(5) Major construction methods of the bridges for the Project are shown in following figures.

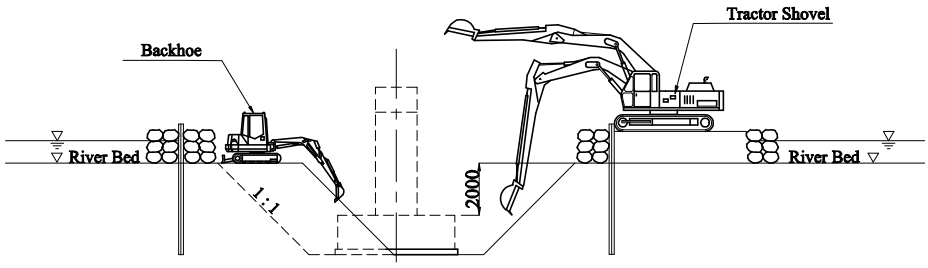


Figure 13-3-6 Excavation and Leveling Concrete for Substructure

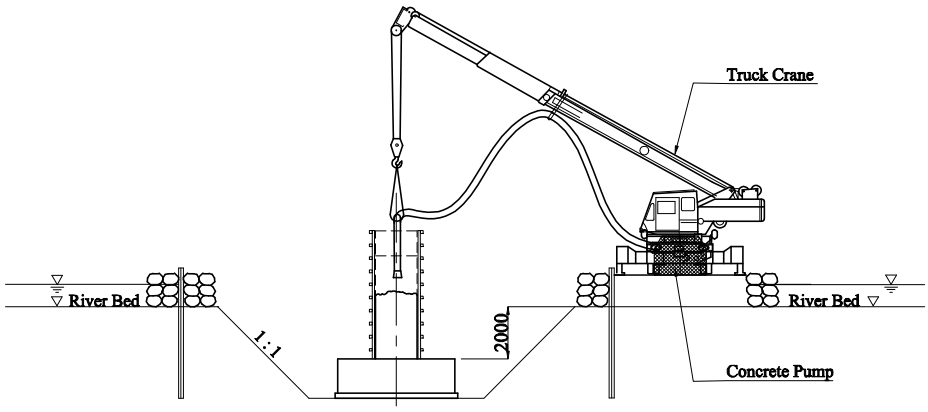


Figure 13-3-7 Pouring Concrete for Substructure

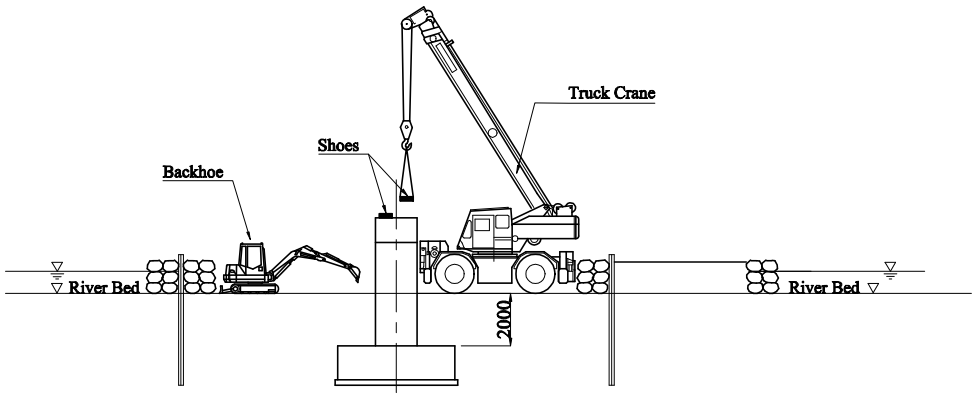
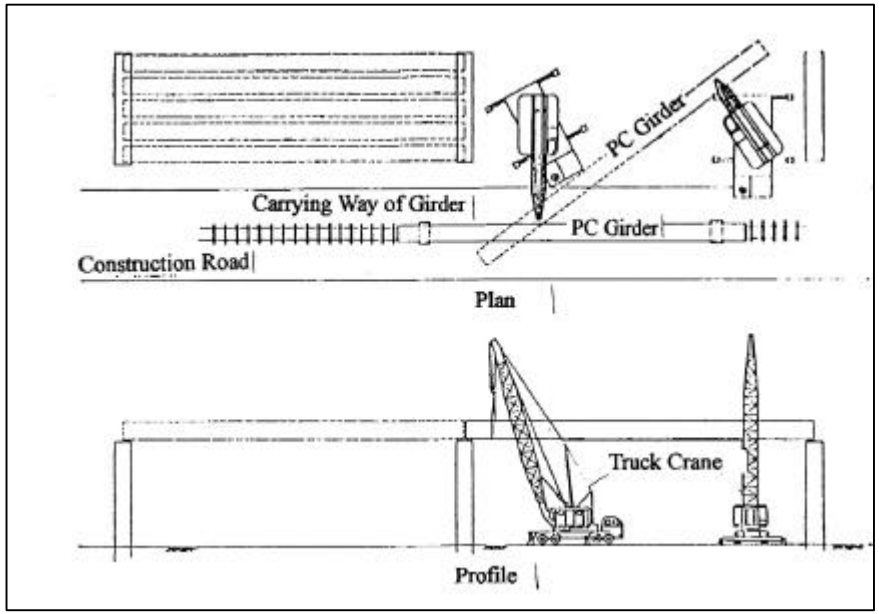


Figure 13-3-8 Backfill and Shoe Setting

***1: Erection of Girder by Self Propelled Crane**

Sequence



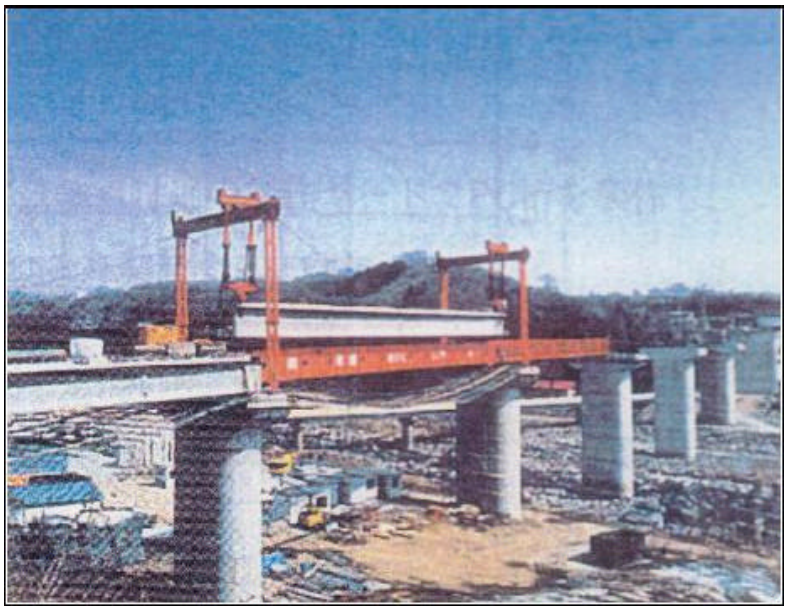
Required Equipment

- Truck Crane or Crawler Crane: 2
- Temporary Steel Panel: one set
- Trailer: 1
- Railing way for carrying girders: one set

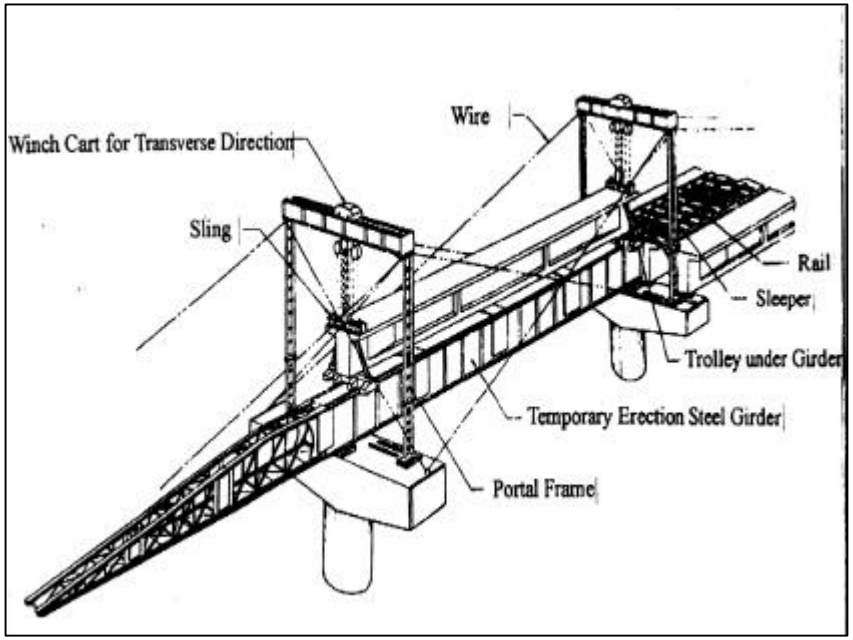
1) To prepare the carrying way (temporary road) for girder and position of crane
2) To set the self propelled crane
3) Carry the girders to the location using temporary road with rail
4) Hang up to fixed position by crane

Figure 13-3-9 Girder Erection Method (1/2)

***2: Erection of Girder by Temporary Steel Girder**



Sequence



Required Equipment

- Temporary Steel Girder: one set
- Winch Cart: two set
- Side Loader: two set
- Portal Frame: two set

1) Pull the girder on the temporary girder by electric winch from approach or erected girders
2) Hang up the girder with sling
3) Set the girder to transverse direction with winch cart
4) Support the girder for safety after setting

Figure 13-3-9 Girder Erection Method (2/2)

(6) Construction Time Schedule

a) Working Days

Considering the conditions of temperature and rain/snow fall in the Project area, mentioned natural conditions, working days at site bridge works are estimated, and shown in Table 13-3-10.

Table 13-3-10 Working Days of Each Month for Project Structures

Month	1	2	3	4	5	6	7	8	9	10	11	12
Approach Road (Earth, Revetment Works)				15	25	25	25	25	25	25	15	
Pavement Work And Concrete Work					25	25	25	25	25	25		

Note —— Works in Site
..... Works in Camp/Casting Yard

b) Construction Time Schedule for Major Work Items

The construction time schedule for major works for Structures are assumed according to working conditions and construction scale of structures.

The examples of construction schedule for bridges and main culverts are shown in Table 13-3-11, Table 13-3-12, and Table 13-3-13.

Table 13-3-11 Construction Schedule for Standard Bridges

Year	1												2											
Month	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
Preparation																	(10 Months)							
Temporary Road																								
Piling/ Foundation																								
Sub Structure																								
Approach Road																								
River Revetment																								
Fabricate of Girder																								
Erection of Girder																								
Cast-in-place, Surface																								
Subsidiary Work																								

Table 13-3-12 Construction Schedule for Kherlen Bridge

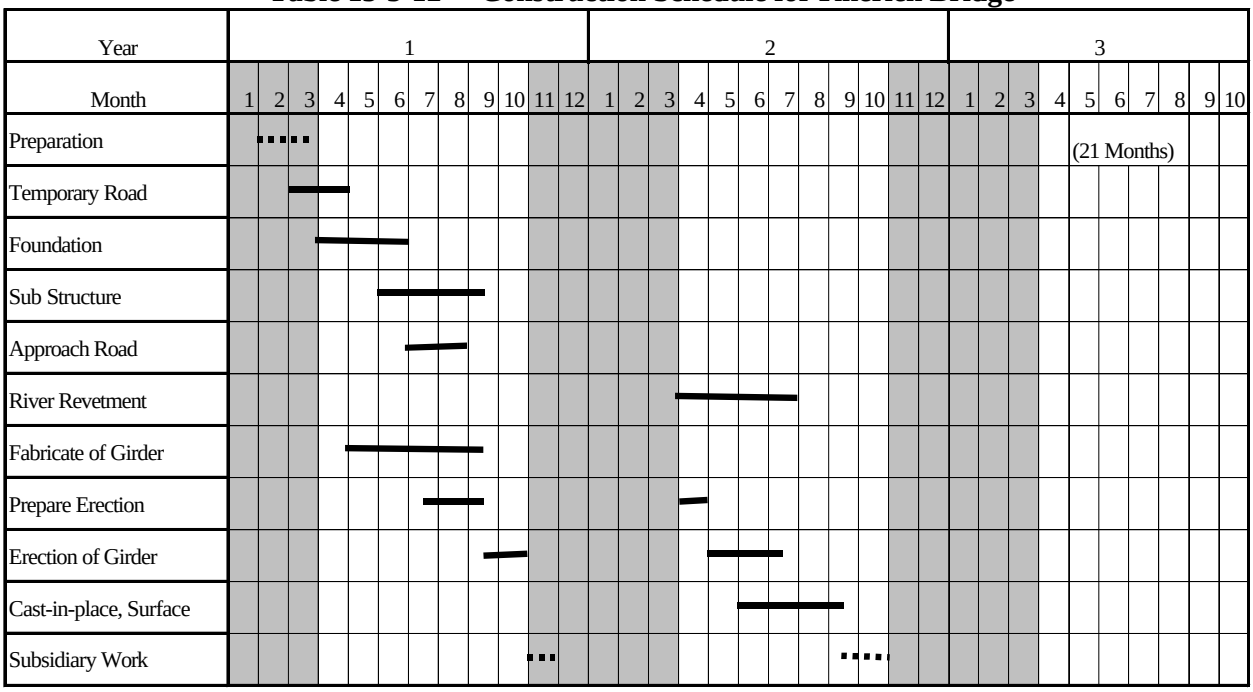
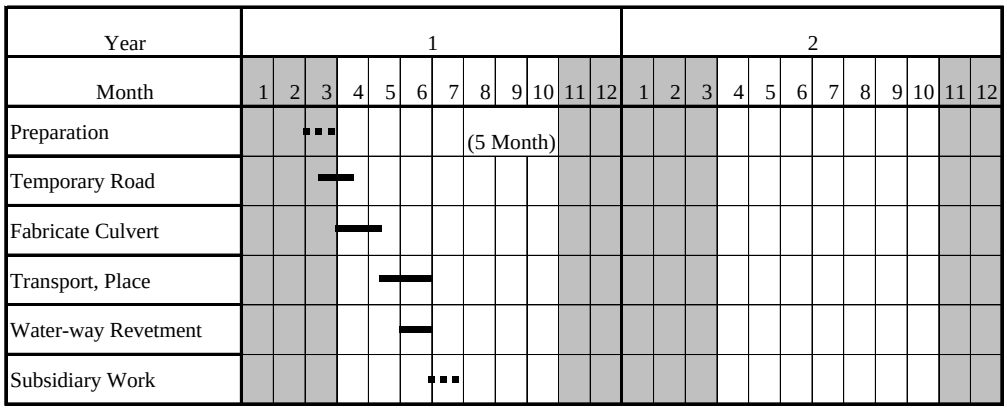


Table13-3-13 Construction Schedule for Main Box Culverts



(7) Equipment for the Bridge Construction

The Governmental and private management Contractors have equipment for the road, bridge and building, etc.

As of year 2001, the equipment in Mongolia (mainly in Ulaanbaatar) is listed below Table 13-3-14 for the bridge construction, especially.

