2.7 Road and Bridge Improvement

2.7.1 Road Improvement

The road sections in this study are designed based on the following criteria.

Road Category :	Category III (as per Kazakhstan Standards)
Road Width :	7m + 2@2.5m (total 12m road width)
Design Axle Load :	10 ton

The road category III was selected based on the traffic forecasts for the year 2018 (i.e. 20 years after the design year), which was about 1,848 vpd (3,983 pcu) for the Karabutak road section and 3,645 vpd (5,907 pcu) for the Atyrau road section.

The pavement design was based on both AASHO design method and FSU (Former Soviet Union) design standards and, the traffic volume for the year 2013 (i.e. 15 years after the design year), was used as the basis for pavement design.

The pavement thickness was designed on the basis of the design CBR of the subgrade and the number of 10 ton equivalent axle load applications in one direction over ten years.

The existing pavement appears to be heavily damaged, and should be reconstructed after removed of the asphalt layer. In this Study, the following four types of pavement improvement method have been considered (i.e. from Improvement Type I to Improvement type IV).

Improvement Type I : The sections with average embankment height of less than 1.0m are inadequate for frost heave protection, so it is necessary to fill-up the embankment approximately 0.5m more. Type I consists basically of filling-up the embankment and new pavement construction. For the pavement structure calculation, Type I is adopted for the sections of which CBR value of the subgrade is 6, and of which accumulative equivalent standard 10 ton axle load/lane(AEAL) is $101.38*10^4$. The pavement structure consists of four layers : dense-graded asphalt concrete 4cm, open-graded asphalt concrete 6cm, crushed stone base course 15cm and sand/gravel subbase course 25cm (Fig. 2.7.1).

Improvement Type II : The sections with average carriageway width of less than 7.0m do not meet Category III road standard, so it is necessary to widen the carriageway. Improvement Type II is to widen the carriageway, to remove the existing black stone asphalt layer and to construct new pavement. For the pavement structure calculation, Type II is adopted for the sections of which CBR value of the subgrade is 6, and of which Accumulative equivalent standard 10 ton axle load/lane(AEAL) is $89.5*10^4$. The pavement structure consists of four layers : dense-graded asphalt concrete 4cm, open-graded asphalt concrete 6cm, crushed stone base course 15cm and sand/gravel subbase course 25cm (Fig. 2.7.2).

Improvement Type III : Type III is to construct new pavement after removal of the existing asphalt layer, and is divided into 2 sub-types (Type III-1 and Type III-2). For the pavement structure calculation, Type III-1 and Type III-2 is adopted for the sections of which accumulative equivalent standard 10 ton axle load/lane(AEAL) is $101*10^4$, Type III-1 is adopted for the sections of which CBR value of the subgrade is more than 10, and Type III-2 is adopted for the sections of which CBR value is between 9 and 5. The former's structure consists of 4cm of dense-graded asphalt concrete, 6cm of open-graded asphalt concrete, 15cm of crushed stone base course and 20cm of sand/gravel subbase course, and the later's structure consists of 4cm of dense-graded asphalt concrete, 6cm of open-graded asphalt concrete, 15cm of crushed stone base course and 25cm of sand/gravel subbase course (Fig. 2.7.3 and Fig.2.7.4).

Improvement Type IV : In some sections, having usable existing subbase, Type IV which is to construct new pavement instead of existing black stones and to thicken the existing subbase is adopted. For the pavement structure calculation, Type IV is adopted for the sections of which CBR value of the subgrade is 6, and of which accumulative equivalent standard 10 ton axle load/lane(AEAL) is $101.4*10^4$. The pavement structure consists of 4cm of dense-graded asphalt concrete, 6cm of open-graded asphalt concrete, 15cm of crushed stone base course and 15cm of sand/gravel subbase course (Fig. 2.7.5).

The Improvement Types for each sub-section of the the priority projects is shown below in Table 2.7.1. The Improvement Types I~IV are illustrated in Fig. 2.7.1 to Fig. 2.7.5.

Table 2.7.1 : Road Improvement by Type of Improvement for Priority Projects

Sub-section (km)	Improvement Types	Subsection (km)	Improvement Types
Karabutak ~ Kzyl Order Border Road Section			
965-971	III-1	1152-1155	III-1
972-977	I	1156-1162	I
978-1069	I	1163-1166	III
1070-1075	III-1	1167-1178	I
1076-1088	I	1179-1181	III-1
1089-1103	III-1	1182-1190	I
1104-1117	I	1191-1225	III-2
1118-1126	III-1	1226-1229	IV
1127-1131	I	1230-1232	III-1
1132-1136	III-1	1233-1240	IV
1137-1151	I	-	-
Atyrau~Mahambet Road Section			
1-71	I	72-83	II

Data Source : JICA Study, 1996

In order to prevent flooding of road along the Atyrau - Mahambet road, box culverts [3 x (2m x 1.5m)] are provided at appropriate locations to allow drainage of flood water. Also, the embankment height has been raised suitably at the flood prone sections.

