JAPAN INTERNATIONAL COOPERATION AGENCY

DEPARTMENT OF ROADS
MINISTRY OF TRANSPORT AND COMMUNICATION
THE REPUBLIC OF KAZAKHSTAN

THE STUDY ON DEVELOPMENT OF ROAD NETWORK IN WESTERN KAZAKHSTAN IN THE REPUBLIC OF KAZAKHSTAN

SUMMARY OF FINAL REPORT

FEBRUARY, 1997

YACHIYO ENGINEERING CO. LTD.
IN ASSOCIATION WITH
PACIFIC CONSULTANTS INTERNATIONAL

Applied Exchange Rate

US$1.00 = 63.60Tenge for the Master Plan Study made in 1995

US$1.00 = 63.50Tenge for the Feasibility Study made in 1996

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Mr. Kimio Fujita
President
Japan International Cooperation Agency

February 1997

LETTER OF TRANSMITTAL

Dear Sir,

We are pleased to submit herewith the Final Report titled "The Study on Development of Road Network in Western Kazakhstan in the Republic of Kazakhstan". The report contains the advice and suggestions of the authorities concerned of the Government of Japan and your Agency as well as the comments made by the Ministry of Transport and Communication of the Government of Kazakhstan. The report consists of Main Report, Summary Report and Appendix Report in English, a Summary Report in Japanese and, a Summary Report in Russian.

The Main Report consists of 14 Chapters and presents the master plan and feasibility study on the road network and priority projects in Western Kazakhstan. It recommends the improvement of 358 km length of roads in Western Kazakhstan. The Summary Reports briefly illustrates the findings of the entire Study. The Appendix Report contains the supporting data including the technical details of the several field surveys carried out by the Study Team in Western Kazakhstan.

All members of the Study Team wish to express grateful acknowledgment to the personnel of your Agency, Ministry of Foreign Affairs, Advisory Committee, Ministry of Construction and Embassy of Japan in Kazakhstan, and also to officials of the Ministry of Transport and Communication, Government of Kazakhstan for their assistance extended to the Study Team. The Study Team sincerely hopes that the results of this study will contribute to the development of road network in Western Kazakhstan.

Yours faithfully,

Akira Ishido

Akira Ishido
Team Leader

PREFACE

In response to a request from the Government of Republic of Kazakhstan, the Government of Japan decided to conduct a master plan study and a feasibility study on road network development for western Kazakhstan and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Kazakhstan a study team headed by Mr. Akira Ishido of Yachiyo Engineering Co., Ltd. (YEC), three times between September 1995 and November 1996.

The team held discussions with the officials concerned of the Government of Kazakhstan, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Kazakhstan for their close cooperation extended to the team.

February 1997

藤田 公郎

Kimio Fujita
President
Japan International Cooperation Agency

Table of Contents

FOREWORD

This Report is the Summary of the Final Report on the "The Study on Development of Road Network in Western Kazakhstan in the Republic of Kazakhstan", which is undertaken by the Japan International Cooperation Agency (JICA) in accordance with the Scope of Work agreed and signed between the Ministry of Transport and Communication, Government of Kazakhstan and JICA.

The Study was carried out in both Kazakhstan and Japan since September 1995 and will be completed by January 1997.

The following Four Study Reports comprising the results of the study were prepared during the course of the Study.

1) Inception Report	September 1995
2) Interim Report	May 1996
3) Draft Final Report	October 1996
4) Final Report	January 1997

This report comprises the results of the Study including analysis and recommendations for the road network and priority projects in Western Kazakhstan which comprises of the four states shadowed in the map below.

The close co-operation given to the Study Team by the Department of Roads and other concerned organisations in the Republic of Kazakhstan is very much appreciated. We hope this report will be useful for the development of road network in Western Kazakhstan.

Location of Western Kazakhstan

Photos of Republican Roads and Bridges in Western Kazakhstan

Photo 1 : Republican Road (Aktyubinsk to Karabutak)

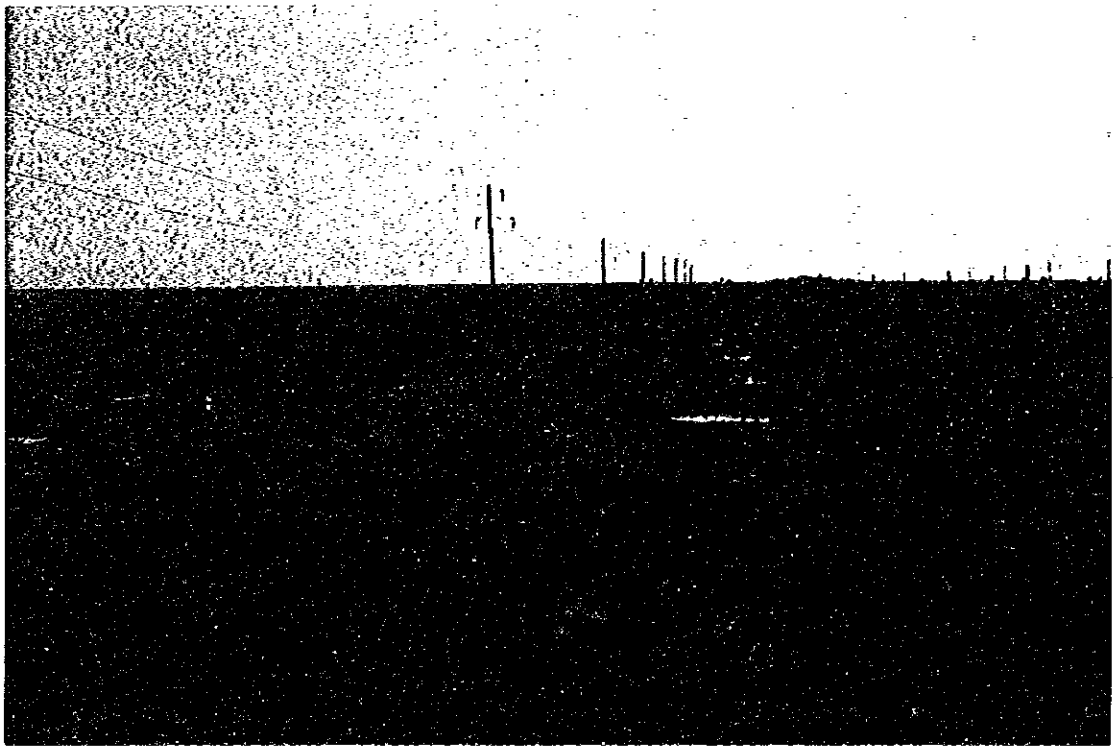


Photo 2 : Republican Road (Karabutak to Irgiz)

Photo 3 : Republican Road (Karabutak to Irgiz; hilly terrain)

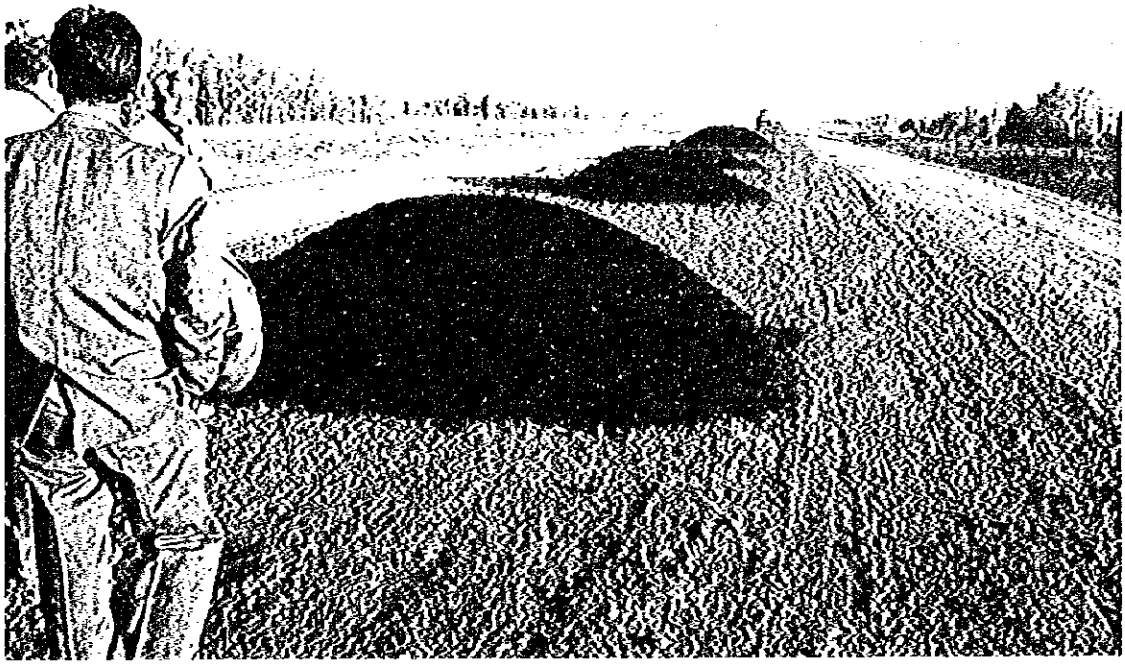


Photo 4 : Republican Road; Construction Material Near Uralsk

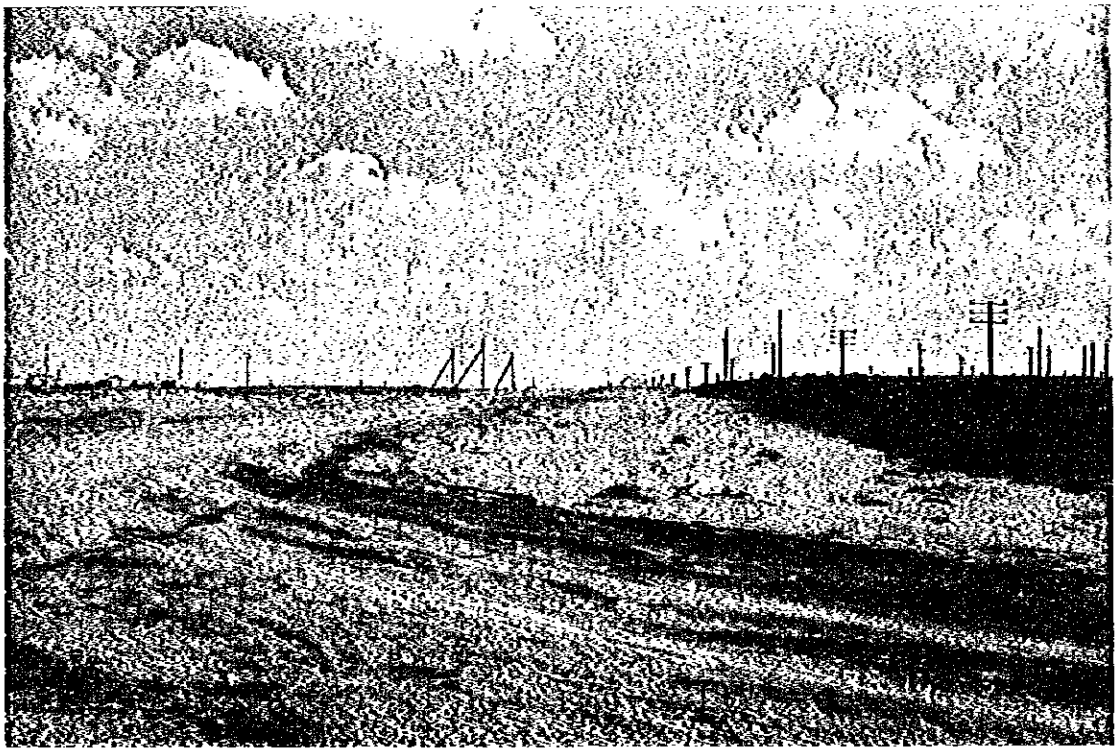


Photo 5 : Republican Road (Kulsary to Beyneu)

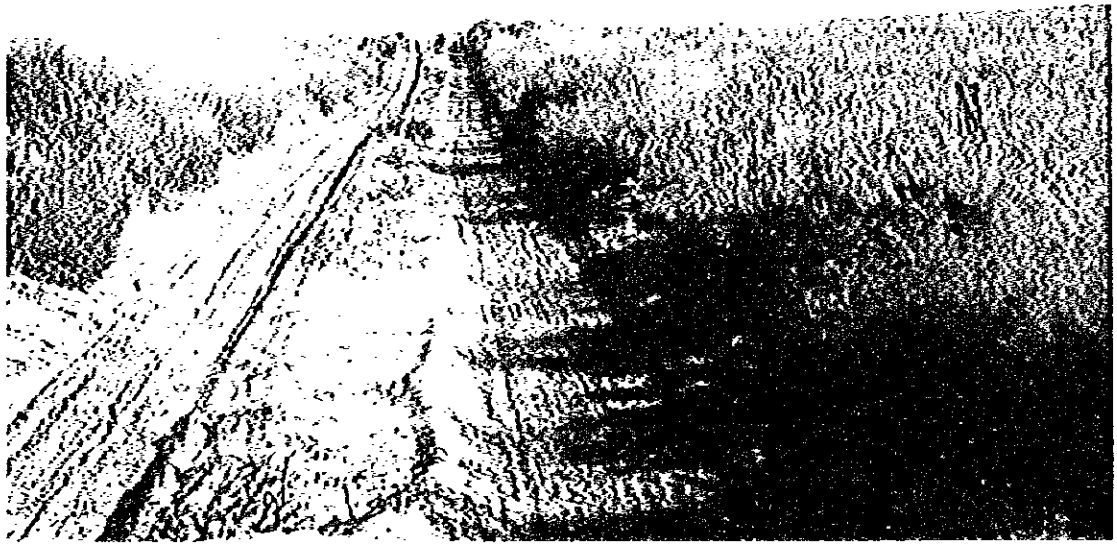


Photo 6 : Republican Road (Kulsary to Beyneu; no road)

