage of taxis in a daily traffic volume is extremely high, sometimes occupies over 50 percent of ADT. This heavy dependence on taxi will be one of the main causes for the traffic congestions in the Municipality in the near future.

10.082 In Amman, the Public Transport Corporation was established in August, 1975. This corporation has replaced several small private companies operated until then, and is now operating about 2,000 buses in the Municipality of Amman without subsidy from the Central Government. Following this example, it is recommended to establish a similar corporation in Irbid and decrease the dependency on taxis. In connection with this, it is prerequisite to study the way of the most appropriate operation of buses, operating route, operating schedule etc. According to our survey, it is at least necessary to operate buses on the main roads from the CBD to the outskirts of the Municipality.

ii. Countermeasure to Traffic Accidents

10.083 It is reported that the occurence of traffic accidents is very high in the Kingdom and this problem is getting serious. The fatality rate (deaths per 100 million vehicle-km of travel) in 1976 was 22.4. This rate is said to be 10 times higher than the average rate found in developed countries. In order to reduce traffic accidents, traffic safety measures should be adopted, for example, re-examination of traffic rules, raising of the standard for obtaining drivers licenses, improvement and additional installment of traffic signs etc.

iii. Cooperation of the Authorities

10.084 Municipalities are responsible for all the aspects of municipality roads, while the Ministry of Public Works controls the national roads. It is recommended to establish a closer relationship between those government authorites through cooperative work in the fields such as road planning and construction, training of engineers and various other professionals etc. The cooperation is useful not only for the recognition of mutual programs, but also for the promotion of capabilities of personnel which will be enabled by exchanging informations.

10.3 Railway

10.3.1 General

10.085 The railway network in the East Bank exists only in the north-south direction with the total length of 694 km. As shown in Figure 10.24, the railway connects the Syrian Border, Mafraq, Zarqa, Amman, Ma'an and Aqaba. Until 1975, there was no line between Aqaba and Batn El Ghul, and in addition, the line between Ma'an and the Saudi Border was in disuse. Accordingly, the railway was terminated at Ras En Naqab. This railway was operated by the Hidjaz Railway Corporation. During the years from 1973 to 1975, a new line was constructed between Batn El Ghul and Aqaba, and at the same time, the old line between Batn El Ghul and Hasa was improved to raise the railway capacity. Then, Aqaba Railway Corporation was newly established to manage and operate the new line for the transport of phosphate from Hasa to Aqaba. The Hidjaz Railway transports general cargo and passengers, while the Aqaba Railway is confined to the transportation of phosphate. The emphasis of this report will be placed on the Hidjaz Railway, since the Irbid Governorate is connected only by this railway with other regions.

10.086 As mentioned previously, the role of railway is insignificant in the Irbid Governorate, but it will be useful to analyse the present situation and find a better way to make use of the existing facilities.

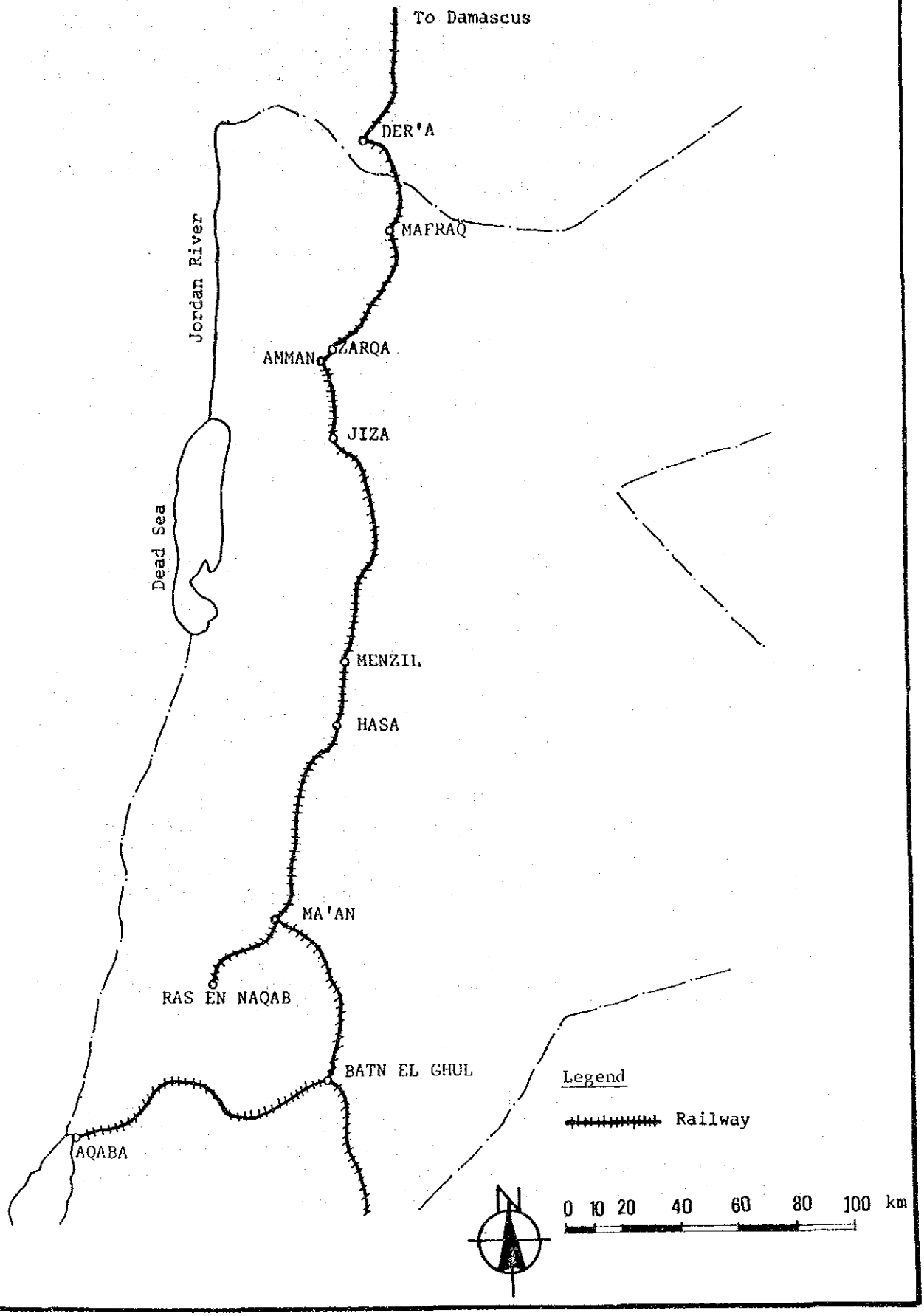
10.3.2 Diagnosis of the Present Situation

a. Inventory

i. Railway Tracks and Stations

10.087 Although the tracks managed by the Hidjaz Railway Corporation is nearly 70 years old, it is not so much deteriorated, because the transport volume has always remained at a low level. However, some steel sleepers are corroded, and the ballast is generally poor. Only the section between Hasa and Batn El Ghul was improved with regard to the sleepers and the ballast. The track is single and its gauge is narrow, only 1.05 meters throughout all the lines in the East Bank. Section rails of 25 kg/m used for

Figure 10.24 Railway Network in the East Bank



the rail and sleepers are usually made of steel. There are many stations with distances of 10 to 36 km between the Syrian Border and Ras En Naqab, but most of them are looping stations, which are used only for exchanging trains. Between Amman and the Syrian Border, there are five stations, Ruseifa, Zarqa, Es-Samra, Mafraq and Jaber.

ii. Locomotives and Rolling Stocks

10.088 Table 10.21 shows the number of locomotives and rolling stocks in the Hidjaz Railway and the Aqaba Railway.

Table 10.21 Locomotives and Rolling Stocks

	Hidjaz Railway	Aqaba Railway
Locomotives	6(Diesel 950 HP) 13(Steam COCO type)	13(Diesel 1800 HP)
Rolling Stocks	n.a.	n.a.
Passenger Cars	5	n.a.
Freight Wagons	107(Steel Box Car 30^t) 50(Steel Box Car 15^t) 40(Disused)	133(Phosphate Car)
Tanks	15	n.a.

Source: Ministry of Tranport-Railway.

10.089 The locomotives and rolling stocks in the Hidjaz Railway are fairly old, compared to the Aqaba Railway. Some of them are over 30 years old. The steam-engine type locomotives of the Hidjaz are now being replaced by the diesel-engine type, and additional 5 diesel locomotives will be purchased during the current Five Year Plan period.

10.090 A passenger train consists of one car for the special class, two for the 1st or 2nd classes, one for the 2nd or 3rd classes and one for the 3rd class. They include two sleeping cars.

b. Ongoing Projects

10.091 As will be stated in the subsequent sections, the Hidjaz Railway has less activity compared to that of the Aqaba Railway. This is due to the small amount of transport demand. Therefore, notable projects cannot be seen in the Hidjaz Railway, while several projects are ongoing in the Aqaba Railway as follows:

(1) Raising Phosphate Transport Capacity

This project aims to raise the phosphate transport capacity between Hasa and Aqaba from 1.6 million tons at present to 4.5 million tons in 1980. This includes the purchase of 18 locomotives and equipment for maintenance.