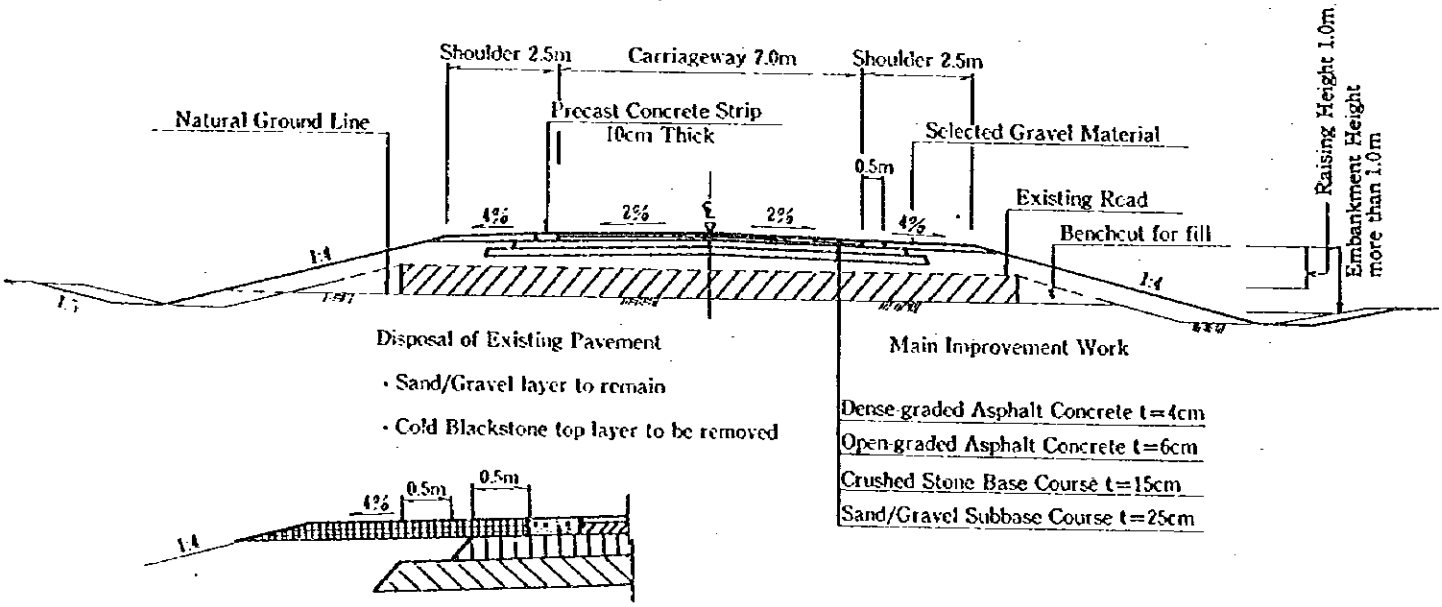


Fig. 2.7.1 : Cross-Section of Road for Type-I Improvement

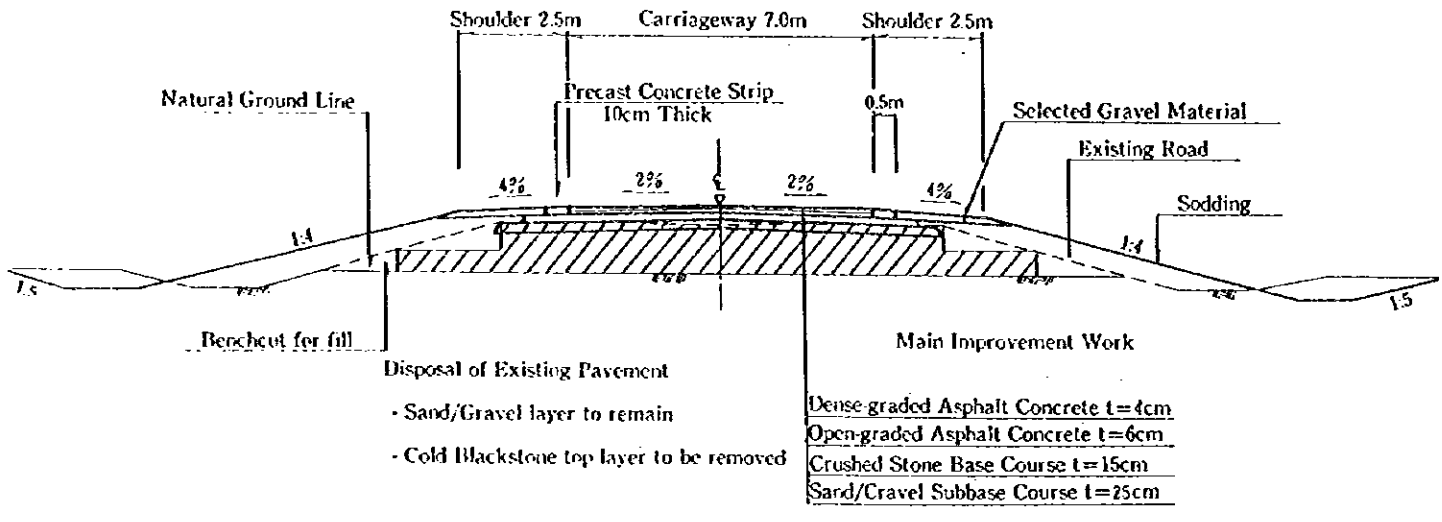


Fig. 2.7.2 : Cross-Section of Road for Type-II Improvement

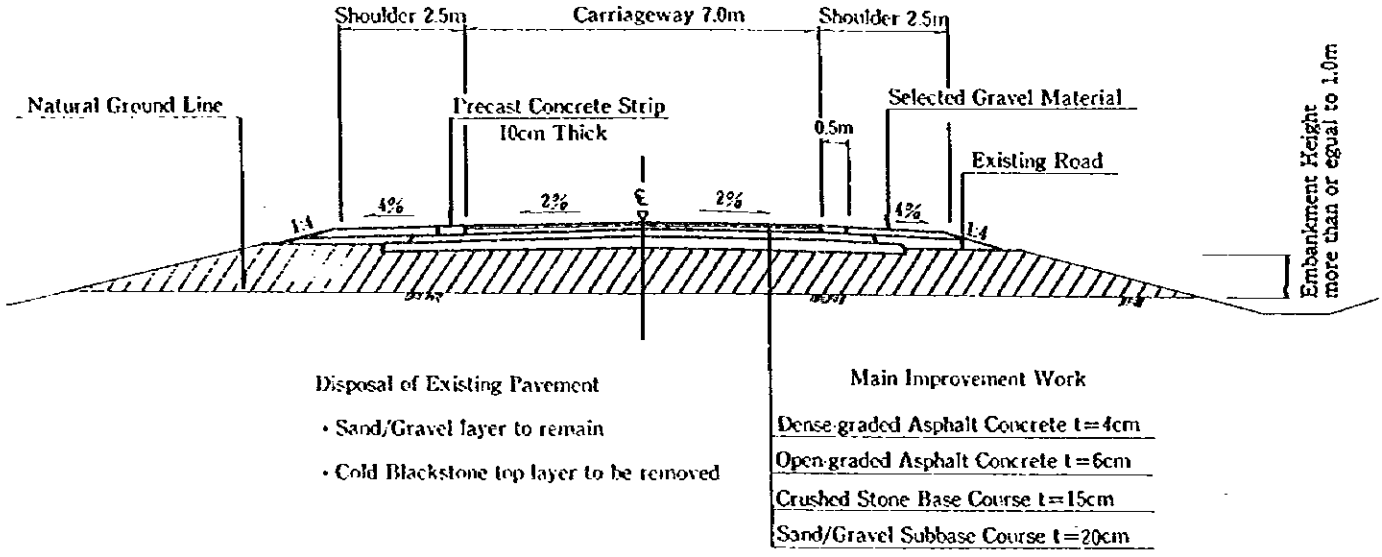


Fig. 2.7.3 : Cross-Section of Road for Type-III-1 Improvement

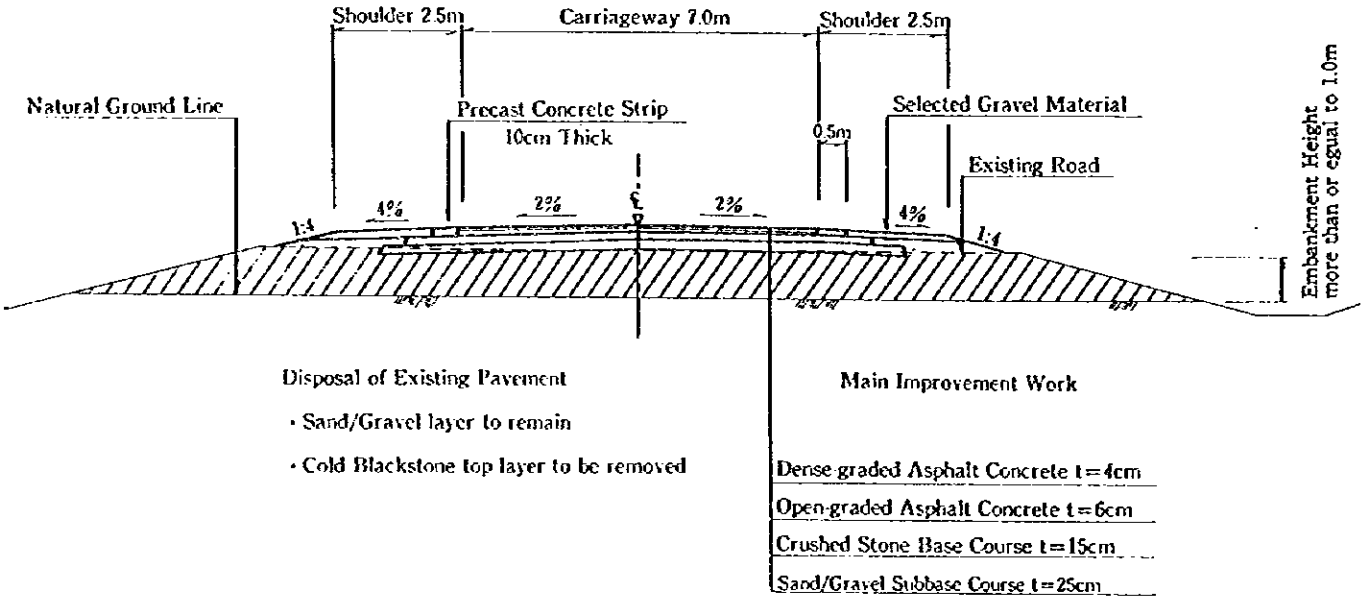


Fig. 2.7.4 : Cross-Section of Road for Type-III-2 Improvement

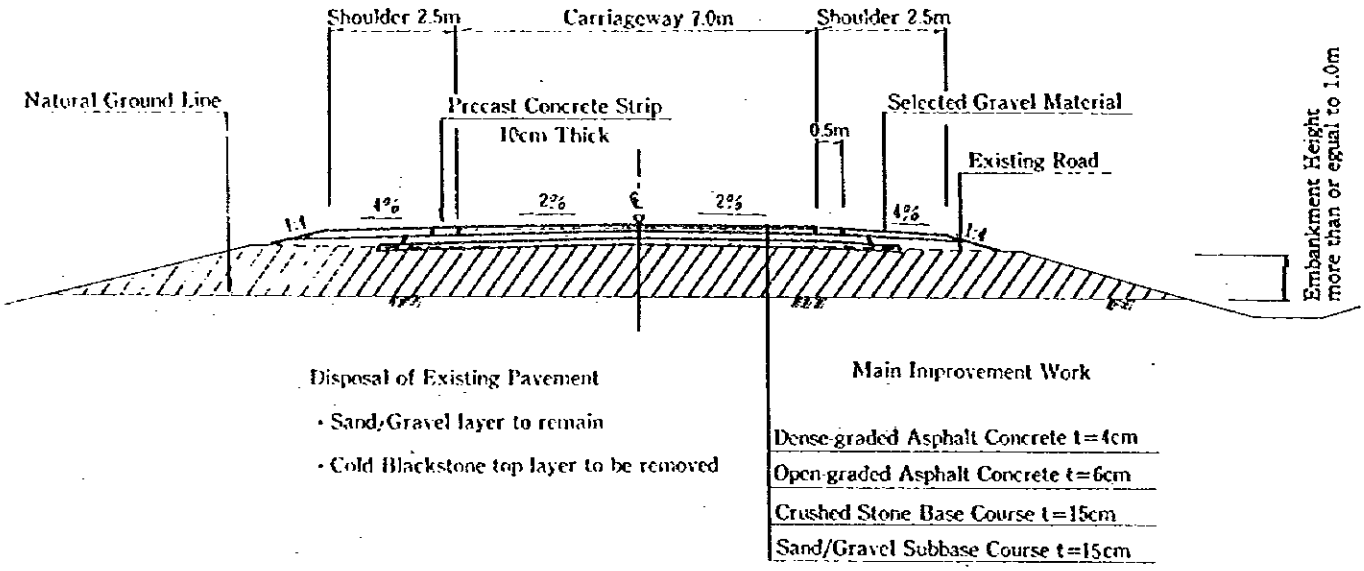


Fig. 2.7.5 : Cross-Section of Road for Type-IV Improvement

2.7.2 Bridge Improvement

The bridge improvement implementation policy was decided as follows in conformity with the evaluation of the existing bridges. For improving the existing bridges, the removal of structural flaws, as well as repairing of the destroyed places, should be executed on them.

(1) Places to be Repaired

a) Extremely deteriorated bridge should be replaced.
b) Because the thickness of the hollow slab beams is too thin, they should be replaced with another type.
c) Destroyed part of the beams should be mended.
d) All the handrails should be changed to new one.
e) The worn out slabs of the carriageway should be fixed.

(2) Repair of Structural Defects

a) Pile bent type abutments for new bridges should not be used. However, the abutments for improving bridges, reformed retaining wall should be applied with the abutments.
b) Some piers for improving bridges which is too slender should be thicken and of which connection of the horizontal member and the vertical member should be renovated.
c) All the beams should be tied by the transverse beams.
d) The span of some bridges should be increased so as not always the walls of the abutments contact with the lake water.

The bridge construction manual used in the Kazakhstan is not very different when compared to those used in Western countries. In the specification, it is prescribed that the caterpillar loads which total weight is 80 ton should be considered in the design of the bridges.

The number of bridges, their type of structure and dimensions for the Karabutak to Kzyl-Orda Border, and for Atyrau to Mahambet road section is shown in Table 2.7.2 and Table 2.7.3 respectively.

The location and number of bridges for the Karabutak to Kzyl-Orda Border, and for Atyrau to Mahambet road section is shown in Fig. 2.7.6 and Fig. 2.7.7 respectively.

Table 2.7.2 : Bridges on Karabutak - Kzyl-Orda Border Road Section

Bridge Number	Type of Structure			Span (m)	Width (m)	Completion Year	Improvement Measure
	Girder	Abutment	Pier				
26	PC T Type Girder	Pile bent Type	Block Stacking Type	5 @ 21.0 m	11.4 m + 2.0 m	1984	To be Improved
27	Hollow Slab Girder	Block Stacking Type		Simple 18.0 m	10.2 m + 1.5 m	1981	To be Renewed
28	PC T Type Girder	Pile bent Type	Composition Type	8 @ 22.6 m	7.0 m + 2.0 m	1974	To be Renewed
29	Hollow Slab Girder	Round Columns	Round Columns	2 @ 18.0 m	10.5 m + 2.0 m	1982	To be Renewed
30	Hollow Slab Girder	Composition Type		Simple 18.0 m	10.0 m + 2.0 m	1982	To be Renewed
31	Hollow Slab Girder	Composition Type	Round Columns	2 @ 18.0 m	10.0 m + 2.0 m	1982	To be Renewed
32	Hollow Slab Girder	Pile bent Type	Cast-in-Place Type	2 @ 18.0 m	10.0 m + 2.0 m	1982	To be Renewed

Table 2.7.3 : Bridges on Atyrau - Mahambet Road Section

Bridge Number	Type of Structure			Span (m)	Width (m)	Completion Year	Improvement Measure
	Girder	Abutment	Pier				
1	PC T Type Girder	Pile bent Type	Pile bent Type	4 @ 16.0 m	8.0 m + 1.5 m	1982	To be Improved
2	PC T Type Girder	Pile bent Type	Pile bent Type	4 @ 15.0 m	8.0 m + 1.0 m	1962	To be Renewed
3	PC T Type Girder	Pile bent Type	Pile bent Type	4 @ 15.0 m	8.0 m + 2.0 m	1962	To be Renewed
4	Hollow Slab Girder	Pile bent Type	Pile bent Type	3 @ 16.0 m	8.0 m + 2.0 m	1983	To be Improved
5	PC T Type Girder	Pile bent Type	Pile bent Type	2 @ 16.0 m	8.0 m + 2.0 m	1969	To be Renewed
6	PC T Type Girder	Pile bent Type	Rigid Frame Type	3 @ 15.0 m	8.0 m + 2.0 m	1972	To be Improved
7	Reinforced T Girder	Pile bent Type	Pile bent Type	3 @ 15.0 m	8.0 m + 2.0 m	1972	To be Improved