Table 13-3-14 Main Equipment List for the Bridge Construction

Name of Equipment	Specification	Quantity
Motor grader	D3-98(99), 557,122,143,180, GD-511,611	64
Roller, Tire roller, Vibrator roller	DU-16,47,48,50, CP-201,221, CS-12, CA-251	72
Back hoe	EO-2621,3322,4121, JCV-3X, CAT-320,330, PW-150, Solar-200W	65
Tractor shovel	TO-10(18), CAT-910F,938F, WA-180	17
Bulldozer	DZ-42,110(117), D-65,85,155	58
Asphalt finisher	DC-126(143), NF-130DM	15
Crane	KC-2561(5 ton) KC-4561(4361) (16 ton) KC-5363(25 ton) 25t TL-250E 8t FH-2245A	8 22 4 1 1 Total 36
Trailer	40t ChMZAP, 20t ChMZAP, 40t SS-633, 40t SS-2FKSA	9
Dump truck	5-8t 12-15t	194 77
Agitator truck	KAMAZ-54112	6
Scraper	MOAZ-546	12
Water lorry		32
Mobile workshop		5
Tractor	UMZ-6	12
Bitumen lorry	Pheonex PA	6
Bitumen sprayer	DC-39, MUFK615	10
Cement lorry		6
Fuel lorry		10
Truck	ZIL-130, GAZ-53	46

13.3.5 Maintenance Method

(1) Maintenance Works of Bridges

- Execution Procedure for Bridge

The inspection works of bridges are important to improve them quickly for their serviceability and for making the improving costs less.

Example of inspection procedure of bridges is shown in Figure 13-3-10 (Flowchart) to be applied.

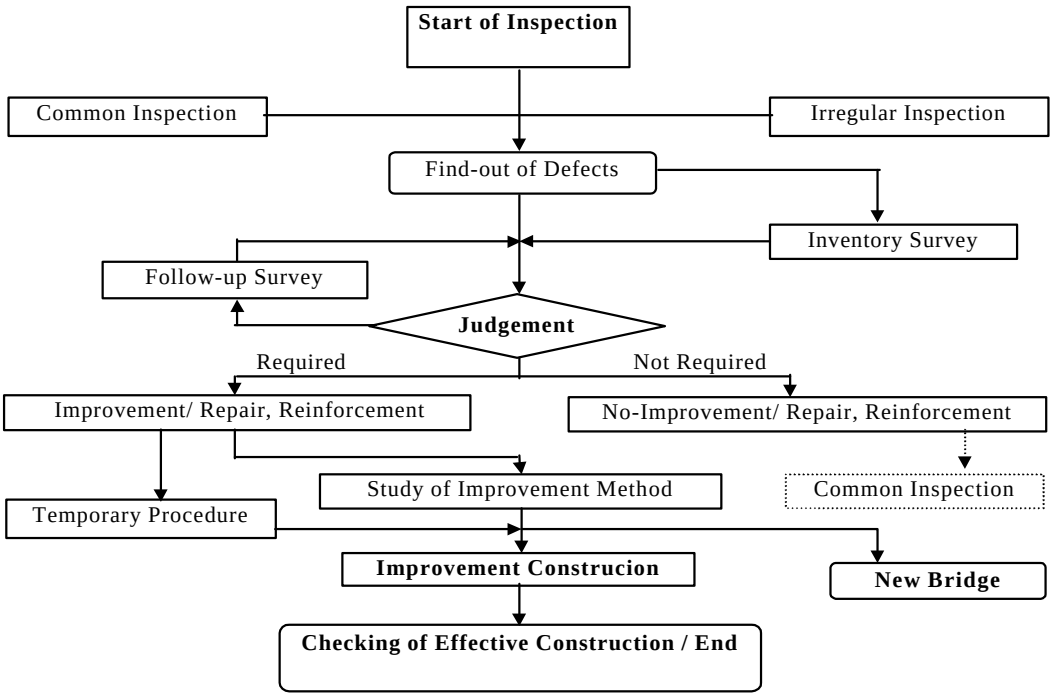


Figure 13-3-10 Flowchart of Maintenance for Bridges

The results of inspection for bridges shall be recorded to sheets with photographs, as Inspection Form in Appendix-C, (Inventory Sheets) which were applied in this Project.

The improving methods for existing Kherlen bridge were reported as mentioned in Chapter 9. Hereinafter, the basic maintenance methods and their works for existing bridges will be expected to execute as shown in Figure 13-3-11.

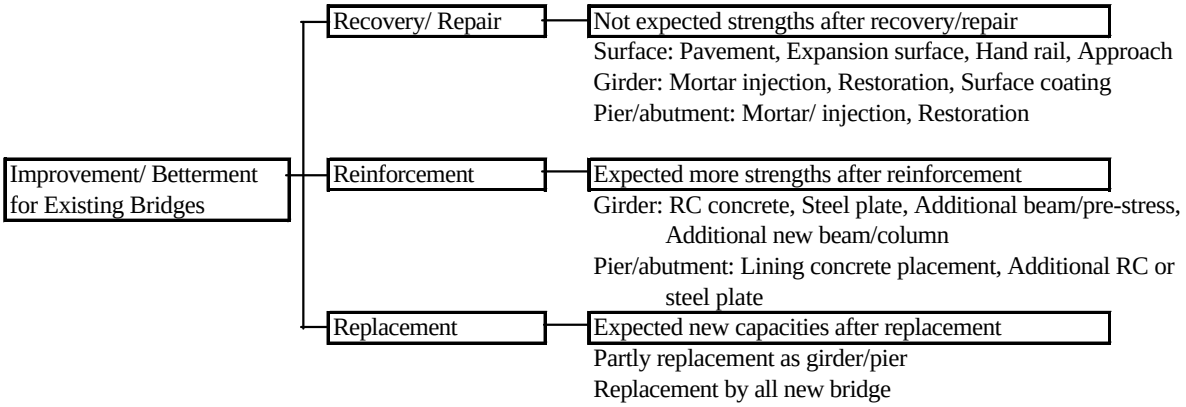


Figure 13-3-11 Basic Maintenance Method for Existing Bridge

(2) Construction Company for Maintenance and Improvement Works

The maintenance and improvement works are mainly ordered to the registered construction companies as below Table 13-3-15.

Table 13-3-15 Construction Company for Maintenance and Improvement Works

Company name	Establish	Engineer	Workers	Others	Total	Main Works
ASBI	1991	9	88	13	110	Road
BAT ZAM	1991	6	15	14	35	Road
GANGUUR	1992	8	90	12	110	Bridge
KHUCHIT ZAM	1991	6	38	14	58	Road
UB-ZAM ZASVAR	1998	5	100	30	135	Road
ERDENE ZAM	1997	14	175	37	226	Road & Bridge
MONROAD	2001	8	50	6	64	Road & Bridge
AZZAN	1999	15	128	37	180	Road

(3) Existing Conditions of Department of Roads (DOR)

a) Organization

Organization of Department of Roads (DOR) including Repair and Maintenance Management Division is shown in Figure 13-3-12.

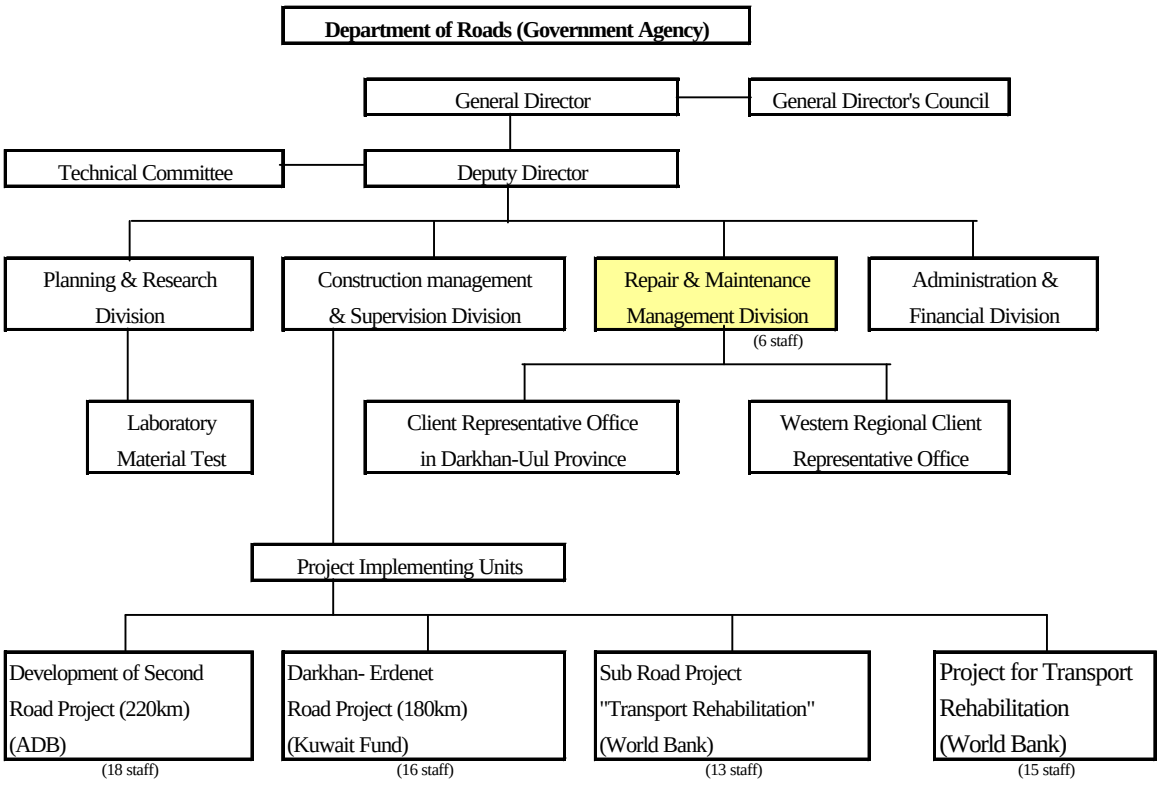


Figure 13-3-12 Organization Chart Related to Maintenance Works of Roads in DOR

b) Annual budget of the executing agency (revenue & expenditure)

The Road Fund is formed of gasoline and diesel fuel taxes and vehicle registration fee as a budget of the DOR shown in Table 13-3-16. The DOR takes hold of the State Road Fund and gives technical advises as an authority specialized in the road sector.

Table 13-3-16 Budget of State Road Fund

(Million Tg.)

	1997	1998	1999	2000	2001.8.20
Road Construction	3,269.6	4,601.6	5,814.7	6,322.8	2,344.6
Road maintenance	911.2	1,297.7	425.1	1,489.9	607.0
Equipment Procurement	180.1	-	182.0	97.3	-
Total	4,360.9	5,899.3	6,421.8	7,910.0	2,951.6
Exchange Rate (Tg/ $)	793.5	865.8	972.0	1,077.7	1,098.0

(4) Activity for Maintenance Works

The construction/ maintenance activities of roads and bridges have been implemented by Governmental State Fund and Road Fund corresponding to Overseas Fund.

Recent Projects of roads and bridges including maintenance/ improvement are listed in Table 13-3-17.

Table 13-3-17 Construction List of Roads and Bridges by State and Road Fund

Year 1999 Project Government Notification No.99-2	Scale	Construction Period	Budget for Year (Million Tg)	Remark
1. paving Road	72.3km	1996-2000	1606.7	
2. Gravel Road, Improve Bridge	20.6km	1995-2000	250	
3. RC Bridge	1749.4m	1994-2001	1955	
4. Wooden Bridge	87.8m	1999-1999	70	
5. Maintenance of Road and Bridge		1999-1999	400	
6. Government Fund for Overseas Loans	576km	1996-2000	4427.4	
Year 2000 Project Government Notification No.136-2	Scale		Budget for Year (Million Tg)	Remark
1. Paving Road	37.5km	1999-2001	150	
2. RC Bridge	1305.4m	1993-2001	1659.9	
3. Wooden Bridge	87.8m	1999-2000	55	
4. Maintenance of Road and Bridge		1999-2000	1400	
5. Government Fund for Overseas loans	987km	1996-2003	5161.4	
Year 2001 Project Government Notification No.36-2				
1. Paving Road	37.5km	1999-2004	560	
2. RC Bridge	772.2m	1994-2002	814	
3. Wooden Bridge				
4. Maintenance of Road and Bridge		2001-2001	560	
5. Government Fund for Overseas loans	727.5km	1996-2004	6188.7	

13.4 Project Cost Estimate

13.4.1 General

Project cost as a financial cost is estimated based on the results of preliminary design, quantity take-off of each work item, and the studies on construction planning and method.

The basic premises of project cost estimates are as follows:

1) The cost is estimated on US Dollar basis, considering the fluctuation of exchange rates against foreign currencies.

2) The unit cost of each cost component is determined based on the economic conditions prevailing in January 2002 (US$ 1.0 = ¥ 133 = 1,100 Togrog).

3) Detailed design and supervisory service costs is assumed to be 7 % of construction cost.

4) The study route is divided into following six (6) sections for the project implementation plan, considering villages and connecting roads.

- Section I: Erdene – Baganuur, 37km
- Section II: Baganuur – Kherlen River East, 30.3 km
- Section III: Kherlen River East – Tsenkhermandal, 49.7 km
- Section IV: Tsenkhermandal – Jargaltkhaan, 44.7 km
- Section V: Jargaltkhaan – Murun West, 50.0 km
- Section VI: Murun West – Undurkhaan, 46.8 km

The cost of Section I that will be completed by the Department of Roads using the Government own fund is referred to the cost estimate made by the Department of Roads.

5) Unit prices of fill materials and fine/coarse aggregates are estimated by every 10 km, considering haling distance of materials from borrow pits and quarry sites individually. Unit prices of pavement are estimated based on the pavement structure designed by each pavement design section.

6) Equipment cost is referred to the local market price as far as they are available. The cost analysis is made in case of special equipment that is not available in Mongolia. Additional equipment will be procured in the proposed road rehabilitation and maintenance center so as to keep supply and demand in balance.

13.4.2 Construction Cost

(1) Basis of Unit Cost of Construction Works

1) The unit cost of each construction work is estimated in principle based on labor costs, material costs, equipment costs prevailing in Ulaanbaatar.

2) The unit costs are analyzed and compared with similar work items of approved engineer's estimate, and they are adjusted as required to obtain more realistic ones.

3) Value Added Tax (VAT) and Income Tax are included in local currency component but excluded in foreign currency component.

4) The cost is split into foreign currency and local currency portions, both indicated in US dollar. Foreign currency and local currency portions of the unit cost of each work item are estimated based on the following classifications:

(a) The foreign currency portion includes but is not limited to the following costs:

- PC wire, sheaths and anchorages for prestressing;
- Temporary steel girder and frame for erection;
- Metal bearing shoes and expansion joints;

- Rubber bearing pads;
- Straight asphalt and emulsion;
- Materials for road supporting facilities; and
- Foreign component of domestic materials.

(b) The local currency portion includes but is not limited to the following costs:

- Portland cement;
- Reinforcing bars;
- Fuel, diesel oil and lubricant
- Salaries and cost of local personnel;
- Overhead and profit of local firms;
- Local component of depreciation and operating/maintenance costs of construction equipment;
- Import duty on imported materials and VAT; and
- Local component of domestic materials.

(2) Economic Indicators

Figure 13-4-1 shows trend of exchange rates against US dollar for five (5) years, and averaged devaluation of 19.7% per annum is found. Figure 13-4-2 shows key macroeconomic indicators of Mongolia. Annual average of inflation based on Consumer Price Index (CPI) is found to be 28.5% per annum.

Then, cost estimate denominated in US dollars in consideration of sharp fluctuations in exchange rate.