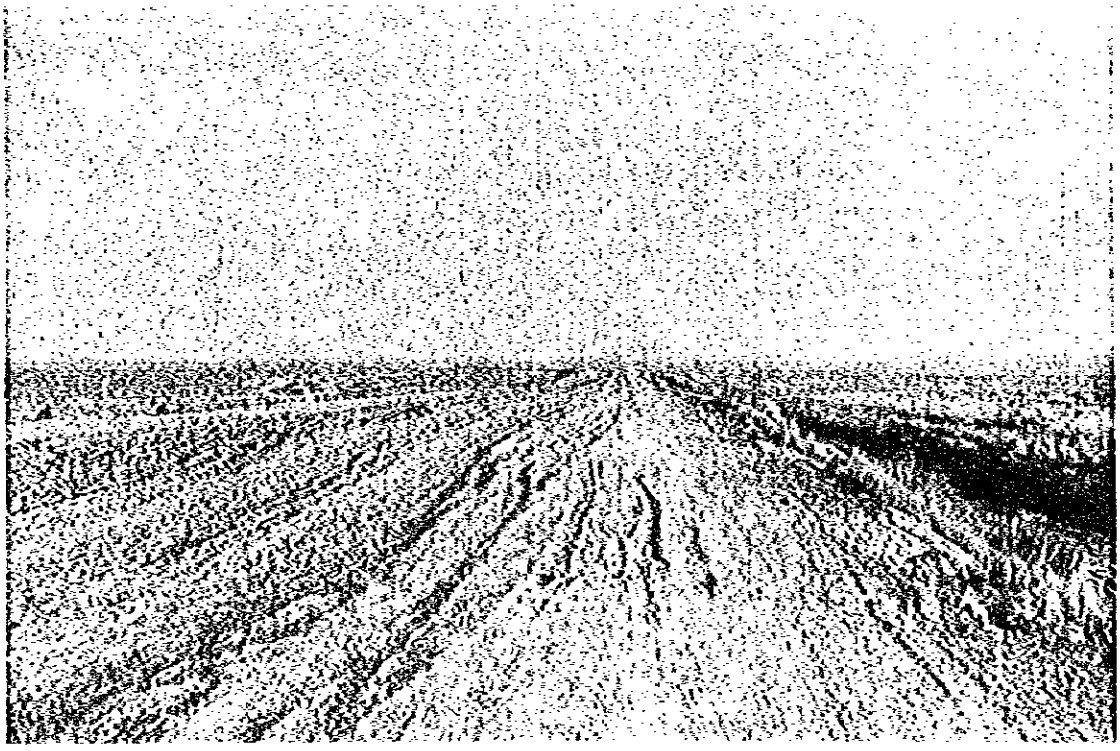


Photo 7 : Republican Road (Kzyl-Orda Border to Irgiz)

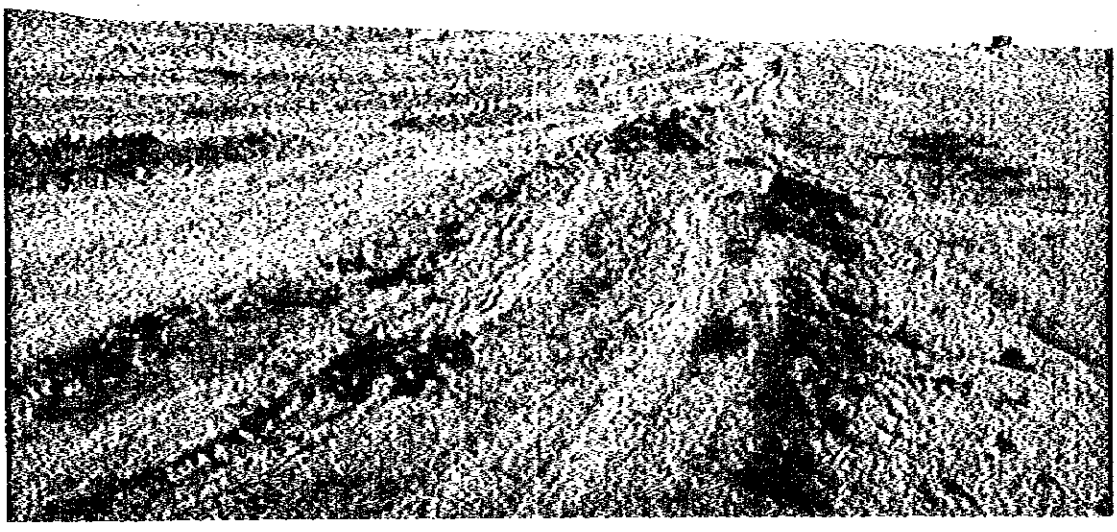


Photo 8 : Republican Road (Kzyl-Orda Border to Irgiz)

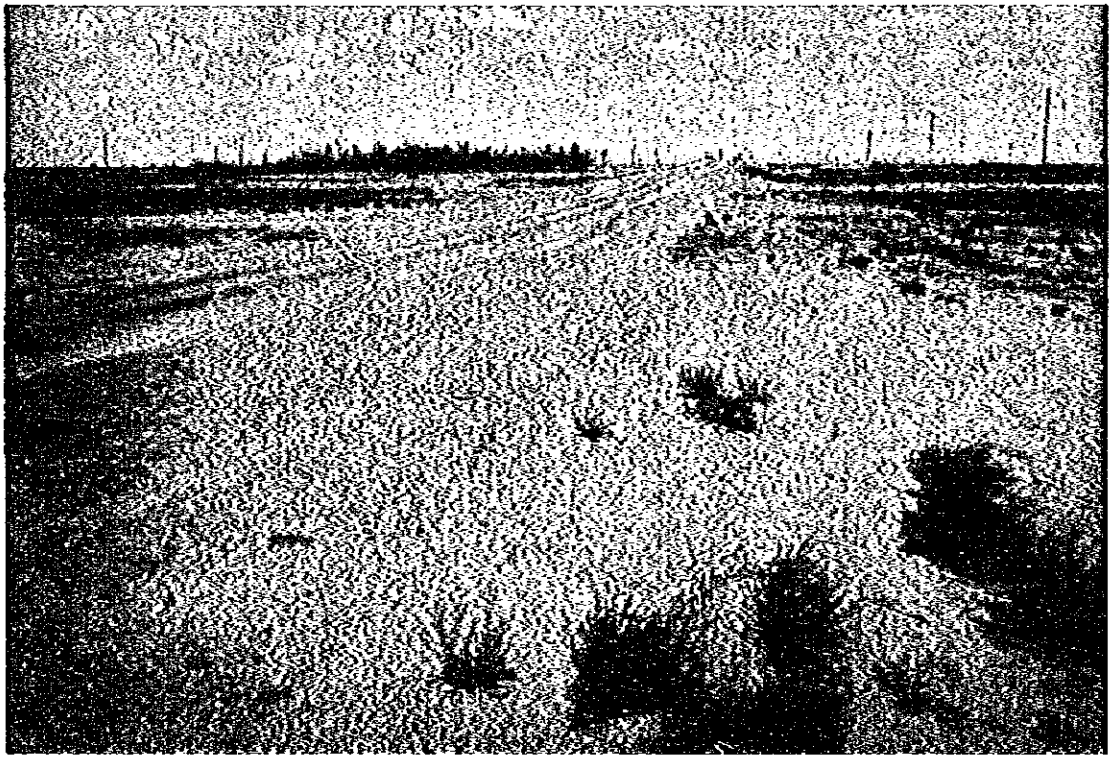


Photo 9 : Republican Road (Atyrau to Mahambet; Flooded Area)

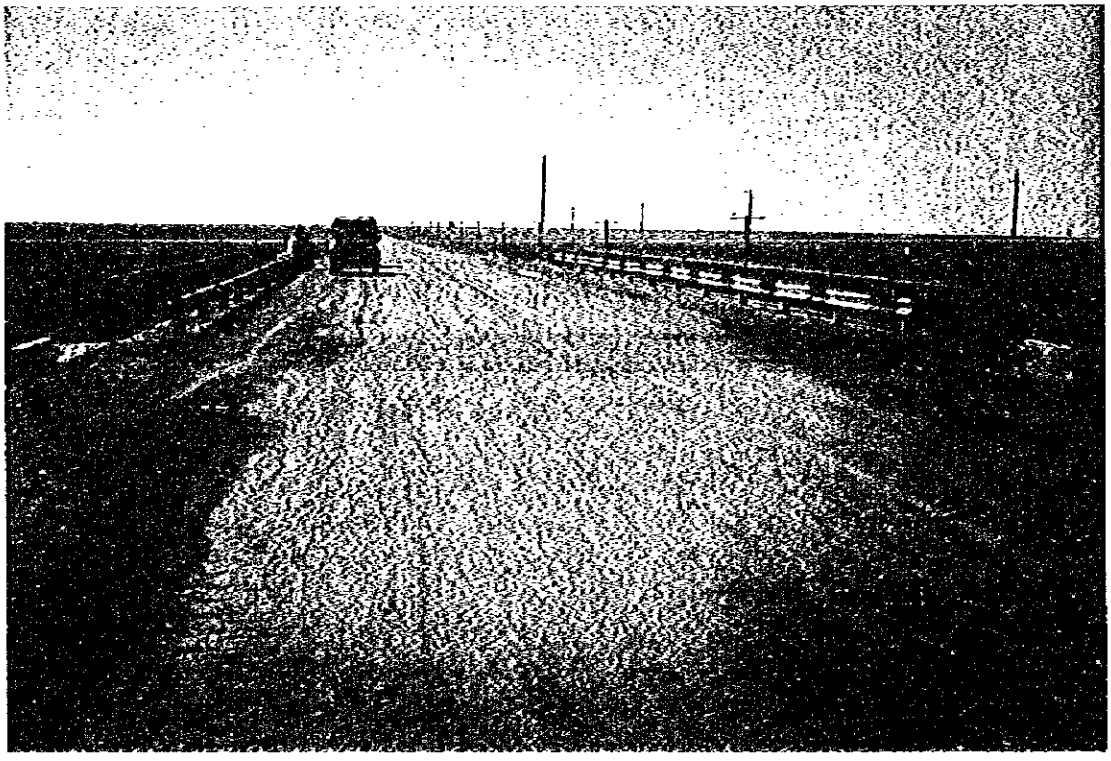


Photo 10 : Republican Road and Bridge No. 4 (Atyrau to Mahambet)

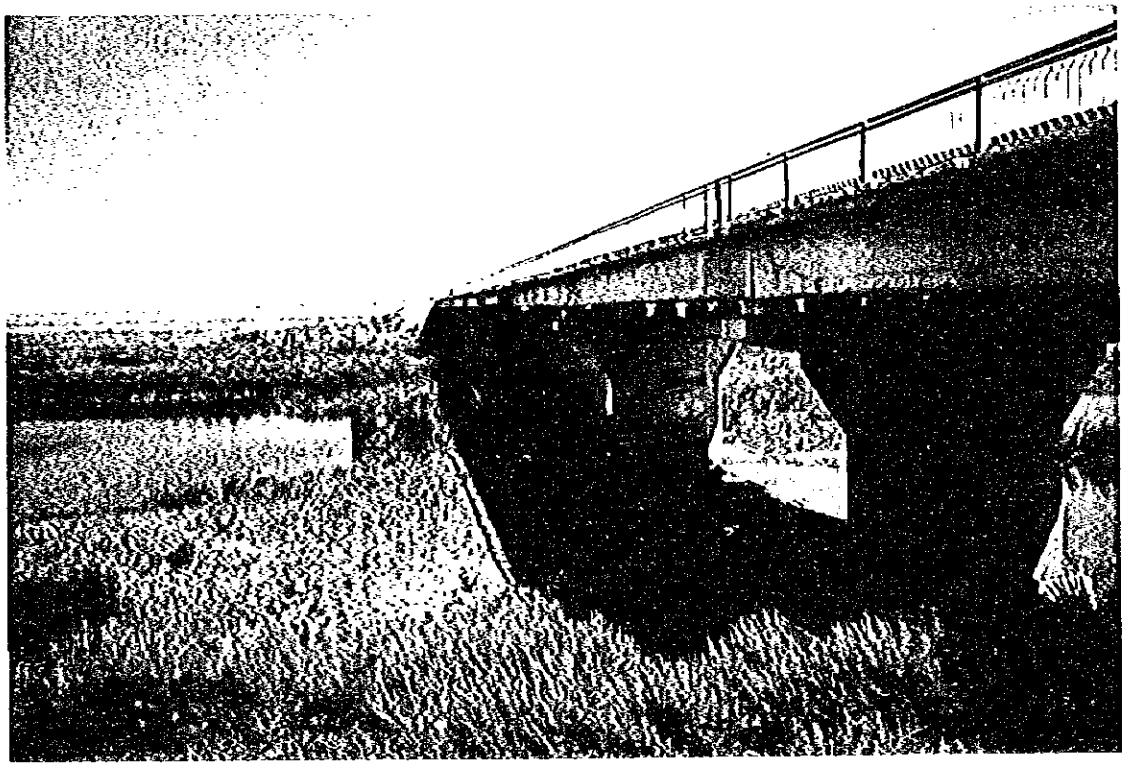


Photo 11 : Bridge No. 28 (Kzyl-Orda Border to Irgiz)

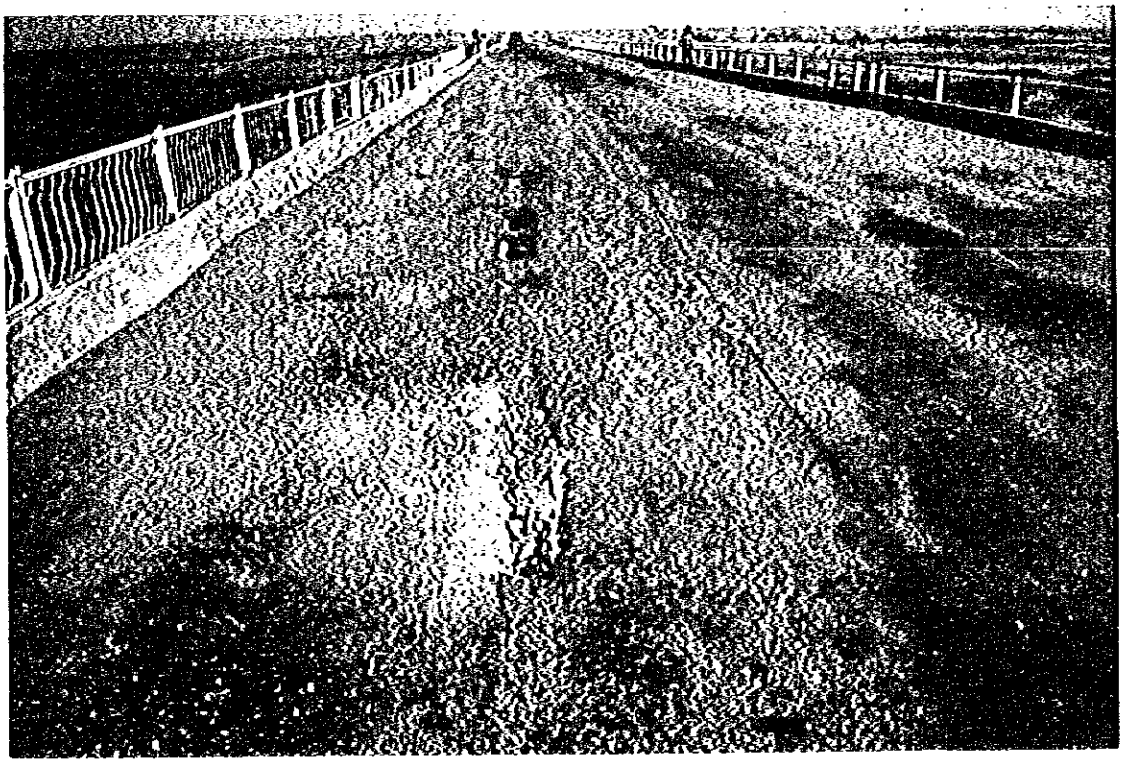


Photo 12 : Bridge No. 28 (Kzyl-Orda Border to Irgiz)

Photo 13 : Bridge No. 2 (Atyrau to Mahambet)