(2) New Branch Line

A new branch line of about 4 km from Menzil to the phosphate mine will be constructed by the end of 1979. It is projected that 1.5 million tons of phosphate are transported from Menzil to Aqaba in addition to 3.0 million tons from Hasa.

(3) Transportation of General Cargo

The Aqaba Railway transports only phosphate at present, but it intends to start the transportation of general cargo, mainly imported goods, from Aqaba to inland in 1980. Therefore, the purchase of 65 box wagons for general cargo and the construction of grain silos at Aqaba and Jiza near Amman are now under consideration.

c. Trends of the Railway Transportation

10.092 The current activity of railway service is given in Table 10.22. Among them, the most active one is the phosphate transportation between El Hasa and Aqaba. In other lines, the actual activity depends upon the transportation demand, and might be less than the schedule listed in the table. In the Irbid Governorate, the line between Amman and the Syrian Border is the sole activity. The scheduled trains for passengers and goods are two times each a week from Amman to Dera's in Syria, requiring 3 hours of travelling time. It extends to Damascus by the Syrian Railway.

10.093 As stated previously, there are several stations between Amman and the Syrian Border, but the volumes loaded and unloaded at those stations are negligibly few except at Zarqa for both people and goods. The dominant through-traffic is between Amman and Damascus. It is reported that a train consists of one locomotive and either 20 goods wagons or several passenger cars. The major commodities carried are consumer's goods, particulary foods like flour, sugar, animals etc.

Table 10.22 Scheduled Train Activity

Route Segment	Number of Trains 1/			
	Passenger Train	Goods Train	Combination	Frequency
Amman-Syrian Border	4	4	-	Weekly
Amman-Zarqa	2	2	-	Daily
Amman-El Hasa	2	2	-	Weekly
El Hasa-Aqaba 2/	-	8	-	Daily

Source: Ministry of Transport-Railways.

Notes: 1/ Values shown represent scheduled two-way volume of train traffic.

2/ This value is maximum scheduled activity. Actual volume depends on demands for phosphate shipment to Aqaba.

10.094 Table 10.23 shows the number of passengers by railway. The number of total passengers has increased during the recent years from 1973 to 1976. This is mainly due to the increase in the domestic passengers of the third class. There are no satistics on the break-down of the passengers by each line, but most of the domestic passengers seem to be those on the lines of short distance between Amman-Zarqa, since the average haul has sharply declined in the corresponding years. However, some inconsistencies are found in this table. Although the total number must include the international passengers, the figures of the total are less than the figures of the international in some places. According to the information from the Railway section in the Ministry of Transport, the number of domestic passengers are very few, and the train service between Amman-Zarqa was stopped in 1977.

Table 10.23 Number of Passenger by Railway

(Unit: 1,000 Persons)

Year	Class			Total	International Passengers
	First	Second	Third		
1960	0.5	4.4	48.5	53.4	-
1961	0.3	2.1	12.2	14.6	-
1962	0.5	3.3	16.7	20.6	-
1963	0.3	2.7	16.4	19.4	-
1964	0.5	4.4	18.5	23.4	-
1965	1.0	8.7	34.1	43.8	-

(to be cont'd)

(Unit: 1,000 Persons)

Year	Class			Total	International Passengers
	First	Second	Third		
1966	0.7	6.9	28.4	36.1	-
1967	0.5	3.8	15.6	19.9	-
1968	0.4	4.2	14.6	19.2	20.1
1969	0.4	3.2	12.4	16.1	15.9
1970	0.6	3.5	12.6	16.8	18.9
1971	0.6	3.5	12.4	16.5	14.5
1972	0.01	0.1	0.4	0.5	0.7
1973	1.5	6.3	25.4	33.2	17.8
1974	1.7	8.3	70.1	80.1	30.1
1975	2.6	11.0	79.9	93.5	35.1
1976	1.5	9.4	85.8	96.6	30.9

Source: Statistical Year Book, 1966, 1973, 1976.

Note: Figures indicate total number of arrivals and departures.

Accordingly, it might be better to consider that the figures of the total passengers on the table are somewhat overestimated.

10.095 The trends of freight traffic by railway are shown in Table 10.24. It indicates that the freight traffic by the Hidjaz Railway has drastically decreased; the total volume in 1976 is only about 10 percent of the late 1960's. Because the dominant source of the revenue is the receipts from the freight, the decrease of the freight means the decline of the railway activity itself. The main reasons for the decline are considered as follows:

(1) Exports and imports are disrupted by the disturbance in the early 1970s and the Civil War in Lebanon in 1975.

(2) The Hidjaz Railway failed to modernize the railway services in terms of efficiency and speed. Consequently, it has lagged behind the road transport.

(3) The number of motorized vehicles has sharply increased, and trucks with large capacity have emerged.

Table 10.24 Freight Traffic by Railway

(Unit: 1,000 tons)

Year	1/ Exports	1/ Imports	Amman 2/ -Mafraq	Amman 3/ -Aqaba	Aqaba 3/ -Amman
1960	45.1	108.6	92.3	73.6	62.1
1961	46.3	42.8	83.1	78.4	65.6
1962	50.3	31.4	68.2	62.2	63.6
1963	36.0	25.2	47.2	40.5	63.6
1964	70.8	21.7	45.1	38.6	71.6
1965	60.5	24.6	57.8	52.5	61.9
1966	65.3	21.6	37.7	29.3	71.7
1967	75.7	27.2	29.7	23.3	41.4
1968	68.4	92.9	23.6	10.8	22.4
1969	48.5	51.8	24.2	2.5	33.5
1970	30.6	47.0	16.7	1.6	92.5
1971	20.2	35.0	24.1	2.5	55.5
1972	24.3	32.0	34.8	21.8	115.6
1973	22.4	29.5	26.0	20.1	74.9
1974	27.2	38.6	3.8	2.2	0.5
1975	17.7	35.4	3.9	0.2	0.1
1976	1.9	10.4	2.1	337.3	0.9

Source: Statistical Year Book 1966, 1973, 1976.

Notes: 1/ Includes the volumes transported between Amman and Mafraq.

2/ Total of both directions.

3/ The figures until 1975 are those transferred at Ras En Naqab from Railway to Trucks and vice versa. The figure in 1976 includes the volumes on the new line to Aqaba.

d. Major Issues

i. Operation and Maintenance

10.096 As mentioned above, the recent transport statistics show relatively stagnant trend in the Hidjaz Railway transportation. This is due to the difficulties in maintaining the speedy services for the customers. One of the reasons for the tardiness is that the tracks have very narrow gauge and many curves. In addition, most of the facilities such as tracks, locomotive power, rolling stocks and other equipments are superannuated because of the lack of fund for the renewal during the past decades. Considerable maintenance costs are therefore required. This high maintenance cost is said to be caused by the fragile tracks, which were originally built for expediency at cheap construction cost.

10.097 The few scheduled trains and the poor connection at the Syrian Border are other reasons for the stagnance. The operation schedule is often unreliable, and the connection at the Border sometimes requires over 10 hours. For the purpose of a drastic improvement of the railway transportation, construction of a new line from Damascus to Saudi Arabia via Amman is to be investigated by the Ministry of Transport. This aims at much speedier services by constructing the track with wide gauge. But the commencement cannot be expected before 10 years.

ii. Shortage of Personnel

10.098 The shortage of skilled laborers or engineers are one of the important problems in the railway section just as seen in other ministries. Persons who are skilled or high educated tend to go either abroad, mainly Saudi Arabia and Kuwait, or to private enterprizes for seeking higher salary. Therefore, the Railway Corporation has hired foreign laborers, mainly from Egypt, as drivers or mechanics for the operation and maintenance. In Amman, there is a training school for railway engineering such as signaling, telecommunication, mechanics, repairing the tracks etc. However, the problem still remains unsolved, because after the training, many of the trained go elsewhere for higher payment.

iii. Financial Problem

10.099 The total income and expenditure of the two Railway Corporations in 1977 are given in Table 10.25. Figures in the table are the total of the Aqaba and Hidjaz Corporations. With regard to the Hidjaz Railway, the total receipt from the services in 1977 is only JD 40,000, while the routine expenditure is reportedly about JD 100,000. The receipts in the past years were much less than in 1977, as shown in Table 10.26. Consequently the Hidjaz Railway seems to have received a large amount of subsidies from the Central Government during the recent years. This is caused by the fact that the maintenance cost is extremely high compared with the operation cost.