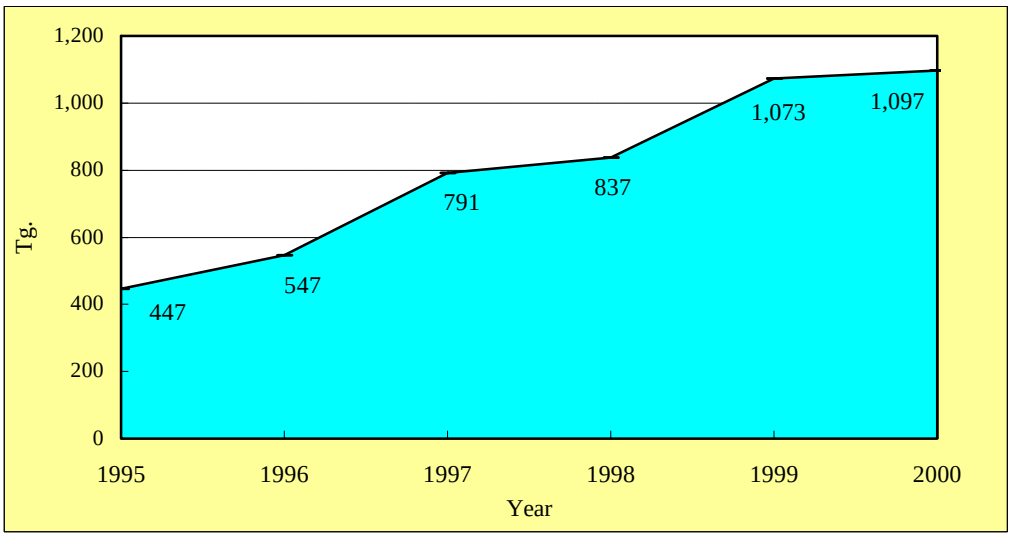


Figure 13-4-1 Trends of Foreign Exchange Rate against US$

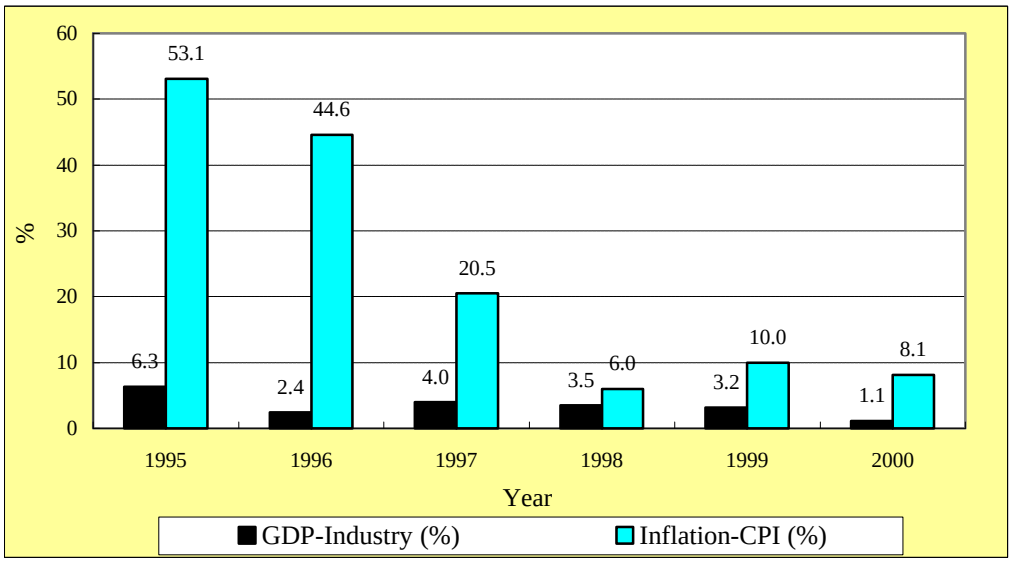


Figure 13-4-2 Key Macroeconomic Indicators

(3) Unit Cost of Labors

Table 13-4-1 shows the unit cost of labors applied to cost estimates, which include such allowances as social benefits, insurance, etc. and are based on eight (8) hours per one working day.

Table 13-4-1 Unit Cost of Labors

Classification	**Total** (US$/Day)
Senior Field Engineer	19.09
Foreman	16.36
Skilled Labor	11.82
Unskilled Labor	9.09
Mason/Carpenter	16.36
Equipment Operator	13.64
Plant Operator	13.64
Driver	9.09

(4) Unit Cost of Materials

Table 13-4-2 shows the unit cost of major construction materials. The cost of imported materials is based on the Ulaanbaatar unloaded prices including handling, clearance charges and import duties (CIP). The cost of domestic materials is based on the market prices in Ulaanbaatar City.

Table 13-4-2 Unit Cost of Major Materials

Materials	Unit	Unit Cost		
		Foreign Portion (US$)	Local Portion (Tg.)	Total (US$)
Gasoline	liter	0	751	0.68
Diesel Fuel	liter	0	450	0.41
Straight Asphalt*	ton	200	0	200.00
Mineral Filler*	ton	0	19,000	17.27
Portland Cement*	kg	0	75,218	68.38
Timber Plank	m^3	0	113,424	103.11
Plywood (12.5mm)	m^2	0	17,182	15.62
Reinforcing Steel (SD 30)	ton	0	497,310	452.10
PC Strand (12T12.7)*	kg	1.888	0	1.89
Crusher-run *	m^3	8.136	2,238	10.17
Pea-gravel	m^3	0	20,543	18.68
Sand (for concrete)	m^3	0	13,446	12.22
Paint	kg	0	2,152	1.96

Notes : 1. Unit Costs of imported goods (marked *) are based on CIF price, i.e. including port handing and clearance costs, plus Mongolian tax and duty.

. Crusher run is average price of sections, including hauling cost at site.

(5) Unit Cost of Equipment

To assist in determining appropriate unit cost for work items, an assessment of hourly costs was made for major plant and equipment, which are likely to be used in the construction of the project roads. The hourly costs comprised depreciation cost, operation and maintenance cost (fuel, lubricants, spare parts, etc.) and management cost. The design life of equipment and usable hours per year were adjusted to reflect local conditions. Table 13-4-3 shows the unit cost of equipment that will be used for major works of road and bridge construction.

Table 13-4-3 Unit Cost of Equipment

Item	Spec./ Capacity	Unit	Unit Cost		
			Foreign Portion (US$)	Local Portion (Tg.)	Total (US$)
Bulldozer	15 ton	hr.	27.10	8,625.00	34.94
Excavator	Backhoe 0.6m^3	hr.	24.29	8,287.50	31.82
Tractor Shovel	1.2 m^3	hr.	19.18	2,418.94	21.38
Truck Crane	15 ton	hr.	0.00	37,996.88	34.54
Truck Crane	20 ton	hr.	0.00	39,375.00	35.80
Truck Crane	40 ton	hr.	0.00	76,920.88	69.93
Crawler Crane	40 ton	hr.	0.00	70,350.00	63.95
Water Tanker	6,000 l	hr.	12.78	1,868.75	14.48
Dump Truck	10 ton	hr.	14.73	5,862.50	20.06
Dump Truck	2 ton	hr.	0.00	19,031.25	17.30
Cargo Truck	2 ton	hr.	0.00	21,600.00	19.64
Motor Grader	W = 3.1 m	hr.	42.95	5,025.00	47.52
Road Roller	Macadam 10~12 ton	hr.	27.31	2,943.75	29.98
Tire Roller	8 ~ 12 ton	hr.	27.31	3,056.25	30.09
Vibratory Roller	4 ton, Combined	hr.	29.76	2,718.75	32.23
Concrete Plant	30 m^3/hr.	m^3	32.08	0.00	32.08
Truck Mixer	4.5 m^3	hr.	0.00	28,200.00	25.64
Asphalt Plant	60 ton/hr.	hr.	40.00	28,000.00	65.45
Asphalt Finisher	2.4 ~ 5.0 m	hr.	67.23	6,768.75	73.38
Air Compressor	17.0m^3/min	hr.	0.00	13,425.00	12.20
Line Marker	10cm, hand guide	hr.	0.00	5,700.00	5.18
Generator	150 kVA	day	0.00	151,500.00	137.73
Generator	2000 kVA	day	0.00	189,000.00	171.82
Erection Girder		each	0.00	202,129.00	183.75
Jaw Crusher	35-85 t/h mobile type	hr.	98.41	8,000.00	105.68
Cone Crusher	40-50 t/h mobile type	hr.	98.41	8,000.00	105.68
Road Sprinkler		hr.	12.78	1,868.75	14.48

(6) Direct Construction Cost

The base cost is obtained to multiply quantity by unit cost and to summarize them by each construction section after totaling them by every 10 km.

The direct construction cost is estimated based on the base cost and additional general cost of 5 % of the base cost which consists of mobilization and demobilization cost, tax and duty and overhead & profit.

(7) Unit Cost for Material Construction Work Items

The unit cost for major construction work items are shown in the Appendix.

(8) Physical Contingency

The physical contingency is estimated as 10 % of Direct Construction Cost to obtain Construction Cost.

13.4.3 Land Acquisition and Property Compensation Costs

The land acquisition cost is ignored because the Government has tenure as the road right-of-way of 100-meter in width form road center, and the project road follows the existing route.

13.4.4 Estimated Project Cost

The summary of project cost at January 2002 prices is shown in Table 13-4-4. The project cost is expressed in terms of financial cost.

Table 13-4-4 Summary of Cost Estimate (1/2)

Base Case: Total Section 258.8km

Alternative-I: All Asphalt Concrete Pavement

AT JAN. 2002 PRICES

Description	Total Financial Cost ($)	Financial Cost of IP Section 1 ($)	Financial Cost of IP Section 2 ($)	Financial Cost of IP Section 3 ($)	Financial Cost of IP Section 4 ($)	
1. Direct Construction Cost	42,870,627	8,531,508	18,736,866	8,691,405	6,910,848	
2. Physical Contingency (10% of 1)	4,287,063	853,151	1,873,687	869,141	691,085	
3. Construction Cost (total of 1&2)	47,157,690	9,384,658	20,610,553	9,560,546	7,601,933	
4. Land Acquisition and Compensation	0	0	0	0	0	
5. Engineering Services	1,302,913	169,722	618,317	286,816	228,058	
6. Supervisory Services	1,737,217	226,295	824,422	382,422	304,077	
Total	50,197,819	9,780,675	22,053,292	10,229,784	8,134,068	50,197,819

Capital Cost $

	Total Financial Cost ($)	Financial Cost of IP Section 1 ($)	Financial Cost of IP Section 2 ($)	Financial Cost of IP Section 3 ($)	Financial Cost of IP Section 4 ($)	
2001	931,818	931,818	0	0	0	931,818
2002	931,818	931,818	0	0	0	931,818
2003	10,732,988	2,747,839	2,987,483	2,557,446	2,440,220	10,732,988
2004	15,182,743	3,353,179	6,018,491	2,557,446	3,253,627	15,182,743
2005	13,842,514	1,816,021	7,028,827	2,557,446	2,440,220	13,842,514
2006	8,575,937	0	6,018,491	2,557,446	0	8,575,937
Total	50,197,819	9,780,675	22,053,292	10,229,784	8,134,068	50,197,819

O/M ($)

	Total Financial Cost ($)	Financial Cost of IP Section 1 ($)	Financial Cost of IP Section 2 ($)	Financial Cost of IP Section 3 ($)	Financial Cost of IP Section 4 ($)	
Routine (annual)	444,620	124,085	158,448	82,815	79,272	444,620
Periodic (year 2012)	4,514,896	952,827	1,834,565	852,166	875,337	4,514,896
Periodic (year 2019)	4,711,497	987,057	1,996,937	852,166	875,337	4,711,497
Road Length (km)	258.8	67.6	94.4	50.0	46.8	258.8

Table 13-4-4 Summary of Cost Estimate (2/2)

Section: Eredene - Undurkhaan L=258.8 km

Alternative-II: Asphalt Concrete Pavement + Bituminous Surface Treatment

AT JAN. 2002 PRICES

Description	Total Financial Cost ($)	Financial Cost of IP Section 1 ($)	Financial Cost of IP Section 2 ($)	Financial Cost of IP Section 3 ($)	Financial Cost of IP Section 4 ($)	
1. Direct Construction Cost	38,752,582	8,531,508	16,704,389	7,614,105	5,902,581	
2. Physical Contingency (10% of 1)	3,875,258	853,151	1,670,439	761,411	590,258	
3. Construction Cost (total of 1&2)	42,627,841	9,384,658	18,374,827	8,375,516	6,492,839	
4. Land Acquisition and Compensation	0	0	0	0	0	
5. Engineering Services	1,167,017	169,722	551,245	251,265	194,785	
6. Supervisory Services	1,556,023	226,295	734,993	335,021	259,714	
Total	45,350,880	9,780,675	19,661,065	8,961,802	6,947,338	45,350,880

Capital Cost $

	Total Financial Cost ($)	Financial Cost of IP Section 1 ($)	Financial Cost of IP Section 2 ($)	Financial Cost of IP Section 3 ($)	Financial Cost of IP Section 4 ($)	
2001	931,818	931,818	0	0	0	931,818
2002	931,818	931,818	0	0	0	931,818
2003	9,744,880	2,747,839	2,672,389	2,240,450	2,084,201	9,744,880
2004	13,736,407	3,353,179	5,363,842	2,240,450	2,778,935	13,736,407
2005	12,401,665	1,816,021	6,260,993	2,240,450	2,084,201	12,401,665
2006	7,604,292	0	5,363,842	2,240,450	0	7,604,292
Total	45,350,880	9,780,675	19,661,065	8,961,802	6,947,338	45,350,880

O/M ($)

	Total Financial Cost ($)	Financial Cost of IP Section 1 ($)	Financial Cost of IP Section 2 ($)	Financial Cost of IP Section 3 ($)	Financial Cost of IP Section 4 ($)	
Routine (annual)	442,858	124,085	157,636	81,905	78,420	442,047
Periodic (year 2008)	777,360	0	0	411,954	365,406	
Periodic (year 2011)	777,360	0	0	411,954	365,406	
Periodic (year 2012)	2,787,393	952,827	1,834,565	0	0	
Periodic (year 2014)	777,360	0	0	411,954	365,406	
Periodic (year 2017)	777,360	0	0	411,954	365,406	
Periodic (year 2019)	2,983,993	987,057	1,996,937	0	0	
Periodic (year 2020)	777,360	0	0	411,954	365,406	
Periodic (year 2023)	777,360	0	0	411,954	365,406	777,360
Road Length (km)	258.8	67.6	94.4	50.0	46.8	258.8

13.4.5 Cost Estimates for Economic Analysis

The financial project costs for economic analysis including the cost of road section between Erdene and Baganuur are shown in Table 13-4-5 respectively for each alternative plan.