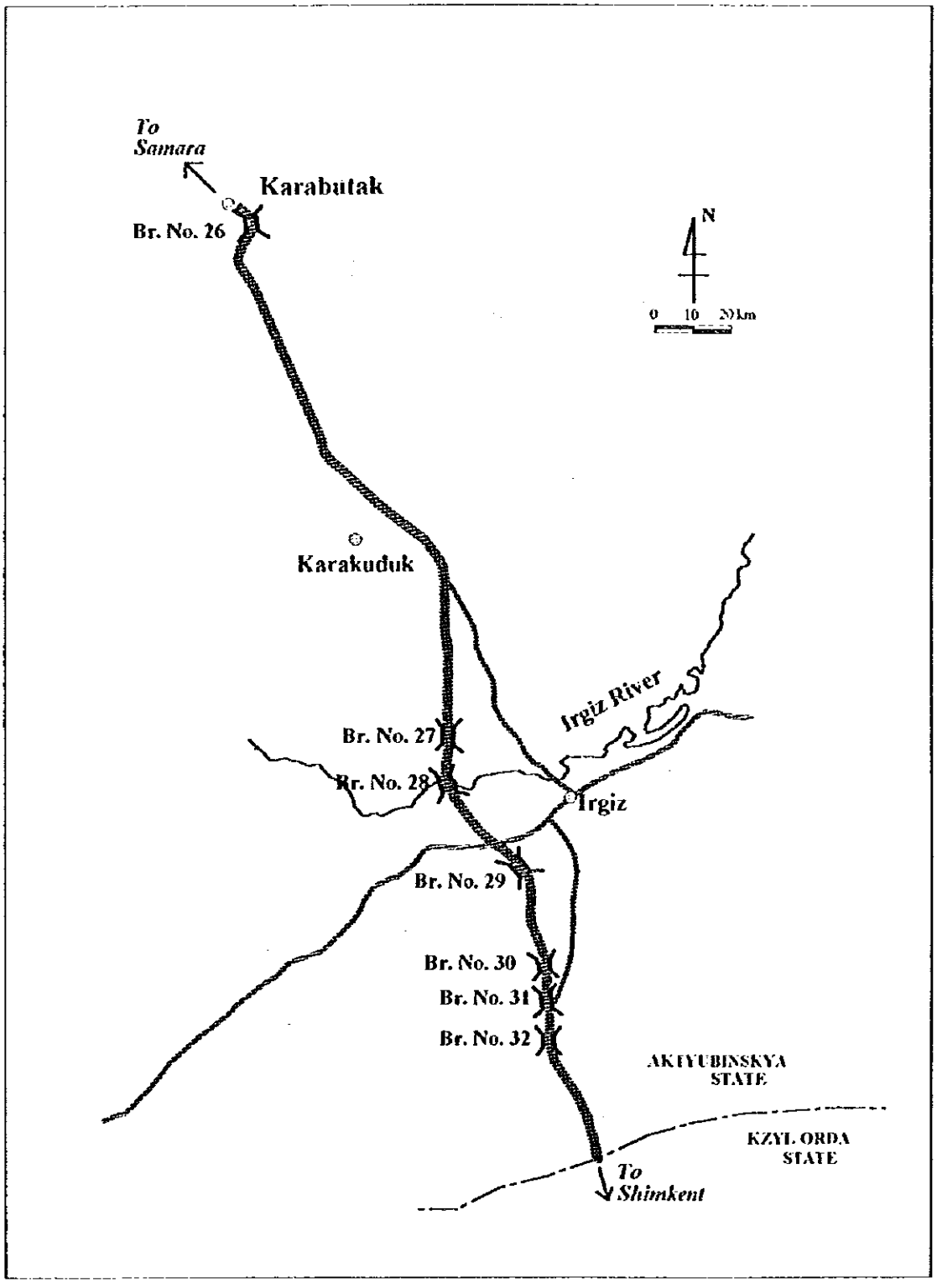


Fig 2.7.6 : Location of Bridges on Karabutak - Kzyl- Orda Border Road Section

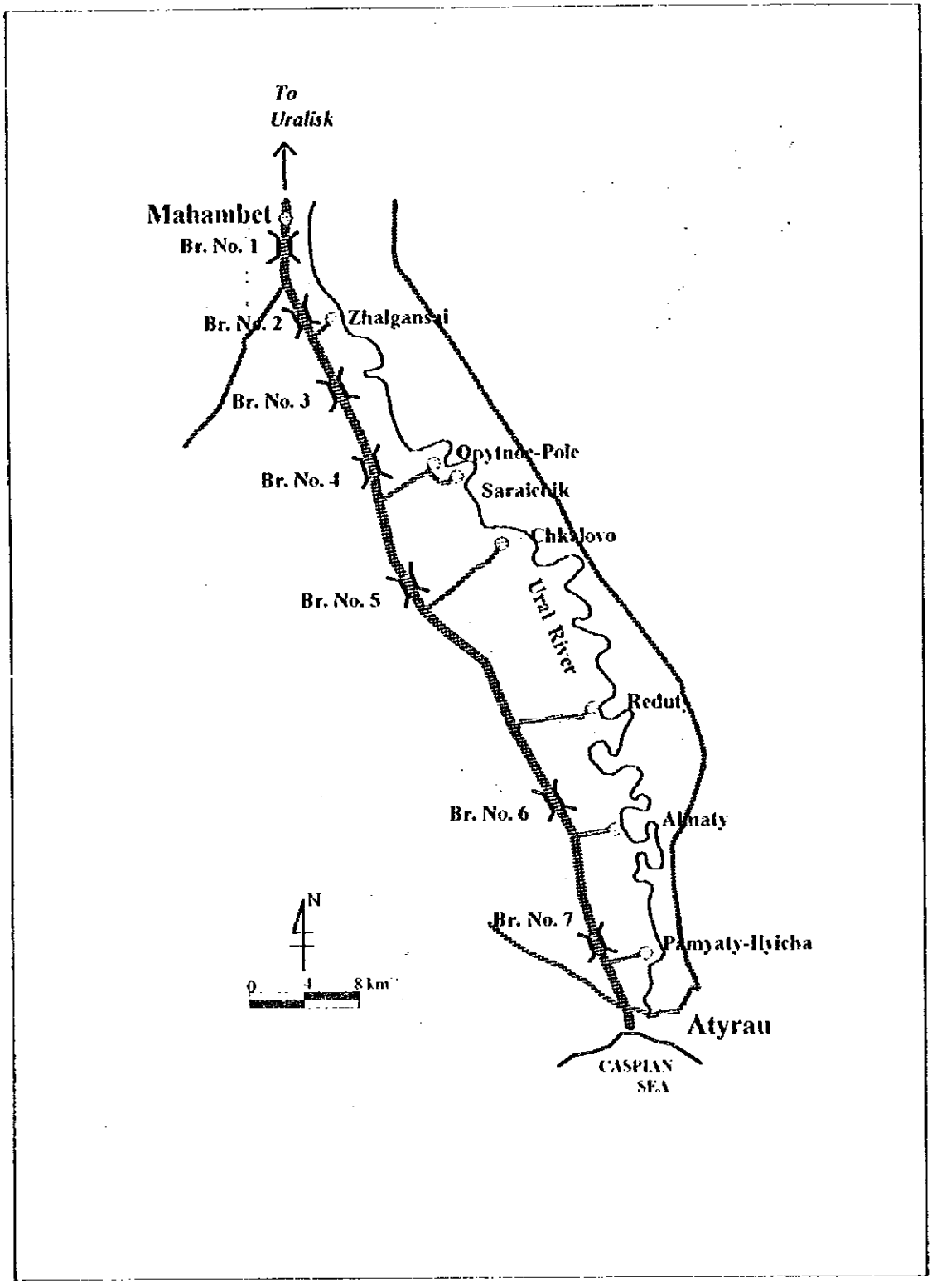


Fig 2.7.7 : Location of Bridges on Atyrau - Mahambet Road Section

2.8 Road and Bridge Improvement Costs

In Kazakhstan, the cost of road construction work is estimated using procedures set out in the standard reference manuals, such as the "Manuals on Construction Cost Estimation for Cargo Transportation" and "Investment Standard per Unit on General Purpose Road", issued in the Former Soviet Union in 1991.

A schedule of basic prices was issued by the central authorities in the Former Soviet Union in 1991, and it is not updated since then. Also, because the market prices for wages, equipment, materials and freight are unstable, determining basic prices is difficult. Therefore, due to the unavailability of realistic data, the JICA Study Team carried out a cost estimate from the basic costs of resources such as labor, equipment and materials.

2.8.1 Method of Cost Estimation

The costs are separated into direct costs, indirect costs, engineering cost and contingencies. Direct cost is further separated into labor, equipment and material cost, and again separated into local currency portion and foreign currency portion.

Basic premises are as follows:

(1) Indirect construction cost consists of contractor's overhead and profit, and site-on-cost. The contractor's overhead and profit is assumed to be 15% of the direct construction cost. The site-on-cost is estimated separately based on actual requirements.

(2) Engineering cost includes detailed design, preparation of tender documents, bid schedule & technical specifications, construction supervision and so on. It is assumed to be 10% of the direct cost.

(3) Contingencies are taken as 15% of the sum of the direct cost, indirect cost, and engineering cost.

(4) The project costs in 1996 Tenge are converted to U.S. Dollars using a conversion rate of US$1=66.5 Tenges.

2.8.2 Total Project Costs

The direct improvement costs of the priority projects is shown in Table 2.8.1. The total road improvement cost, bridge improvement cost and the total project cost is shown in Table 2.8.2, Table 2.8.3 and Table 2.8.4 respectively.

The total project cost by local and foreign currency portion is shown in Table 2.8.5.

The road improvement works and their costs for the Karabutak and Atyrau road section are shown in Figure 2.8.1 and 2.8.2 respectively.