Table 10.25 Total Income & Expenditure in 1977

(Unit: JD 1,000)

Income		Expenditure	
Receipt from service	710	Salary	650
		Fuel	80
Loan through the Central Government	8,000	Maintenance	300
		Overhead and other operation cost	150
Total	8,710	Sub Total	1,180
		Loan Repayment (30 years)	650
		Interest	400
		Investment	6,000
		Total	8,230

Source: Ministry of Transport-Railway

Table 10.26 Receipts from Railway Services

(Unit: JD 1,000)

Year	1970	1971	1972	1973	1974	1975	1976
Passengers	2.2	2.0	0.01	5.6	5.0	7.1	11.0
Freight	125.1	108.1	183.0	154.0	49.3	24.1	429.1
Total	127.3	110.1	183.1	159.6	54.3	31.2	440.1

Source: Statistical Year Book, 1976.

Note: The receipts from passengers belong to Hidjaz Railway.

The receipts from freight are the total of the two corporations.

10.100 The railway tariff is considered to be cheaper than that of road transportation cost, which is about 11 Fils per ton-km according to the information from the Jordan Syrian Transport Corporation. The tariff schedules have been kept unchanged since 1960 for freight and since February 1976 for passengers. This suggests that it is of no use to change the tariff schedule of the Hidjaz Railway to mitigate the annual deficit, since the customers are seeking for the speedier services rather than for the cheaper transportation. Therefore, partial improvement of equipment and facilities, such as renewal of locomotives and rolling stocks will not, by itself, be effective in attracting additional customers.

10.3.3 Estimation of the Future Transport Demand

a. General

10.101 The railway transportation demand in the future is estimated on the basis of the past trends, assuming that no change from the present pattern of modal split would occur by 1985. However, in the long run, the railway transportation demand should be viewed from a different standpoint, taking account of a drastic improvement on the railway facilities.

b. Estimation of Railway Transportation Demand in 1985

i. Passengers

10.102 As mentioned in the previous section, at present, most of the railway passengers are international passengers from Amman to Damascus or vice versa. The number of domestic passengers can be considered negligible in the future as well as at present. For this being the case, the prediction was made only for the international passengers. The past trend show large fluctuations, which is due to the unsteady situation in the Country as well as in the neighbouring countries. Taking account of the continuation of the unstable social situation in neighbouring countries, the total number of passengers in the both direction combined is expected to be 52,300 persons in 1985 as shown in Figure 10.25. From the past records, we can infer that the majority of the future passengers would be second or third class passengers.

ii. Goods

10.103 The past trends on freight traffic by the Hidjaz Railway also have large fluctuations but have a declining tendency on the whole. Figure 10.26 shows the freight traffic of the Hidjaz Railway excluding the traffic volume on the line southward from Amman. The projection of 1985 freight traffic was made separately for the international and domestic goods. The former was estimated to be 36,000 tons. With regard to the latter, the traffic volume would remain unchanged from the level of the present, 4,000 tons per year.

Figure 10.25 International Passengers by Railway

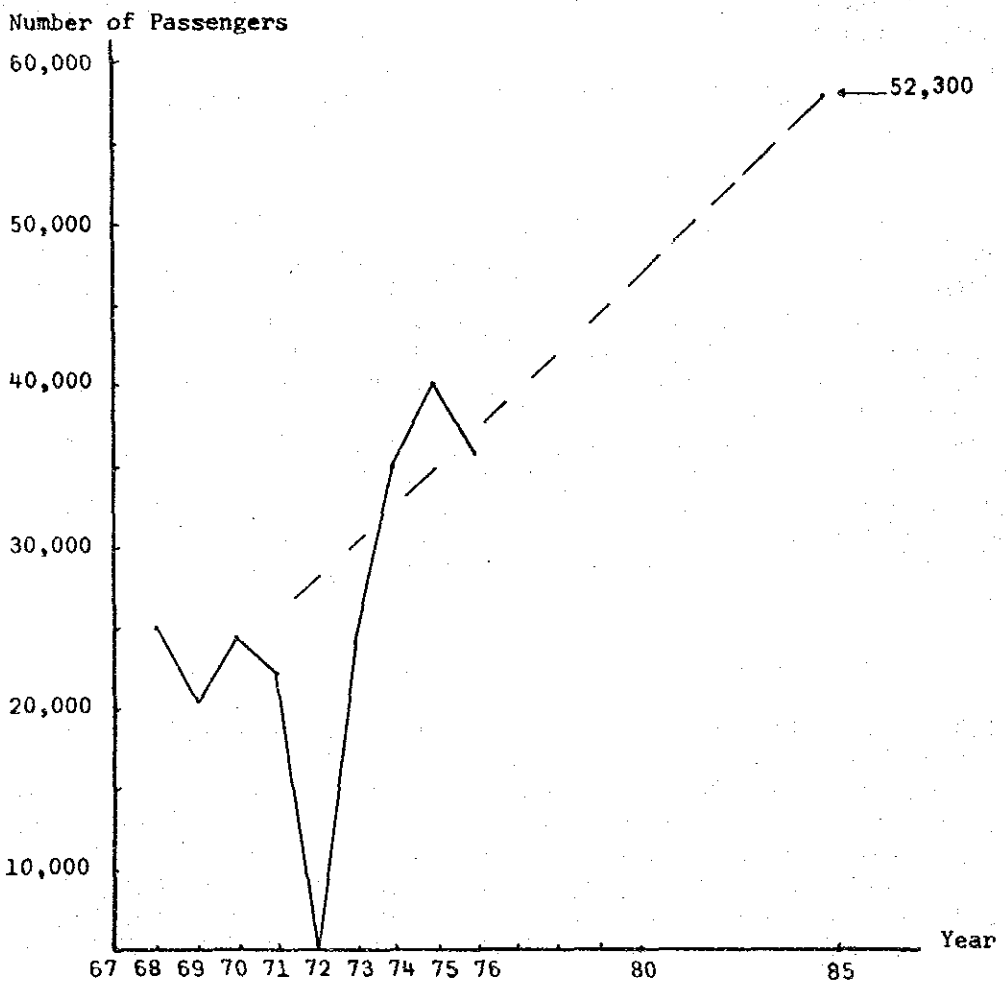
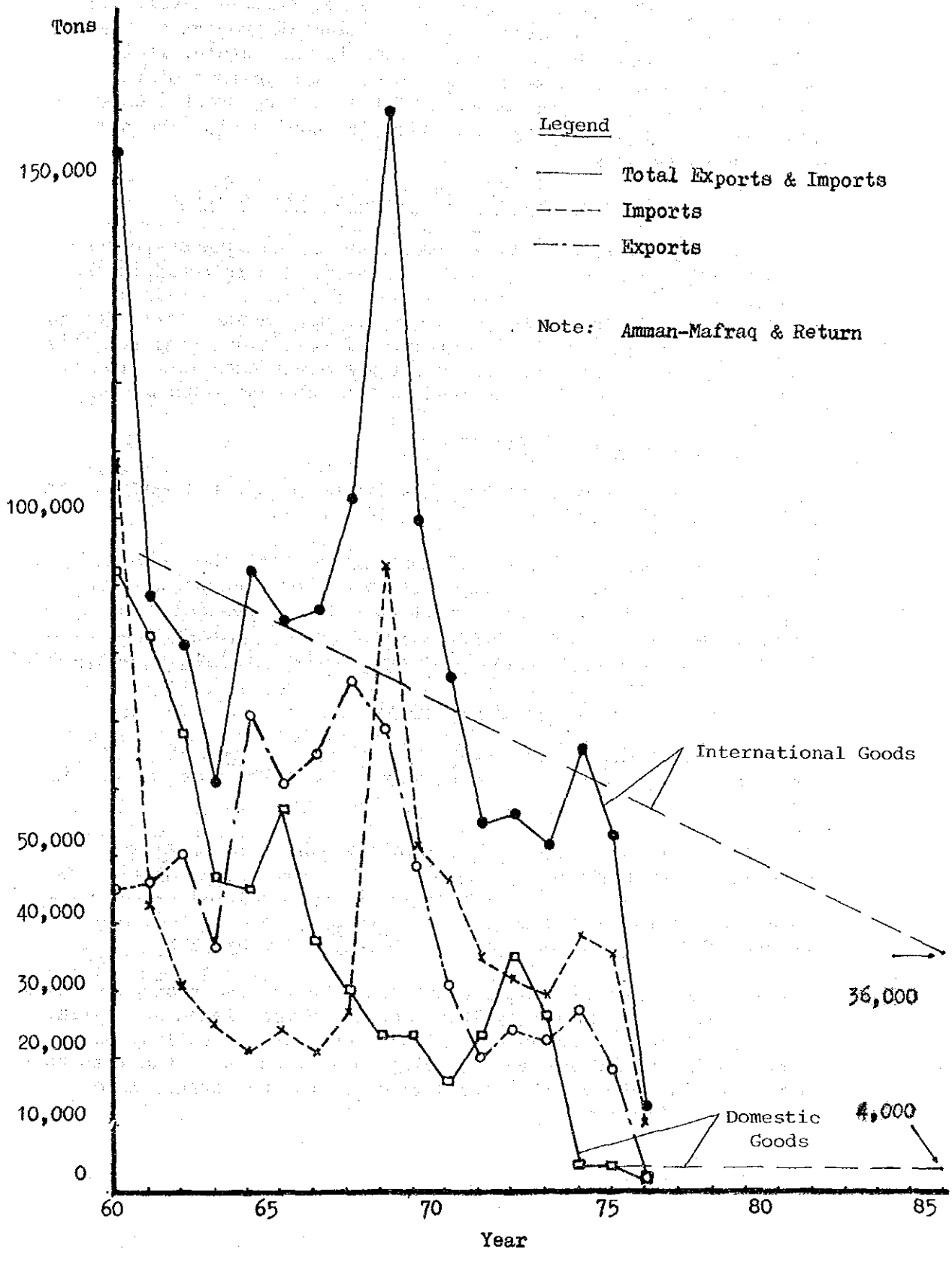