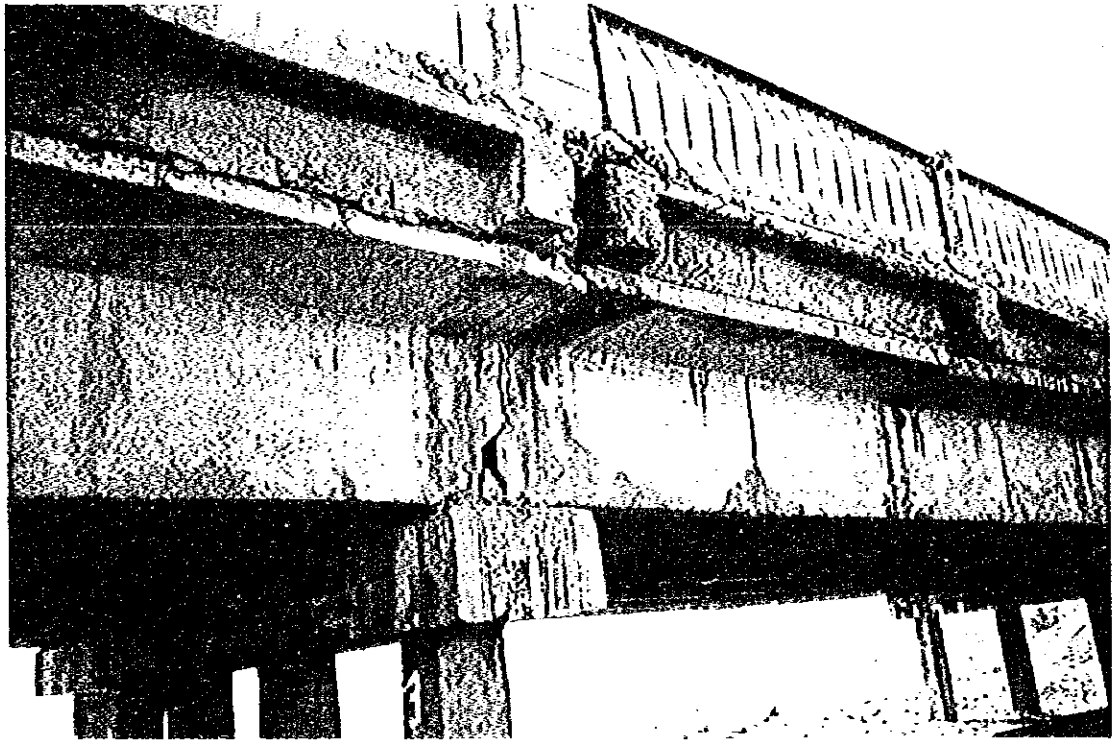


Photo 14 : Bridge No. 2 (Atyrau to Mahambet)

Photo 15 : Existing Road Construction and Maintenance Equipment (Actobe Zholdary)

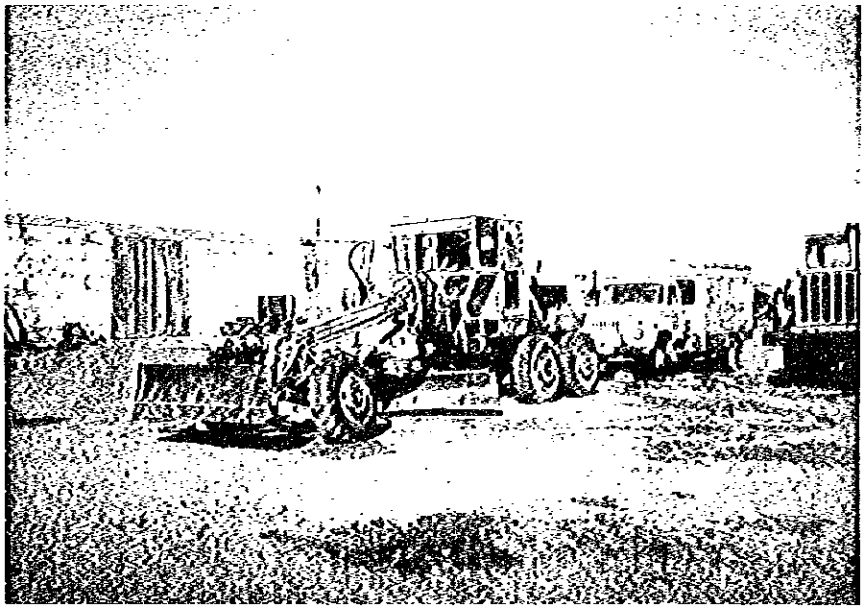


Photo 16 : Existing Road Construction and Maintenance Equipment (Actobe Zholdary)

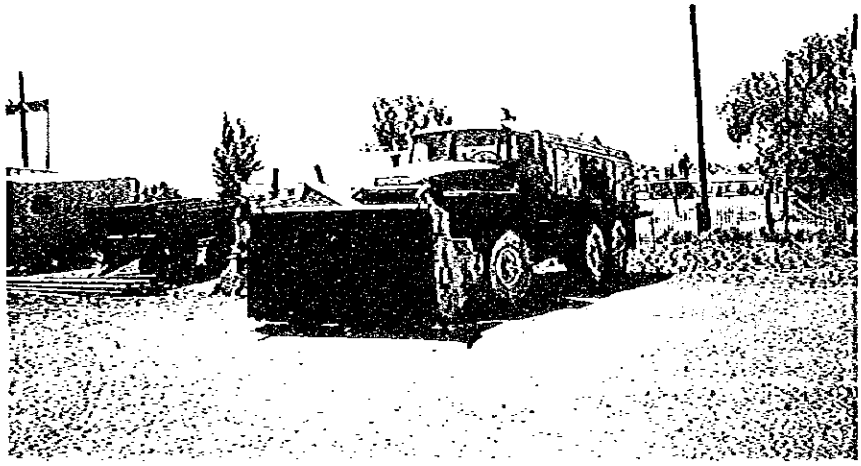


Photo 17 : Existing Road Construction and Maintenance Equipment (Atyrau Zholdary)

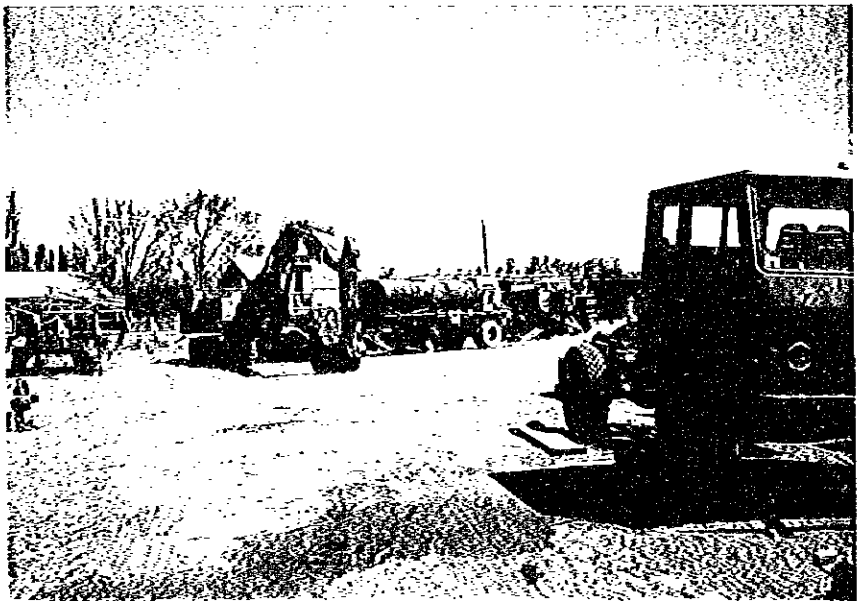


Photo 18 : Existing Road Construction and Maintenance Equipment (Atyrau Zholdary)

SUMMARY

1. Objectives of the Study

The road network of Kazakhstan comprises of about 160,000 km of several categories of roads as shown in the Table 1.

Table 1: Length of Roads in Kazakhstan

Republican Road	17,670 km
Local Road	69,667 km
Service Road	71,451 km
Total	158,788 km

The Objectives of the study are;

1) to formulate road network in Western Kazakhstan and
2) to conduct feasibility study on priority projects to be selected from long-list projects.

2. Formulation of the Road Network in Western Kazakhstan

Considering the population, number of vehicles, land extent and traffic, the existing road network which includes republican road, local roads and part of newly adopted Asian Highway forms sufficient road network in Western Kazakhstan. The total length of this road network is about 17,000 km as shown Figure 1 and Table 2.

Table 2: Road Length, Population and Area of Kazakhstan and Western Kazakhstan

Road Category	Kazakhstan	Western Kazakhstan
Republican Road	17,670 km	3,721 km
Local Road	69,667 km	13,336 km
Total	87,337 km	17,057 km
Population	16,679,000	2,207,000
Area	2,725,000 km^2	736,000 km^2

3. Feasibility Study on Priority Projects

The feasibility study was carried out on three priority projects which were selected from the 33 long-list projects having a total length of 4010 km. The feasibility study included estimation of road and bridge improvement costs, maintenance costs, vehicle operating costs and economic evaluation. (See Figure 2 and Table 3)

The results of the feasibility study are shown below in the Table 3.

Table 3: Economic Evaluation of Priority Projects

Road Section No.	Name of Road	Section	Length (km)	Project Cost (1,000US$)	IRR %	B/C (12%)
1	Samara-Shimkent	Kzyl-Orda Border to Igriz	86	19,079	28.55	2.91
2	same as above	Igriz to Karabutak	189	43,605	23.28	1.93
18	Atyrau-Uralsk	Atyrau to Mahambet	83	26,729	23.01	2.15
Total			**358**	**89,413**	**24.44**	**2.08**

Based on the future traffic forecasts, the road category III was adopted for the priority projects. The three road sections mentioned above shall be improved to Category III road standard with pavement width of 7 m and shoulder width of 2.5m on both sides, thus the total width of roadway will be 12 m.

Typical cross section of road after improvement is shown below in Figure 3.

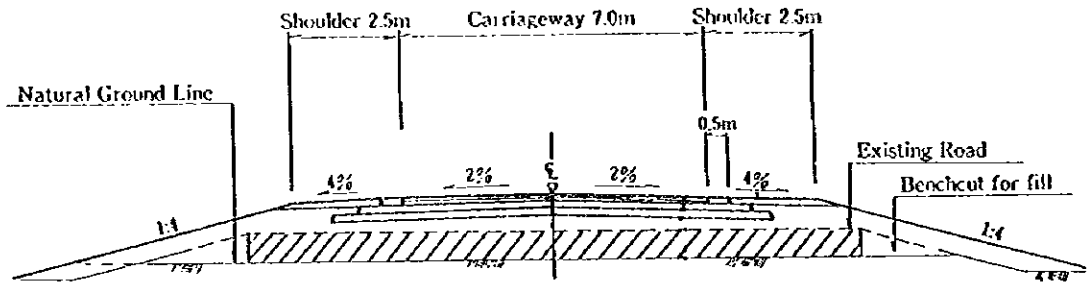


Fig. 3: Typical Cross Section of Road After Improvement

4 Recommendations

The Study Team recommends as follows.

1) Implementation of the three priority projects and, strengthening of the road maintenance system.
2) Introduction of the concept of cost accounting and quality control in construction works including structures.

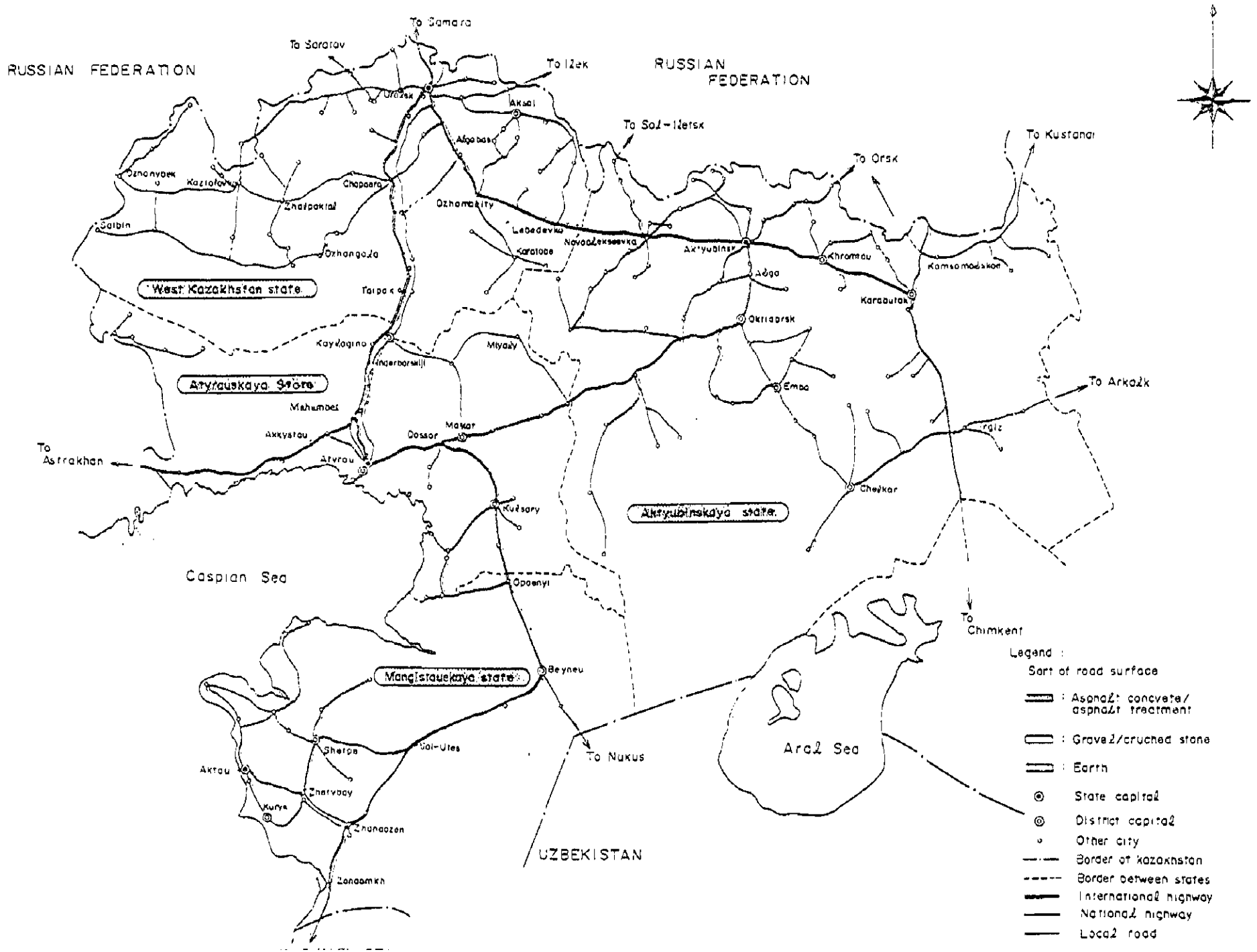


Fig. 1 : Roads in Western Kazakhstan

(XIII)