Table 2.8.1 : Direct Improvement Costs

(unit : US$1000)

Type of Improvement	Karabutak-Kzyl Orda B. Road Section				Atyrau-Mahambet Section	Total
	Karabutak-Irgiz		Irgiz-Kzyl Orda B.	Total		
	km					
	965-1060	1060-1154	1154-1240	965-1240	0-84	
Road Improvement Cost	11,715	9,995	8,805	30,515	11,917	42,432
Culvert Improvement/New Cost	132	48	56	236	1,587	1,823
Bridge Improvement/New Cost	290	1,950	1,332	3,572	1,948	5,520
Total Direct Cost	12,137	11,993	10,193	34,323	15,452	49,775

Data Source : JICA Study,1996

Table 2.8.2 : Road and Culvert Improvement Cost

(unit : US$1000)

Cost Component		Karabutak-Kzyl Orda B. Road Section				Atyrau-Mahambet Section	Total
		Karabutak-Irgiz		Irgiz-Kzyl Orda B.	Total		
		km					
		965-1060	1060-1154	1154-1240	965-1240	0-84	
Direct Cost		11,847	10,043	8,861	30,751	13,504	44,255
Indirect Cost	Contractor's Over-head & Profit(15%)	1,777	1,506	1,329	4,612	2,026	6,638
	Site-on-Cost	2,932	2,932	2,932	8,796	2,932	11,728
Sub Total		16,556	14,481	13,122	44,159	18,462	62,621
Engineering Cost(10%)		1,656	1,448	1,312	4,416	1,847	6,262
Sub Total		18,212	15,929	14,434	48,575	20,309	68,883
Contingencies (15%)		2,732	2,389	2,165	7,286	3,046	10,332
Gross Total Cost		20,944	18,318	16,599	55,861	23,355	79,216

Data Source : JICA Study,1996

Table 2.8.3 : Bridge Improvement Cost

(unit : US$1000)

Cost Component		Karabutak-Kzyl Orda Road Section				Atyrau-Mahambet Section	Total
		Karabutak-Irgiz		Irgiz-Kzyl Orda B.	Total		
		km					
		965-1060	1060-1154	1154-1240	965-1240	0-84	
Direct Cost		290	1,950	1,332	3,572	1,948	5,520
Indirect Cost	Contractor's Over-head & Profit(15%)	44	293	200	536	292	828
	Site-on-Cost	428	428	428	6,284	428	1,712
Sub Total		762	2,671	1,960	5,392	2,668	8,060
Engineering Cost(10%)		76	267	195	539	267	806
Sub Total		838	2,938	2,156	5,931	2,935	8,866
Contingencies (15%)		126	441	323	890	440	1,330
Gross Total Project Cost		964	3,379	2,479	6,821	3,375	10,197

Data Source: JICA Study,1996

Table 2.8.4 : Summary of Total Project Cost

(unit : US$1000)

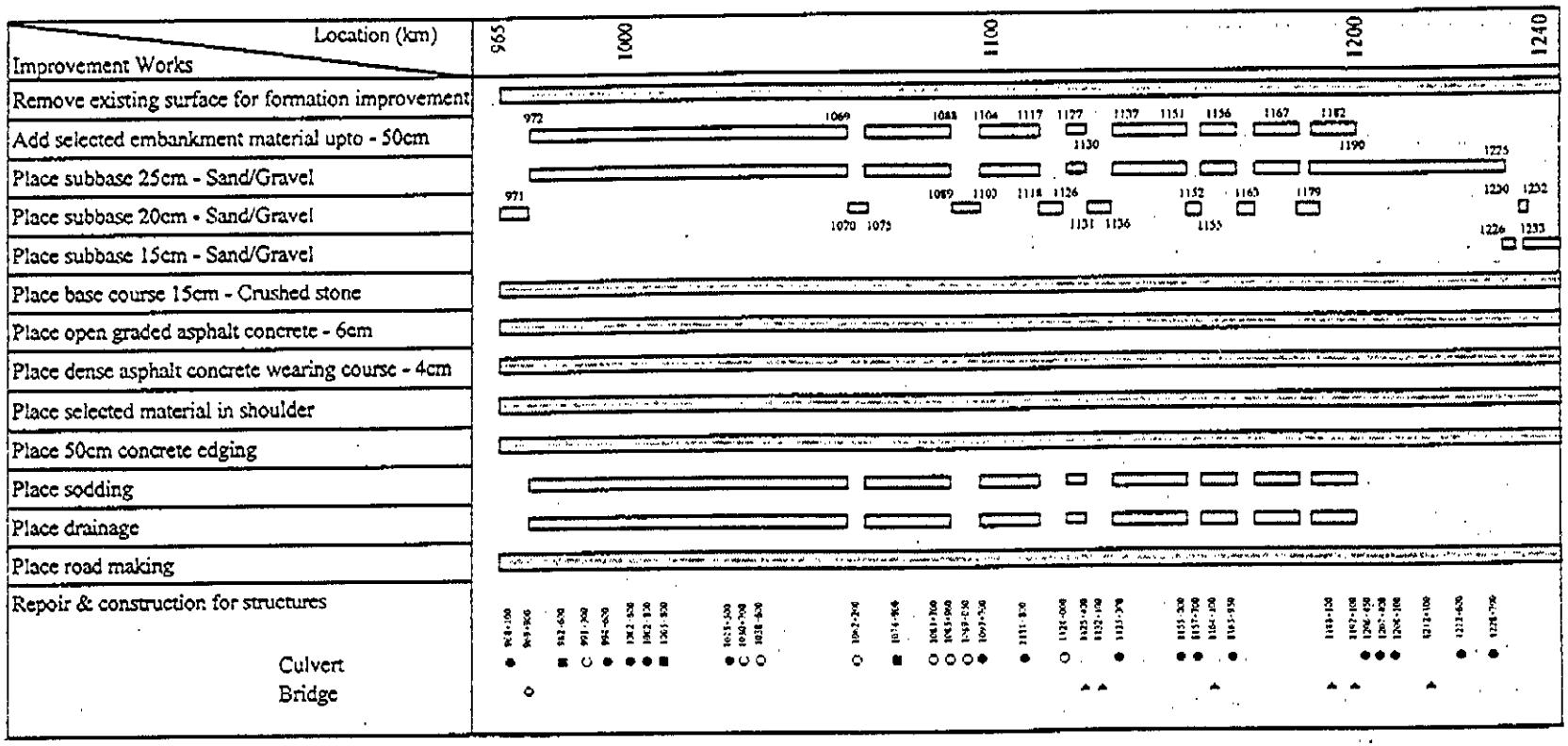
Cost Component		Karabutak-Kzyl Orda Road Section				Atyrau-Mahambet Section	Total
		Karabutak-Irgiz		Irgiz-Kzyl Orda B.	Total		
		km					
		965-1060	1060-1154	1154-1240	965-1240	0-84	
Direct Cost		12,136	11,993	10,193	34,323	15,452	49,775
Indirect Cost	Contractor's Over-head & Profit(15%)	1,821	1,799	1,529	5,149	2,318	7,467
	Site on Cost	3,360	3,360	3,360	10,080	3,360	13,440
Sub Total		17,318	17,152	15,082	49,552	21,130	70,682
Engineering Cost(10%)		1,732	1,715	1,508	4,955	2,113	7,068
Sub Total		19,050	18,867	16,590	54,507	23,243	77,750
Contingencies(15%)		2,858	2,830	2,489	8,177	3,486	11,663
Gross Total Project Cost		21,908	21,697	19,079	62,684	26,729	89,413

Data Source ; JICA Study, 1996

Table 2.8.5 : Total Project Cost by Local and Foreign Currency Portion

Road Section	Project Cost (US$ 1000)		
	Local Currency Portion	Foreign Currency Portion	Total
Irgiz - Kzyl Orda Border	14,309	4,770	19,079
Karabutak - Irgiz	32,704	10,901	43,605
Atyrau - Mahambet	20,047	6,682	26,729
Total	67,060	22,353	89,413

Note : 1US$ =66.5 Tenges.
Data Source : JICA Study, 1996

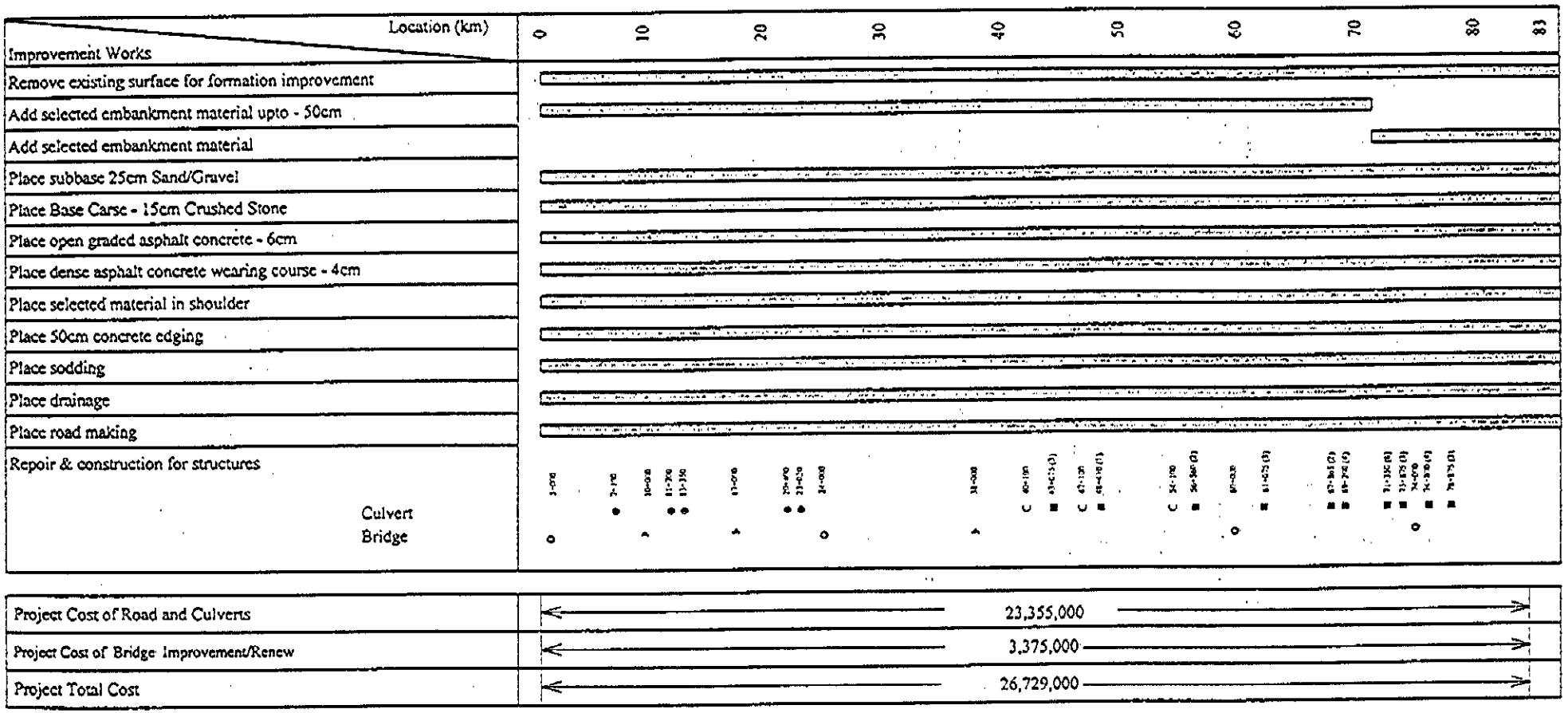


Note : Unit : US$

Legend : ■ : Reconstruction of boxculverts ○ : Repair of pipe culverts ▲ : Reconstruction of bridges

● : Reconstruction of pipe culverts ◎ : Repair of briges

Fig. 2.8.1 : Road Improvement Works and their Costs for the Karabutak Road Section



Legend : ■ : New construction of equalizer channels (box culverts)
○ : Repair of pipe culverts
▲ : Reconstruction of bridges
● : Repair of boxculvert
◎ : Repair of briges

Note : The figure in parentheses are the number of the equalizer channels

Unit : US$

Fig. 2.8.2 : Road Improvement Works and their Costs for the Atyrau Road Section

2.9 Road Maintenance and Costs

The methods of road maintenance and repair are indicated in the norms of the Former Soviet Union such as "Technical Rules for Repair and Maintenance". These guidelines are similar to that of western developed countries. Actual works are executed based on such guidelines. Some items of these guidelines were rearranged by Kazakhstan considering the conditions of the areas.