Figure 10.26 Freight Traffic by Railway



As a consequence, it can be said that the freight traffic of the Hidjaz Railway will decrease year by year, and might result in the cut down of the railway operation to its minimum level. This forecast implicity indicates that the financial problem of the Hidjaz Railway would become more serious in the future. It is of no use to make investment in the minor improvements of the existing tracks, or in the renewal of the rolling stocks. Only the maintenance of the existing facilities is required for the safe operation of railway.

c. Possibility of a New Branch Line to Irbid

10.104 The existing railway between Amman and Damascus passes through Mafraq and Dera'a in spite of the fact that Irbid is the activity center in the Northern Jordan. If there is a railway station in the vicinity of Irbid, the railway transportation would be more accessible for the inhabitants of the Study Area. For this reason, the possibility of constructing a new branch line from the existing line to Irbid is examined in the subsequent paragraphs.

i. Transportation Demand

10.105 Railway transportation has its comparative advantages to highways obviously in bulk cargo and long haul.

10.106 As seen in Figure 10.5 and Figure 10.6, the major origins and destinations for the transportation of both passengers and freight from or to the Irbid Governorate are Amman, Balwa and Syria. Among these transportation demand, the demand for those related to Amman and Syria will be served, if the new branch line is constructed.

ii. Freight Transportation

10.107 According to Table 10.17, the total volume of goods crossing the Syrian Border is approximately 2,600 tons per day in 1976.

10.108 From this figure, we calculated the traffic volume between Irbid and Syria, and between Irbid and Amman, as 800 tons and 1,900 tons per day in 1976 respectively, assuming there would be no difference on the loading efficiency. These demands would grow to about 1,150 tons and 2,600 tons per day by 1985.

10.109 According to the present modal split, the transport share of railway is approximately 13.5 percent between Amman and Syria, 0.7 percent between Amman and Mafraq. The share of railway may decrease in the future, but applying these figures to the transport demand estimated for 1985, the demand for the new branch line would be as follows:

Irbid and Ramtha - Syria	39,000 tons per year
Irbid and Ramtha - Amman	5,000 tons per year
Total	44,000 tons per year

iii. Passenger Transportation

10.110 With regard to passengers, the possible demand inferred from the present situation for the new branch line is considered to be the demand between Irbid and Syria.

10.111 Excluding the passengers by air, the percentage of railway transport between Amman and Syria at present is about 2.0 percent on the basis of assumption that the average number of passengers per vehicle is 3.

10.112 The total number of passengers between Irbid and Syria is estimated to be 1,140,000 in 1985, and we expect the number of passengers for the new branch line to be at most 23,000 in 1985.

d. Preliminary Feasibility

10.113 On the existing line, Dera'a is the closest station to the Irbid-Ramtha district. For this reason, the construction of a new branch line with a single narrow gauge track of 18 km is considered between Irbid and Dera'a. The construction cost is estimated at about JD 5 million at 1977 price, using the cost data from the new line between El-Hasa and Aqaba. This figure does not include the costs for locomotives, rolling stocks or other equipment , since they would be brought in from other sections of the Hidjaz Railway.

10.114 Assuming for the simplicity that the operation and maintenance costs are in proportion to ton-mileage, the operation and maintenance (O/M) cost of the new branch line is estimated as about JD 20,000 annually.

10.115 The following table compares the expenditures and revenues expected in 1985 for the new branch line, assuming the life span of tracks would be 40 years.

Expenditure		Revenue	
Payment Annuity (5% interest)	JD 300,000	Revenue From Freight Service	JD 20,000
O/M	JD 20,000	Revenue From Passenger Service	JD 8,000
Total	JD 320,000		JD 28,000

10.116 As a consequence, the construction of the new branch line will not be practical, since it is not realistic to consider that the revenue would exceed the annual expenditure even in the far future.

10.3.4 Project Formulation and Recommendations

a. General

10.117 As mentioned in the previous section, the activities of railway in the Irbid Governorate is and will be negligibly small for both passengers and goods. Therefore, the subsequent paragraphs describe the whole Hidjaz Railway, including the portions outside of the Irbid Governorate.

10.118 The financial problem of the Hidjaz Railway, which seems to be getting deeper, is anticipated to continue to the coming decade, since it cannot be expected that Hidjaz Railway would have a significant increase of demand in the future without adopting any drastic measures. It may be of no use to simply renew the locomotives and rolling stocks or to partially replace the railway tracks,

10.119 The construction of a new branch line connecting Irbid with Damascus seems to be unfeasible both from financial and economic viewpoints.

10.120 As a consequence, there is no recommended project for the Hidjaz Railway to be initiated at least by the end of 1985. Hence, the best way could be the maintenance of the existing facilities for keeping the present demand level, and reducing the routine expenditures to its minimum level. Nonetheless, there are some possibilities to improve the present situation in the long run as will be discussed next.

b. Recommended Studies

i. Accessibility to Terminal Stations

10.121 The Hidjaz Railway transportation is lagging behind the road transportation due to its unpopularity which comes from slow service and difficulty in access. It requires time and trouble to get to the stations. Thus it is recommended to study ways to

improve the accessibility to the stations for both passengers and goods.

10.122 One of the ways to improve the freight transportation by railway is to establish close cooperation with truck owners to smoothly transfer freights to trucks at the main stations. Much speedier service and less troubles to customers will be expected from this cooperation. If containerization is introduced to the Hidjaz, the time and cost for loading and unloading would be saved, and besides, not only the goods from Syria but also the imports from the port of Aqaba could be transported directly to Irbid region through the Mafraq station.

10.123 One of the ways for the Hidjaz to improve the passenger transportation service is to cooperate with bus companies and adjust the time schedules in order to minimize the waiting time of passengers at the stations.

10.124 But for these purposes, it may be necessary to scrutinize the strategies mentioned above, because their actualization will involve some amount of investment in the facilities in and around the stations.