Table 13-4-5 Summary of Cost Estimate by Section (1/2)

■ ALT - 1 : Aspalt Concrete Pavement at All Sections

ITEM No.	Description	Section II	Section III	Section IV	Section V	Section VI	Total
		Cost (US$)	Cost (US$)	Cost (US$)	Cost (US$)	Cost (US$)	Cost (US$)
1	Clearing and Surface Stripping	73,083	276,598	251,395	257,962	213,942	1,072,980
2	Excavation	6,529	360,062	162,904	462,380	189,341	1,181,216
3	Embankment	904,040	3,842,241	2,808,091	2,642,946	1,642,822	11,840,139
4	Earth work for raising	25,660	0	0	0	0	25,660
5	Maintaining hauling route	6,980	29,075	26,150	29,250	27,407	118,860
6	Subbase	224,980	881,849	880,825	925,011	858,853	3,771,518
7	Graded Base Course	218,891	912,912	762,342	1,012,253	716,438	3,622,836
8	Bituminous Surface Treatment	0	0	0	0	0	0
9	Asphalt Concrete Surface	457,223	1,885,201	1,692,963	1,896,580	1,775,047	7,707,013
10	Asphalt Concrete Overlay for Ac surface	550,406	0	0	0	0	550,406
11	Asphalt Concrete Overlay for BST surface	81,572	0	0	0	0	81,572
12	Granulaer Shoulder	72,938	297,126	266,828	298,920	279,765	1,215,578
13	Shoulder modification	34,283	0	0	0	0	34,283
14	Kilometer marker posts	2,100	3,500	3,150	3,500	3,220	15,470
15	Guard post	36,680	132,080	54,680	34,600	8,800	266,840
16	Pavement markings	87,600	142,800	127,200	144,000	135,600	637,200
17	Signs	8,960	6,440	10,920	2,800	3,080	32,200
18	Road Station	24,596	0	49,193	24,596	24,596	122,982
19	Obsevation Platform	0	24,596	0	24,596	0	49,193
20	Lined Drain	22,800	109,160	86,800	52,960	16,000	287,720
21	Culvert Type A (1 @ 1.0m dia)	37,908	227,449	124,555	135,386	135,386	660,686
22	Culvert Type B (1 @ 1.5m dia)	16,940	135,520	118,580	110,110	101,640	482,790
23	Culvert Type C (2 @ 1.5m dia)	12,306	61,532	61,532	73,838	12,306	221,515
24	Culvert Type D (1 @ 2.5m x 2.5m)	0	106,402	53,201	17,734	35,467	212,804
25	Culvert Type E (2 @ 2.5m x 2.5m)	0	128,077	76,846	51,231	51,231	307,385
26	Culvert Type F (3 @ 2.5m x 2.5m)	0	32,525	97,576	32,525	0	162,627
27	Culvert Type G (3 @ 3.0m x 3.0m)	0	0	0	0	0	0
28	Bridge Type 1 (l = 15.0m)	92,005	0	92,005	0	0	184,009
29	Bridge Type 2 (l = 17.5m)	102,885	0	0	0	0	102,885
30	Bridge Type 3 (l = 35.0m)	0	0	0	0	0	0
31	Bridge Type 4 (l = 52.5m)	0	0	308,673	0	308,673	617,345
32	Bridge Type 5 (l = 70.0m)	0	0	0	0	0	0
33	Bridge Type 6 (l = 268.8m)	1,778,217	0	0	0	0	1,778,217
34	Environmental countermeasure for borrow pit	5,336	30,510	11,521	11,282	548	59,198
35	Environmental conuntermeasure for quarry	3,142	8,316	9,101	0	13,814	34,373
36	Slope for domestic animal crossing	3,090	6,180	11,331	3,090	0	23,691
37	Planting tree	0	0	545	727	873	2,145
38	Reinstate of hauling road	7,020	29,250	26,325	29,250	26,910	118,757
39	Total	4,898,170	9,669,402	8,175,232	8,277,529	6,581,760	37,602,092
40	General	244,908	483,470	408,762	413,876	329,088	1,880,105
	Construction Cost	5,143,078	10,152,872	8,583,994	8,691,405	6,910,848	39,482,197

Note : 1 US$ = 1,100 Tg

Table 13-4-5 Summary of Cost Estimate by Section (2/2)

■ ALT - 2 : Both Aspalt Concrete Pavement and Bituminous Surface Treatment

ITEM No.	Description	Section II	Section III	Section IV	Section V	Section VI	Total
		Cost (US$)	Cost (US$)	Cost (US$)	Cost (US$)	Cost (US$)	Cost (US$)
1	Clearing and Surface Stripping	73,083	276,598	251,395	257,962	213,942	1,072,980
2	Excavation	6,529	360,062	162,904	462,380	189,341	1,181,216
3	Embankment	904,040	3,842,241	2,808,091	2,642,946	1,642,822	11,840,139
4	Earth work for raising	25,660	0	0	0	0	25,660
5	Maintaining hauling route	6,980	29,075	26,150	29,250	27,407	118,860
6	Subbase	224,980	881,849	880,825	925,011	858,853	3,771,518
7	Graded Base Course	218,891	912,912	762,342	1,012,253	716,438	3,622,836
8	Bituminous Surface Treatment	0	0	0	870,580	814,793	1,685,373
9	Asphalt Concrete Surface	457,223	1,885,201	1,692,963	0	0	4,035,386
10	Asphalt Concrete Overlay for Ac surface	550,406	0	0	0	0	550,406
11	Asphalt Concrete Overlay for BST surface	81,572	0	0	0	0	81,572
12	Granulaer Shoulder	72,938	297,126	266,828	298,920	279,765	1,215,578
13	Shoulder modification	34,283	0	0	0	0	34,283
14	Kilometer marker posts	2,100	3,500	3,150	3,500	3,220	15,470
15	Guard post	36,680	132,080	54,680	34,600	8,800	266,840
16	Pavement markings	87,600	142,800	127,200	144,000	135,600	637,200
17	Signs	8,960	6,440	10,920	2,800	3,080	32,200
18	Road Station	24,596	0	49,193	24,596	24,596	122,982
19	Obsevation Platform	0	24,596	0	24,596	0	49,193
20	Lined Drain	22,800	109,160	86,800	52,960	16,000	287,720
21	Culvert Type A (1 @ 1.0m dia)	37,908	227,449	124,555	135,386	135,386	660,686
22	Culvert Type B (1 @ 1.5m dia)	16,940	135,520	118,580	110,110	101,640	482,790
23	Culvert Type C (2 @ 1.5m dia)	12,306	61,532	61,532	73,838	12,306	221,515
24	Culvert Type D (1 @ 2.5m x 2.5m)	0	106,402	53,201	17,734	35,467	212,804
25	Culvert Type E (2 @ 2.5m x 2.5m)	0	128,077	76,846	51,231	51,231	307,385
26	Culvert Type F (3 @ 2.5m x 2.5m)	0	32,525	97,576	32,525	0	162,627
27	Culvert Type G (3 @ 3.0m x 3.0m)	0	0	0	0	0	0
28	Bridge Type 1 (l = 15.0m)	92,005	0	92,005	0	0	184,009
29	Bridge Type 2 (l = 17.5m)	102,885	0	0	0	0	102,885
30	Bridge Type 3 (l = 35.0m)	0	0	0	0	0	0
31	Bridge Type 4 (l = 52.5m)	0	0	308,673	0	308,673	617,345
32	Bridge Type 5 (l = 70.0m)	0	0	0	0	0	0
33	Bridge Type 6 (l = 268.8m)	1,778,217	0	0	0	0	1,778,217
34	Environmental countermesure for borrow pit	5,336	30,510	11,521	11,282	548	59,198
35	Environmental conuntermesure for quarry	3,142	8,316	9,101	0	13,814	34,373
36	Slope for domestic animal crossing	3,090	6,180	11,331	3,090	0	23,691
37	Planting tree	0	0	545	727	873	2,145
38	Reinstate of hauling road	7,020	29,250	26,325	29,250	26,910	118,757
39	Total (Base Cost)	4,898,170	9,669,402	8,175,232	7,251,529	5,621,506	35,615,838
40	General	244,908	483,470	408,762	362,576	281,075	1,780,792
	Direct Construction Cost	5,143,078	10,152,872	8,583,994	7,614,105	5,902,581	37,396,630

Note : 1 US$ = 1,100 Tg

CHAPTER 14 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

CHAPTER 14 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

14.1 Objectives of Environmental Impact Assessment

This Chapter presents the results of the Environmental Impact assessment (EIA) for the Feasibility Study on Construction of the Eastern Arterial Road (EAR) in Mongolia which covers 258.8 km of National Road No.501 from Erdene to Undurkhaan.

14.1.1 Scope of Work for EIA

According to the IEE evaluation and the Schedule and direction of EIA by Information, Monitoring and Assessment Department of Ministry of Nature and Environment (MNE), JICA Study Team has set the Scope of work for EIA as follows.

(1) Social Environmental Conditions

1) Socioeconomic condition

- Assessment of socio-economic affect of the project
  Road crossing of local community people and livestock, safety traffic management and measures.

2) Quarry site

- Making optimal selection on location of quarry sites with widely distributed materials, and define their resources, making plan of recovery measures.

3) Urbanized area

- Formulation and reflection of proposals on construction of the road in accordance with the regulations on urbanization.

4) Solid waste management system including surplus soil during construction stage

- Management of construction waste, solid waste and surplus soil.
- Disposal site for these waste materials and their impacts, considerations and mitigation measures.

5) Territories of historical heritage and specially protected areas

- To define areas with ancient heritage, and to plan measures for their protection if the planned road is situated nearby.
- Determination of boundaries of specially protected and surrounding areas, and mention required measures.

(2) Natural Environmental conditions

1) Hydrological conditions

- Determination in detail catchments area, length, minimum and maximum width and distribution density of rivers, streams and dry washes crossed by the project road.
- Conducting detailed hydrological study of rivers, streams and dry washes not covers by the IEE study.
- Detailed calculation of water conduction facilities and formulate measures to mitigate affect to river and streams and dry washes basins.
- To define changes and stability of riverbed because of periodic cycle in years with low and high water level and to find out its affect.
- To calculate inundation water discharge and to find out its affect.
- Detailed calculation and measurement of objective sections by the road shall be made.

2) Soil

- Agro-chemical study of soil.
- Assessment of existing condition of soil erosion.
- Determination of basic condition of soil quality of the right of way along the road.
- Assessment of surface soil, rock and their stability.
- Determination of parameters of gradient of probable erosion, and formulating of actions to mitigate negative affect.
- Determination of permafrost distribution, and assessment of its affect. Boring test at locations of Murun area and other locations identified.

3) Flora and fauna species

- To define list and distribution of flora of the area to be affected by the road construction, to make conclusion on existence of rare and very rare flora and in case of their being affected by the construction, and to estimate cost for their protection and transplantation.
- Determination of location, distribution and quantity of fauna in the current area, and to define negative affect by the project implementation.
- Assessment of road crossings appropriate for fauna migration.

4) Pollution

- Determination of weather (atmospheric air) conditions and changes of the current area and its probable affect to the project works.
- Based on road capacity and expected traffic, to define level of exhaust gas and other pollutants to be spread into air, dust, noise during the road construction and operation in the populated areas.
- To define optimal introduction of plants and trees for neutralization of noise and pollutants in populated areas.

5) Formulation of nature and environment protection plan and monitoring program.

6) Assessment of probable accidents that may occur due to project implementation and natural calamities, and mention in the report measures for their prevention, mitigation and clearance.

- Environmental protection and risk management during the construction and operation stage.

14.1.2 Survey Methods

(1) Interview and field Survey with Environmental Experts

- Experts related to environment of Mongolia

(2) Field Exploration Survey

- Video and photographs to ensure/confirm all data collected

The objective of data analysis is to evaluate the anticipated impact which might be caused by construction of road. The works of EIA have been conducted in accordance with Mongolian Environmental Laws, and relevant administrative guidelines of Tuv province and Baganuur, Khentii province and Undurkhaan city.

Recommendation on Environmental conservation measures, management and control, monitoring plan have been made. Outline cost estimation for environmental mitigation measures and monitoring have been calculated.

14.1.3 Implemented Schedule of EIA

The works of EIA have been conducted in according to the following schedule.

Collection of data: Period of the end of September to early November 2002

Data analysis for EIA: Period of the middle of October to early December 2002

Site Exploration: Period of the end of September to early November 2002

- Assigned local consultants

The main researches of the detailed evaluation work on impacts on the EAR to the environment have been made by local consultants Eco-Trade with participation of specialists: Drs A.Bold, D.Bazargur, and Drs of Ch.Gonchigsumlaa, D.Dorjsuren, R.Battumur, J.Puntsagdulam, O.Enkhmaa, G.Namkhaijantsan, T.Munkhbat, D.Enkhbayar, Ts.Enkhmaa, Ya.Jambaljav, Ts.Sugar, A.Tsend-Ayush; specialists and scientists of the Department of geography and geology of the Mongolian National University; NERIL; analysis laboratory of the Scientific and Technical University; the construction, engineering and expedition company "Tavan undes"; the Institutes of Geography, Geoecology, Botany, Biology, History of Academy of Science; research department on meteorology of EIOM; and other organizations.

14.1.4 The EIA Report and Evaluation by MNE

The EIA study has been finalized by the local consultant and the EIA study report has been submitted to the Ministry of Nature and Environment (MNE) for its evaluation.

14.2 Socio-economic Environmental Impact Assessment

14.2.1 Environmental Assessment on Socio-economic Condition

(1) Local community and administration

The rural settlements along the eastern main road have informal social and economic dependence on Baganuur and Ulaanbaatar. Some settlements as Jargaltkhaan, Tsenkhermandal sums and the province center get their fuel energy needs by transported coal from "Chandgana" coal mine. These sums are in constant close relationship with each other, because nomadic livestock breeders settle for a while in the territory of other sums. By the construction of the EAR, relationship between the settlements along the road must be improved and so it would positively influence in socio-economic conditions.

(2) Population and Socio-economic conditions

Population density is lower in these rural areas (0.5 to 3 peoples per km^2) than in the settled areas.

In last 10 years, the urban population has increased 1.5 to 2 times with rural population growing along the road. According to the data of the Ministry of Infrastructure and Development, by 2010 the population of Erdene sum is expected to increase to 750, Jargaltkhaan and Murun 900, "Chandgana" town 2,500, and Undurkhaan 18,500.

(3) Employment structure

Center of sum and other settlements play different roles in socio-economic terms. For instance, Erdene and Bayandelger sums are engaged in livestock and agriculture.

Chandgana is engaged in coal mining. Murun has business of livestock husbandry and vegetable farming and Tsenkhermandal sum has non-ferrous metals mining and agriculture. A center of the sums has more of an administrative function than an economic function.

Regarding employment structure of this region, 20% of the labor force works in Baganuur in government organizations and 55% are engaged in coal mining. However, over 70% of population of Erdene, Tsenkhermandal, Jargaltkhaan and Murun sums is engaged in cattle breeding activities. Of the settled people engaged in Chandgana mining, about 30% used to work in Chandgana crop farming.

(4) Income distribution

Income distribution of the peoples in large settlements such as Baganuur and Undurkhaan varies widely. About 10% of population belongs to large production-trade companies, small and medium enterprises, and businesses; their annual income is more than 2,000 USD. Over 60% of the population has an average annual income of 400 to 600 USD. As for Undurkhaan town, this average is not more than 500 USD.

In the rural area, the income level is not so variable, but it depends on occupation. Monthly income of people who live in the center of the sum and work in government organizations is lower than of herdsmen who work along the road. In these sums, an average monthly salary of government employees is Tg 70,000.

Impacts of the project on socio-economic conditions

Regarding EAR project assessment results for both possible negative and positive impacts to socio-economic conditions are as follows:

1) Negative impacts on socio-economic conditions

   a) Possible negative impact on cattle breeding moving activity.
   b) Probability of some accidents due to unregulated activities of community inhabitants and cattle.
   c) Generated noise may negatively influence people living close by.
   d) Increased traffic volume may negatively affect health condition of the inhabitants.

2) Positive impacts of the project on socio-economic conditions

   a) Since the road will become a main trunk axis for rural people, their income should increase.
   b) The road will allow flexible traveling.
   c) Infrastructure networks will be developed.
   d) The land for pasture will increase.

e) Employment opportunity will increase widely in the region.
f) Time and fuel spent for driving and transport will be saved.
g) Generation of new settlements along the road will positively affect the life style of cattle breeders.

Assessment of the project impacts on socio-economic conditions

The following Table 14-2-1 shows the comparative estimation of positive and negative impacts of the EAR on socio-economic conditions.

Table 14-2-1 Assessment Results of Positive and Negative Impacts on Socio-economic Conditions

No	Negative impacts	Assessment	Positive impacts	Assessment
1	Possible negative impact on cattle breeding moving activity	Medium negative impact	Since the road will become the main trunk axis for rural people, their income should increase.	Specially important positive
2	The road might influence normal conditions of the settled population.	Less negative impact	The road begin to stimulate new business and activity such as trading, food selling, hospitals, schools and energy supply along the road.	Much important positive impact
3	The noise level may negatively influence people living close by.	Intensive negative impact	EAR will become an important function for regional development. Small settlements may generate along this road.	Specially important positive impact
4	Increased traffic may negatively affect health condition of inhabitants.	Medium negative impact	Infrastructure network will be developed. The sum centers and small settlements along the road will develop.	Specially important positive impact
5	—	—	With the asphalt paved road, use of multi-trails will be reduced by 20 times and new pasture land will be gained (est. 1,092 more hectares).	Much important positive impact
6	—	—	Employment opportunity will increase region-wide	Much important positive impact
7	—	—	The time and fuel spent by driving and transport will be saved.	Much important positive impact
8	—	—	Generation of new settlements along the road will influence positively on the cattle breeders' lifestyle.	Much important positive impact
Assessment results		Total of 8 positive and 4 negative impacts: 25% of them have much importance, 41.7% special importance, 8.3% intensive negative impact, 16.7% medium negative impact and 8.3% less negative impacts. Hence, this project has special importance and less negative impacts on socio-economic condition of the country.		