In February, 1996, State Road Authority was established to be in charge of ordering and superintending of road construction and maintenance works in each State. The construction and maintenance of roads will be executed on contract basis. The Kazakhstan Zholdary including state zohldaries remained as contractors.

Road maintenance consists of routine maintenance and periodic maintenance. The work items for routine and periodic maintenance are listed in the guidelines for road maintenance.

The standard maintenance costs are summarized in Table 2.9.1 which were prepared by Kazdornii for the planning of the road budget for 1996. However, in this Study, the maintenance costs for the "With Project" case and the "Without Project" case were actually estimated by modifying the standard maintenance costs through the discussion with Kazdornii and, also on the basis of actual road construction costs for overlay and leveling works.

The costs of road maintenance and repair per km for the "With Project" case and the "Without Project" case are shown in the Table 2.9.2 and Table 2.9.3 respectively.

Table 2.9.1 : Standard Costs of Road Maintenance and Repair

Types of pavements	Norms of money expenditures per km of the road			
	(In Tenges as on 01.01.91)		(in US$)	
	black gravel and black crash stone	gravel and crash stone	black gravel and black crash stone	gravel and crash stone
Types of works				
1.Periodic maintenance (restoration of the pavement, surface treatment, restoration of the wearing layer):	23,900	9,100	0 14,130	5,380
2.Routine maintenance				
2.1.Road management (organisation works, evaluation of the road condition, etc.)	282	282	170	170
2.2. Maintenance, including winter maintenance	1,430	1,430	850	850
2.3. Routine repair	2,410	2,049	1,420	1,210
2.4.Tree and shrub planting, including forestry care	774	774	460	460
Total	4,896	4,535	2,894	2,680

Remarks:
1. Source : Department of Roads
2. Refering to "Norms of money consumption (expenditure) are worked out by "Kazdornii" and are to be approved by the Ministry of Finance, Govt. of Kazakhstan
3. The routine repair costs for gravel road are estimated 15% less compared to black gravel roads

Table 2.9.2 : Road Maintenance Costs per km for the "With Project" Case

Types of pavement	Cost per km of the Road Maintenance	
	Asphalt concrete (in Tenges as on 01.01.91)	Asphalt concrete (US$ in 1996)
Type of works		
1. Periodic maintenance (4cm overlay and 3cm leveling)	-	59,000
Frequency	-	7 years
2. Routine maintenance (annual)		
2.1 Road management (organisation works, evaluation of the road condition, etc.)	282	170
2.2 Maintenance, including winter maintenance	1,430	850
2.3 Routine repair	350	210
2.4 Tree and shrub planting, including forestry care	774	460
Total	2,836	1,676

Remarks:
1. Based on "Norms of money consumption (expenditure) which are worked out by "Kazdornii" and were approved by the Ministry of Finance of Govt of Kazakhstan
2. Also based on discussions with "Kazdornii"

Table 2.9.3 : Road Maintenance Costs per km for the "Without Project" Case

Types of pavements	Cost per km of the Road Maintenance			
	black gravel and black crush stone	gravel and crush stone	black gravel and black crush stone	gravel and crush stone
	(in Tenges as on 01.01.91)		(US$ in 1996)	
Types of works				
1. Periodic maintenance (restoration of the pavement, surface treatment, restoration of the weariness layer):				
Cost	23,900	9,100	14,130	5,380
Frequency	3 years	2 years	3 years	2 years
2. Routine maintenance(annual)				
2.1.Road management (organisation works, evaluation of the road condition, etc.)	282	282	170	170
2.2. Maintenance, including winter maintenance	1,430	1,430	850	850
2.3. Routine repair	5,690	4,837	3,360	2,860
2.4.Tree and shrub planting, including forestry care	774	774	460	460
Total	8,176	7,323	4,832	4,328

Remarks.
1. Based on "Norms of money consumption (expenditure) which are worked out by "Kazdornii" and were approved by the Ministry of Finance of Govt. of Kazakhstan
2. Also based on discussions with "Kazdornii"
3. The routine repair costs for gravel road are estimated 15% less compared with black gravel roads costs based on "Norms for Maintenance and Repair of Automobile roads, 1965"

2.10 Environment Assessment

The Initial Environmental Examination (IEE) and the Environmental Impact Assessment was prepared in accordance with JICA guideline and requirements of Department of Roads, the Ministry of Transport and Communication for the environmental review of road reconstruction and rehabilitation project, based on "The Nature Conservation Law of Kazakhstan" 1991 and the "Environmental Impact Assessment Act" 1993.

The project types of this study are reconstruction of existing roads, and so the negative impacts are much smaller than for new road construction projects. The reconstruction work will mainly consist of removal of existing road surface and placement of base course and surface course, and bridge rehabilitation. Most of the reconstruction works will be confined to the existing road structure.

As the road width of most existing roads is wide enough to rehabilitate, major earth-moving and resettlement will not be required. Most existing roads are far away from residential areas, so the impact of noise vibration and air/water pollution will not occur. The roadside slopes in the steppe area so gentle that livestock are not prevented from crossing.

With regard to this project, as most of the project area is steppe with spotted shrubbery, the vegetation is poor, moreover substantial removal of vegetation is not required at the construction stage.

As most existing roads are far enough from the cultural and architectural monuments, there is no direct impact on the monuments during the construction stage and after implementation.

Figure 2.10.1 shows the environmental conditions along the Kzyl-Orda Border - Karabutak road section.

Figure 2.10.2 shows the environmental conditions along the Atyrau - Mahambet road section.

In conclusion, this project will have limited and trivial environmental impacts, so further environmental studies are not required.

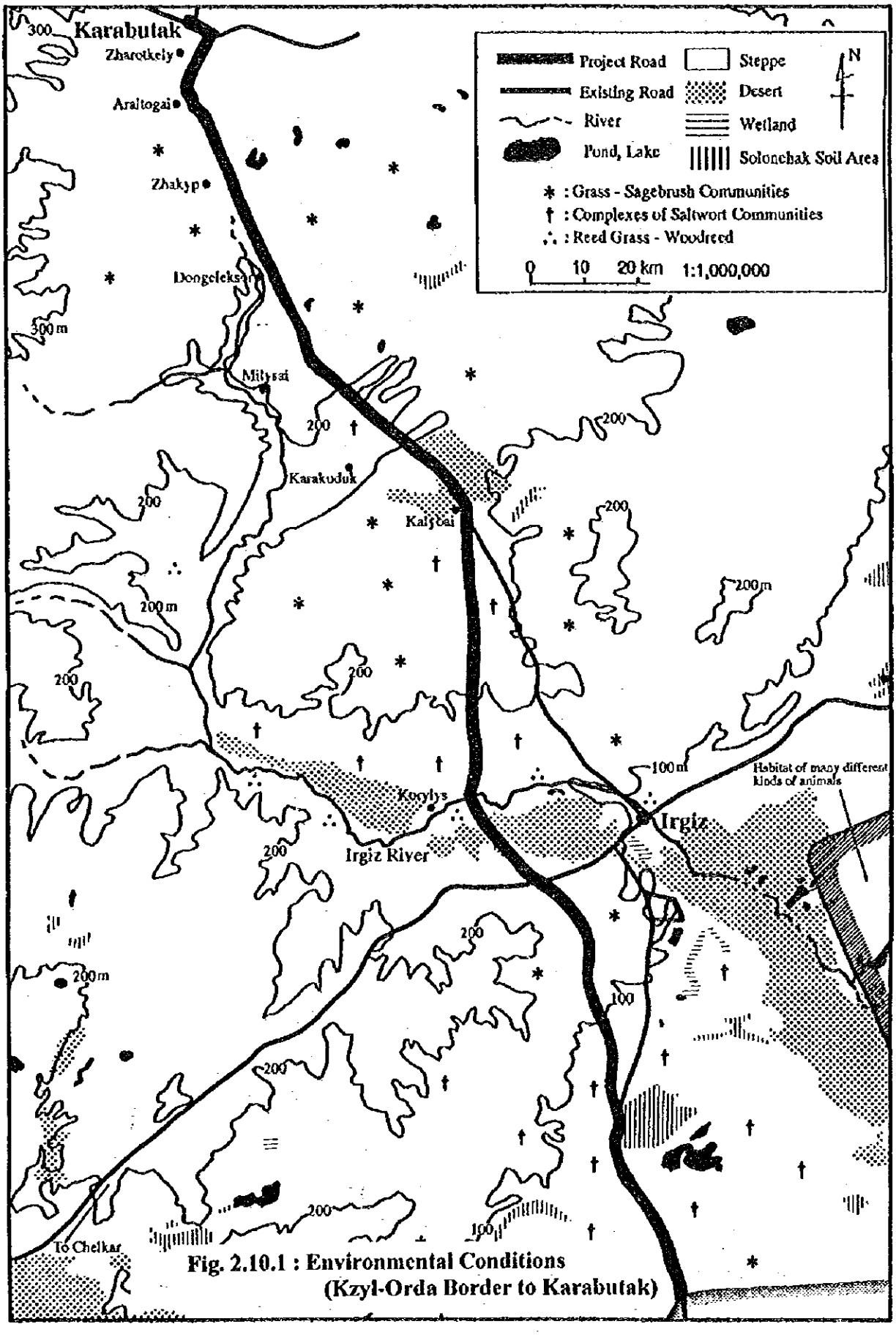


Fig. 2.10.1 : Environmental Conditions (Kzyl-Orda Border to Karabutak)