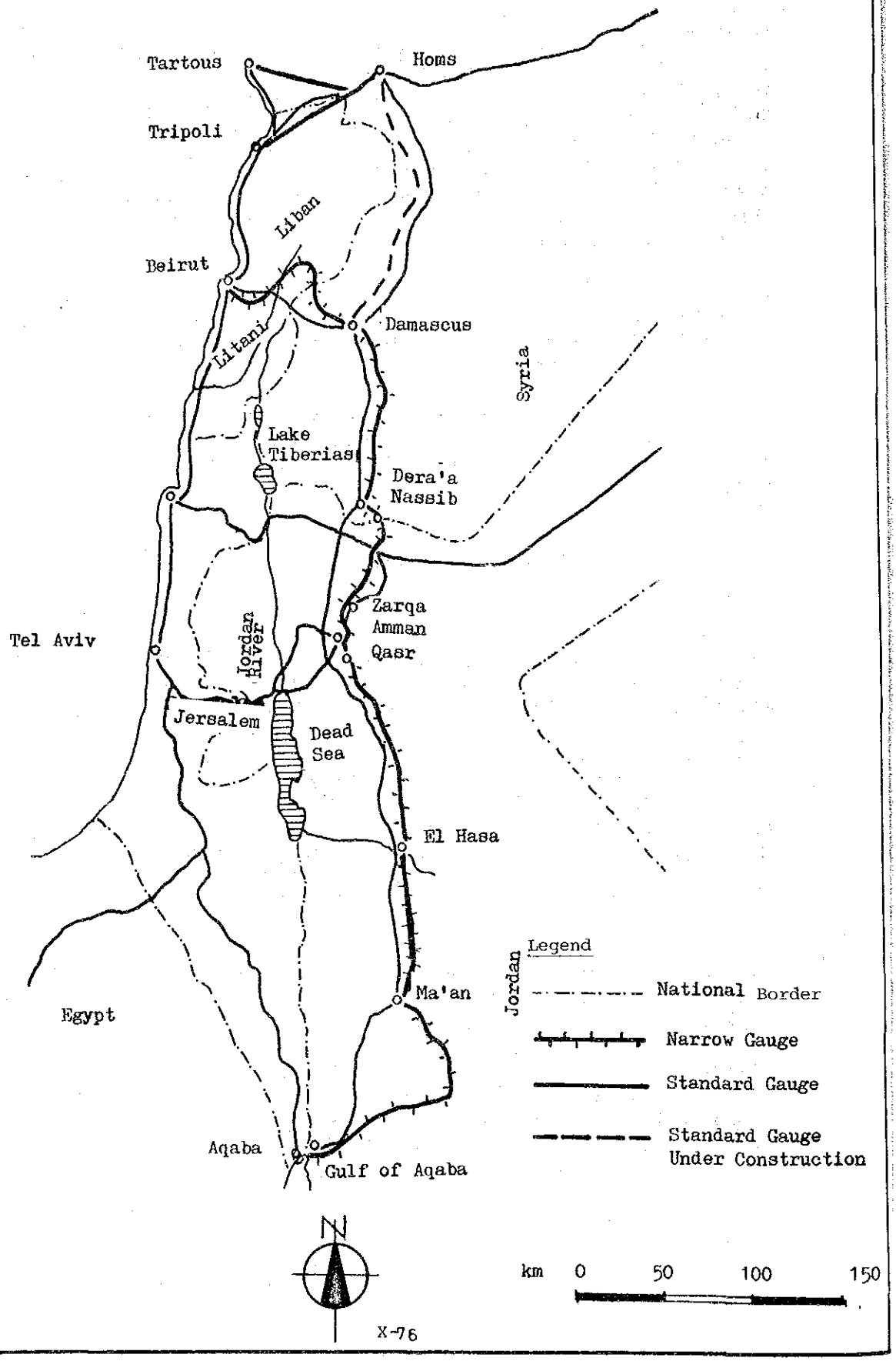
ii. Recommendation on the Study of the Reconstruction of the Hidjaz Railway

10.125 The Ministry of Transport is preparing for a study on the reconstruction of the Hidjaz Railway between Damascus, Amman and Medina, since the existing railways are poorly designed and superannuated. The new railway envisaged in this study has modern facilities with standard gauge based on the international specifications.

10.126 Figure 10.27 shows the link between Jordanian and Syrian Railways. The Syrian Railway is now being modernized and the tracks are of standard 1.435 m gauge, except for the section between Damascus and the Jordan Border. A new line between Damascus and Homs is under construction, which will be connected to the recently renovated line to Tartous. If a new line between Damascus, Amman and Medina is completed, the Country would be linked by the standard gauge railways with the European transport networks and Mediterranean sea ports such as Tripoli, Tartous and Latakia. This being the case, immeasurable benefits are expected for the Kingdom from this construction.

10.127 The line planned by the Ministry is close and parallel to the existing line. For the Study Area,the distance between the proposed line and Irbid or a new growth center(Yarmouk complex) will be one of the major subjects to be studied.

Figure 10.27 Jordan Syrian Railways



10.128 One possible alternative for the to-be-studied new railway line is the alteration of its alignment from Mafraq to the new proposed growth center around the permanent site of the Yarmouk University. Although the construction cost of this new alternative seems to be much higher than that of the original alignment through Mafraq because of the topographical conditions, we can expect a large stimulus for the Yarmouk complex area to grow and not so small amount of demand for railway transportation generated in the complex area in the long run.

10.129 For example, just based on the past trend of the Irbid-Syria demand alone, the transportation demand in 2000 would become the double of that in 1976, resulting in 1,000,000 tons in 2000. Assuring that the share of railway within the total transportation is 30 percent, we can expect at least 300,000 tons of transportation by railway between Irbid and Syria in 2000. Moreover, we can expect additional railway-transportation demand generated by the Yarmouk complex area.

10.130 Thus, it is recommended to take account of this new alignment passing through Yarmouk complex area or the Irbid Municipality itself as an alternative in the study by the Ministry of transport.

c. Recommendations on the Institutional Arrangement

i. Unified Management

10.131 As stated previously, the railway in the Country is operated by the two corporations, the Hidjaz Railway Corporation and the Aqaba Corporation. It is recommended to set up an unified management of the two corporations at the earliest convenience for coordinating their activities and reducing the management and operating cost. This unified management would be more effective after the year 1980 when the Aqaba Corporation starts its transport of general cargo from the Port of Aqaba.

CHAPTER XI

POWER AND TELECOMMUNICATION

CHAPTER XI

POWER AND TELECOMMUNICATION

11.1 Power

11.1.1 General Description

11.001 All undertakings for power generation and supply are under the control of the Jordan Electricity Authority (JEA), which was established in 1967, and the chairman of JEA is the Minister of Industry and Trade. JEA has full responsibility for the electric power generation and transmission in the whole Country to supply power in bulk to power-supply companies and to supply directly to consumers in areas which are not within the concession areas of the power-supply companies.

11.002 There are two major power-supply companies in Jordan. One is the Jordanian Electric Power Company (J E P C O) which services the Amman and Balqa Governorates and the other is the Irbid District Electricity Company (I D E C O) which services the Irbid Governorate.

11.003 JEPCO became the first consumer of JEA in 1975 when JEA started its first thermal generation by a gas-turbine generator at the Hussein Thermal Power station in Zarqa, and the Marqa power station of JEPCO was subsequently taken over by JEA in October of 1976.

11.004 At the Hussein Thermal Power Station, there are two units of 33 MW steam turbine generators and two gas turbine generators of 14 MW and 19 MW each. The third unit of 33 MW is now under construction and expected to be commissioned at the end of 1978 or early 1979. Marqa power station has a total capacity of 60 MW (diesel), and two additional units of 18 MW gas turbines have been in operation since April and June 1978.

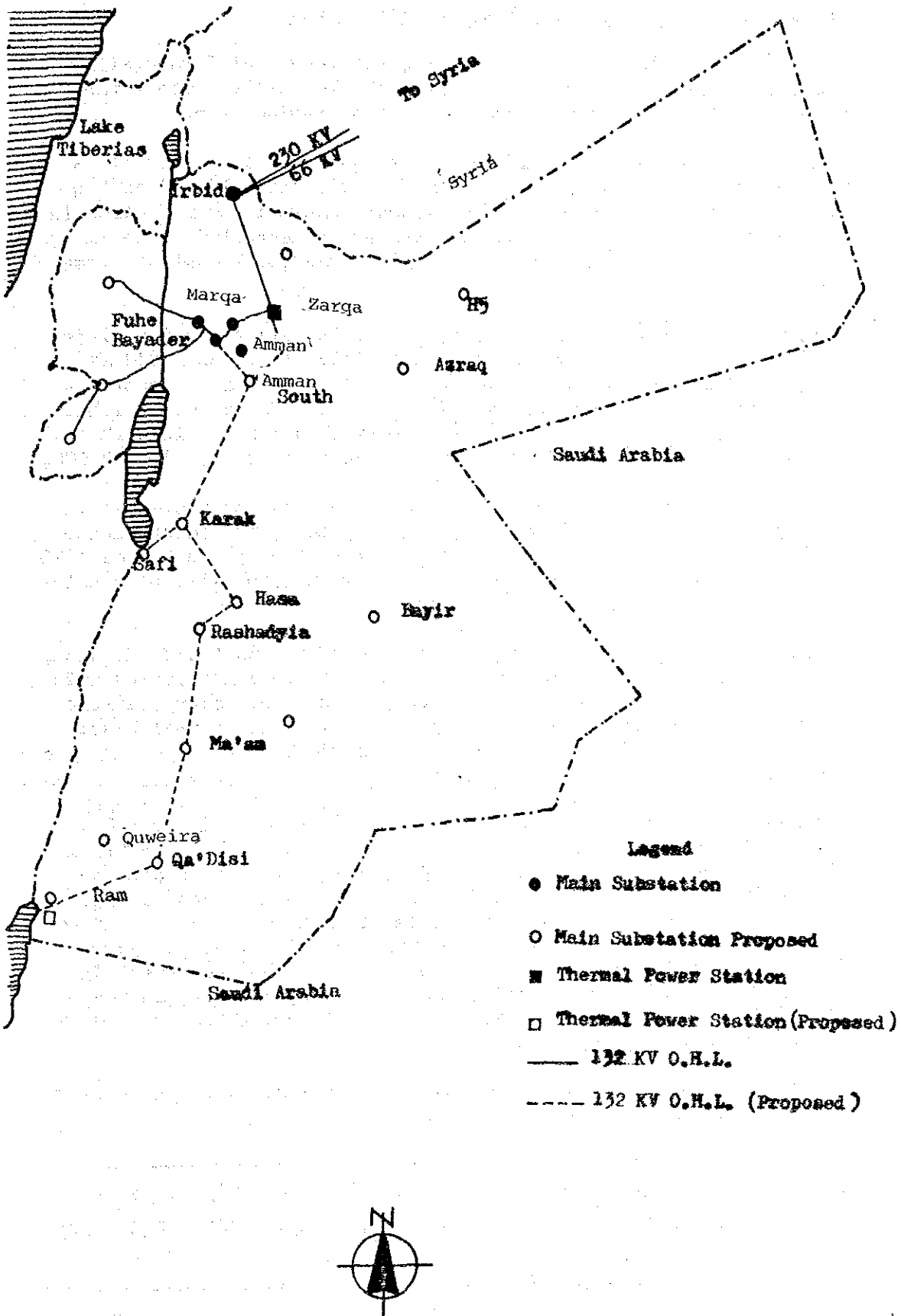
11.005 The Irbid substation and the 132 KV double circuit transmission line between the Hussein Thermal Power Station and the Irbid substation are now under construction. They are expected to be put into operation by the end of 1978 or early 1979. At the same time,