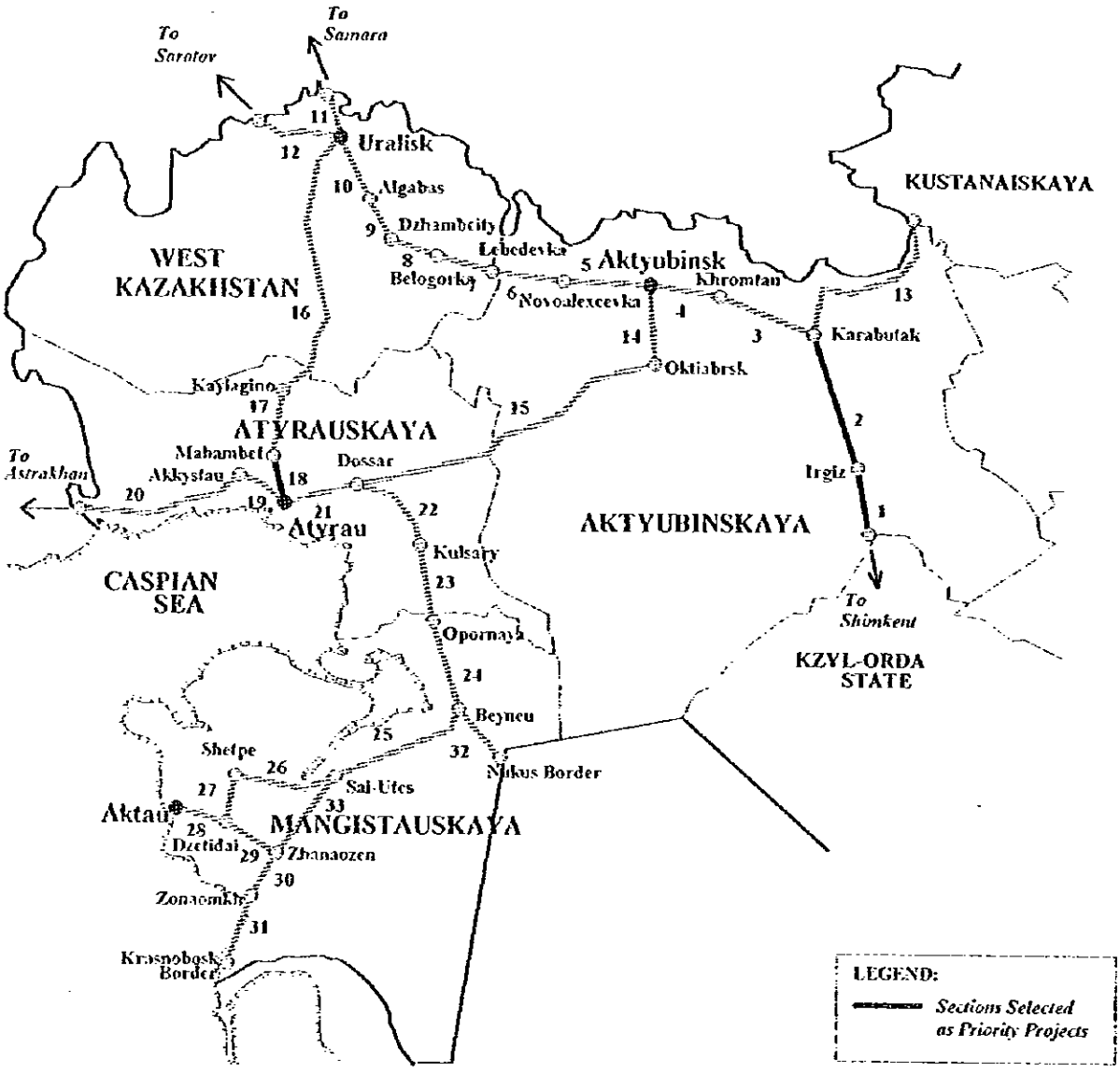


Fig. 2 : Long-List Projects and Selected Priority Projects

Chapter 1 Introduction

1.1 Background of Study

In response to the request of the Government of the Republic of Kazakhstan (hereinafter referred to as "the Government of Kazakhstan"), the Government of Japan decided to conduct the Study for Development of Road Network in Western Kazakhstan in the Republic of Kazakhstan (hereinafter referred to as "the Study") in accordance with the relevant laws and regulations in force in Japan.

Accordingly, Japan International Cooperation Agency (hereinafter referred to as "JICA"), the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, undertook the Study in close relation with the authorities concerned of the Republic of Kazakhstan.

JICA organized the Study Team to conduct the Study. The Study Team carried out the study in close cooperation with the Kazakhstan authorities for one and a half year since September 1995.

This report comprises the results of the Study including analysis and recommendations for the road network and priority projects in Western Kazakhstan.

1.2 Objectives of the Study

(1) To formulate road network in Western Kazakhstan.
(2) To conduct feasibility study on priority projects to be selected from long-list projects.

The target year shall be 2010.

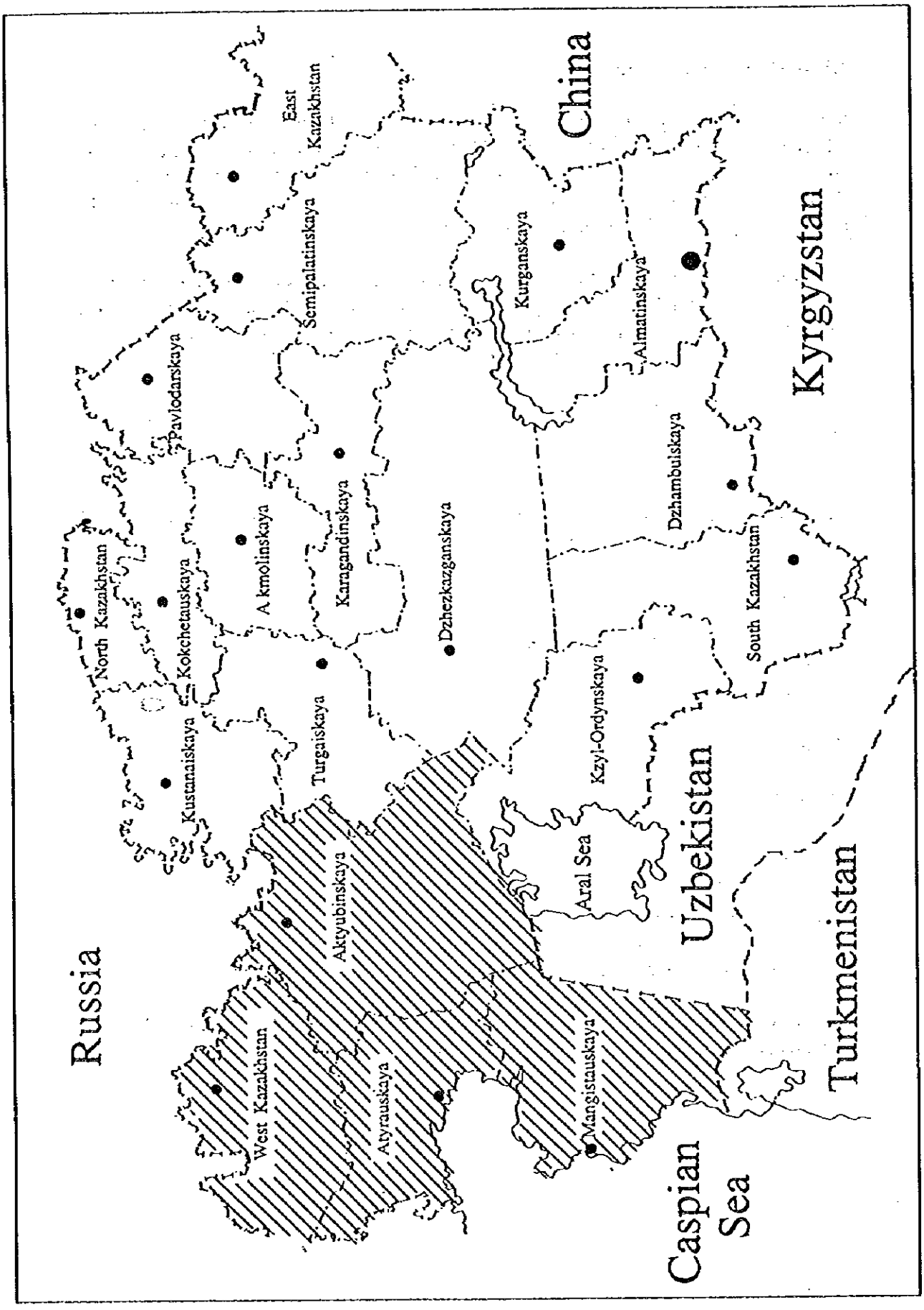
1.3 Study Area

The study area covers the following four states of the Republic of Kazakhstan.

1. Aktyubinskaya state
2. West Kazakhstan state
3. Atyrauskaya state
4. Mangistauskaya state

The above-mentioned four states have been collectively referred to as "Western Kazakhstan" in this Study and are shown in Fig. 1.3.1.

Fig. 1.3.1 : Study Area



1.4 Study Schedule and Organization

1.4.1 Study Schedule

The duration of Study is 17 months commencing from September 1995 till January 1997. The study schedule is shown in Fig. 1.4.1. Following reports were prepared in English including a Summary Report in Russian, during the course of the Study and submitted to the Government of Kazakhstan.

(1)	Inception Report	Sept. 1995
(2)	Interim Report	May, 1996
(3)	Draft Final Report and Summary	Oct. 1996
(4)	Final Report and Summary	Jan, 1997

1.4.2 Study Organization

The parties directly concerned with implementation of the Study are the Department of Roads, Ministry of Transport and Communication as counterpart agency to the Study Team, JICA, Steering Committee organized by the Government of Kazakhstan, the Advisory Committee organized by JICA, and the Study Team. The schematic organization chart for the Study is shown in Fig. 1.4.2.

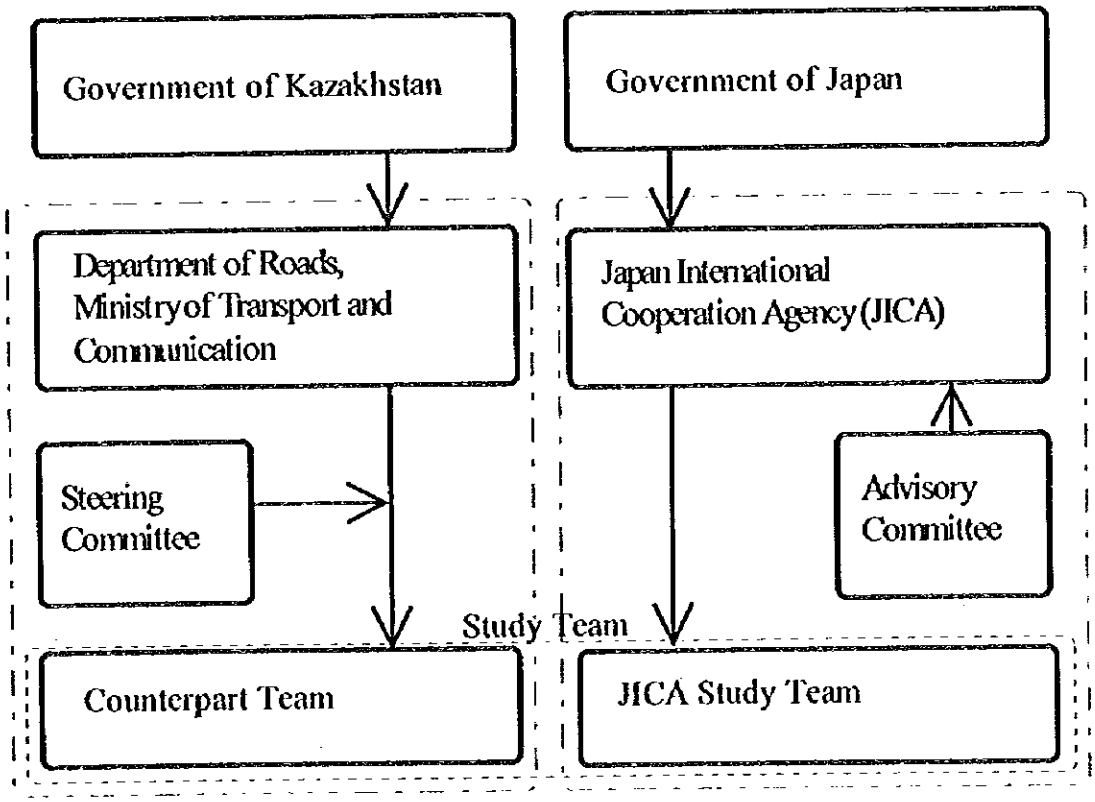


Fig. 1.4.2 : Organizational Chart for the Study

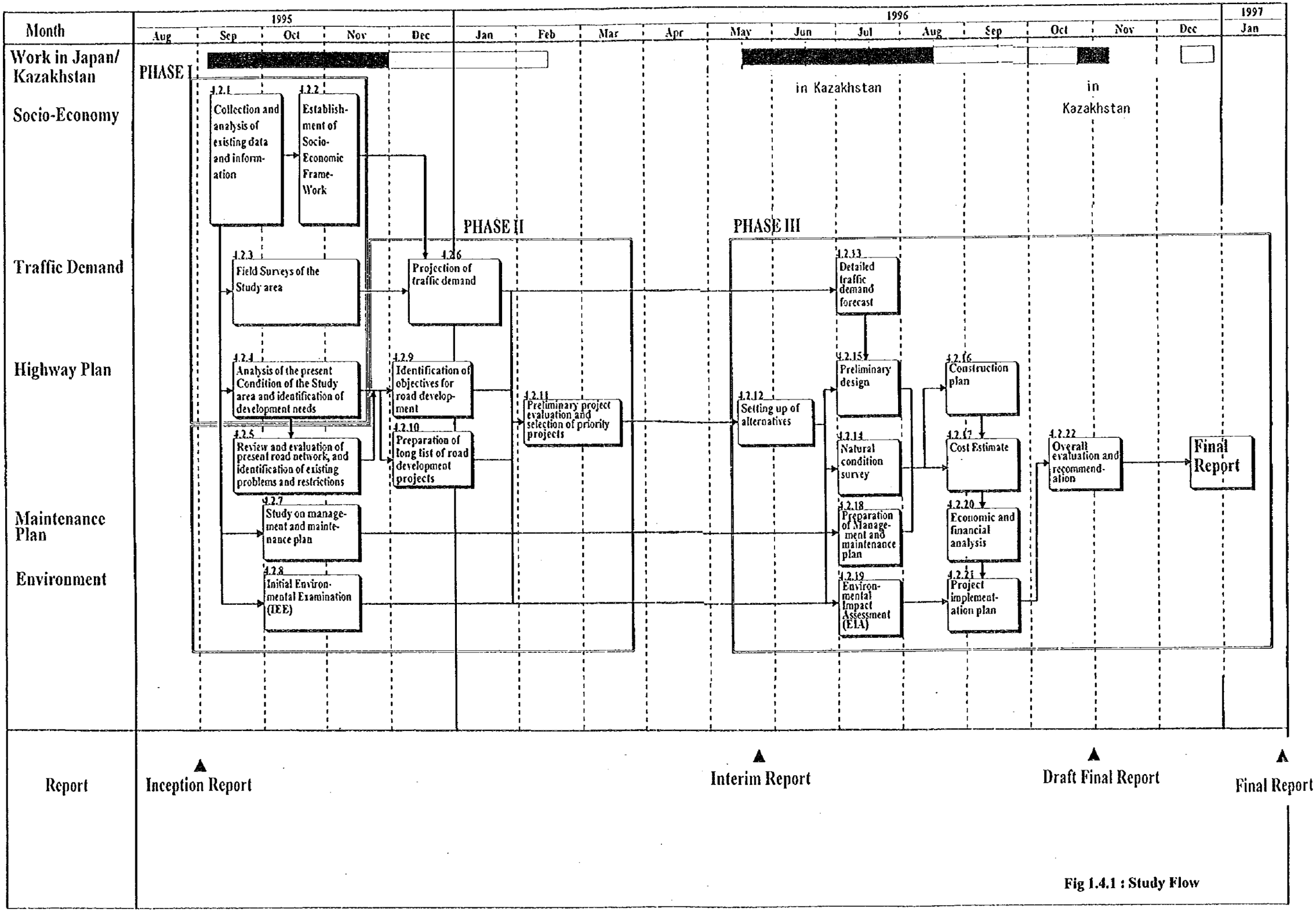


Fig 1.4.1 : Study Flow

(1) JICA Study Team Members

Dr. Akira ISHIDO	Team Leader/Highway Planner
Mr. Tetsuo KAWAMURA	Regional Development Planner
Mr. Tetsuo HORIE	Traffic Surveyor
Mr. Yoshimasa ISHII	Traffic Demand Analyst
Mr. Akihiko KITAYAMA	Highway Engineer
Mr. Yukio KOSAKA	Maintenance Planner
Dr. Ravinder KATIYAR	Economist
Mr. Kanji WATANABE	Environment Analyst
Mr. Atsushi KUMAGAMI	Structure Planner
Mr. Katsumi FUJII	Coordinator