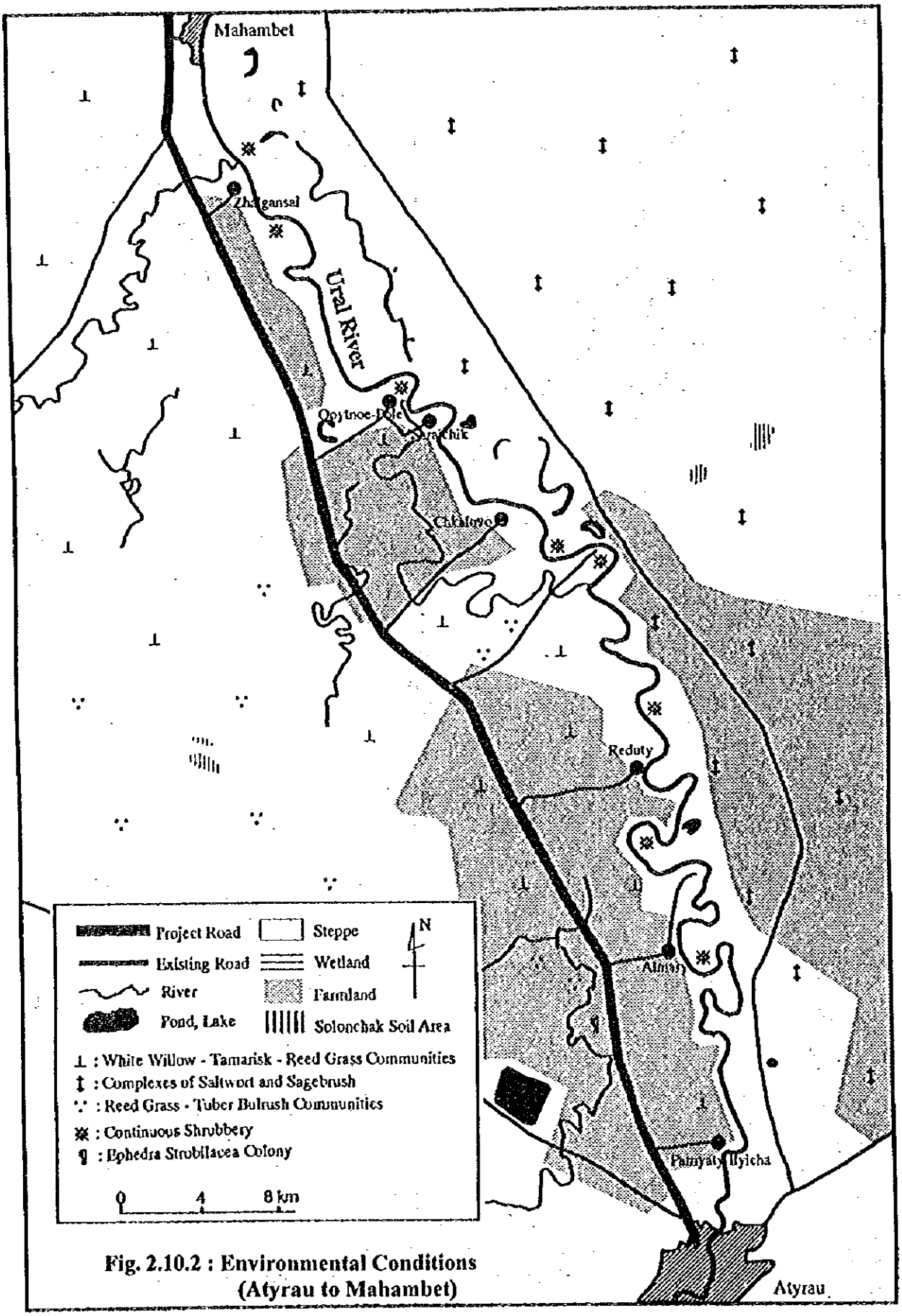


Fig. 2.10.2 : Environmental Conditions (Atyrau to Mahambet)

2.11 Vehicle Operating Costs

2.11.1 General

The running of vehicles on road incurs several type of costs to the road user such as cost of fuel, tire, spare parts, maintenance etc. These costs incurred in running vehicles on road are termed as Vehicle Operating Costs (VOC) and, depend on several factors such as surface condition of road, geometric characteristics of road, vehicle characteristics, cost of vehicle and resources consumed in vehicle operation such as fuel, tire, spare parts etc. The improvement in road section such as improvement in type/condition of pavement or geometric characteristics leads to reduction in VOC on that road section. These reductions (or savings) in VOC constitute the major portion of benefits arising from the road improvement projects.

2.11.2 HDM-VOC Model

The HDM-VOC model developed by the World Bank was used to compute the VOC. The HDM-VOC model is a computer program for estimating the various components of VOC such as cost of fuel consumption, lubricant consumption, tire consumption, maintenance and crew labor costs, depreciation costs etc. This model is designed to estimate VOC for 10 types of vehicles ranging from small car to an articulated truck. For estimating the different components of VOC, this model requires the following main input data;

a) Roadway characteristics such as roughness (IRI), gradient, curvature etc.
b) Vehicle characteristics and vehicle utilization data such as average annual veh-kms, average life of vehicle etc.
c) Average consumption rate of resources such as fuel consumption, tire consumption etc.
d) Unit cost of resources such as cost of new vehicles, cost of fuel, lubricants, tire, maintenance and crew labor rates, interest rate etc.

The input data was collected through field surveys, traffic surveys, road inventory data; the costs of resources were obtained from visits to relevant firms and organizations, interviews with vehicle dealers and operators and discussion with Kazdornii. The input data used for estimating the VOC is shown in Table 2.11.1.

This HDM-VOC model predicts the various components of VOC using the input data related to roadway characteristics, vehicle characteristics and unit costs of resources consumed in vehicle operation such as fuel, tire, spare parts etc. The HDM-VOC model follows the following four steps to compute the VOC for each vehicle type;

a) Computes the average operating speed for the vehicle.
b) Computes the amount of resources (such as fuel, tires) required per 1000 veh-km of vehicle operation for the different components of the VOC.
c) Multiplies the amount of resource consumption to the unit cost of resources to compute the VOC for each item.
d) Sum the VOC of each item to compute the total VOC per 1000 veh-km.

Table 2.11.1 : Input Data for Estimating VOC

S. No	Item	P. Car	Bus	L.Truck	H.Truck
1. Vehicle Characteristics					
1.1	No. of axles	2	2	2	3
1.2	No. of tires	4	6	6	10
1.3	Tare weight (kg)	1,250	11,000	3,700	8,200
1.4	Load carried (kg)	400	3,150	3,500	10,000
2. Vehicle Utilization					
2.1	Annual veh-kms	25,000	140,000	75,000	150,000
2.2	Annual veh-hrs	500	2,750	1,750	3,100
2.3	Average service life (yrs)	9	11	9	8
2.4	Average age (in kms)	115,000	925,000	400,000	600,000
2.5	Hourly utilization Ratio	0.5	0.8	0.9	0.9
3. Economic Costs (US$)					
3.1	New vehicle price	8,500	48,000	15,000	42,000
3.2	Fuel price (per lt)	0.3	0.25	0.25	0.25
3.3	Lubricant price (per lt)	1.2	1.0	1.0	1.0
3.4	Tire price	55	250	140	225
3.5	Crew time cost (per hr)	0	2.25	1.25	1.75
3.6	Maintenance labor cost (per hr)	3.5	3.0	1.75	2.25
3.7	Annual interest rate (%)	5	5	5	5

2.11.3 Estimation of VOC

Since VOC vary considerably depending on the type of vehicle and road surface condition, the VOC was estimated for the following four types of vehicles and five types of road surface condition.

The four type of vehicles considered were;

(1) Passenger car
(2) Bus
(3) Light Truck
(4) Heavy Trucks

The five categories of road surface condition were considered depending on its International Roughness Index (IRI in m/km) value as follows;

(1) Good (IRI <= 4)
(2) Fair (4 < IRI < 7)
(3) Poor (7 <= IRI < 9)
(4) Very Poor (IRI >= 9)
(5) Very Poor -Gravel (IRI >= 12)

The VOCs were estimated in US$ per 1000 veh-km and the total VOC consisted of the following 8 components as follows.

1) Fuel
2) Lubricants
3) Tires
4) Crew
5) Maintenance labor
6) Maintenance parts
7) Depreciation
8) Interest

The unit VOC for roads in Western Kazakhstan by type of vehicle and road surface condition is shown below in Table 2.11.2.

Table 2.11.2 : Unit Vehicle Operating Cost (VOC) in Western Kazakhstan

(US$ per 1000 veh-km)

Vehicle Type	VOC by Type of Road Surface Condition				
	Good	Fair	Poor	Very Poor	Very Poor (Gravel)
P. Car	96.40	106.95	139.75	174.05	209.45
Bus	292.32	311.44	360.16	410.96	478.63
L. Truck	170.57	196.56	251.10	295.99	344.53
H. Truck	353.27	410.35	526.93	619.90	718.24

The total VOC for any particular type of road surface condition and vehicle type is estimated by multiplying its unit VOC by total traffic volume for that vehicle type and the length of the road section.

2.12 Economic Evaluation

The economic evaluation was carried out for the three priority projects selected for the feasibility study. These three priority project are as follows.

a) Road section from Kzyl-Orda Border to Irgiz (86 km)
b) Road section from Irgiz to Karabutak (189 km)
c) Road section from Atyrau to Mahambet (83 km)

The economic evaluation was carried out using the standard cost-benefit techniques in which costs are compared with benefits over the project's life. As an output of economic analysis, three economic evaluation indices i.e. NPV (Net Present Value), B/C (Benefit-Cost Ratio) and IRR (Internal Rate of Return) were computed for all the three priority projects to check their economic feasibility. The methodology used for economic analysis is described below.

2.12.1 Methodology of Economic Analysis

For each priority project, the road improvement cost (including cost of bridges and culverts), maintenance costs and vehicle operating costs (VOC) were estimated for the "With Project" case and the "Without Project" case. These costs were estimated for each year of the project's life. The project's life was taken as 20 years from the completion of the project. The VOC and maintenance costs of "With Project" case were subtracted from that of "Without Project" case for each year to obtain the VOC benefits and the maintenance benefits. These VOC benefits and the maintenance benefits for each year were added to obtain the total benefits of the project for that year. This total benefit together with the road improvement cost was discounted to obtain the discounted cost-benefit stream over the project's life. The discount rate of 12% was taken. The discounted cost-benefit stream was used to compute NPV and B/C. IRR was computed from the undiscounted cost-benefit stream.

For economic analysis, it is necessary to estimate the economic costs of road improvement and maintenance. Since the break-up from the Former Soviet Union, Kazakhstan has undergone rapid changes such as introduction of market economy, new currency and new fiscal and tax structures. These changes in addition to the fact that a lot of rules and regulations still persist that of the Former Soviet Union has made it difficult to estimate the economic cost of resources consumed in road construction. In this study the economic costs were estimated based on previous studies and discussion with concerned government organizations. It was assumed that the economic costs are about 95% of the financial costs and the same is used here in the economic analysis.

The road improvement costs were estimated for all the three priority projects. These costs also includes the cost of rehabilitation of bridges and culverts on that road section. These road improvement costs consists of direct costs (cost of labor, materials and equipment), indirect costs, costs of engineering services (10%) and an contingency of 15%. The financial and economic costs of the three priority projects is shown in the Table 2.12.1.

Table 2.12.1 : Economic and Financial Costs of Priority Projects

	Road Section	Financial Cost (in 1000 US$)	Economic Cost (in 1000 US$)
1.	Kzyl-Orda Border to Irgiz	19,079	18,125
2.	Irgiz to Karabutak	43,605	41,425
3.	Atyrau to Mahambet	26,729	25,392
	TOTAL	89,413	84,942

The maintenance costs consists of routine maintenance such as patching, repair of potholes etc. which need to be carried out every year and, periodic maintenance works such as surface dressing and overlays.

For economic analysis, the maintenance costs were estimated for both, the "With Project" case and the "Without Project" case. For the "Without project" case, all maintenance works necessary to keep the road open to traffic and to maintain a minimum acceptable serviceability were considered. The maintenance costs were estimated separately for paved roads (mainly AC pavement) and unpaved roads (mainly gravel).