IDECO will be the new consumer of JEA, and the power systems of Irbid and Amman and Balqa will be united into one system (see Figure 11.1). JEA also constructed the 66 KV single circuit transmission line from the Syrian border to Irbid. Since March 1976, this line has been used to import approximately 5 to 6 MW of electric power through 10 MVA transformer from Syria to the Irbid Municipality to meet the demands in the area in addition to the supply from the diesel units of IDECO.

11.006 The other main power systems of JEA are at Karak and Aqaba which are isolated from one another. Total generating capacities in Karak and Aqaba are about 4.5 MW and 11 MW respectively.

11.007 Total energy generated, energy consumed, and peak power in the whole Country in 1977 were about 594 GWH, 513 GWH and 125 MW, respectively.

Figure 11.1 132 KV Transmission System, East Bank, 1977



Source: J.A, Eleventh Annual Report 1977

11.1.2 Electric Power Supply to the Study Area

11.008 Electricity is supplied by IDECO whose total generating capacity is 11 MW and by JEA through a 10 MVA 66/33KV transformer receiving power from Syria by a 66 KV transmission line.

11.009 Irbid substation is now under construction at the place adjacent to the Irbid Power station of IDECO, and a 132 KV double circuit transmission line from the Hussein Thermal Power Station is also under construction. These facilities are expected to be in service by the end of 1978 or early 1979. The total cost of these works amounts to JD 3 million.

11.010 The transformers initially installed are two units of 30 MVA 132/33 KV, (see Figure 11.2). In addition to these a 230 KV single circuit transmission line from Syria is now under construction. This line is to be connected to the 132 KV bus in the Irbid substation through a 100 MVA 230/132 KV transformer. This work will be completed by the end of 1978, and the cost amounts to JD 300,000.

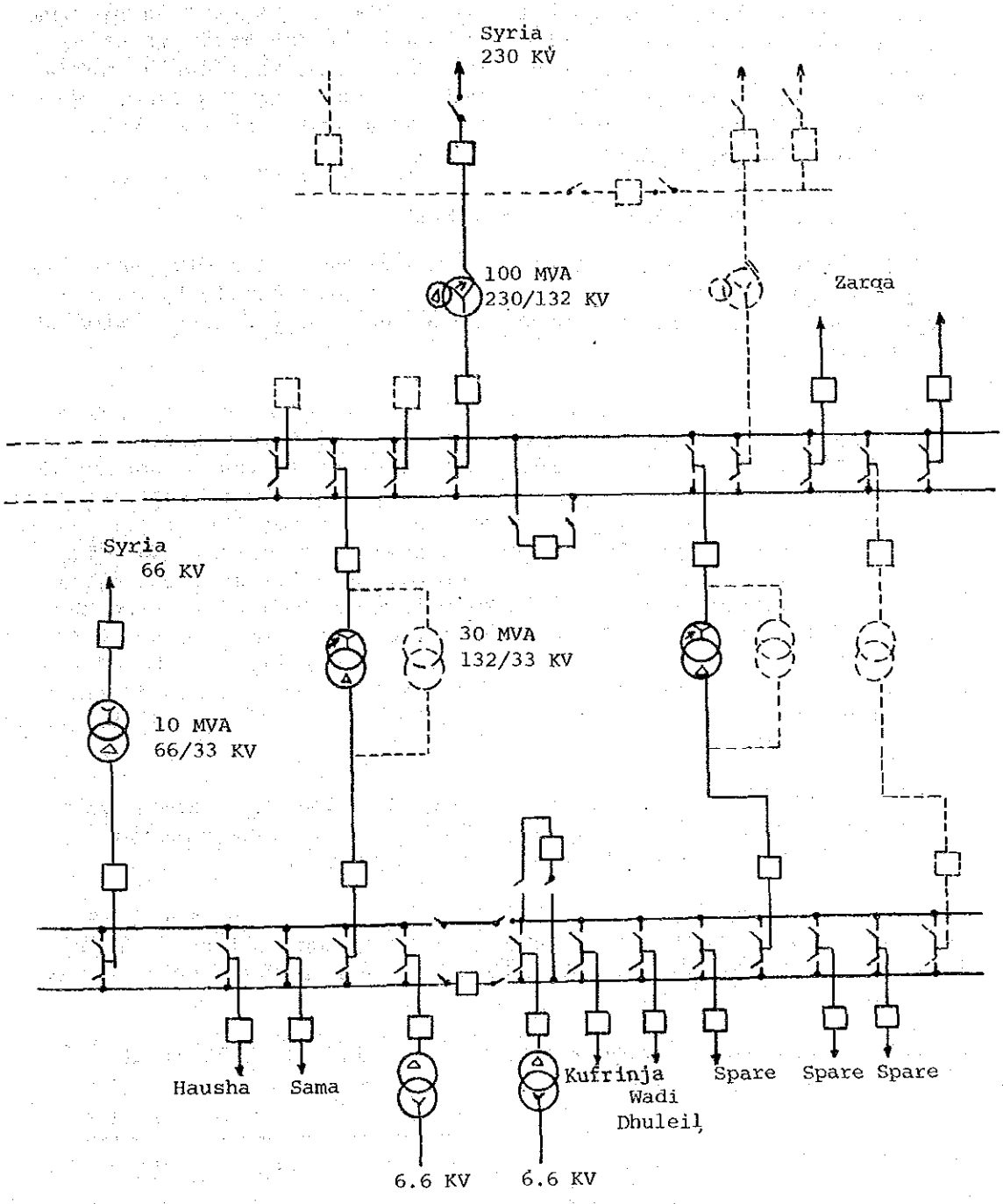
11.011 The number of 132/33 KV transformers can be increased in accordance with the growth of demand. Therefore, the power source in the Study Area will become strong and reliable by the end of 1978 or early 1979, because the total generating capacity will be greater than the maximum demand in the system.

11.012 As for the future supply of electricity to the Study Area, the power supply system in the Study Area will be consolidated into the National system, and hence will be supported by power stations in other regions. The total capacity of the Hussein Thermal Power Station will be 330 MW by the year 1983 or 1984. Three units of 5 MW diesel generators will be added to Aqaba Central Power Station to be in operation by the year 1981. The Aqaba thermal power station will be built nearby with two units of 60 MW in the year 1983 or 1984. The 132 KV double circuit transmission line is to be extended from Amman to Aqaba by the year 1983 or 1984, and at that time all the systems in the whole country will be united into one system. The total generating capacity in this system in 1983 or 1984 amounts to 584.5 MW. Other than this capacity, there are 14 MW of the generation in the Fuheis cement factory and 4.8 MW of the generation in the oil refinery in Zarqa. Thus, the generating capacity in the system amounts to 603.3 MW in total, and moreover, there are 100 MW supplied from Syria.

11.013 On the other hand, maximum demand estimated in the system of the Country as a whole is as follows:

Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Demand (MW)	139	198	239	305	404	461	517	565	615	673

Figure 11.2 Connection Diagram of Irbid Substation



Source: IDECO

11.014 The total firm generating capacity is expected to be around 622.3 MW (603.3MW + 100 MVA x 0.85 - 66 MW = 622.3 MW, where 0.85 is the power factor assumed). Therefore, the generating capacity is enough until 1986.

11.015 To meet the demand after 1986, the third thermal power station in addition to the Hussein Thermal Power Station and the Aqaba Thermal Station are now being carefully studied aiming at peak demand of 1.650 MW in the year 2000.

11.016 A feasibility study has been started in regards to placing a 230 or 400 KV transmission line between Amman and Aqaba in order to get a high power exchange capacity. This line will begin operation in or around the year 1983 or 1984. Such being the case, there is no fear with regard to electrical power shortage in the system, which covers the Study Area.

11.1.3 Demand Forecast in the Study Area

11.017 There are no remarkable big consumers in the Study Area at present, consequently, power forecast may be made easily by an analysis of the past trend, and then adding the expected consumption of new consumers.