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(2) JICA Advisory Committee Members

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Mr. Yasuo OGUCHI (Ex.)	Ministry of Construction
Mr. Takio MABASHI	Ministry of Construction

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(4) Steering Committee Members

Department of Roads, Ministry of Transport and Communication
Kazakhstan Zholdary, State Joint Stock Company
Kazdoroproject, State Joint Stock Company
Kazdornii, Joint Stock Company
Ministry of Environment
Statistic Research Committee
Representatives from Aktyubinskaya, West Kazakhstan, Atyrauskaya and Mangistauskaya state

Chapter 2 Contents of Study

2.1 Socio-Economic Conditions

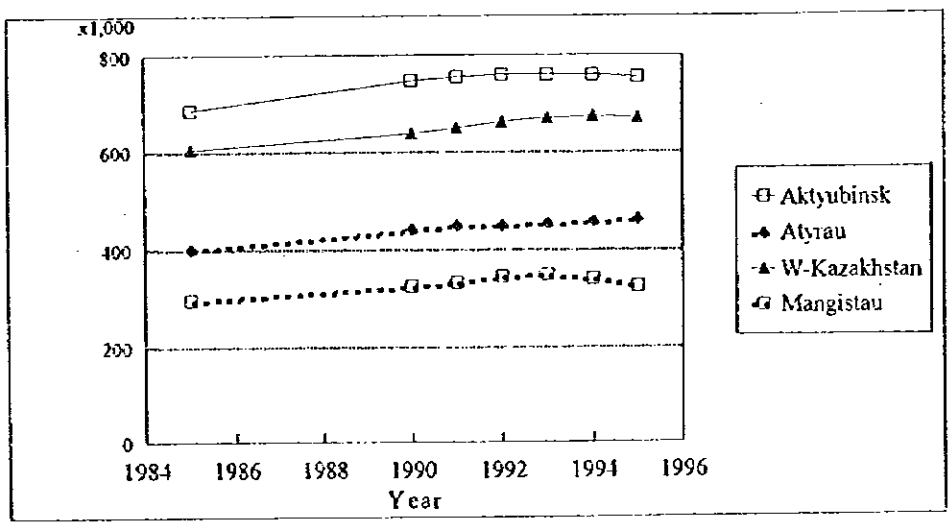
2.1.1 Population

The population and area in the four states and whole of the Kazakhstan are shown in Table 2.1.1

Table 2.1.1 : Area and Population in 1995

State	Area (km^2)	Shared area (%)	Population (x1,000)	Shared population (%)
Aktyubinskaya	300.6	11	752.8	5
Atyrauskaya	118.6	4	459.6	3
West Kazakhstan	151.3	6	669.8	4
Mangistauskaya	165.6	6	324.4	2
Four states of Western Kazakhstan	736.1	27	2,206.6	13
Whole Kazakhstan	2,724.9	100	16,679.1	100

Because of migration to FSU and other states of CIS, the population is decreasing in general. The population trend in the three states other than Atyrauskaya state turned to decrease in 1995, while that in Atyrauskaya state is increasing since 1985 at an annual rate of 0.4% (Fig. 2.1.1). The average share of urban population the four states is about 54.7% which is similar to that of the country's average at 56.0%.

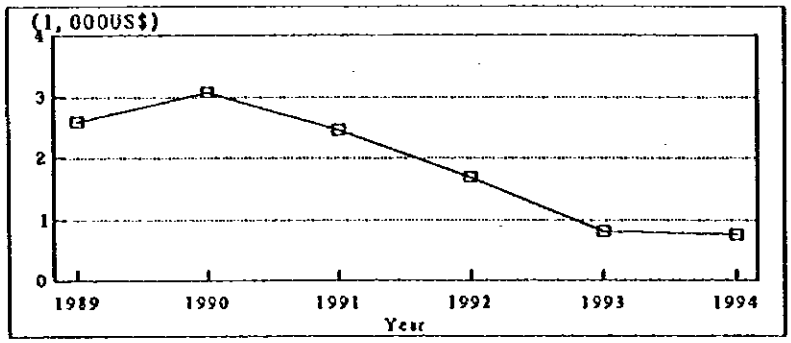


Source: 1995 Annual Statistics

Fig. 2.1.1 : Population Trend by State

2.1.2 Economy

GDP in 1994 was 449,916 million Tenge. The trend of GDP per capita in terms of US$, which recorded the highest of about 3,000 US$ in 1990 and shows sharp decrease until 1993 as shown in Figure 2.1.2. However after 1993, the national economy started to stabilize and the figure indicates the possibility of increase afterwards. GDP per capita in 1994 was about 740 US$.



Source: 1994 Annual Statistics

Fig. 2.1.2 : Trend in GDP per Capita

2.1.3 Industries

Mining including oil and natural gas is the main industry in Kazakhstan. The crude oil production recorded 23 million ton in 1993 and the total share of crude oil production in the four states of Western Kazakhstan is about 93%. The oil and natural gas fields are mainly located along the Caspian sea.

The copper production and reserve of Kazakhstan is the largest in the FSU. The annual chrome ore production in Kazakhstan is about 3.6 million ton which is about 95% of the FSU.

In the agriculture sector, the cereals yield of Western Kazakhstan was 3.02 million ton which is 14.6% of the country's yield in 1994. The live stock raising and fishery are also the main sectors of the economy.

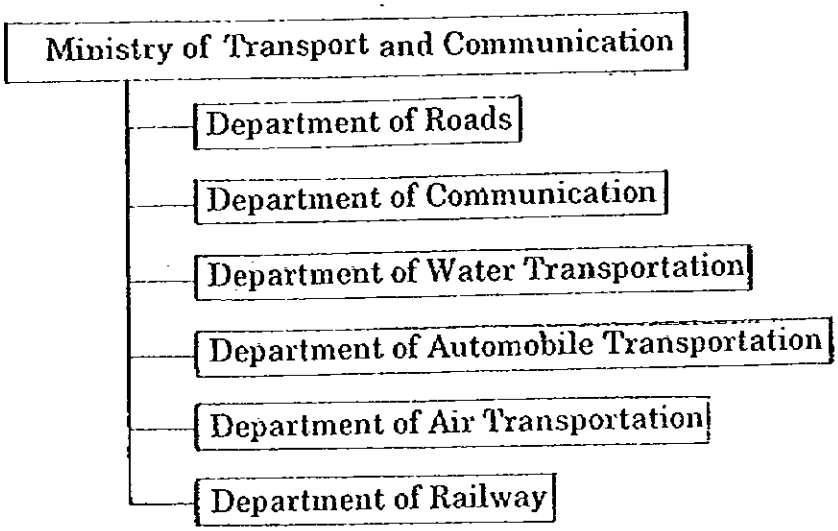
2.2 Road Administration

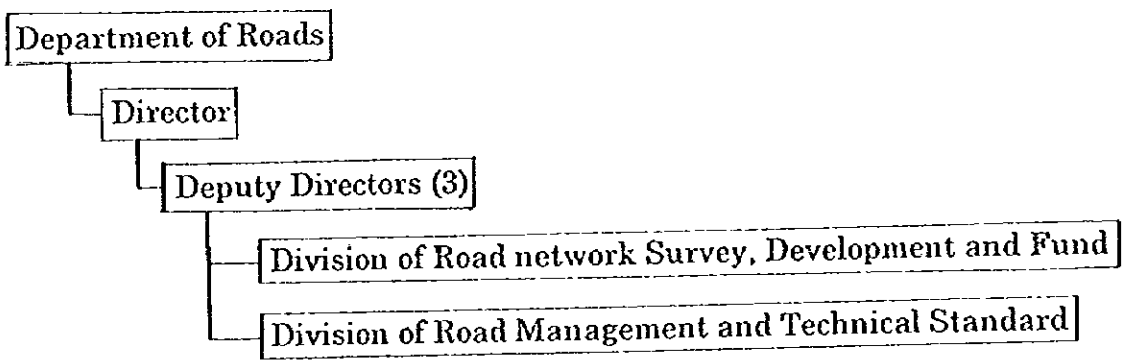
2.2.1 Road Management

All roads were controlled by the Ministry of Transportation and Construction at the beginning of independence of the Country.

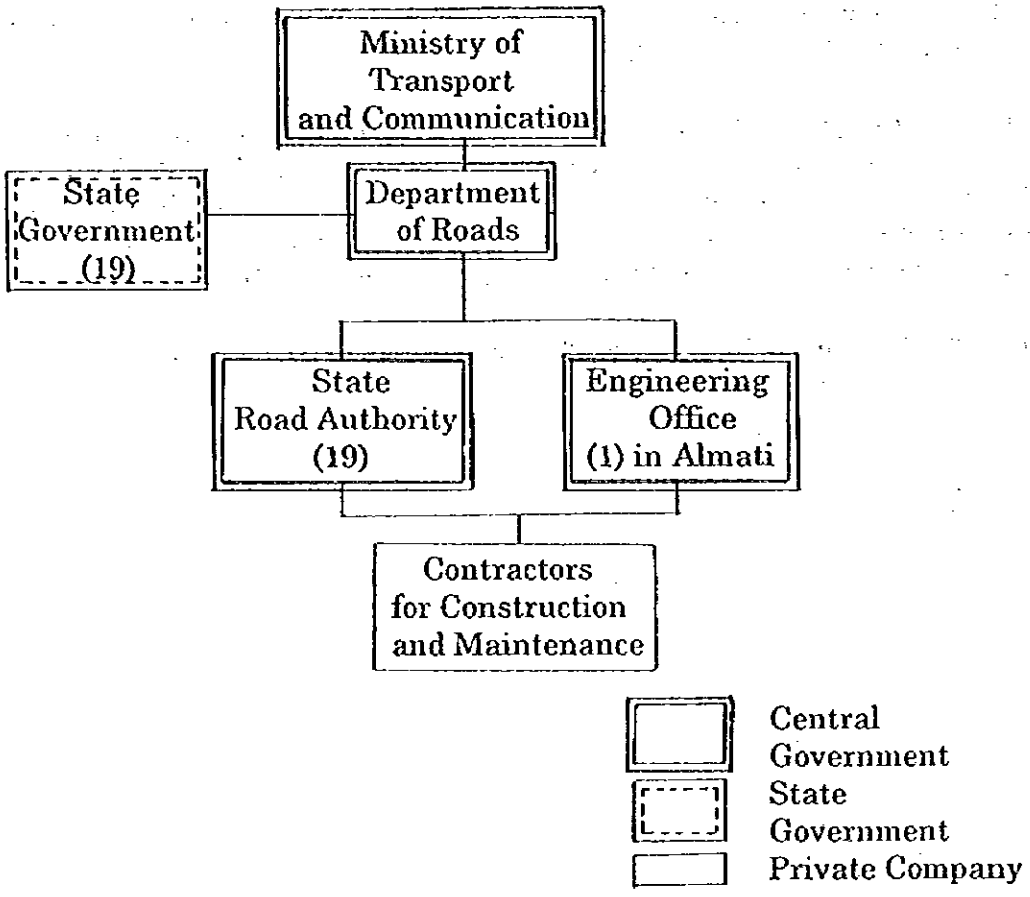
The former government organizations were privatized into various companies and, the Department of Roads has been established to manage road administration under the Ministry of Transport and Communication since 19th July 1994. The Department of Roads manages the Republican Roads and also the Local Roads in close cooperation with state governments. City Roads are managed by the State Governments.

The organization of the Department of Roads and the Ministry of Transport and Communication is shown below.





Administrative reforms were carried out on the various organizations related to transport and road sector. The relationship of various organizations after the administrative reforms is shown below.



Management and maintenance of both Republican Roads and the Local Roads belongs to the State Road Authorities with close cooperation of the State Governments. The funds for the construction and maintenance of roads comes from the Road Fund.

2.2.2 Road Network and Classification

Roads in Kazakhstan can be broadly classified as Public Roads, Service Roads and City Roads. The Public Roads are further divided as Republican Roads and Local Roads. The total road network of Kazakhstan comprises of 158,788 km of which 87,337 km is Public Roads.

The length of Republican Roads and Local Roads in Kazakhstan and the four states of Western Kazakhstan is shown in Table 2.2.1 below.

Table 2.2.1 : Public Road Length in Kazakhstan

Road Category	Road Length (km)	
	Kazakhstan	Western Kazakhstan states
Republican Road	17,670	3,721
Local Road	69,667	13,336
Total	87,337	17,057

Data Source : Department of Roads, Ministry of Transport and Communication, 1995

Table 2.2.2 shows the Public Road length by pavement type and paved ratio in Kazakhstan.