For the "With Project" case the maintenance costs were estimated so as to keep the road in good condition. These maintenance costs were estimated based on discussions with Kazdornii and relevant studies in the road sector and are shown in Table 2.12.2. Here again, similar to the road improvement costs, the economic maintenance costs were assumed to be about 95% of the financial costs.

Table 2.12.2 : Economic Maintenance Costs per km in Western Kazakhstan

(Costs are in US$ per km)

Case	Routine Maintenance	Periodic Maintenance	Frequency (years)
"With Project" Case	1,590	56,050	7
"Without Project" Case			
AC Road	4,590	13,420	3
Gravel Road	4,110	5,110	2

The estimation of VOC, the method used and the input data required are discussed in the previous section. The unit VOC for roads in Western Kazakhstan by type of vehicle and road surface condition were estimated. The total VOC for any particular type of road surface condition and vehicle type is estimated by multiplying its unit VOC by total traffic volume for that vehicle type and the length of the road section.

2.12.2 Economic Analysis of Priority Projects

The economic analysis of the three priority projects was carried out based on the following data.

Discount rate :	12% per annum
Economic life of project :	20 years after construction (from 2002 to 2021)
Implementation period :	4 years from 1998 to 2001

The economic analysis was carried out using the standard cost-benefit techniques in which the costs and benefits accrued from the project are compared over the life of the project. Two project scenarios were considered. The first scenario is the "Without Project" case in which the project is not implemented and the second scenario refers to the "With Project" case in which the project is fully implemented. The benefits of the project are estimated by subtracting the total costs (road improvement costs, VOC and maintenance costs) for the "Without Project" case from that of "With Project" case.

For the purpose of economic analysis, two main types of benefits were considered viz. VOC benefits and the maintenance benefits, although the project will have several other benefits such as savings in travel time for passengers and freight, increased opportunities for economic development, increased road safety and others.

The VOC benefits were estimated by subtracting the VOC of the road sections for the "Without Project" case from that of "With Project" case. The VOC's of the "With Project" case are generally lower due to the increased speed of the traffic resulting from improved surface condition and pavement structures.

Similar to the VOC benefits, the maintenance benefits were estimated by subtracting the maintenance costs for the "Without Project" case from that of "With Project" case. The maintenance costs for the "With Project" case are generally lower due to the improved and more durable pavement and drainage structures.

The economic evaluation of the three priority projects is shown in Table 2.12.3, Table 2.12.4 and Table 2.12.5.

The overall economic evaluation (i.e. all the three priority projects together) including the cost-benefit stream is shown in Table 2.12.6.

Table 2.12.3 : Economic Evaluation of Kzyl-Orda Border to Irgiz Section

Section Kzyl-Orda Border to Irgiz
Length 86 km

Discount Rate = 12%
Economic Life = 20 years (after construction; i.e. 2002 - 2021)
Implementation Period = 4 years (1998 - 2001)

(Costs and Benefits are in US$)

Year	AADT veh/day	VOC Benefit	Maintenance Benefit	Total Benefit	Total Cost	Discounted Benefit	Discounted Cost
1998	648	0	792,920	792,920	-1,812,500	792,920	-1,812,500
1999	710	0	353,460	353,460	-5,437,500	315,589	-4,854,911
2000	778	0	792,920	792,920	-5,437,500	632,111	-4,334,742
2001	815	0	353,460	353,460	-5,437,500	251,586	-3,870,305
2002	853	5,083,140	656,180	5,739,320	0	3,647,441	0
2003	894	5,323,366	216,720	5,540,086	0	3,143,593	0
2004	936	5,574,949	656,180	6,231,129	0	3,156,884	0
2005	981	5,838,426	216,720	6,055,146	0	2,739,040	0
2006	1,027	6,114,359	656,180	6,770,539	0	2,734,507	0
2007	1,076	6,403,338	216,720	6,620,058	0	2,387,259	0
2008	1,127	6,705,980	-4,164,120	2,541,860	0	818,411	0
2009	1,180	7,022,931	216,720	7,239,651	0	2,081,227	0
2010	1,236	7,354,867	656,180	8,011,047	0	2,056,236	0
2011	1,295	7,702,498	216,720	7,919,218	0	1,814,880	0
2012	1,356	8,066,565	656,180	8,722,745	0	1,784,847	0
2013	1,420	8,447,847	216,720	8,664,567	0	1,582,984	0
2014	1,487	8,847,157	656,180	9,503,337	0	1,550,200	0
2015	1,558	9,265,349	-4,603,580	4,661,769	0	678,960	0
2016	1,632	9,703,314	656,180	10,359,494	0	1,347,144	0
2017	1,709	10,161,990	216,720	10,378,710	0	1,205,039	0
2018	1,790	10,642,354	656,180	11,298,534	0	1,171,282	0
2019	1,875	11,145,434	216,720	11,362,154	0	1,051,677	0
2020	1,964	11,672,304	656,180	12,328,484	0	1,018,857	0
2021	2,057	12,224,090	216,720	12,440,810	0	917,982	0
Total	-	163,300,258	1,381,160	164,681,418	-18,125,000	38,087,738	-13,059,958

NPV (million US$)	25.028
B/C	2.916
IRR (%)	28.55

Table 2.12.4 : Economic Evaluation of Irgiz to Karabutak Section

Section Irgiz to Karabutak
Length 189 km

Discount Rate = 12%
Economic Life = 20 years (after construction; i.e. 2002 – 2021)
Implementation Period = 4 years (1998 – 2001)

(Costs and Benefits are in US$)

Year	AADT veh/day	VOC Benefit	Maintenance Benefit	Total Benefit	Total Cost	Discounted Benefit	Discounted Cost
1998	605	0	3,403,890	3,403,890	-4,142,500	3,403,890	-4,142,500
1999	658	0	867,510	867,510	-12,427,500	774,563	-11,095,982
2000	716	0	867,510	867,510	-12,427,500	691,574	-9,907,127
2001	755	0	3,403,890	3,403,890	-12,427,500	2,422,822	-8,845,649
2002	795	7,529,860	567,000	8,096,860	0	5,145,701	0
2003	838	7,924,693	567,000	8,491,693	0	4,818,415	0
2004	884	8,340,348	3,103,380	11,443,728	0	5,797,749	0
2005	931	8,777,928	567,000	9,344,928	0	4,227,171	0
2006	982	9,238,597	567,000	9,805,597	0	3,960,316	0
2007	1,035	9,723,582	3,103,380	12,826,962	0	4,625,531	0
2008	1,091	10,234,172	-10,026,450	207,722	0	66,881	0
2009	1,150	10,771,728	567,000	11,338,728	0	3,259,613	0
2010	1,212	11,337,683	3,103,380	14,441,063	0	3,706,661	0
2011	1,278	11,933,546	567,000	12,500,546	0	2,864,803	0
2012	1,347	12,560,907	567,000	13,127,907	0	2,686,230	0
2013	1,420	13,221,442	3,103,380	16,324,822	0	2,982,484	0
2014	1,497	13,916,914	567,000	14,483,914	0	2,362,640	0
2015	1,578	14,649,183	-10,026,450	4,622,733	0	673,275	0
2016	1,663	15,420,208	3,103,380	18,523,588	0	2,408,800	0
2017	1,753	16,232,053	567,000	16,799,053	0	1,950,484	0
2018	1,848	17,086,891	567,000	17,653,891	0	1,830,122	0
2019	1,949	17,987,014	3,103,380	21,090,394	0	1,952,119	0
2020	2,054	18,934,835	567,000	19,501,835	0	1,611,681	0
2021	2,166	19,932,897	567,000	20,499,897	0	1,512,646	0
Total	-	255,754,483	13,914,180	269,668,663	-41,425,000	65,736,168	-33,991,258

NPV (million US$)	31.745
B/C	1.934
IRR (%)	23.28

Table 2.12.5 : Economic Evaluation of Atyrau to Mahambet Section

Section : Atyrau to Mahambet
Length : 83 km

Discount Rate = 12%
Economic Life = 20 years (after construction; i.e. 2002 - 2021)
Implementation Period = 4 years (1998 - 2001)

(Costs and Benefits are in US$)

Year	AADT veh/day	VOC Benefit	Maintenance Benefit	Total Benefit	Construction Cost	Discounted Benefit	Discounted Cost
1998	1,183	0	1,494,830	1,494,830	-2,539,200	1,494,830	-2,539,200
1999	1,400	0	380,970	380,970	-7,617,600	340,152	-6,801,429
2000	1,656	0	380,970	380,970	-7,617,600	303,707	-6,072,704
2001	1,730	0	1,494,830	1,494,830	-7,617,600	1,063,990	-5,422,057
2002	1,808	5,186,622	249,000	5,435,622	0	3,454,436	0
2003	1,889	5,419,557	249,000	5,668,557	0	3,216,492	0
2004	1,973	5,662,955	1,362,860	7,025,815	0	3,559,497	0
2005	2,062	5,917,285	249,000	6,166,285	0	2,789,314	0
2006	2,154	6,183,037	249,000	6,432,037	0	2,597,792	0
2007	2,251	6,460,726	1,362,860	7,823,586	0	2,821,263	0
2008	2,352	6,750,886	-4,403,150	2,347,736	0	755,908	0
2009	2,457	7,054,080	249,000	7,303,080	0	2,099,461	0
2010	2,567	7,370,891	1,362,860	8,733,751	0	2,241,736	0
2011	2,682	7,701,931	249,000	7,950,931	0	1,822,148	0
2012	2,802	8,047,840	249,000	8,296,840	0	1,697,698	0
2013	2,928	8,409,286	1,362,860	9,772,146	0	1,785,334	0
2014	3,059	8,786,965	249,000	9,035,965	0	1,473,962	0
2015	3,196	9,181,609	-4,403,150	4,778,459	0	695,956	0
2016	3,339	9,593,978	1,362,860	10,956,838	0	1,424,823	0
2017	3,489	10,024,869	249,000	10,273,869	0	1,192,866	0
2018	3,645	10,475,113	249,000	10,724,113	0	1,111,734	0
2019	3,809	10,945,581	1,362,860	12,308,441	0	1,139,264	0
2020	3,979	11,437,180	249,000	11,686,180	0	965,775	0
2021	4,157	11,950,859	249,000	12,199,859	0	900,203	0
Total	-	162,561,249	6,110,460	167,176,879	-25,392,000	39,453,511	-18,296,190

NPV (million US$)	21.157
B/C	2.156
IRR (%)	23.01

Table 2.12.6 : Overall Economic Evaluation and Cost-Benefit Stream

Priority Sections : 1) Kzyl-Orda B. to Irgiz; 2) Irgiz to Karabutak; 3) Atyrau to Mahambet
Total Length : 358 km

Discount Rate = 12%
Economic Life = 20 years (after construction; i.e. 2002 - 2021)
Implementation Period = 4 years (1998 - 2001)

(Costs and Benefits are in US$)