11.018 According to the comment of the Yarmouk University, the existing power demand is 20 MW, and the already available power is 13 MW. Then, there is power shortage of 7 MW at present at its temporary site. The information gathered about the Yarmouk University is that at first 20 MW will be installed at the factory in the University at its permanent site to manufacture appliances, such as desks and chairs, and other various facilities for the construction of the University buildings. After the completion, additional 8 MW will be needed to service the campus. The total of 28 MW seems to be too large, when compared to the peak demand of 15 MW in the whole Study Area in 1977. On the other hand, an IDECO's Technical Manager is of the opinion that the new demand will be 5 to 10 MW, mostly accruing from the University and the diffusion of TV sets in the Area.

11.019 The staff of the power company have the expertise about the demand factor and the diversity factor, so in this case the latter shall be taken as the basis for estimation.

11.020 Assuming that the peak demand is 7,000 KW and the load factor is 0.5, then the annual energy consumption will be 30.7 GWH. In 1978, the effect of these additional consumers may appear in the last quarter of the year.

11.021 Past data of energy consumed from 1971 to 1977 in the Study Area is as follows:

Year	1971	1972	1973	1974	1975	1976	1977
GWH	8.8	11.5	13.0	13.5	20.0	33.3	44.6

Using the above data, the approximation formula by the method of least squares is as follows:

$$Y = 15.24 + 5.63X + 1.357X^2$$

where Y = energy consumption (GWH), and

X = year, but to simplify the calculation of coefficient, take the year 1974 = 0.

11.022 Then the total consumption including the new consumers discussed above is as follows:

$$Y = 15.24 + 5.63X + 1.357X^2 + 30.7$$

But just for the year 1978, the total consumption will be

$$Y = 15.24 + 5.63X + 1.357X^2 + 7.7$$

Energy consumption forecast by this formula is as follows:-

Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Consumption (GWH)	67	108	129	152	178	207	238	272	309	348

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Consumption (GWH)	391	436	483	534	587	637	701	763	827	893

Year	1998	1999	2000
Consumption (GWH)	957	1,035	1,110

On the other hand, JEA's forecasts, as shown below, are close to the Figures presented above.

Year	1978	1979	1980	1981	1982	1983	1984	1985
(GWH)	70	105	126	151	177	208	240	274

JEA's forecasts must have been derived from more accurate and detailed information, their Figures are more reliable.

11.023 As for the peak demand, there are usually more complicated integration methods than for energy consumption. In this case, to simplify the calculation, the annual load factor is taken to be constant at 0.45. Then the peak demand forecast is as follows:

Year	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
Peak Demand (MW)	20	27	33	39	45	53	60	69	78	82

Year	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Peak Demand (MW)	99	111	123	135	149	162	178	194	210	227

Year	1998	1999	2000
Peak Demand (MW)	243	263	282

On the other hand, JEA's forecasts are as follows:

Year	1978	1979	1980	1981	1982	1983	1984	1985
(MW)	20	30	35	41	47	54	61	68

11.1.4 Power Distribution in the Study Area

a. Study Area

11.024 The Study Area is the concession area of IDECO. Power is transmitted at 33 KV and subtransmitted at 6.6 KV. The rated distribution voltage is 380/220 V, three phase four-wire at 50 HZ.

11.025 The power transmission capacity of a 33 KV line from Irbid substation to the Irbid Municipality will be determined by the power factor of load and current carrying capacity of the conductor rather than the voltage regulation, because the distance between the substation and the center of the city is very short (approximately 2 Km). For example, if the conductor size and power factor is ACSR 330 m/m^2 and 0.8 respectively, then the transmission capacity per circuit will be 31 MW. Therefore, power transmission to the Irbid Municipality, load center in the Study area, is easy. In otherwords, the necessary work to meet demand growth is only the additional construction of the new transmission line with bigger conductors or the exchange of the conductors of existing lines.

b. Rural Electrification

11.026 A long-term plan of rural electrification was started by JEA in 1974 for the Country as a whole. The target of this plan is

to supply power to all villages with a population of more than 500. In the Study Area, IDECO has been carrying out the construction works along with the JEA Plan.

11.027 For rural electrification, the outline of 33 KV lines is shown on Figure 11.3. The proposed line between Jerash and Mafraq is now being designed and expected to be in service in approximately 5 years.

11.028 JEA has a financial policy to promote the rural electrification. According to a document on the power supply tariff, one Fils per KWH of electricity sold is deposited to a special fund in JEA for the purpose of financing the rural electrification projects in Jordan. By this fund, the 33 KV lines, which are associated with 6.6 KV lines, will be extended year by year. In the Study Area, about 130 villages in the area to the north of Irbid will be electrified in 1982 by the JEA rural electrification plan.

c. Bulk Supply

11.029 At the Irbid substation, there are three spare circuits for 33 KV, and in addition spaces for the extension of(1) 3 circuits of 230 KV line and (2) 4 circuits of 132 KV line are reserved. Thus, there is a sufficient supply capacity at the substation. If there is a request for bulk supply, it can be satisfied by either 33 KV lines, 132 KV lines or 230 KV lines, depending on their respective feasibility. Also if a bulk request comes from near the proposed industrial Free Zone, it may be possible to import power from Syria to service the demand.

d. Consumers in the Study Area

11.030 The number of consumers in 1977 is shown in Table 11.1.

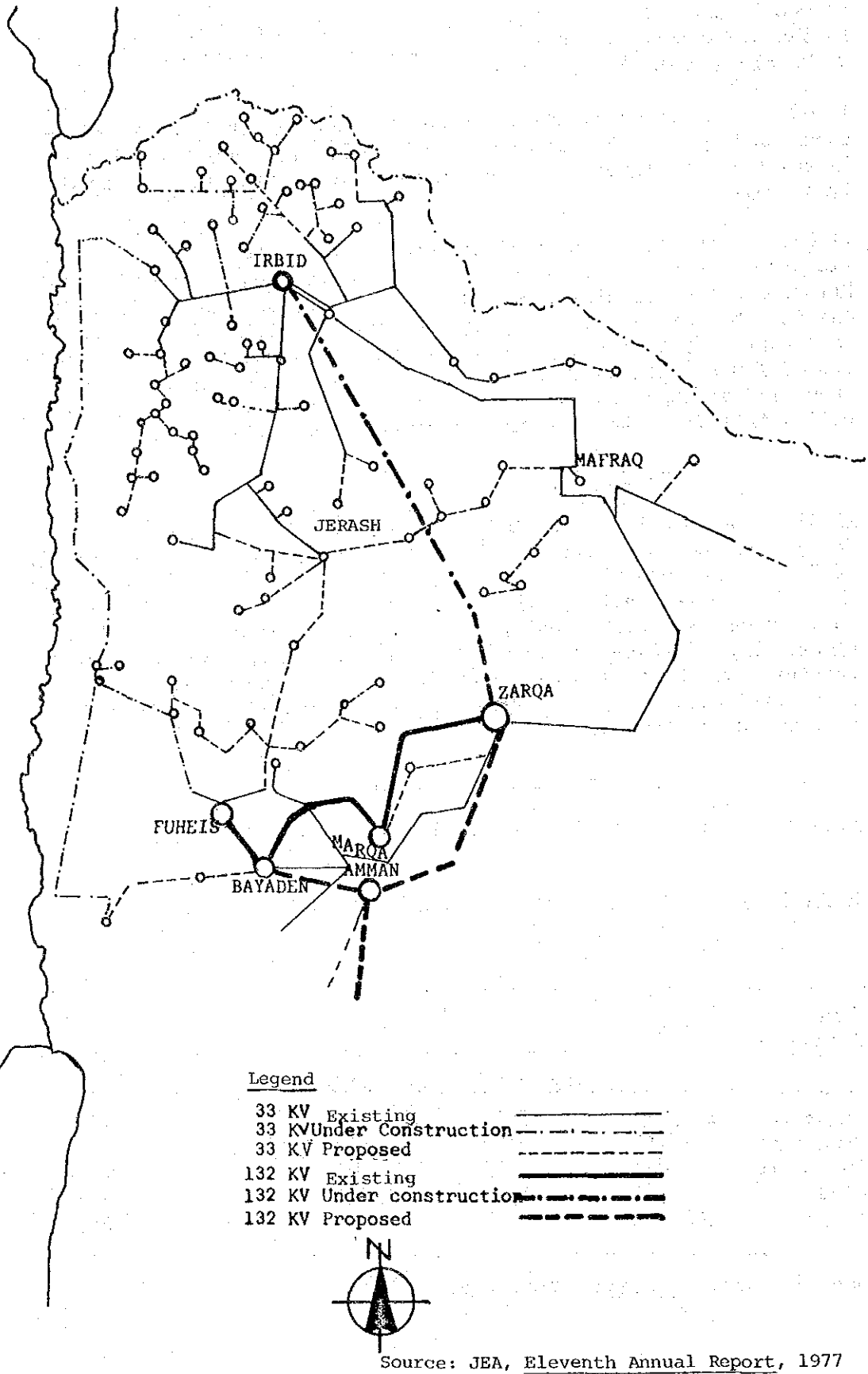
Table 11.1 Number of Consumers in 1977, East Bank

(Unit:Subscribers)

Type of Consumers	Total	District			
		Amman & Balqa	Irbid	Karak	Ma'an
Domestic	133,928	93,070	31,544	4,574	2,740
Commercial	21,692	13,880	6,312	698	802
Industrial	4,043	3,138	703	66	136
Others	2,761	1,335	1,264	101	61
Total	162,424	111,423	39,823	5,439	5,739

Source: JEA, Eleventh Annual Report, 1977.