Table 2.2.2 : Public Road Length by Pavement Type and Paved Ratio

Classification of Road	Total Length (km)	Asphalt Concrete	Gravel or Crushed Stone	Earth	Paved Ratio
Republican Road	17,670.0	16,433.0	1,063.0	174.0	99.1 %
Local Road	69,667.0	39,960.0	25,027.0	4,680.0	93.3 %
Total	87,337.0	56,393.0	26,090.0	4,854.0	94.5 %

Data Source : Department of Roads, Ministry of Transport and Communication, 1995

2.2.3 Transportation

The main modes of public passenger transportation in Kazakhstan are bus and rail. In 1994, buses carried about 77% of all passengers across the country, the largest among all modes. Regarding the freight transportation, roads carried about 800 million tons or about 81.8% of total for all modes of transportation.

2.3 Formulation of Road Network in the Study Area

The existing road network in Western Kazakhstan which includes the Republican Roads, Local Roads and roads newly adopted as Asian Highway is considered as the road network for traffic demand forecast for the study. The total length of this road network is about 17,670 km. The city and service roads are not included in this road network as they do not form the main part of the road network.

There are two reasons for formulating the above mentioned road network as follows.

(1) Road capacity of the present road network mentioned above exceed both the present traffic volume and forecasted traffic volume in 2010 in any roads.

(2) Road Service Level of the present road network in terms of road length per person, registered vehicles and land extent are higher than the average of whole Kazakhstan and are not lower in comparison to other countries as shown in Table 2.3.1 and Table 2.3.2.

Table 2.3.1 : International Road Development and Service Levels for Trunk Roads

Country Name	Land Area (A) (x1,000Km²)	Population (P) (x10,000)	Road Length (L) (km)	Number of Motor Vehicles Registered (x10,000)	Road Development Ratio		Road Service Levels	
					Road Development Index	Road Density (km/km²)	km/1,000 per	km/10,000 veh
USA	9,373	24,633	6,230,000	18,347	410 0	0 66	25 29	339 57
England	244	5,708	340,000	2,467	268 1	1 39	6 05	158 18
France	552	5,587	810,000	2,534	451 2	1 47	5 96	137 82
Canada	9,970	2,730	285,532	1,761	54 7	0 03	10 46	167 9
Japan	378	12,261	1,110,000	5,245	515 6	2 94	5 22	39 96
Ma'aysia	330	1,891	63,000	553	81 7	0 19	9 05	211 63
Indonesia	1,919	16,405	230,000	254	41 0	0 12	3 50	113 9
Kazakhstan	2,725	1,694	88,000	156	41 3	0 03	5 19	554 1

Data Source 1) World Road Statistics 1994
2) Doro Gyousei (Road Bureau of Construction Department in Japan 1994)
3) Department of Roads, Ministry of Transport & Communication, 1995

Note 4) Road Development Index $D = L \sqrt{A \times P}$

Table 2.3.2 : Road Development and Sevice Levels in Western Kazakhstan

State Name	Land Area (A) (x1,000Km²) (1)	Population(P) (x10,000) (2)	Road Length (L) (km) (3)	Number of Motor Vehicles Registered (x10,000) (4)	Road Development Ratio		Road Service Levels	
					Road Development Index	Road Desity (km/km²)	km/1,000 per	km/10,000 veh
Atyrauskaya	118 6	45 77	2,587 0	4 11	42 0	0 03	6 27	753 5
West Kazakhstan	151 3	67 43	5,384 0	5 89	53 3	0 04	7 98	914 7
Aktyubinskaya	300 6	76 02	6,143 0	4 92	49 6	0 02	8 08	1249 8
Mangistauskaya	165 6	33 85	2,543 0	2 81	34 5	0 02	7 64	919 1
Total	736 1	223 07	17,657 0	17 73	42 5	0 02	7 71	970 7

Data Source : 1) (1), (2), (4) - - - Westen Kazakhstan an Regional Annual Statics, 1994
2) (3) — Department of highways, Ministry of Transport & Communication, 1995

Note : 1) Road Development Index $D = L/\sqrt{A \times P}$

2.4 Selection of Priority Sections

The Republican Roads with some part of Asian Highways form the trunk road network in Western Kazakhstan and has a total length of 4010 km. The process of selection of priority projects is as follows.

(1) Formulation of road network for feasibility study (total length 4010 km) and division of this road network into 33 road sections: Long-List projects (Figure 2.4.1)

(2) Selection of road-sections as priority projects

The existing road characteristics of long-list projects is shown in Table 2.4.1 and also Fig. 2.4.2 and Fig. 2.4.3.

The selection of road sections as priority projects is based on the following criteria.

(1) Benefit - Cost Ratio (B/C)
(2) Traffic Growth Ratio
(3) Improvement Cost per km of the Road Section
(4) Total Length of Priority Projects

Based on the above-mentioned selection criteria, the following three road sections were selected as priority projects for the feasibility study (refer Table 2.4.2).

a) Kzyl-Orda Border to Irgiz (Road section No. 1)
b) Irgiz to Karabutak (Road section No. 2)
c) Atyrau to Mahambet (Road section No. 18)

These selected priority projects (road sections) are shown in Fig. 2.4.4.

During the feasibility study, based on actual field surveys, the length of the selected road sections was revised as follows;

a) Kzyl-Orda Border to Irgiz (Road section No. 1 = 86 km)
b) Irgiz to Karabutak (Road section No. 2 = 189 km)
c) Atyrau to Mahambet (Road section No. 18 = 83 km)

Thus the total length of the selected road sections comes to 358 km.

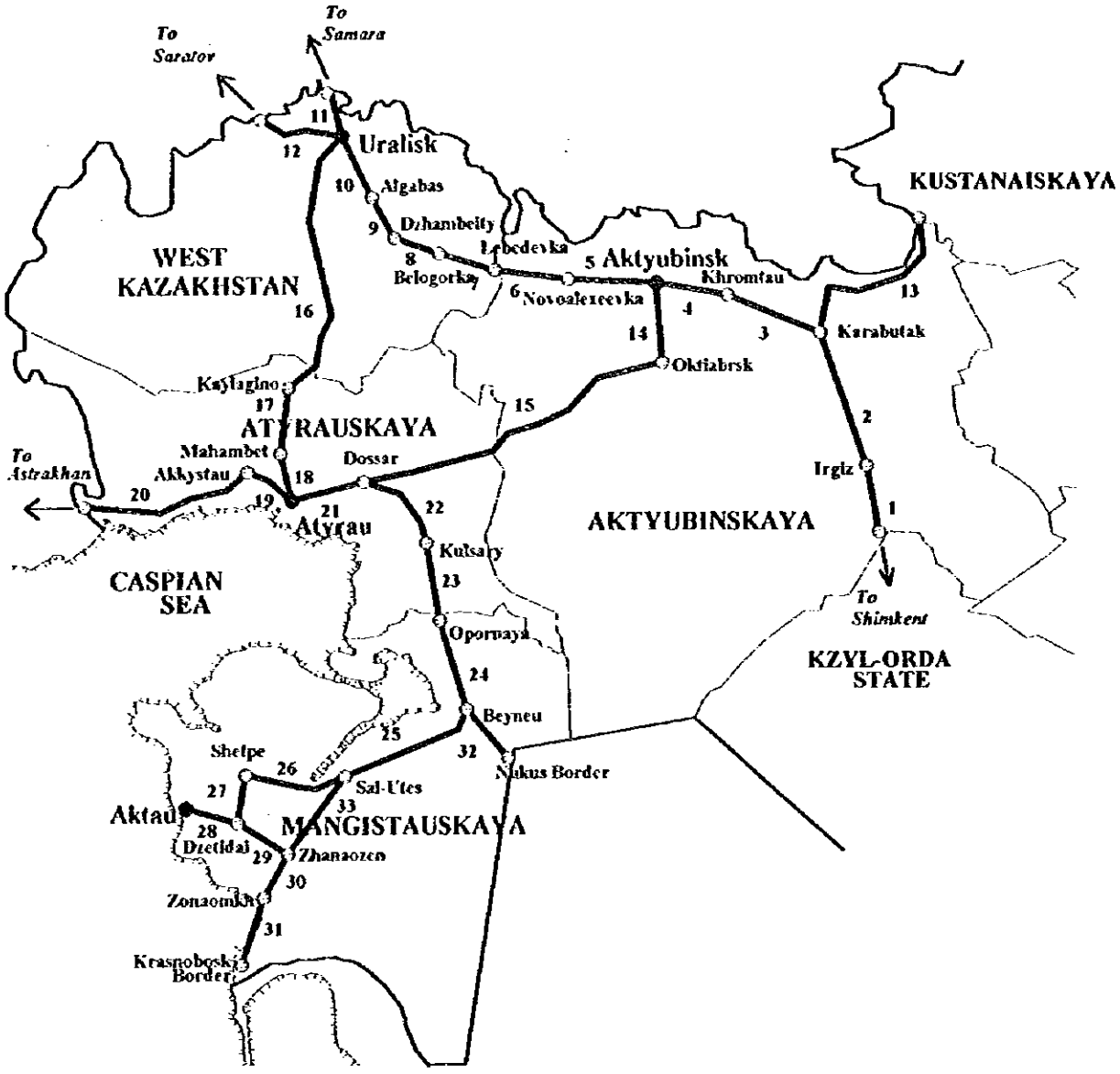


Fig. 2.4.1 : Location of Long-List Projects

Table 2.4.1 : Existing Road Characteristics of Long-List Projects

No.	Road Section	Length (km)	(1) Type of Pavement	(2) Road Surface Condition	(3) Type of Highway
1	Kzyl-Orda Border - Irgiz	80	G	VP	IH
2	Irgiz - Karabutak	195	AC	VP	IH
3	Karabutak - Khromtau	124	AC	VP	IH
4	Khromtau - Aktyubinsk	98	AC	P	IH
5	Aktyubinsk - Novoalexeevka	114	AC	F	IH
6	Novoalexeevka - Lebedevka	142	AC	F	IH
7	Lebedevka - Belogorka	25	E	VP	IH
8	Belogorka - Dzhambeity	54	AC	VP	IH
9	Dzhambeity - Algabas	71	AC	P	IH
10	Algabas - Uralsk	68	AC	F	IH
11	Uralsk - Samara Border	50	AC	F	IH
12	Uralsk - Saratov Border	100	AC	F	NH
13	Karabutak - Kustanaiskaya B.	250	AC	VP	NH
14	Aktyubinsk - Oktiabrsk	85	AC	F	NH
15	Oktiabrsk - Dossor	417	AC	F	NH
16	Uralsk - Kaylagino	386	AC	F	IH
17	Kaylagino - Mahambet	50	AC	P	IH
18	Mahambet - Atyrau	70	AC	VP	IH
19	Atyrau - Akkystau	60	AC	P	IH
20	Akkystau - Astrakhan B.	232	AC	P	IH
21	Atyrau - Dossor	92	AC	P	IH
22	Dossar - Kulsary	118	AC	P	IH
23	Kulsary - Opornaya	104	E	VP	IH
24	Opornaya - Beyneu	122	E	VP	IH
25	Beyneu - Sai-Utes	181	G	VP	IH
26	Sai-Utes - Shetpe	120	G	VP	NH
27	Shetpe - Dzetidai	85	AC	F	NH
28	Dzetidai - Aktau	82	AC	P	NH
29	Dzetidai - Zhanaozen	69	AC	F	LR
30	Zhanaozen - Zonaomkh	60	AC	P	IH
31	Zonaomkh - Krasnobosk B.	100	G	VP	IH
32	Beyneu - Nukus Border	84	E	VP	IH
33	Sai-Utes - Zhanaozen	122	E	VP	IH
Total Length		**4010**			

(1) Type of Pavement; AC = Asphalt Concrete/ Asphalt Treatment; G = Gravel; E = Earth

(2) Road Surface Condition; G = Good; F = Fair; P = Poor; VP = Very Poor

(3) Type of Highway; IH = International Highway; NH = Republican Road; LR = Local Road