Year	VOC Benefit	Maintenance Benefit	Total Benefit	Construction Cost	Discounted Benefit	Discounted Cost
1998	0	5,691,640	5,691,640	-8,494,200	5,691,640	-8,494,200
1999	0	1,601,940	1,601,940	-25,482,600	1,430,304	-22,752,321
2000	0	2,041,400	2,041,400	-25,482,600	1,627,392	-20,314,573
2001	0	5,252,180	5,252,180	-25,482,600	3,738,398	-18,138,011
2002	17,799,622	1,472,180	19,271,802	0	12,247,578	0
2003	18,667,617	1,032,720	19,700,337	0	11,178,500	0
2004	19,578,251	5,122,420	24,700,671	0	12,514,129	0
2005	20,533,638	1,032,720	21,566,358	0	9,755,525	0
2006	21,535,994	1,472,180	23,008,174	0	9,292,615	0
2007	22,587,646	4,682,960	27,270,606	0	9,834,054	0
2008	23,691,038	-18,593,720	5,097,318	0	1,641,200	0
2009	24,848,739	1,032,720	25,881,459	0	7,440,301	0
2010	26,063,441	5,122,420	31,185,861	0	8,004,634	0
2011	27,337,975	1,032,720	28,370,695	0	6,501,831	0
2012	28,675,313	1,472,180	30,147,493	0	6,168,774	0
2013	30,078,574	4,682,960	34,761,534	0	6,350,802	0
2014	31,551,037	1,472,180	33,023,217	0	5,386,802	0
2015	33,096,141	-19,033,180	14,062,961	0	2,048,191	0
2016	34,717,500	5,122,420	39,839,920	0	5,180,767	0
2017	36,418,911	1,032,720	37,451,631	0	4,348,388	0
2018	38,204,359	1,472,180	39,676,539	0	4,113,138	0
2019	40,078,029	4,682,960	44,760,989	0	4,143,060	0
2020	42,044,319	1,472,180	43,516,499	0	3,596,313	0
2021	44,107,846	1,032,720	45,140,566	0	3,330,830	0
Total	581,615,990	21,405,800	603,021,790	-84,942,000	145,565,166	-69,699,105

NPV (million US$)	75.866
B/C	2.088
IRR (%)	24.44

The economic evaluation of the three priority projects is shown in Table 2.12.7.

Table 2.12.7 : Economic Evaluation of Priority Projects
(12% Discount Rate)

Section	Length (km)	Financial Cost (1,000US$)	NPV (mil US$)	B/C	IRR
Kzyl-Orda Border to Igriz	86	19,079	25.02	2.91	28.55
Igriz to Karabutak	189	43,605	31.74	1.93	23.28
Atyrau to Mahambet	83	26,729	21.15	2.15	23.01
Total	**358**	**89,413**	**75.86**	**2.08**	**24.44**

2.12.3 Sensitivity Analysis

Sensitivity analysis was carried out to check the effect of changes in construction costs, benefits and discount rate on the economic feasibility of the project. The following cases were checked.

1) Discount rate : For 10% per annum and 15% per annum
2) Construction costs : For +10% and -10% variation
3) Total benefits : For +10% and -10% variation

These sensitivity tests were carried out by changing the above mentioned variable while keeping all other variable fixed. The results of the sensitivity analysis is shown below in Table 2.12.8.

Table 2.12.8 : Results of Sensitivity Tests

Item		Kzyl-Orda B. to Irgiz			Irgiz to Karabutak			Atyrau to Mahambet			Overall		
		NPV	B/C	IRR	NPV	B/C	IRR	NPV	B/C	IRR	NPV	B/C	IRR
Base Case	**(12%)**	**25.02**	**2.91**	**28.55**	**31.74**	**1.93**	**23.28**	**21.15**	**2.15**	**23.01**	**75.86**	**2.08**	**24.44**
Discount Rate	10%	33.07	3.44	28.55	44.43	2.26	23.28	29.21	2.54	23.01	104.66	2.45	24.44
	15%	16.47	2.32	28.55	18.35	1.56	23.28	12.62	1.72	23.01	45.38	1.68	24.44
Construction Cost	+10%	23.72	2.65	26.34	28.34	1.75	21.22	19.32	1.96	21.10	68.89	1.89	22.38
	-10%	26.33	3.24	31.22	35.14	2.14	25.81	22.98	2.39	25.31	82.83	2.32	26.94
Traffic Volume	+10%	28.70	3.19	30.51	37.39	2.10	24.91	24.84	2.35	24.66	88.88	2.27	26.16
	-10%	21.35	2.63	26.49	26.09	1.76	21.57	17.46	1.95	21.27	62.85	1.90	22.64

2.13 Implementation Program

The construction period is expected to last for about 30 months which includes two winter seasons each six months long. To achieve mobilization and a start of construction work in the 1999 work season, the tender procedures should take place over the winter period of 1998/1999. Detailed design and prequalification of contractors would run concurrently and be completed by the end of November 1998. Preparation and approval of prequalification documents should be undertaken as soon as possible.

The tentative work implementation is shown in the Fig. 2.13.1.

It is recommended that the detailed design and construction work for this project should be carried out according to standard international practices.

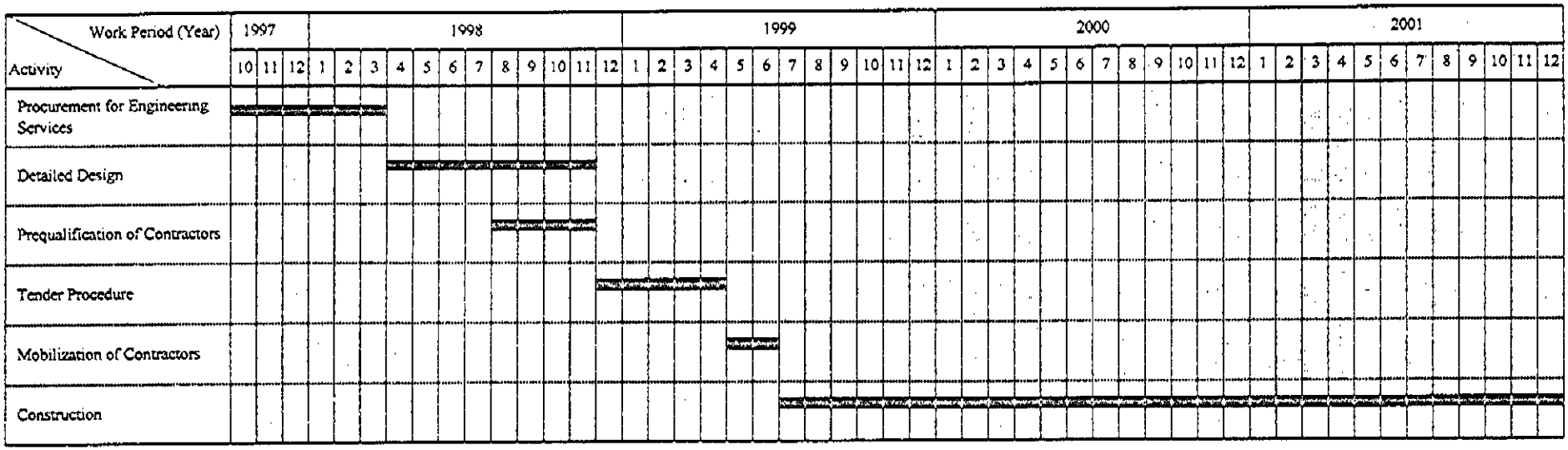
For executing the construction work, the total project has been divided into the following four construction packages as shown below in the Table 2.13.1.

Table 2.13.1 : Construction Packages for the Priority Projects

(unit US$ x 1000)

NO.	Sub-section	Length (km)	Project Cost
1	Kzyl Orda border - Irgiz (1240-1154)	86	19,079
2	Irgiz - Karakuduk (1154-1060)	94	21,908
3	Karakuduk - Karabutak (1060-965)	95	21,697
4	Atyrau - Mahambet (0-83)	83	26,729
	Total	358	89,413

Data Source : JICA study, 1996



Legend ▭ : Winter season
Data Source : JICA study, 1996

Fig. 2.13.1 : Tentative Work Implementation Schedule

2.14 Training

During the course of the study, the Study Team had opportunities for technology transfer to the Department of Roads counterpart staff, and to the staff of Zholdary, Kazdornii and Kazdorproject and other related organizations. Most of this technology transfer was done on-the-job and during the meetings to discuss various aspects of the project.

Items of technology transfer are as follows.

1) Formulation of road network
2) Method of traffic forecast
3) Geometric standards of roads
4) Design of road pavement
5) Design and investigation of bridges
6) Construction cost estimation
7) Maintenance of roads and bridges
8) Method of estimation of vehicle operating cost
9) Environmental considerations
10) Method of economic evaluation

Chapter 3 Findings and Recommendations

3.1 Findings

The JICA Study Team as listed and organized in Chapter 1, conducted the study for one and half year in Kazakhstan and in Japan with close cooperation of the Department of Roads of the Republic of Kazakhstan and other organizations.

Through the study following items becomes clear.

1) Lack of budget after independence of the country has caused road deterioration and dismissal of technical personnel on roads from the government departments.

2) Since the time of the Former Soviet Union, the Government does not pay enough attention to evaluate the quality of pavement and structures, which also causes deterioration of roads and bridges.

3) Considering the recent economic situation and the future development of the country, the Government of Kazakhstan formulated a new road management and budget system at the beginning of this year. This new system is expected to be extended further in near future.

4) The Republican Roads, Local Roads and a part of Asian Highways with a total length 17,000 km form sufficient road network in the four states in Western Kazakhstan.

5) The roads which form the above mentioned road network are mainly in poor condition and the bridges are also not in good condition in order to carry the present traffic.

6) The Feasibility Study on the three road sections shows that the implementation of these sections is economically feasible.

Section No.	Name of Road	Section	Length (km)	Project Cost (1,000US$)	IRR (%)	B/C (12%)
1	Samara-Shimkent	Kzyl-Orda Border to Irgiz	86	19,079	28.55	2.91
2	same as above	Irgiz 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**

7) The technical standards of roads, bridges and their maintenance are formulated but not implemented properly in order to maintain quality.

8) The implementation of the three priority projects is technically feasible and will

have minimal and trivial environmental impact, so further environmental studies are not required.

3.2 Recommendations

1) The implementation of the road improvement project on the three priority projects which have favorable economic evaluation factors, will be useful for the development of Kazakhstan and, strengthening of the road maintenance systems in the Western Kazakhstan.

2) The detailed design and construction work for the three priority projects should be carried out according to standard international practices.

3) In order to realize the project it is necessary to introduce the most modern maintenance and management system. It is also necessary to have personnel training and introduce suitable equipment.

4) Equipment for road maintenance shall be arranged under a suitable organization and staff with the help of foreign funds and also internal funds.

3.3 Training

Based on the observations of the Study Team and, field surveys of existing roads and structures, the following items are recommended for further training.

1) Method of feasibility study and economic evaluation.
2) Cost estimation of construction works.
3) Concept of quality control for construction works and materials.
4) Evaluation of road maintenance and organization.