Figure 11.3 Transmission System in Northern Jordan



Source: JEA, Eleventh Annual Report, 1977

11.1.5 Power Resources

11.031 All electric power in Jordan comes from petroleum which is imported from Saudi Arabia. Other possible sources for power in Jordan are oil-shale, solar energy, and wind-power. It is reported that there are huge deposits of oil-shale at Wadi Esh-Shallala in the Study Area. According to officials at the Ministry of Industry and Trade, however, the quality of the deposits are sub-standard for exploitation in the currently available technology. The harnessing of oil-shale will have to be postponed until some better and more economical extraction technology is developed. Solar energy has a potential as a source of power in Jordan, but its harnessing will require further development of technology. For wind-power, there is as yet no commercially successful wind-power generation in the world. Thus, at this moment of technology level none of these potential sources for power can be exploited.

11.1.6 Voltage Examination

11.032 It is said there are some complaints around the Mafraq area about the low voltage. It is recommended that after the opening of the Irbid substation and a 132 KV transmission line, the voltage at the consumers' service wire terminals should be measured by the recording voltmeter for 24 hours. This should be done at every town and village selecting a suitable number of consumers. At the same time, it is better to measure the transformer terminal voltage, and the current and power factor, if possible. If the large voltage drop is true, a suitable counter-measure should be taken to improve the power supply service.

11.2 Telecommunications

11.2.1 General

11.033 Telecommunication services in Jordan have been under the Jurisdiction of the state-owned Telecommunications Corporation (TCC hereinafter) since 1971. The TCC is an independent and monopolistic organization in terms of both administration and finance. The organization has some 3,000 personnel, of which 120 are engineers. To overcome severe shortages of qualified staff, the TCC established its own Technical Training Center in 1973.

11.034 In 1975, the TCC commissioned consultants (Teleconsut Inc., USA) to provide a comprehensive master plan, which covered and defined the TCC's needs for equipment and personnel in technical, financial and administrative fields for the coming fifteen years. The master plan which is entitled "A National Telecommunications Fundamental Plan" (NTFP henceforce) was completed in early 1978.

11.035 Expansion in telecommunication facilities in the past years is remarkable, viz., the number of telephone subscribers have rocketed from 17,776 in 1970 to 43,109 in 1977. As for the

telex service, the maximum exchange capacity was only 300 lines in the beginning of 1976, and although it has now increased to 800 lines, still it cannot satisfy the current demand. The TCC envisages an increase of additional 1,200 telex lines by the year 1979. Telegram services are also to be improved. Combined with these improvements, telephone facilities at a growing number of local post offices have brought telecommunications within reach of more people in remote rural areas.

11.2.2 Development Program Proposed in National Telecommunications Fundamental Plan (NTFP)

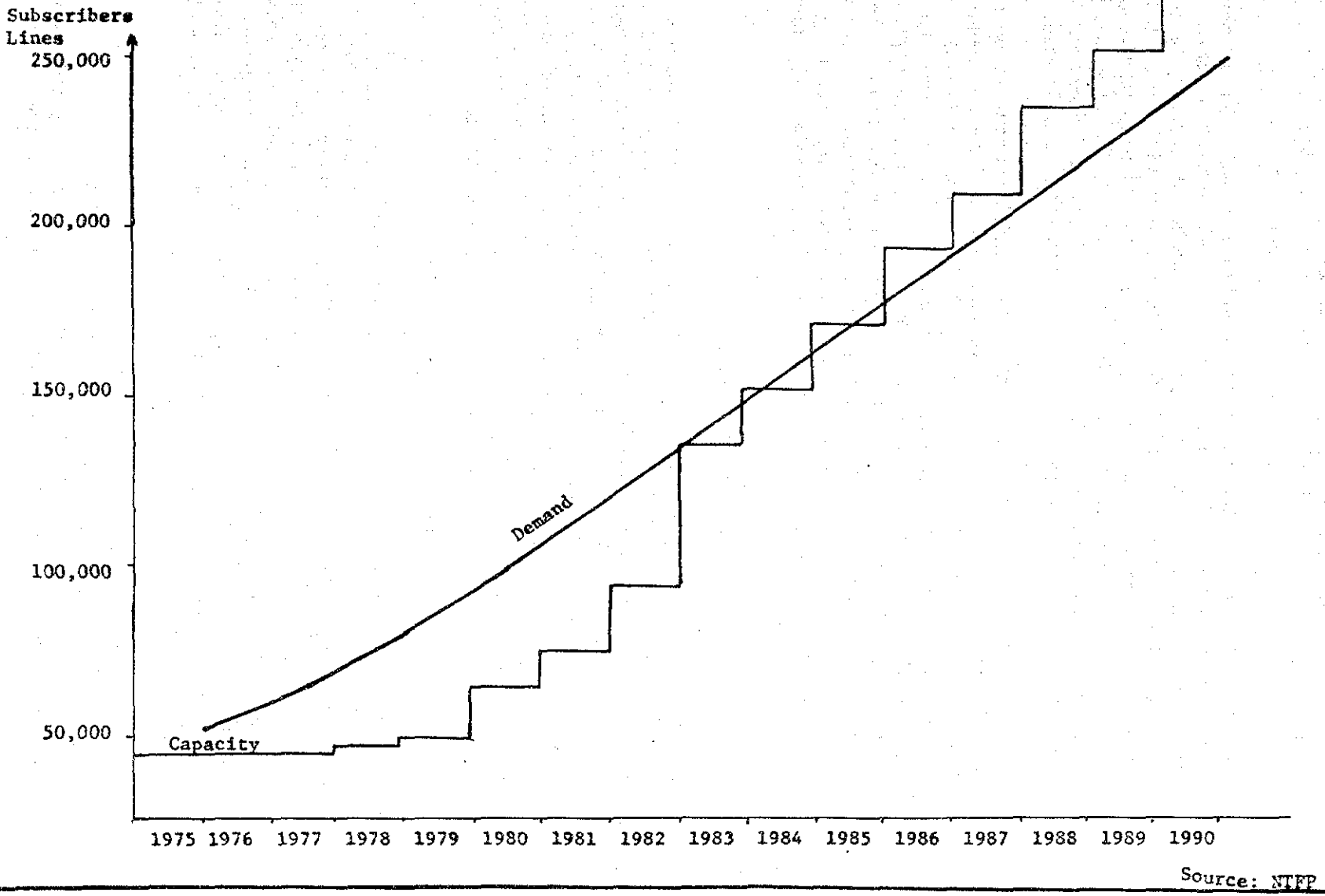
11.036 The National Telecommunication Fundamental Plan (NTFP) proposes an overall development program up to 1985 with a total investment cost of $ 250 million.

11.037 The development program (Steps One through Three) anticipates the addition of 160,000 lines in total to the telephone system of the Country. The maximum capacity is expected to exceed 200,000 by 1985, and to be sufficient to meet the demand for telephone service at that time. The projected demand and planned system capacity for Jordan as a whole up to the year 1990 is given in Figure 11.4. The program also plans to provide adequate international and national toll facilities and includes the provision of modern telex services.

11.038 The program has three steps: the first step is scheduled for completion by 1980, the second by 1982 and the last by 1985.

11.039 Step One (1977-1980) of the Program sets up the National/International Switching Center in Amman, and comprises a net addition of 40,800 subscribers lines at an estimated cost of $ 70 million. Step Two (1981 - 1982) tries to continue the policy of expanding DDD (Direct Distance Dialing) service after the completion of the National/International Switching Center. Also, an effort will be placed on providing local telephone services in those areas where demand is more likely to be urgent. The Step Two provides a net additional increase of 62,500 subscribers lines at an estimated cost of $ 89 million. Step Three (1983 - 85) tries to meet fully the demand for services throughout the entire Country. In the metropolitan Amman and Urban areas, the existing exchanges will be extended, and new exchanges will be installed in the more remote and rural areas. The Step Three gives a net addition of some 58,000 lines at an estimated cost of $ 93 million.

Figure 11.4 Summary of Telephone Demand and System Capacity in Jordan



Source: NTFP