According to the assessment, positive impacts of EAR on socio-economic conditions are dominant and EAR will play an increasingly important role in the community life of peoples in the region. As one of mitigation measures figure 14-2-1 shows provision of a service area with gas station and restaurant and figure 14-2-2 shows safety consideration of slope for cattle crossing with caution sign installation along EAR.

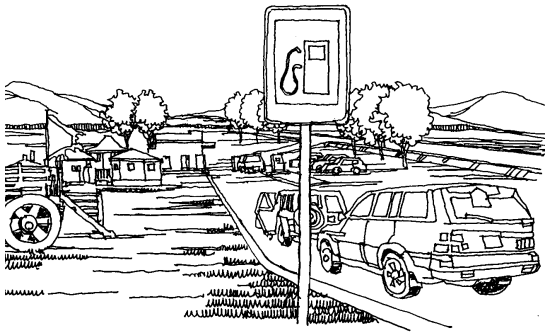


Figure 14-2-1
Service Area with Gas Station and Restaurant

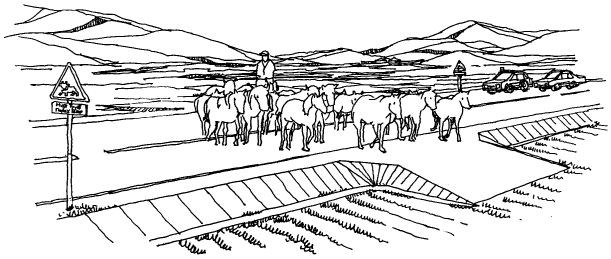


Figure 14-2-2
Slope for Cattle Crossing and Signs

(5) Mitigation measures for negative impacts

a) To install warning and traffic regulating signs
b) To provide road crossings at critical places along the road.
c) EAR must not disturb the required crossing movement of people and cattle.
d) The road must not disturb moving and migration activities of wild animals.
e) People, cattle and vehicles that cross on the road must not disturb main traffic flow on the road.
f) To regulate crossing movements on the road for cattle breeders
g) To regulate traffic control within the settlement and town areas.
h) To protecting people from generated noise by driving vehicles, some planting of trees is required in the settled areas.

14.2.2 Impact Assessment on Quarry Sites

(1) Briefing on geo-environment and quarries

During the investigation, 26 quarry sites have been selected as for most suitable sites along EAR. In these quarry sites, surface soil consists of dark chasten sand and loam of alluvium origin. The depth of the surface layer is 15 to 50 cm, and it contains the root systems of vegetation. The following materials have been selected for extraction and are expected to be used in road construction.

1) Granite

Granite is expected to be extracted from two sites: the hill in the northern side of Erdene sum and Tumur Mountain which is situated 3 km on the northeast side of Kherlen bridge.

2) Other rocks

The widespread occurrence of weathered tuff and andesite in the northern parts of Murun sum could be used as aggregate. Jargaltkhaan Mountain is formed from basalt and its quality is suitable for aggregate. Also there is a rock sites 1 to 3 km northeast from Dutluur hill and it is possible to use it for aggregate.

(2) Possible sites for the quarries

The following quarry sites shown Table 14-2-2 can be used for gravel, sand and aggregate for the construction of the road and embankment.

Table 14-2-2 Location of Quarry Sites and Materials

No	Location	GP location		Material	Remarks
		Latitude	Longitude		
1	Erdene	47.44. 11	107. 47. 47	Granite	Operated now
2	The northeast side from Dutluur mountain	47. 42. 83	107 .57 .01		New
3	Tumur ulgii	47. 42 .93	108 .25 .84	Granodiorite	Used for a while
4	The east side of Kherlen bridge	47. 41. 71	108. 31. 61	Diorite	New
5	4 km on the east side from ZAYAT mountain	47. 47. 23	108. 39. 72	Diorite	New
6	Tag mountain	47. 40. 52	109. 08. 20	Quartz granite	Left
7	Khamar davaa	47 .34 .07	109 .13 .99	Granodiorite	Weathered part
8	Salbar mountain	47 .23. 23	110. 07. 24	Granite	Weathered part
9	Ikh del mountain	47 .23 .39	110 .16 .84	Granodiorite	New
10	The north side of Ikh del mountain	47 .23. 80	110. 17. 44	Diorite	New
11	Delger mountain	47 .23 .30	110 .23 .20	Tuff	New
12	Bayanmunkh mountain	47 .24. 39	110. 35. 89	Tuff	Used in 1970
13	The old mine in Tsenkhermandal	47. 40 .64	109 .07 .96	Gravel	Less resource

(3) Impact of the project on quarry sites

Whetstone, rock and sand are indispensable materials used in road construction. Excavation of these materials from the quarry sites may have following negative and positive impacts.

1) Negative impact of quarry sites

a) To generate noise during explosions, if any.
b) To generate noise during operation.
c) Dust generates during operation.
d) To degrade the natural landscape due to excavation activities.
e) To affect underground water (if any) and possibility to pollute.
f) Quarry pit as dangerous place for animals or cattle to drop in.
g) To cause mammals, insects and rodents to escape from the area.
h) To disturb surface soil and plant vegetation by erosion due to excavation and transport activities.

2) Positive impacts of the project to geo-environment by supply of quarry materials

a) To contribute mitigation of some active geo-dynamic phenomena (such as eroding on the hydrological sections, sliding etc) by supplying the materials for the construction of the road and bridges.
b) Through supplying materials, to contribute to the protection of river sections through the construction where the facility is implemented for reducing damages and corruption of the riverbank.
c) To contribute to stopping of multi-trails by the EAR construction through supplying materials.

(4) Impact assessment results on quarry sites

The results of negative and positive impacts of quarry sites for road construction are shown in Table 14-2-3.

Table 14-2-3 Assessment Results of Positive and Negative Impacts of Quarry Sites

No	Negative impacts	Assessment	Positive impacts	Assessment
1	To have much noise from explosions.	Intensive negative impact	To mitigate some active geodynamics such as erosion sliding and damage by supply of construction materials.	Important positive impact
2	To have much sound and noise during the operation of extraction and processing.	Intensive negative impact	To mitigate impact of damage and corruption of the river in parts where the facilities are installed by supply of construction materials.	Important positive impact
3	Dust generating during extraction activities.	Intensive negative impact	To contribute to stopping of multi-trails by supplying important materials for the construction.	Important positive impact
4	To degrade the natural landscape.	Medium negative impact	—	—
5	To affect underground water (if any) and cause pollution.	Less negative impact	—	—
6	To cause mammals, insects and rodents to escape during operation.	Less negative impact	—	—
7	To pose a danger for animals or cattle by deep excavation pits.	Medium impact	—	—
8	To disturb surface soil and plants by erosion due to excavation and transport activities.	Intensive negative impact	—	—
Assessment results		27 % of them have positive important impacts, 50% of all negative impacts are intensive impact, and 25% of them have medium impacts. As a conclusion, the quarry sites have intensive negative impact on the geo-environment.		

(5) Mitigation measures for negative impacts

The following measures should be taken in order to mitigate the negative impacts of the quarry sites:

It is vital to select the proper location, field, and the amount of materials for the following reasons:

a) Quarry sites must be located far from settlements or towns
b) Quarry sites must not be located in zones of special protected areas (SPA), near natural resource or historical monuments, in zones of forest protection or rare plants, or nearby water sources.
c) Quarry sites must not be located too close to flow of water, drainage areas or road.

d) It is necessary to remove fertile soil layer of 20 to 30 cm thickness, to keep it separately at the storage area, to have all protective measures in case of explosions, and to operate without dusting.
e) It is vital to recover the excavated pits by applying fertile soil on slope surfaces and edges. Also, the excavated pits could be reformed as a basin for surface water storage.

The main items to monitor are depth of the quarry, height of the heaped edge and slope, total area, used material amounts, etc.

14.2.3 Environmental Assessment on Urbanized Area

(1) Impacts of the project on urbanized areas

Regarding EAR project, , the following are both possible negative and positive impacts to urbanized areas.

1) Negative impacts on urbanized areas

a) Probability of accidents due to unregulated activities of community people and cattle.
b) The generated noise will negatively influence the people of the settlements.
c) The increased traffic volume may negatively affect health condition of the inhabitants.

2) Positive impacts of the project on urbanized areas

a) Increased accessibility and advantages of movement for people through EAR.
b) Infrastructure network will be developed and reinforced.
c) Employment opportunity will be increased region-wide.
d) Establishing of new settlements will positively influence the lifestyle of cattle breeders.

(2) Assessment of the project impacts on urbanized areas

The following Table 14-2-4 shows assessment results of positive and negative impacts on the urbanized areas of EAR.

Table 14-2-4 Assessment Results of Positive and Negative Impacts on Urbanized Areas

No	Negative impacts	Assessment	Positive impacts	Assessment
1	It might interfere with the normal lifestyle of settlers	Less negative impact	Accessibility to the road brings big advantages: generate more service facilities as trading, food selling, hospitals, schools and energy supply along the road which will be good for communities.	Much important positive impact
2	Generated noise will negatively influence the people of the community if the road is near by settlements.	Intensive negative impact	EAR will become important for community development, and it may support small settlement to become larger and also to generate new settlements.	Specially important positive impact
3	There might be negative affects on health condition of people.	Medium negative impact	Infrastructure network will be developed. The sum centers and small settlements along the road will develop and become bigger.	Specially important positive impact
4	—	—	Asphalt paved road will reduce existing multi-trails. These lands will decrease by 20 times and pasture land will increase by more than 1092 ha.	Much important positive impact
5	—	—	Generating new settlements will positively influence lifestyle of cattle breeders.	Much important positive impact
Assessment results		Total 5 positive and 3 negative impacts. The project has special importance and less negative impacts on urban areas along EAR.		

According to the assessment, positive impacts of EAR on urban areas are dominant and the road will play an important role for the urbanized areas.

(3) Mitigation measures for negative impacts

a) To install warning and traffic regulating signs.
b) To provide road crossings at critical places.
c) EAR must not disturb the required crossing movement of people.
d) People and vehicles that cross on the road must not disturb the main traffic flows on EAR.
e) To regulate traffic in the settlements and towns.
f) For mitigation of noise level generated by driving vehicles, some planting of trees are to be provided in the settled area.

As a mitigation measure, figure 14.3 shows provision of rows of tree planting nearby settlements on both sides of EAR.

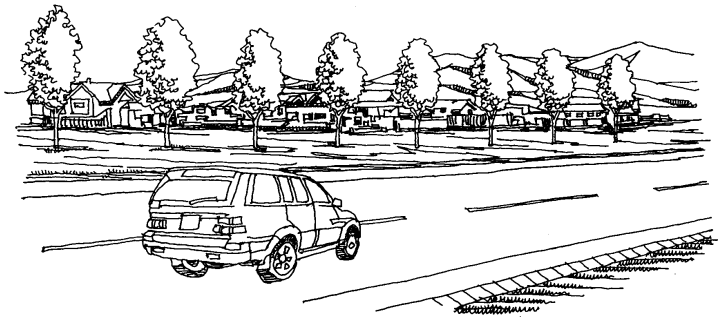


Figure 14-2-3 Tree Planting near by Settlement Area for Environmental Mitigation

14.2.4 Impact Assessments of Protected Areas and Historical Monuments

(1) Review and main characteristics of protected areas and historical monuments

There are some natural aesthetic areas and historical monuments along EAR as follows:

a) Tsenkher River: the River once was noted in the famous ancient Mongolian book "Secret history of Mongolia" as Sengur. Then the name was changed to Tsenkher, which is literally translated as "Blue".
b) Baganuur coal mine: The coal mining site is also the home of the famous Mongolian writer D.Natsagdorj, and Lake Gun Galuutai is situated near there.
c) Burgi coast: The coast is mentioned in the "Secret history of Mongolia." The name could have originated from the name Burkh (literally could be translated as Cover) because of its location near the Rivers Burkh and Baidrag.
d) Kherlen River: One of the largest and most famous rivers of Mongolia. The total length of the river is 1,264 km. The river is rich in fishes, ruff, pike, etc, as well as many species of waterfowl and birds.

(2) The ancient historical monuments and review of their protection

Under the state policy of protecting nature and environment, it is important to provide ecological balance using natural reserves according to social development. Nowadays, the problem of maintaining the wild natural disposition of Mongolia, supporting extremely important ecological conditions, protecting naturally beautiful places, unique historical and cultural monuments is becoming more and more important.

Many precious ancient historical and cultural monuments are located along EAR at not so far distances. One of them is Khun burial mound of Duulga Mountain, which is situated 27 km southeast of Jargaltkhaan sum, Khentii province. It consists of 242 graves. Also 5 km east of the upper bridge of the River Kherlen, on the territory of Tsenkhermandal sum, Khentii province there is a burial mound called *Ustiin amnii*

durvuljin bulsh, in which there are altogether 10 large and small size square graves and 6 small size round graves. There is also a special landscape located in the territory of Murun sum, Khentii province 25 km west of Undurkhaan town. It is the ruins of a city in the Kidan dynasty called Zuun Kherem, Baruun Kherem, which is literally translated as East Wall and West Wall. Landscape called *Salbar uuliin bichigt hanangiin ikh baga bichees* is located in the territory of Murun sum, Khentii province and is considered a quite special monument related to the great writing memorial of the Kidan dynasty.

To the list of monuments, the precious place of *Tsenkhermandaliin tureg bichig* is added at the locality "Burgastain bichigt tsokhio"(the rock with inscription of Burgastai). All of these monuments are currently not under the special protection of the state.

Impacts of project on protected areas and historical monuments

Regarding EAR project, the following are both possible negative and positive impacts to protected areas and historical monuments.

1) Forecasting of the possible negative impact

   Air: According to the traffic volume increase, the air of protected areas will become slightly dusty, and exhaust gas would cause pollution. However the impact to natural and historical monuments is not so harmful since they are isolated far from the road.

   Water: Dirt left near rivers would cause serious pollution of the water and riverside areas, such as the constant flows of Tsenkher and Kherlen rivers.

   Fauna: In order to protect fish and aquatic habitats in the rivers, it is important to prohibit fishing activities without permission. There are small rodents at the river sites; however the impact of the road to animals and biological creatures is not so harmful.

2) Positive impacts of project on the protected areas and historical monuments

   Flora and soil: Many multi-trails will cease being used. Installation of traffic signs to point the way to the cultural and historical monuments sites will help protect generating of new trails randomly.

   Fauna: High positive impact to the ecology of the area along the road can be foreseen after noise pollution will decrease and small animals will return to the native land where they escaped from. Actually, the positive impact of EAR to animal life becomes absolutely high.

Monuments: It is obvious that EAR has high importance for the state policy on the protection special protected areas and their neighboring regions.EAR will play an important positive role.

Impact assessments on protected areas and historical monuments

Proportion of the positive and negative impacts of EAR to the protected areas and historical monument will determine the ecological effectiveness of the road construction. The following Table 14-2-5 shows the proportion of the positive and negative impacts of EAR.

Table 14-2-5 Assessment Results of the Positive and Negative Impacts on the Protected Areas and Historical Monuments

Negative impacts	Evaluation	Positive impacts	Evaluation
By the increase of traffic volume, environmental, pollution will increase slightly.	Slight negative impact	The current condition will be completely recovered for fauna, soil and wild natural disposition near the road.	High importance positive impact
Dirt left near rivers would cause pollution of the water and riverside area in such constantly flowing rivers as Tsenkher, Kherlen.	Slight negative impact	—	—
Assessment results	1 is positive, 2 are negative, it is estimated the negative impact is low level for protected areas and historical monuments		

Mitigation measures for negative impacts on Special Protected Areas (SPA)

1) Management of protecting Special Protected Areas (SPA)

Forming the system of protection and control: To execute the agreements on protection of nature along the road between local administrative office and community people along the road.