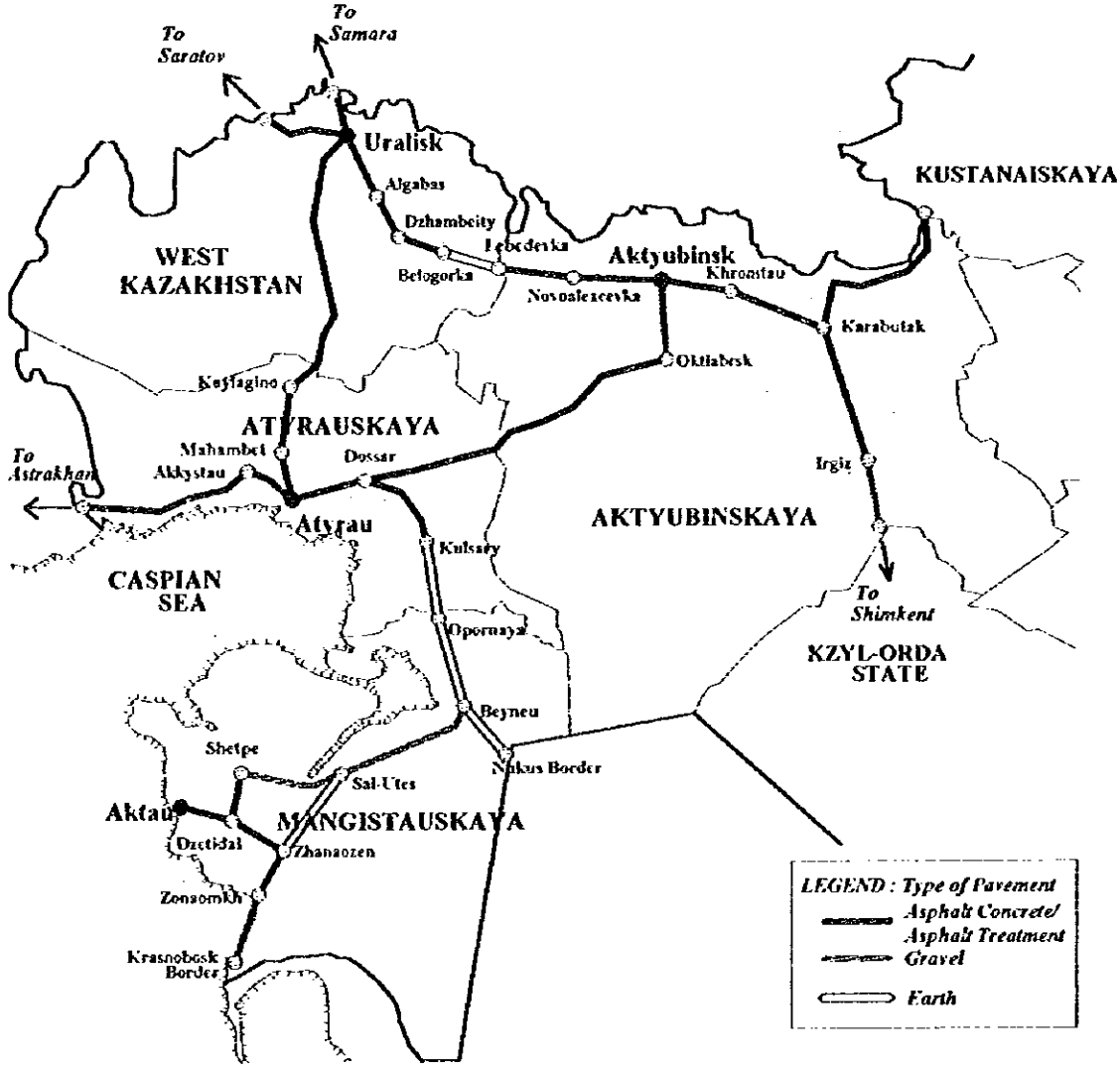


Fig. 2.4.2 : Long-List Projects by Type of Pavement

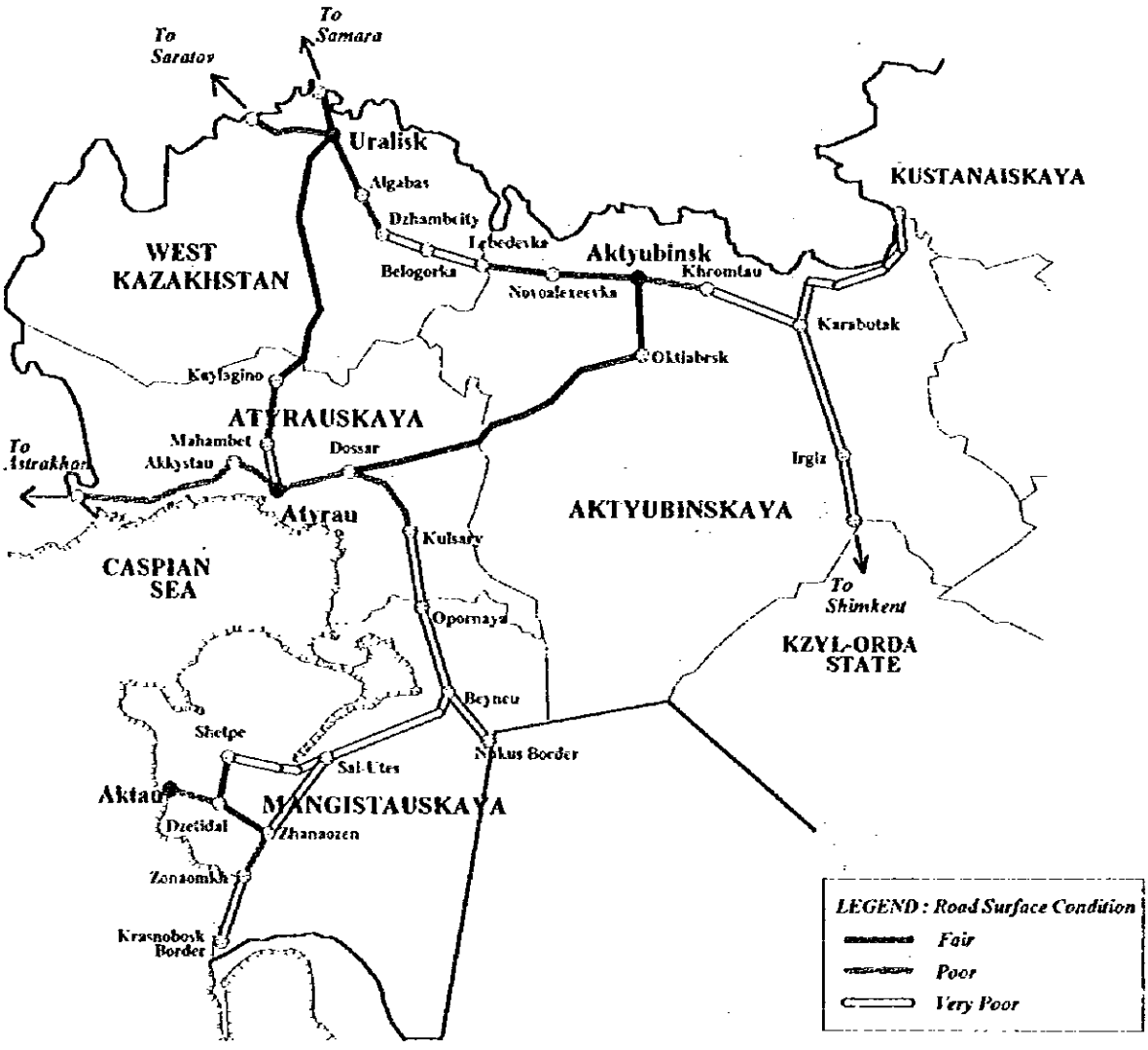


Fig. 2.4.3 : Long-List Projects by Road Surface Condition

Table 2.4.2 : Selection of Priority Projects

No.	Road Section	Length (km)	Cost (Mill. US$)	Preliminary Selection and Evaluation Criteria				Final Selection		
				B/C > 1	Traffic Growth Ratio > 2.0 Over 2010/1995	Imp.Cost per km >0.1M.US$	Preliminary Selected Projects	B/C	B/C Ranking	Finally Selected Projects
1	Kzyl-Orda Border - Irgiz	80	10.97	O	O	O	O	2.02	2	O
2	Irgiz - Karabutak	195	33.21	O	O	O	O	1.94	3	O
3	Karabutak - Khromtau	124	21.12	O	O	O	O	1.52	4	
4	Khromtau - Aktyubinsk	98	15.47		O	O				
5	Aktyubinsk - Novoalexeevka	114	6.75	O	O					
6	Novoalexeevka - Lebedevka	142	31.00		O	O				
7	Lebedevka - Belogorka	25	8.73		O	O				
8	Belogorka - Ozhambelty	54	18.86		O	O				
9	Ozhambelty - Algabas	71	15.64		O	O				
10	Algabas - Uralsk	68	4.03	O	O					
11	Uralsk - Samara Border	50	10.92		O	O				
12	Uralsk - Saratov Border	100	21.83			O				
13	Karabutak - Kustanaiskaya B.	250	87.33	O		O				
14	Aktyubinsk - Oktiabrsk	85	5.03	O						
15	Oktiabrsk - Dossor	417	24.69	O	O					
16	Uralsk - Kaylagino	386	22.85	O						
17	Kaylagino - Mahambet	50	30.00		O	O				
18	Mahambet - Atyrau	70	7.77	O	O	O	O	2.55	1	O
19	Atyrau - Akkystau	60	35.98			O				
20	Akkystau - Astrakhan B.	232	25.75			O				
21	Atyrau - Dossor	92	34.66		O	O				
22	Dossar - Kulsary	118	14.64	O	O	O	O	1.08	5	
23	Kulsary - Opornaya	104	17.71			O				
24	Opornaya - Beyneu	122	42.61			O				
25	Beyneu - Sal-Utes	181	57.20			O				
26	Sal-Utes - Shetpe	120	16.46			O				
27	Shetpe - Ozetidal	85	5.03							
28	Ozetidal - Aktau	82	9.10			O				
29	Ozetidal - Zhanaozen	69	4.08							
30	Zhanaozen - Zonaomkh	60	6.66			O				
31	Zonaomkh - Krasnobosk B.	100	13.72			O				
32	Beyneu - Nukus Border	84	54.48			O				
33	Sal-Utes - Zhanaozen	122	79.13			O				
	TOTAL LENGTH (in km)	4010	-				587			345
	TOTAL COST (in mill. US$)	-	793.41				87.7			51.95

The length of the selected priority projects is revised for the feasibility study and is as follows;

No. 1 : 86 km
No. 2 : 189 km
No. 18 : 83 km
Total : 358 km

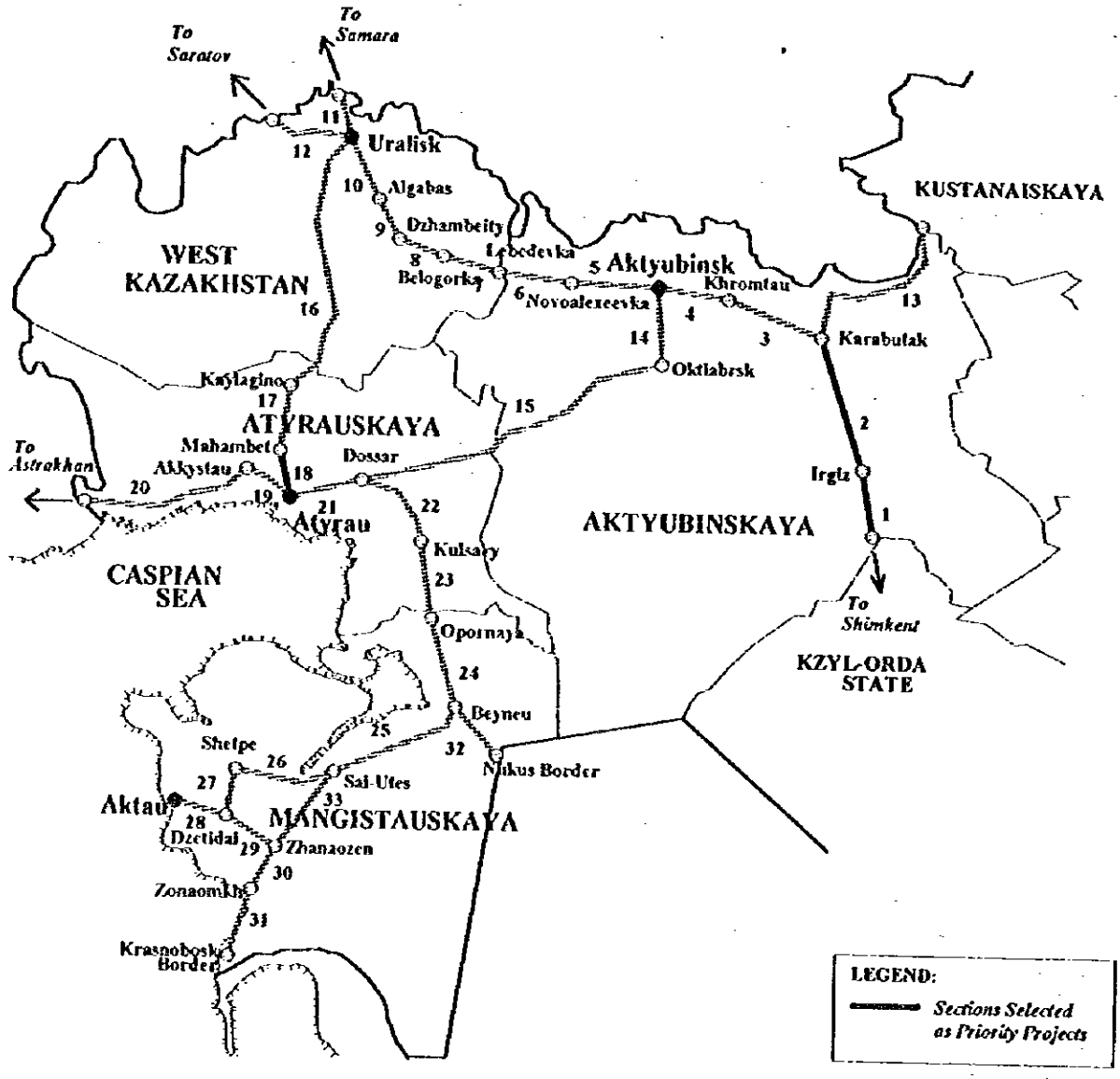


Fig. 2.4.4 : Selected Priority Projects for Feasibility Study

2.5 Traffic Studies

2.5.1 Traffic Survey

Traffic volume survey was carried out at 20 locations in Western Kazakhstan to assess the passenger and truck movements in the area and for the purpose of traffic studies. In addition to traffic count survey, O-D survey was also carried out. The location of the 20 survey points is shown in Figure 2.5.1.

This survey was carried out between 9th October (Monday), 1995 and 12th October (Thursday) for 12 hours from 08:00 to 20:00. As part of the survey, the vehicle type, its origin, its destination, purpose and type of load carried (for freight vehicles) was recorded.

The results of the traffic volume survey is shown in the below in Table 2.5.1 and the location of traffic survey stations is shown in Fig. 2.5.1.

Table 2.5.1 : Results of Traffic Volume Count Survey (Oct. 1995)

Location	Traffic Volume (veh/12h)						
NO.	Motor-cycle	Passenger car	pick-up	Bus	2 axle Truck	H.Truck	Total
1	1	51	2	7	33	24	118
2	3	122	8	12	37	72	254
3	0	153	21	7	90	85	356
4	17	165	5	15	26	35	263
5	5	158	3	27	70	107	370
6	9	84	39	16	73	15	236
7	4	124	16	11	44	52	251
8	0	70	2	9	55	21	157
9	0	52	2	6	41	0	101
10	0	209	24	29	224	38	524
11	0	91	0	17	87	27	222
12	0	67	1	11	73	18	170
13	0	163	7	11	162	57	400
14	0	124	4	41	123	20	312
15	0	119	0	33	78	138	368
16	32	175	63	25	145	173	613
17	10	186	48	29	147	198	618
18	31	216	60	35	190	256	788
19	2	113	50	1	113	185	464
20	0	189	79	6	128	305	707

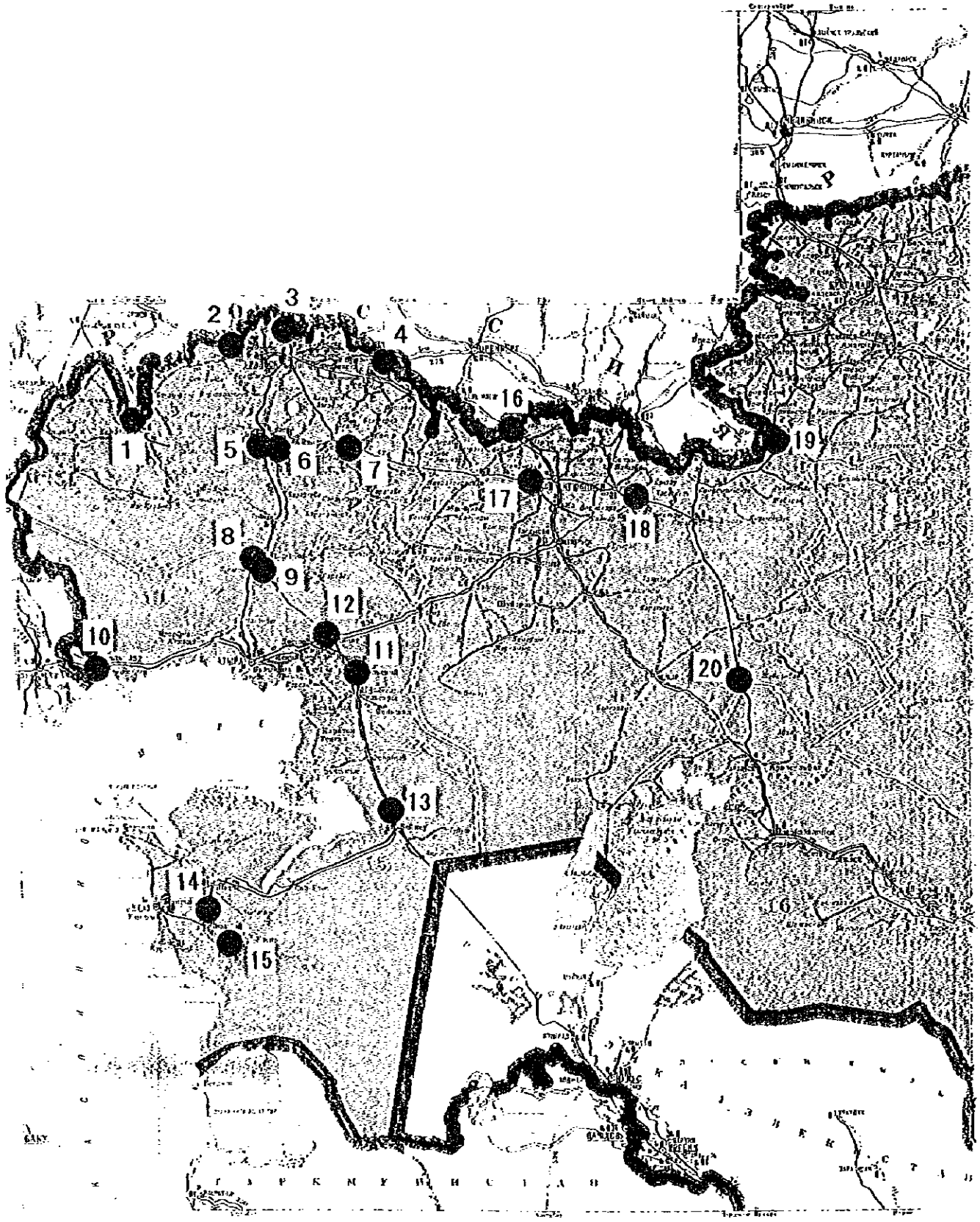


Fig. 2.5.1 : Location of Survey Stations

2.5.2 Traffic Demand Forecast

The traffic forecast was carried out using the vehicle generation/attraction sub-model and the traffic assignment sub-model. The procedure of the traffic demand forecast is shown in the below in figure 2.5.2.

The assigned traffic volume for the "Do Nothing" case (i.e. none of the road sections is improved) and the "Do Maximum" case (i.e. all the road sections of the long-list projects are improved) for the year 2010 is shown in Fig. 2.5.3 and Fig. 2.5.4.

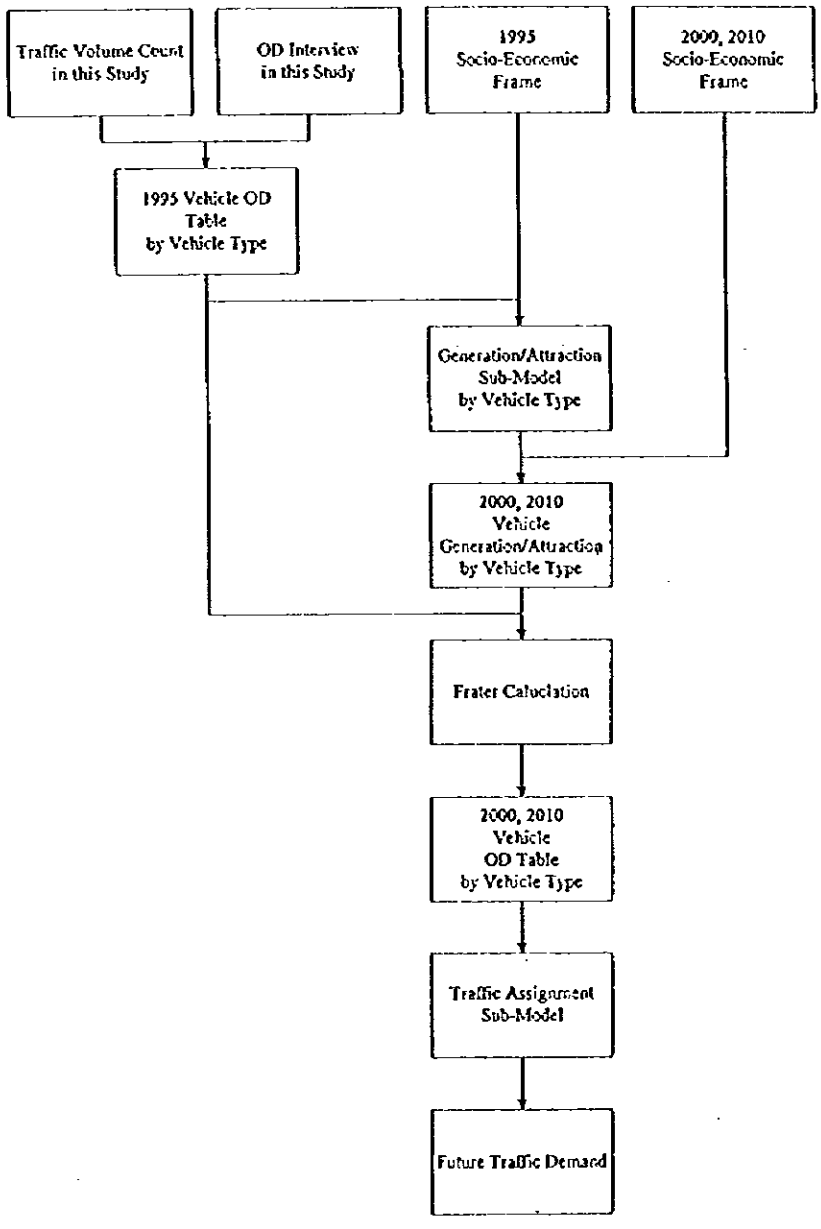


Fig. 2.5.2 : Procedure of Traffic Demand Forecast

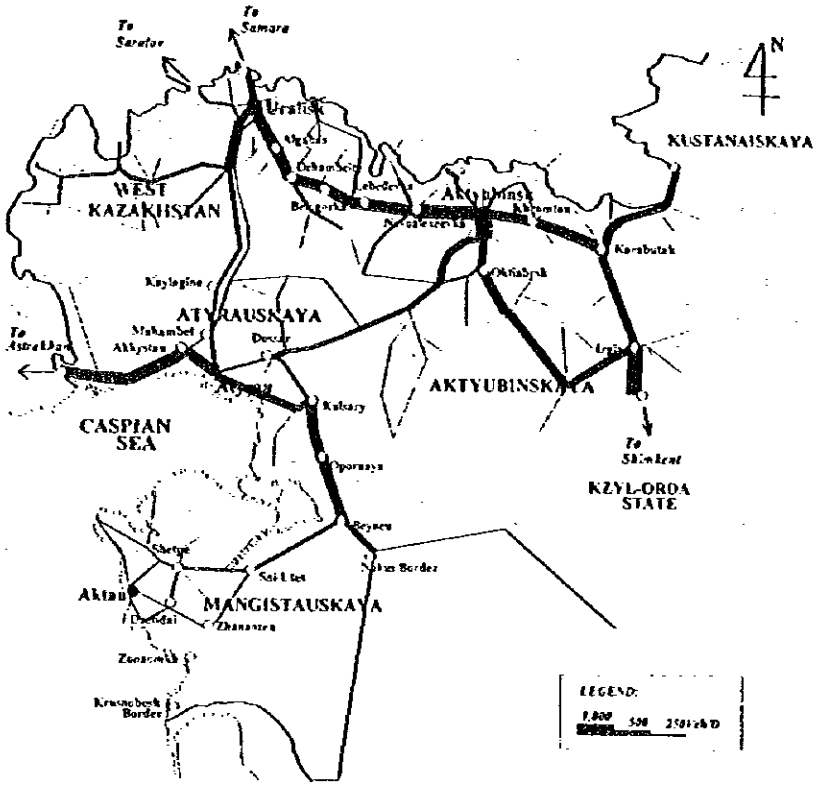


Fig. 2.5.3 : Assigned Traffic Volume for Do Nothing Case for Year 2010 (When none of the road sections is improved)

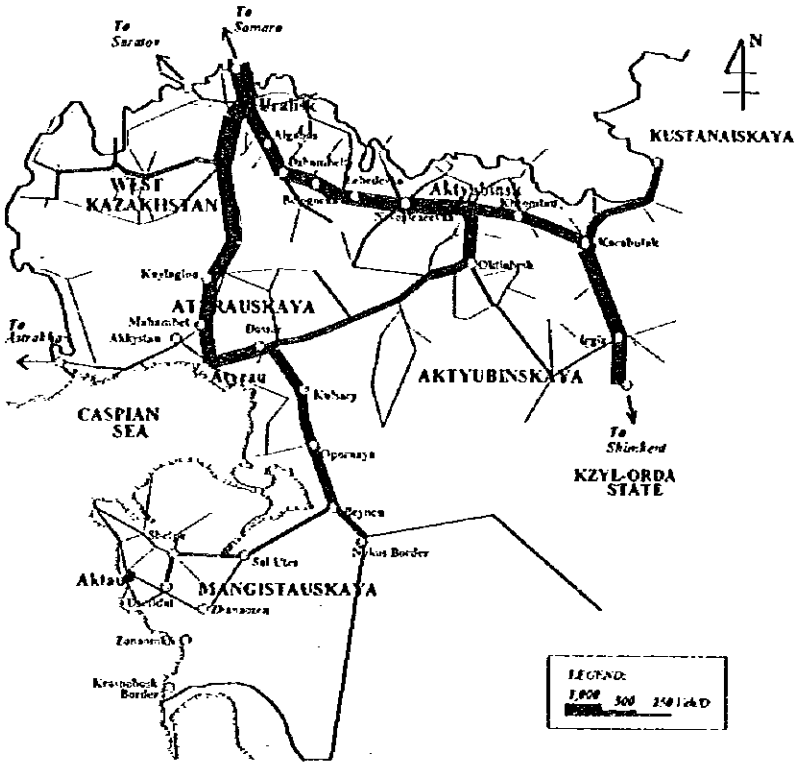


Fig. 2.5.4 : Assigned Traffic Volume for Do Maximum Case for Year 2010 (When all the 33 road sections are improved)

As per the traffic survey carried out in October 1995, the traffic volume at point no. 8 (near Inder), point no. 20 (near Kzyl-Orda state border) and point no. 18 (near Khromtau) is 157, 707 and 788 vehicles per day respectively. However, these traffic volumes cannot be treated as the representative volumes for the priority projects because the survey points are located away from the priority projects, and also in case of Atyrau-Mahambet section the intra-city traffic of Atyrau city is not included. In order to estimate the representative traffic volumes for the priority projects for the base year 1995, traffic assignment was carried out to take account of the above problems. As a result of this assignment, the traffic volumes for the base year 1995 comes to 707, 639 and 714 vehicles per day for priority project no. 1, 2 and 18 respectively as shown in Table 2.5.2 below. This Table also shows the forecasted traffic volumes for the for the year 2000, 2010, 2013 and 2018.

Table 2.5.2 : Assigned Traffic Volume for the Priority Projects

(Unit:Vehicle/Day)

Link No.	Year	P. Car	Bus	L. Truck	H. Truck	Total
1	1995	211	13	206	277	707
	2000	232	14	227	305	778
	2010	366	23	365	482	1236
	2013	421	26	420	553	1420
	2018	531	32	529	698	1790
2	1995	190	14	179	256	639
	2000	213	16	201	286	716
	2010	364	27	357	464	1212
	2013	427	31	419	543	1420
	2018	556	41	545	706	1848
18	1995	310	152	191	61	714
	2000	721	352	442	141	1656
	2010	1116	544	687	220	2567
	2013	1273	620	784	251	2928
	2018	1585	772	976	312	3645

For traffic forecasting, the following three socio-economic characteristics were used.

1. Population
2. GRDP
3. Number of registered vehicles

The present (i.e. year 1995) and the future (i.e. year 2000 and 2010) values for these socio-economic characteristics was estimated for all the zones. The future values were estimated based on past trend and future development scenario.

The traffic generation/ attraction sub-model by vehicle type was formulated and calibrated based on the present traffic generation/ attraction and socio-economic data. The future traffic was estimated using this sub-model and the future values of the socio-economic data for each zone. The traffic O-D was calculated by Fratar's method. The traffic O-D was assigned to routes having the minimum travel time.

2.6 Road Design Standards

Standards for the road design which were developed in the Former Soviet Union are still in force in the Republic of Kazakhstan, such as the Road Construction Standard 2.05, 02-85 (State Committee of USSR, 1986) and Instructions for Flexible Pavement Design (USSR, Ministry of Transportation/Construction, 1985) etc. The design standards include a wide range of norms for roads, bridges and tunnels.

2.6.1 Geometric Design Standards

In the road design standards of the Republic of Kazakhstan, the roads are classified into five categories according to traffic volume, economic and administrative significance and others. The geometric standards for each road category are summarized in Table 2.6.1 below.

Table 2.6.1 : Road Categories and Geometric Standards in Kazakhstan

Road Category	Traffic volumes		Economic and administrative significance of roads	Design speed (km/h)			No. of lanes	Lane width (m)	Shoulder width (m)
	Pcu	Vehicle		Flat	Rolling	Mountainous			
Ia	> 14,000	> 7,000	Movement between states	150	120	80	4,6 or 8	3.75	3.75
Ib	> 14,000	> 7,000	"	120	100	60	4,6 or 8	3.75	3.75
II	6,000 - 14,000	3,000 - 7,000	"	120	100	60	2	3.75	3.75
III	2,000 - 6,000	1,000 - 3,000	Movement between states within state	100	80	50	2	3.50	2 50
IV	200 - 2,000	100 - 1,000	Movement between major regional cities and local cities	80	60	40	2	3.00	2.00
V	< 200	< 100	Movement between local cities	60 0	40	30	1	-	1.75

Source : Road Construction Standard 2.05, 02-85, State Committee of USSR, 1986

2.6.2 Pavement Design Standard

The design approach used for pavement in Kazakhstan is essentially based on the theory of flexible pavement developed before World War II. Later, this theory was substantially modified after its assumptions of elastic pavement deformation were contradicted by large-scale road experiments, the prominent AASHO (American Association of the State Highway Officials) tests (now AASHTO).

In Kazakhstan, existing pavement types and their scope of application are divided into four basic categories as indicated in Table 2.6.2. For each pavement category, a combination of layer compositions and thickness is selected, based on traffic requirement, economic and administrative significance, local conditions and availability of materials.

Pavement structure is, at present, designed by using a standard axle load of 10 tonnes, which is similar to the AASHTO standard; however, most of roads were designed using a standard axle load of 6 tonnes.

Table 2.6.2 : Categories of Existing Pavement Types

Types of pavement	Main kinds of Surface Course	Categories of Roads
High	• Cement concrete or asphalt concrete	• I ~ IV
Semi - high	• Asphalt concrete • Crushed rock, gravel and sand treated with binder	• III and IV • At 1st stage of two stage road construction of Category II
Intermediate	• Crushed rock and gravel • Soil and local low strength rock materials treated with binder	• IV and V • At 1st stage of two stage road construction of Category III
Lowest	• Ground reinforced or improved with admixtures	• V • At 1st stage of two stage road construction of Category IV

Data Source : Road Construction Standard 2.05, 02-85, state Committee of USSR, 1986