Making research: To clarify the natural and historical monuments by their importance, to make various researches and analysis on previously data and determine the areas for study of state protection.

Information, training and public relations: To carry out public relations of the areas requiring protection measures in the future for settlements of sums and bags.

a) To implement the project “Public ecological education” for SPA.
b) To systemize legislation and publish ecological information.
c) To raise the traditional methods of nature protection

Improve measures on recovering nature and protecting flora and fauna: The earth disturbed by the multi-trails will take more than 10 years to recover. Once the ground is recovered, other related natural system will recover by itself.

a) To take proper measures on protecting animals
b) To improve recovering measures for protecting plants

Conducting exploitation of natural resources with well-developed regulations: One of the problems to protect nature is people's lifestyle and improper exploitation of natural resources. In order to avoid these problems, active participation of the local people to form proper regulations is required. The improvement of controls and permission of exploitation of nature resources is necessary.

a) To develop information databank on natural resources
b) To develop cooperation between local administrative offices and rural people for proper exploitation of natural resources
c) To make control system and well-developed permission system

Cooperation with officials and unofficial organizations: To establish close cooperation with local private and official organizations, to choose volunteers and with their support to conduct control of nature and environment.

2) Protection management of the ancient historical and the cultural monuments along the road

Currently the ancient historical and cultural monuments are not still determined in the areas which needed to be protected; hence, it required to conduct further researches. People should be informed about the natural and historical places through public relations activities. Also it is required to grade the importance of such places and provide proper information regarding them. The protection zone for each valuable site must be demarcated with a radius of more than 50 m.

For enhancement of the scenic points along EAR, some observation places or service areas will be provided. Figure 14-2-4 shows observation deck with service facility.

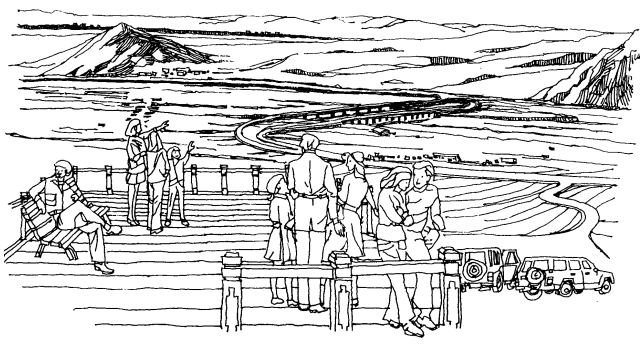


Figure 14-2-4 Observation Deck and Panoramic View for Traveling Passengers

14.3 Natural Environmental Impact Assessment

14.3.1 Impact Assessment on Hydrological Condition

(1) Review of hydrological environment and main peculiarities

Survey on hydro sections was conducted and calculated major discharge parameters. Table 14-3-1 shows main index of river forms, streams and dry ravines.

Table 14-3-1 Main Index of River Forms, Streams, Dry Ravines

	Hydrological names	Catchment area km^2	Length km	Altitude m	Length/Catchment km/km^2	Width of flow m	Water depth m	Slope ratio m/km
1	Shand am stream	Construction of the road has been begun.						
2	Togos bridge	119.2	67.8	1397.0	0.57	12.0	0.80	5.80
3	Togos bridge	127.4	64.6	1463.0	0.63	15.0	0.90	5.07
4	Delger bulag stream	16.3	4.80	1407.0	0.29	1.20	0.30	79.9
5	Beginning of river Rashaant	34.5	11.7	1387.0	0.34	5.55	1.30	391.0
6	Junction of three roads	1.2	1.0	1371.0	0.83	1.20	1.15	312.0
7	Khujirt river (crossing)	1017.9	32.6	1370.0	0.03	16.0	0.30	32.6
8	Khutsaa river A	3.9	3.0	1328.0	0.76	1.20	0.75	10.8
9	Khutsaa river Á	1.9	3.0	1330.0	1.21	1.20	1.20	9.30
10	Nariin bridge	70.6	21.7	1330.0	0.30	2.00	0.15	0.94
11	Kherlen bridge	7350.0	152.0	1300.1	0.20	70.0	1.20	30
12	Dry ravine	3.16	2.4	1360.0	0.75	1.30	0.50	125.7
13	Khartsat stream	7.80	3.3	1432.2	0.42	1.30	0.70	62.7
14	Kharkhiraa valley	23.9	9.0	1440.0	0.38	1.65	0.40	15.7
15	Dry ravine	0.8	0.6	1600.0	0.75	6.00	2.50	136.7
16	Dry ravine	6.7	5.1	1480.0	0.51	6.50	0.25	74.9
17	Bor Khujir	11.4	5.8	1510.7	0.52	4.90	0.90	209.3
18	Dalbain stream	13.3	1.7	1380.0	0.27	2.40	0.40	74.9
19	Dry pebble	4.8	4.2	1320.0	0.87	1.65	1.30	35.5
20	Bor Khujirt stream	44.7	6.3	1436.3	0.13	2.50	0.45	62.5
21	Sar bulag valley	18.4	6.6	1442.0	0.54	1.2	0.20	57.77
22	Tsenkher bridge	172.9	54.0	1385.0	0.11	10.2	0.40	8.64
23	Tsenkher bridge	32.7	21.3	1380.0	0.65	3.70	1.80	22.4
24	Dry pebble	8.5	3.7	1370.0	0.43	3.20	0.35	129.7
25	Ar khadagtai	36.7	16.0	1355.0	0.43	1.20	0.15	6.87
26	Uvur Kadagtai	13.1	10.8	1360.0	0.82	0.70	0.45	180.0
27	Urti river bridge	73.4	27.3	1370.0	0.37	2.70	0.65	195.0
28	Nuurentiin khundii	40.8	19.6	1372.0	0.48	0.90	0.15	8.84
29	Gichgenii khundii	102.7	16.7	1349.5	0.16	1.30	0.25	11.2
30	Duut pass bridge	73.4	27.3	1382.0	0.37	7.00	0.40	10.9
31	Urt valley	27.9	5.8	1260.0	0.21	2.10	0.60	8.2
32	Duut bulag stream	5.8	2.5	1246.0	0.43	70.0	0.30	4.0
33	Murun bridge	214.0	106.0	1120.0	0.20	7.0	0.25	6.9

Other variants

	Hydrological names	Catchment area km^2	Length km	Altitude m	Length/Catchment km/km^2	Width of flow m	Water depth m	Slope ratio m/km
1	Ulaan chuluut stream	12.2	6.4	1480.0	0.49	1.50	0.15	44.5
2	Dry ravine	1.0	1.4	1495.0	1.40	5.00	3.05	246.4
3	Dry ravine	46.4	8.6	1470.0	0.49	4.00	0.80	51.2
4	Dry ravine	77.9	14.6	1530.0	0.38	3.50	0.70	27.6
5	Jargalant river	289.7	20.4	1380.0	0.16	12.0	0.20	27.2
6	Dry ravine	0.9	0.17	1320.0	0.19	15.0	4.5	117.6
7	Rail way crossing	-	-	-	-	-	-	-
8	Khujirt river	999.6	31.4	1338.0	0.03	3.25	0.12	0.39

(2) Impacts of the project on hydrological environment

Regarding EAR project, the following are both possible negative and positive impacts to hydrological conditions.

1) Negative impacts on hydrological environment

a) The riverbed forms could be deformed and damaged by bridge construction.
b) The balance of river water could be changed temporally.
c) During construction of bridges at Kherlen, Tsenkher and Murun rivers, riverbed and sediment could be affected.
d) Due to bridge construction on those rivers, the turbidity of water could rise and spread 4 to 6 km, and fish and other aquatic animals could escape to other locations.
e) Spilling of oil products from vehicles and construction machines into the water body, causes dirtiness and turbid conditions of the water.
f) Permanent and temporary flows at the construction sites in the rivers could be affected, and they could cause some changes of hydrological regimes.
g) Due to provision of levees at the bridge sites some small natural flows may be disturbed.
h) Some erosion along road embankment may appear.
i) Water level could be increased. Steaming and seeping may be generated. If underground water exists, it may affect the physical conditions around the road embankment.

2) Positive impacts of the project on hydrological environment

a) When the bridge construction is complete, dirtiness of water will be reduced due to vehicles not crossing the rivers and streams directly. Turbidity originating from oil products and other machines will definitely decrease.

b) Possible erosion will decrease if control and management systems are applied properly for the construction.

(3) Impact assessment result on hydrological environment

The results of negative and positive impacts to the hydrological environment from the road construction are shown in Table 14-3-2.

Table 14-3-2 Assessment Results of Positive and Negative Impacts on Hydrological Environment

No	Negative impacts	Assessment	Positive impacts	Assessment
1	Form of the riverbeds could be deformed and damaged.	Intensive negative impact (during the construction)	When bridge construction is complete, dirtiness of water will be decreased due to vehicles not crossing the rivers and streams directly. Turbidity from oil products and other machines will definitely decrease.	With important positive impact
2	The balance of river water could drop temporally.	Medium negative impact	To control possible erosion by implemented road structures and facilities.	With positive impact
3	During the new construction of bridges on rivers Kherlen, Tsenkher and Murun, form of riverbeds and sediment could be damaged.	Medium negative impact	Installation of facilities and structures for hydrological control and measures against damage.	With positive impact
4	Due to bridge construction, turbidity of water could be generated and spread 4 to 6 km; fishes and other aquatic fauna could escape.	Intensive negative impact (during the construction)	—	—
5	Spilling of oil products into water body, causes dirtiness and turbidity of the water.	Intensive negative impact	—	—
6	Permanent and temporary flows of rivers at bridge crossings could be disturbed and affect hydrological regimes.	Less negative impact	—	—
7	Due to provision of levees nearby bridge sites, small water flows are disturbed.	Less negative impact	—	—
8	To activate erosion along the road embankment.	Less negative impact	—	—
Assessment results		27% of impacts are positive, intensive impacts are 37%, medium impact is 25%; less impact is 37.5%, so that the project has Intensive negative to medium negative impact on hydrology.		

14.3.2 Impact Assessment on Permafrost

(1) Review of Permafrost condition on the EAR

The frozen ground of sporadic permafrost is mostly characterized by more moisture clay and loamy clay. It is situated in following areas:

a) Middle portions of the tectonic depression
b) Places in the dry valleys of rivers originating in the mountains
c) In the valleys of large rivers (Kherlen river valley)
d) Around the spring (Ust valley).

In the Study area the permafrost thickness is no more than 10m and it is usually from 1 to 5m and scarred islands of permafrost are allocated mostly in following areas:

a) Along a small-river and stream with regularly water flow, where soil is covered by clay and loam clay.
b) Along a small river, where the alluvial deposit consists of some clay and loam clay.
c) In the origin of small rivers, where soil is clay and loam clay with aggregates.
d) Along a small riverbed, where river water sneaks down to ground.
e) Surrounding a spring, where soil is clay and loam clay.

The permafrost fluctuates from 5 to 20 meters in range. The seasonal freezing of ground along the road is shown Table 14-3-3. Thawing depth is measured by direct measuring method at two points.

Table 14-3-3 Seasonal Freezing Depth of Ground (unit=meters)

No	Center of settlements	Clay and loam clay	Sandy loam	Sand	Aggregates with sand and sandy loam fill
1	Undurkhaan	2.6	2.8	3.1	3.6
2	Murun	2.6	2.8	3.1	3.6
3	Jargaltkhaan	2.7	2.9	3.2	3.8
4	Tsenkhermandal	2.6	2.8	3.1	3.6
5	Bayandelger	2.8	3.1	3.5	4.3
6	Erdene	2.8	3.1	3.5	4.2

(2) Impacts on permafrost

Regarding EAR project, the following are both possible negative and positive impacts to permafrost.

1) Negative impacts on permafrost

During the construction and operation period of the road the following impacts to the permafrost may occur.

a) If the road is located on the permafrost area, then it may change the temperature regime of Permafrost and it may thaw after a few years.
b) If temperature of the permafrost changes, then it has a worse affect to the frozen ground.
c) If there is permafrost in a quarry site, then the quarry site shall be canceled.

Also during construction and operation stage of the road, the following negative influences shall be considered.

a) If the drilling point of permafrost has a little moisture, ice and ground subsidence, permafrost will lower the road surface deformation.
b) If upper layer of permafrost is characteristically clay and clay loam, underground water exists on the permafrost table.
c) Icing and solifluxion occur in the permafrost areas where ground water is on the permafrost table.

2) Positive impacts on permafrost

There are no positive impacts on permafrost area during construction or when using the road.

(3) Impact assessment result on permafrost

The results of negative and positive impacts to permafrost by the road construction are shown in Table 14-3-4.

Table 14-3-4 Assessment Results of Positive and Negative Impacts on Permafrost

No	Negative impact	Assessment	Positive impact	Assessment
1	Permafrost may change and thaw if the the road is on it. The impacts (heave, subsidence, icing and solifluction) depend on misture of soil.	Low negative impact	—	—
2	Permafrost may change mechanically and become worse (changing temperature regime)	Low negative impact	—	—
3	If permafrost exists in quarry sites, then that quarry site will be cancelled.	Low negative impact	—	—
Assessment results		All impacts on permafrost are negative, but all of them are low level. Therefore the EAR project has a low level impact to the permafrost. However, consideration to secure the road from permafrost may be needed.		

(4) Mitigation measurements for negative impacts

For reducing of impacts of the road construction from permafrost, the following mitigation measures are considered.

a) Permafrost must be in stable condition after the road is completed.
b) For permafrost with less moisture and ice, the road construction will be implemented the same as in the common area.
c) In the permafrost area with groundwater on the permafrost table, it appears heave, so that subsidence by freezing and thawing of permafrost are active, and the proper road construction methods will be applied as follows:
1) On the bottom side of road embankment, geo-textile sheets shall be installed if permafrost exists.
2) Where ground moisture and heave subsidence of surface are high, water ducts shall be installed. Khutsaa riverbed is higher than water level of the river, so that water conducts shall be installed.

14.3.3 Impact Assessment on Geography and Landscape

(1) Review of specific character of geography and landscape conditions

1) Characteristics of concave and convex of the geography

In the western part of the area, mountains dominate and transfer to steppe into the eastern. The highest point at the Bayandelger sum territory of the Tuv province reaches 1,800m and in the Kherlen river valley, the lowest is 545m. Most parts of the area are uplifted from sea level; therefore, absolute pitch variation is higher in the area. In the area of lower mountains, formed convex and concave hills and hillocks are found mostly side by side and rarely one by one. An average mountain height is more in the areas with granite and bare rocks at the top, steep at the side of the mountain and sloped in the lower parts. In such kind of mountains, granite crumb is common.

2) Main landscape formation

In the Study area, many kinds of landscape such as forest steppe, steppe, arid-steppe, real meadow, salt marsh can be found. There are Khentii mountain forest and forest steppe region; Mongolian forest steppe of south border, eastern Mongolian steppe, arid-steppe region and different sizes of lakes and rivers are situated.

(2) Impacts of project on geographical conditions and landscapes

Regarding EAR project, the following are both possible negative and positive impacts to geographical conditions.

1) Negative impacts of the EAR on landscape complex of this region are as follows:

a) The vegetation cover also soil cover could be polluted by chemical pollutants exhausted by vehicle traffic.
b) Some plants might become rare or extinct.
c) Spread and dynamic movement of wild animals and vegetation would be reduced.
d) By construction of the EAR, the number of vehicle trips will increase and cause the pollution of soil surface and vegetation cover.
e) Emission gas from driving vehicles may affect natural plants and reduce harvest 3 to 4 times. Exhaust gas from vehicles may stay within the area 10 to 15 km along the road. This might cause animals to escape from the polluted areas and annihilate some rare plants. If it happens, the landscape complex of this region will be much changed.
f) If embankment of the road is rather high, it may become a very strong barrier to affect animal trans-movement.

2) Positive impacts of the project on geographical conditions and landscape

a) The multi-trails along the EAR occupy a large area of the field. These will change fully to good landscape after the completion of the road. Also these areas will give effective impact to disturbed earth surface in the region.
b) The soil influenced deeply by chemicals over long periods, will recover in 3 years after the asphalt-paved road is constructed. By construction of EAR, negative impacts from multi-trails will be reduced a lot.
c) 1,531,240 tons of phyto-product on 40,000 ha will be recovered and it will actively help in the ecological life cycle. Annual harvest will increase 40 to 51% of green mass, and as a result, the green products and plant mass will be improved.
d) Permanent air dust will be much reduced by completion of the asphalt paved road. Pollution of noise from automobiles will be reduced by 2 to 3 times. Duration of noise from one automobile will be reduced much and it will be contribute to recovering the life of animals in this region.

(3) Impact assessment result on geographical condition and landscape

The results of negative and positive impacts on the geographical conditions and landscape by road construction are shown in Table 14-3-5.

Table 14-3-5 Assessment Results of Positive and Negative Impacts on Geographical Conditions and Landscapes

No	Negative impacts	Assessment	Positive impacts	Assessment
1.	The vegetation cover, soil surface and air condition will be polluted by chemicals from vehicles.	Not much negative impact	When the EAR is completed multi-trails will ceased to be used; this will impact effectively on recovery of disturbed surface soil and vegetation in this region.	Important positive impact
2.	Some kinds of plant will become rare or extinct because of pollution from traffic.	Not much negative impact	The soil influenced deeply by chemicals over long periods, will recover in 3 years after the asphalt-paved road is constructed. By construction of EAR, negative impacts from multi-trails will be reduced a lot.	Important positive impact
3.	road embankment will disturb animal movement and dynamics.	Dynamic Negative impact	1,531,240 tons of phyto-product on 40,000 ha will be recovered and it will actively help in the ecological life cycle. Annual harvest will increase by 40 to 51% of green mass, and as a result, the green products and plant mass will be improved.	Important positive impact
4.	—	—	No more permanent air dust caused by dusty earth road.	Important positive impact
Assessment results		4 positive and 3 negative impacts, 42.9% of them have negative impact, 66.6% has medium impact and 33.3% of them have more negative impact. Hence, the project has not much or medium impact on the geographical condition and landscape in this region.		

As the conclusion, since negative impacts on the geographical and landscapes of the regions are few, it is possible to consider that the positive impacts are greater than negative impacts.

14.3.4 Impact Assessment on Flora Environment

(1) Review of vegetation and main characteristics

1) Plant distribution

The Study area is included in Mongolian Daguurian mountain forest steppe and Middle Khalha steppe region as described in the botanical and geographical region of Mongolia (Olziihutag N., 1989). During the field survey 40 vegetation descriptions were recorded and some important land surface and vegetation cover photos were taken.

In the west and eastern part of the round forest, clumped population of Larix with grassland is found mostly at the back side of the mountain and mixed forest of Betula-Pinus, Betula-Larix, Betula, bushy jungle-like habitats are presented. Meadow steppe exist with high density grass and meadow either. In the steppe region, average height mountains and rocky hills are found and plants that survive in dry, humid-dry and dry-rocky habitats. Forb-festuca grassland is more condensed in the mountain steppe. This kind of steppe is mostly found at average height mountain tops and small hills. Plant communities covers 60 to 70% of this region.

Agropyron-poa-koeleria grassland is found at average height mountain hillside and its dry valley. According to the species community, this grassland is almost same as previous type of grassland, but instead of *Festuca lenensis, Poa attenuata* and *Koeleria cristata* are more condensed.

In plant community of steppe region Stipa krylovii, Allinum bidentatum, Cleistogenis squarrosa, Agropyron cristatum, Leymus chinensis are more common. In the community with caragana, C. stenophylla is more abundant than C. microphylla and C. pygmea. Artemisia frigidae is a dominant species in any community of steppe grassland.

The most common community of steppe grassland of Mongolia is Caragana grassland that grows in sandy and small rocky habitats. From the point 18 km to the west of Undurkhaan, the presence of caragana in the community increases.

2) Species composition of flora

Plant diversities within the Study area determined 803 species of vascular plants that included in 82 families and 5 phyla; 705 of them were included in Mongolian Daguurian mountain forest steppe region and 518 were included in Middle Khalha steppe region.

Plant diversity of this region has a 705 species of vascular plants and that covers 23.5% of the vascular plants in Mongolian. This implies species richness in the region. Plant species of Mongol Daguuurian region play an important role in the ecosystem. Species richness of this area is relatively high since peripheral connection areas of the geographical regions include a high number of species.

3) Rare and endangered species

In the Study area rare and endangered species grow in different habitats: 30 of them are found in mountain-steppe and 15 of them are found in steppe grassland. Also, some species can be found in desert-steppe grassland. 33 species of endangered plants were registered and 11 of them are found in steppe grassland.

(2) Impacts on flora environment

1) Negative impacts on flora environment

Results of the study indicate there is no direct serious affect to the vegetation from the project. However during road construction such as, removal of the soil, activities of transporting the materials and constructing the road can give some temporary impact. However these can recover in 2 to 4 years after completion of the road.

2) Positive impacts on flora environment

a) Many multi-trails have some influence on soil erosion, vegetation productivity, recovery and seed germination. If in this region the EAR is constructed, all these influences may disappear. In plant regeneration, soil nutrition becomes high to regenerate the destroyed and damaged vegetation.
b) The dominant species near the road such as, Artemisia frigidae, Carex Duruiscula, P*otentilla* are reduced and natural primitive community would possibly regenerate.

If the EAR is completed, 1,531,240 tons of phyto-mass covering 40,000 ha area of those multi-trails can be regenerated. 36,233.7 to 40,277.3 tons of green biomass would regenerates and vegetation productivity would increase 40 to 51% per year; thus, pasture resources would increase.

(3) Assessment results on vegetation

The following Table 14-3-6 shows environmental impact assessments of the road on vegetation.

Table 14-3-6 Assessment Results of the Road on Vegetation

No.	Negative impacts	Assessment	Positive impacts	Assessment
1	During road construction 13,666.3 tons of biomass on 357 ha of area would be damaged and 326.3 to 362.7 tone of vegetation products will fail.	Low negative impact	All influences on vegetation by multi-trails may disappear. Plant regeneration, soil nutrition become high and will regenerate destroyed and damaged vegetation.	Great positive importance
2	—	—	The dominant species near the road such as, Artemisia frigidae, Carex etc, will be affected by construction, but soon after, the natural primitive community would regenerate. Species richness also increases.	Great positive importance
3	—	—	1,531,240 tons of phyto-mass covering 40,000 ha of multi-trails will regenerate. 36,233.7 to 0,277.3 tons of green biomass would regenerate and vegetation productivity increase by 40 to 51% per year; thus, pasture resources would increase.	Much positive importance
Assessment results		Ratio of negative and positive impacts is 3:1 and negative impact takes 25%, so that it has a low level of impact on vegetation.		

As a result, impact level of EAR on vegetation is low.

(4) Mitigation measures for the negative impacts

Numbers of mitigation measures should be used to reduce the negative environmental impacts of the project as follows.

a) To chose the best way to construct new bridges as soon as possible and minimize use of explosive substances.
b) To maintain clean soil, water and air as much as possible away from the fuel products of construction machines during the construction of the bridges and the roads.
c) During the road construction, avoiding damage to rare and endangered plant species which are registered in Mongolian “Red book”.
d) For the road construction, the surface soil will be removed, and this good topsoil should be used for covering the embankment slope of the road.
e) To recover the surface edge of the excavated quarry site with removed soil and round the surface after construction activities.

f) To provide some tree planting in strategic areas nearby settled areas along the road to reduce negative environmental impacts.
g) To recover construction sites for by cleaning and re-soiling after finishing construction.
h) To recover the construction sites, grass seeding should be provided in the area if necessary.
i) In case of new quarry site selection, the sites without rare species of plants should be selected.
j) To keep the areas of multi-trails free from settlement and livestock pasturing in next 5 to 10 years to allow the natural conditions for recovery.
k) To introduce proper management system for traffic control and conservation of natural environment to reduce negative impacts.

14.3.5 Impact Assessment on Fauna Environment

(1) Review of biodiversity of fauna

Along EAR, to protect the survival of fauna ecosystem habitats and rare species, the following facts should be considered.

Fish-Pisces:

Along the road till Undurkhaan, all the small rivers (Khutsaa, Tsenkher, Murun) flowing into Kherlen river and lakes (Baganuur, Gungaluutai) have fishes. In Kherlen river system, only taimen fish (1997) is registered in Mongolian "Red book". Decrease of the fish resources is directly related to human activity.

Reptiles-Reptilians and Amphibians-Amphibia:

Only one species of *Salamandrella keyserlinqii* lives near Kherlen river that is registered in the "Red book". Some snakes such as, *Elaphe dione* (included in family of *Colubridae)* and *Aqkistrodon halys* (included in family of *Crotalidae)* and those included in class of *Serrentes* are found in this region.

Birds – Aves:

In this region 135 species of birds are registered and the Great bustard and Crane are registered in the "Red book".

Shorebirds:

In this region, crane, shell duck, duck, common shell duck, a few brown duck, cranes, bustard, swan, natural duck, sea gull survive here. Some species live on the steep banks of rivers and lakes.

Birds in forest:

Some Falcon nests are found on trees. In the willows close by the bridge, cuckoo, owl are found. But in forests, *Melvis migrans*, *Accepiter nisus* survive.

Steppe birds:

The most common species found in the steppe are Buteo hemilasius, Aquila nipalensi and larks. These birds fly back and forth along the power lines up to Undurkhaan. At the places with carrion of a domestic animals, lark population density is high in the steppe grassland.

Synanthrope and semi-synanthrope birds:

These kind of birds are composed of Milvus migrans, Falcon species, and etc.

Rare species of birds:

Pandion haliaetus,Circus cyanus, C. aeruqinosus, Haliaeetus leucoryphus, falco pereqrinus, F. subbuteo, F. columbarius, Syrrhaptes paradoxus are included. Total of 32 species of birds pass in winter time.

Mammals - Mammalia:

Animals that hibernate in winter and survive in forest and habitats with willows and tall grasses include hedgehog Erinaseus dahuricus (registered in the “Red book”), bats, rodents in pica family, rabbit family, mouse, hamster, voles. Wolf, red fox, corsac fox, lynx, wildcat, badger, roe deer and Mongolian gazelle.

Insects - Insecta:

In the study area insects of 2 orders, 7 kinds, 151 species have been registered. Along the road there is a rare plant and in connection with poor fauna. Only two kinds of beetles live here. In the pasture, species of Orthophagus and Aphodius are plentiful. There are no rare insects or insects which are included in the Red Book. As for the insects there are many kinds in steppe and forest-steppe regions of Mongolia.

Along the road, grasshoppers are seen in large numbers and they are growing in number in this region and it could negatively influence pasture. This situation has no negative influence from the road construction activities; however, if construction work is done in the last month of spring when eggs of grasshoppers are in the soil, it will decrease their numbers.

(2) Impacts on fauna

Several impacts could be considered in each field of fauna as follows.

1) Negative impacts on fauna

(a) Ecological condition and habitat of fish:

i) Water flow during the construction period of the bridge over Kherlen rivers may affect the ecological balance of fish habitats.
ii) Some benthos animals and mollusks may be influenced during bridge construction.
iii) Animal burrows, dens and nests can be damaged during construction of the bridges.
iv) Decrease of the fish population by fishing due to human activities after the construction by increase in travelers.
v) Organic substance pollution to the river water by human activities will increase after the construction.
vi) Fish population would exhibit mutation and body shape may be influenced by pollution in the water originating from fuel products.

(b) Influences on habitat of amphibians and reptiles:

i) During the construction of bridges, habitat of rare and endangered species registered in the "Red book" would be impacted and can be destroyed.
ii) Nests and holes of reptiles would be damaged during the construction.
iii) If artificial barriers will be constructed, migration paths of reptiles and amphibians will be influenced.

(c) Influences on insects and rodents:

i) Number of soil insects (including eggs and larva) would be reduced by removal of surface soil especially in spring.
ii) Most insects could be killed and damaged living along the road, but they would survive.

(d) Influences on bird ecology:

i) Birds sitting and feeding on the road could be hit and killed by driving vehicles.
ii) Construction of bridges temporarily threatens the habitat of shorebirds and bird nesting places could become scarce.
iii) Rare bird species could be killed if they escape during the construction period.
iv) Birds can acquire disease from decomposed food and rubbish originated from waste.
v) Rare and endangered bird species registered in the "Red book" can be hunted and traded without proper knowledge of the threatened condition of these species.

(e) Influences on ecology of mammals:

i) Some animals would emigrate due to the road construction and human activities.
ii) Catching and hunting of animals.

2) Positive impacts on fauna:

Several benefits by the project on fauna may be considered as follows.

a) The soil on multi-trails will be recovered and bring benefits to animal habitat areas.
b) The bridges crossing rivers are good niches for amphibians, birds and fish that they hide and provide cool shade in the hot season.
c) After the construction, animals will return and live in the areas of multi-trails where once they escaped from noise and polluted air. They will come to stay in a band 1 to 2 km wide along the road.
d) Bridges provide good and easy passageways for wild animals to migrate to other locations.

(3) Impact assessment results on fauna

The following Table 14-3-7 shows environmental impact on fauna.

Table 14-3-7 Impact Assessment Results of the Road on Fauna

No.	Negative impacts	Assessment	Positive impacts	Assessment
1.	Installation of barriers for flow control at the bridge construction sites, will affect ecological balance and habitats of fish. It will cause water pollution and affect flow regimes of the river.	Very intensive negative impact while the construction	The soil on multi-trails will recover previous natural condition, and thus benefit animal habitats and populations.	High beneficial positive impact
2.	Temporary work facilities and structures on riverbank will disturb animal movements and activities.	Low negative impact	The bridges on river become good niche habitats for amphibians, birds and fish that they hide with shadows and cool places in hot season.	Beneficial positive impact
3.	Animal burrows, dens and nests can be damaged and animals killed during the construction of bridges and road activities.	Not so much negative impact	Animals will return and live in areas of multi-trails where they escaped from noise and polluted air in strips 1 to 2 km wide along the road.	Less beneficial positive impact
4.	Decreasing the population of fish by fishing due to increase in travelers and human activities after the construction.	It should be controlled	Bridges are the good passageways for migration of animals from location to location.	High beneficial positive impact

No.	Negative impacts	Assessment	Positive impacts	Assessment
5.	Polluting river water caused by fishing and use of organic substances for fish food that may cause disease to hydro-biota.	Intensive negative impact	There is a possibility to help animals when natural disaster and drought occur.	High beneficial positive impact
6.	Fish population would exhibit mutation and unusual body shapes from pollution with fuel products.	Intensive positive impact	—	—
7.	During the construction of bridges and facilities, habitats of rare and endangered species registered in “Red book” would be impacted and can be damaged.	Low negative impact	—	—
8.	Nests and holes of reptiles would be damaged during construction.	Low negative impact	—	—
9.	Birds sitting and feeding on the road could be hit and killed by vehicles driven with high speed.	Intensive negative impact	—	—
10.	Construction of bridges and facilities may temporarily impact shorebirds for nesting places may become scarce.	Medium level negative impact	—	—
11.	To damage to the rare bird species by construction activities that makes birds escape.	It should be controlled	—	—
12.	Rare and endangered species of birds registered in “Red book” can be hunted and traded without knowledge of them being threatened species.	It should be controlled.	—	—
13.	Animals emigrations affected by the road construction activities.	Low negative impact	—	—
14.	Due to installation of facilities, migration passes would be closed.	Low negative impact	—	—
15.	Catching and hunting animals.	It should be controlled	—	—
Assessment results		23% of total is beneficial, 25% is intensively negative, 18.5% is not so intensively negative and 56.5% is should be controlled. Hence, the project impact on fauna is low level.		

(4) Mitigation measures for negative impacts

Several mitigation measures should be considered to reduce the negative impacts during the construction and operation period of the road.

a) To construct new bridges as soon as possible and to minimize use of harmful substances.
b) To take all possible efforts to keep the soil, water and air clean from the fuel products during the bridge and road construction.
c) To avoid damage to animal burrows, dens and nests and not to kill animals of registered in the "Red book" while constructing bridges.
d) Because of high population of marmots in some areas, to select construction timing with less impact to marmot habitats.
e) To install speed regulation signs for car drivers to avoid hitting and killing big birds on the road.
f) To provide management system of traffic control for protecting natural environment to reduce negative impacts during operation stage of the road.
g) To avoid capture, killing and chasing of animals listed in Mongolian "Red book" and CITES convention and avoid damage to their dens, holes, burrows and nests.

14.3.6 Impact Assessment on Soil Environment

(1) Review and specific characters of soil environment

Distribution and characteristics of soil

According to the survey, samples representing all soil types in this area have made. The following laboratory analysis was conducted at Soil laboratory of Institute of Geography, Mongolian Academy of Science. The soil analysis sampling location is stated in Table 14-3-8.

Table 14-3-8 Soil Analysis Sampling Location

No	Analysis	Description method by	Number of sample
1	Humus	I.V.Turin	11
2	Potassium, Phosphorus extracted	B.P.Machigin	11
3	Soil reaction pH	Potentiometer	16
4	Carbonate CO_2	Calcimeter	5
5	Texture	N.A.Kachinskii	16

Some references and data that had been used for territory of Tuv and Khentii province (Erdene, Bayandelger, Tsenkhermandal, Jargaltkhaan, murun sum) were used by the government's Implementation Agency, Land Management Department.

Results of soil investigations revealed 13 kinds of soils within the 3 main soil types. All of these soils formed on the eluvial, eluvial-deluvial, deluvial, alluvial, lacustrine and quaternary sediments.

Eluvial sediment: Eluvial sediment is residuum in-place deposits of rock weathering product, characterized by very angular, less rounded different sized stones, pebbles and gravels. Eluvial sediments usually formed mountain weak developed soils.

Deluvial sediment. This is transported by periodical water sediment which accumulated in the mountain low slopes and foothills of the Area. Characterized by medium rounded, angular and sub angular stones, gravels, silt and sands.

Alluvial sediment accumulated in the river floodplains consist of well-rounded gravels and sands. Some parts of flood plains have thickness of alluvial sediment up to the 100 meters in deep valley of the Area.

Lacustrine sediment accumulated in the former lake bottom areas, consists of layered clay silt and sands. Lacustrine sediment is distributed in Nuurentein valley of Baganuur, Chandagana valley plain in Murun sum of Khentii province.

For all variations of areas of EAR, thickness of humus layer are approximately 15 cm in 16 types of soil as follows.

a) Sandy mountain dark kashtan (chestnut) soil. (Index – DKsp)
b) Clayey mountain dark kashtan (chestnut) soil. (Index – DKcp)
c) Clayey (clayey-sandy) mountain meal carbonated DK (chestnut) soil. (Index – DKc, DKcc)
d) Sandy mountain meal carbonated DK (chestnut) soil. (Index – DKs, DKsc)
e) Clayey, alpine-meadow DK (chestnut) soil. (Index – DKca)
f) Clayey (sandy-loamy) kashtan (chestnut (soil in hummock, hillock areas)) soil. (Index - Kc)
g) Sandy, sandy-loamy, normal thickness dark kashtan (chestnut) soil (Index–DKs)
h) Clayey/loamy sandy, normal thickness dark kashtan (chestnut) soils (Index-DKtc)
i) Clayey, normal thickness and solo nets (dark) kashtan (chestnut) soils (Index-Kss)
j) Sandy, sandy loamy dark kashtan (chestnut) soils (Index-DKs)
k) Alluvial clayey/ sandy loamy soil (Index-Ac)
l) Alluvial sandy soil (Index–As)
m) Alluvial static, sandy/loamy sandy soil (Index-Ass)
n) Clayey alluvial morass creosol (Index-Amc)
o) Meadow morass cryomorphic clayey soil (Index -Mc)
p) Meadow morass clayey, cryomorphic, Salted soil (Index-Mcs)

(2) Impacts of the project on soil environment

Several negative and positive impacts can be identified due to the asphalt paved road with increase of traffic volume, polluting the air by exhaust gas and its affect on soil environment.

1) Negative impacts on soil environment

If the humus layer thickness on 357 ha which is the direct area of the road is approximately 15 cm and 2.5% of humus content, 75 tons of humus, 60 tons of P and 600 tons of K would be damaged.

When a single vehicle drives on the road at 20 to 30 km/h speed, then 50 to 150 meters long and 10 to 20 meters width of the road area is blanketed by dust which lingers 5 to 8 hours in the air on a windy day, and 10 to 15 hours on a normal day.

2) Positive impacts of project on soil environment

a) All multi-trails will cease to be used anymore in the future and soil erosion from them will stop. From the Zuun modnii els of Tuv province, Baganuur in Togosiin Khundii until the Kherlen bridge, 2 km of width has 20 to 42 trails, and 2 to 2.5 km in width at Jargalantiin khundii, Khunkhiin baruun khutul of Tsenkhermandal sum, and near bridge of Murun sum center has more or less 40 trails. These multi-trails cover 25,500 to 51,000 ha but just 357 ha of area is used for EAR and 25,143 to 50,643 ha of area would be converted into agriculturally useful area.
b) All the degraded soil will be recovered by completion of the project within the next 3 years.
c) The area of soil degraded by multi-trails covers 40,000 ha, and it would recover again and be converted into agricultural land.
d) Soil degradation by multi-trails would be stopped and impacts to the environment would be much reduced.

(3) Impact assessment results on soil environment

Comparison of negative and positive impacts on soil environment determines the ecological importance of the EAR construction. Assessment is given in the following Table 14-3-9.

Table 14-3-9 Assessment Results on Soil Environment

No	Negative impacts	Assessment	Positive impacts	Assessment
1.	357 hectare of pastureland is converted into the road area.	Medium negative impact	Area of all multi-trails will cease to be used anymore in the future and soil erosion will decrease.	Special beneficial positive impact
2.	75 tons of humus, 60 tons of P and 600 tons of K would be damaged by exhaust gas by increase of traffic volume.	Medium negative impact	After the construction, degraded soil by human productive activities and agri-chemicals will recover in next 3 years.	Special beneficial positive impact
3.	Accumulated pollutants will affect soil by increase of the number of vehicles.	Intensive negative impact	Degraded earth by water and wind covers 40,000 ha ,. It would recover again and will be converted into pasture and agricultural land.	Special beneficial Positive impact
4.	Toxic substances such as lead give negative impact to soil environment, pasture and human health.	Medium negative impact	—	—
5.	Most pollutants are difficult to decompose in nature, and therefore are difficult to clean up.	Intensive negative impact	—	—
6.	Development of socio-economic conditions along the road will impact soil.	Low negative impact	—	—
Assessment results		3 positive, 6 negative and total 9 impacts. Negative impacts share 66.6% and 33.3% is intensive, 50% is medium and 16.7% have low impact on soils.		

Generally, medium negative impact is dominant; however 33% is more than medium negative level, so that negative impact is rather dominant.

(4) Mitigation measures for negative impacts

Several mitigation measures are required during the construction and operation periods of the project.

a) During the road construction, 357 hectare of surface nutritional soil layer needs to be removed, and these soils should be utilized for surface treatment on the embankment slope of the road.

b) To recover sand and gravel mining after these operations, excavated area during operation shall be recovered in unity with the surrounding landscape.

c) To recover used work sites and to make them clean, re-soiling and replanting if necessary.
d) To construct new bridges as soon as possible and minimize use of explosive substances.
e) To take measures of all possible ways to keep soil and water clean from the fuel products of operating machines during the construction.
f) To maintain natural conditions on the areas of multi-trails without allowing any settlements or livestock pasturing in next 5 to 10 years in order to allow natural recovery.
g) To set up management systems by the state and local authorities for environment protection to reduce negative impacts during construction of the road.

14.4 Environmental Impact Assessment on Pollution

14.4.1 Impact Assessment on Air and Noise Condition

(1) Impacts of project on air and noise condition

Regarding EAR project, the following are possible negative and positive impacts on air and noise pollution.

1) Negative impacts of project on air and noise condition

a) When motor vehicles drive from east to west, the wind pressure could render up to 50 to 70 kg/m2 supplementary force to the vehicle surface. Vehicle velocity is reduced and requires additional 5 to 20 % of fuel for driving.
a) Vehicle speed and wind also could cause noise problems; however due to low density of population and few settlements along EAR, noise disturbance is low And limited to only 6 to 15 km or 2.4 to 6 % area along the total 250 km of the route.
c) During the construction period, the noise generated by the operated machines and vehicles in the construction sites may be disturbing if settlements and cattle ranches are located nearby.

2) Positive impacts of project on climate environment

When the EAR is completed, chemical air pollution from vehicles is reduced. Earth road conditions are a major cause of low speed of driving and additional use of fuel disperses a lot of dust. When asphalt paved road is completed, vehicles can drive at constant speed and fuel consumption per km will be saved 1.5 to 3.0 times in comparison to the earth road.

As for Noise pollution, the following positive impact may arise:

a) Increasing of driving speed by 2 to 3 times will save traveling time by 2 to 3 times from point of origin to destination.

b) In surrounding areas of the EAR, cattle, sheep, caws and horses are few; therefore negative impact for them is very low level.

(2) Impact assessment result

The results of negative and positive impacts on air and noise are shown in Table 14-4-1.

Table 14-4-1 Impact Assessment Results of Positive and Negative Impacts on Air and Noise Condition

No.	Negative impact	Assessment	Positive impact	Assessment
1	Wind speed and pressure affect reduction of real speed and power when vehicles drive from east to west.	Low negative impact	Asphalt paved road will save fuel so that pollutants from exhaust gas to the ambient air will be reduced.	Very important positive impact
2	Due to low numbers of animal species and their population, the noise level is not serious.	Low negative impact	Asphalt paved roads could reduce noise level and air pollution 2 to 3 times.	Important positive impact
3	Traffic volume through the EAR could increase daily by 0.08 to 0.18 ratio, but it negatively influences noise level and air quality	Low negative impact	—	—
Assessment results		2 kind of positive and 3 kind of negative impacts. All of the negative impacts are low impacts, so that the project impact to air and noise conditions has positive impact as a whole.		

EAR construction could positively impact air and noise conditions since direct negative influence is quite low level. EAR construction should not bring about any negative air and noise impact.

(3) Mitigation measures for negative impacts

1) It is important to provide trees in critical areas along EAR, to reduce some negative impacts such as reducing noise level, protecting against snowdrift, storms and also chemical pollution.

It is necessary to consider protective measures for nearby settlement areas such as tree plantings to secure people's health from noise and other pollutants.

14.4.2 Impact Assessment on Surface Water Quality

(1) Impacts of the project on surface water quality

Regarding EAR project, the following are both possible negative and positive impacts to surface water quality.

1) Negative impacts on hydrological environment

a) Due to bridge construction on the rivers, the turbidity of water could rise and spread 4 to 6 km, and fish and other aquatic animals could escape to other locations.

b) Spilling of oil products generated by vehicles and construction machines into the water body, causes dirtiness and turbid conditions.

2) Positive impacts of the project on hydrological environment

a) When the bridge construction is completed, dirtiness of water will be reduced due to vehicles not crossing the rivers and streams directly. Turbidity originating from oil products and other machine products will definitely be reduced.

(2) Impact assessment result on hydrological environment

The results of negative and positive impacts to the surface water quality are shown in Table 14.4-2.

Table 14-4-2 Impact Assessment Results of Positive and Negative Impacts on Surface Water Quality

No	Negative impact	Assessment	Positive impact	Assessment
1	Due to bridge construction on the rivers, turbidity could be generated and spread 4 to 6 km; river fishes and other water animals could escape.	Intensive negative impact (the construction period)	Due to vehicles crossing rivers on bridges, the dirt generated from oil products and other operation machines will be definitely reduced.	With important positive impact
3	Spilling oil products into water, causes dirtiness and turbidity.	Intensive negative impact	It is possible to install facilities for hydrological control measures.	With positive impact
Assessment results		2 impacts are positive, 1 impact is intensively negative and 1 impact is medium negative. So that the project has rather in range of medium negative to positive impact on surface water quality.		

14.4.3 Impact Assessment on Solid Waste

(1) Impacts of project on solid waste

Several negative and positive impacts can be identified due to generating solid waste during the construction and operation period of the road. One of the major solid wastes is removing surface soil, excavated earth, other surplus construction materials and temporary used materials which are generated in the construction sites.

1) Negative impacts of solid disposals

a) Removal of surface soil for early stage of the construction. The humus layer of surface soil of the affected direct area of the road is approximately 75 tons of humus. The nutrients contained (60 tones of P and 600 tons of K) would be damaged.
b) Construction debris may cause impact to the area along the road if site management of the construction is not controlled properly.
c) Garbage and litter, waste generated in the work camps may cause impacts to the natural environment especially to the aesthetic conditions if good management is not applied well.
d) Garbage and litter generated by the drivers and passengers along the road will increase; they cause rubbish scattering along the road and settled areas.

2) Positive impacts of project on solid disposals

a) Removed surface soil can be utilized for recovery of the degraded and damaged ground surface of the areas.
b) Removed rich humus layer will allow the degraded earth surface to have natural germination conditions for vegetation.

(2) Impact assessment results on solid disposals

Comparison of negative and positive impacts on solid disposals is given in the following Table 14-4-3.

Table 14-4-3 Assessment Results of Positive and Negative Impacts on Solid Disposals

No	Negative impact	Assessment	Positive impact	Assessment
1.	75 tons of humus, 60 tons of P and 600 tons of K would be removed.	Medium negative impact	Removed surface soil can be utilized for recovery of the degraded and damaged ground surface of areas.	Special beneficial positive impact
2.	Construction debris may cause impact to the area along the road if site management of the construction is not controlled properly.	Medium negative impact	Removed rich humus layer will allow the damaged earth surface to have natural germination conditions for vegetation.	Special beneficial positive impact
3.	Garbage and litter, waste generated in the construction work camps may cause impacts to the natural environment especially to the aesthetic conditions if good management is not well applied.	Slightly negative impact	—	—
4.	Garbage and litter generated by the drivers and passengers along the road will increase; they cause rubbish scattering along the road and settled areas.	Medium negative impact	—	—
Assessment results		2 positive, 4 negative impacts. Negative impacts are more dominant than positive impacts of solid disposals.		

Generally, medium impact is mostly dominant; however, these negative impacts all rely on management systems.

(3) Mitigation measures for negative impacts

Several mitigation measures are required during the construction and operation periods of the project according to valid management systems as follows.

a) During the road construction, 357 hectare of surface nutritional soil layer needs to be restored, and these soils should be utilized in surface treatment on the embankment slope of roads and degraded soil surface areas.
b) To recover work sites from all generated solid debris.
c) To take measures of all possible ways to keep construction sites clean; also the areas along the road to be litter free.
d) To provide garbage disposal places and litter bins in rest and service areas along the road.
e) To set up a management system by state and local authorities as well as community people for environment protection and cleanliness in the operation stage of the road.

14.5 Summary of Impact Assessment

14.5.1 Conclusion and Main Recommendations of EIA on the EAR Project

Through conducting the EIA on the EAR construction project, summary of the EIA is shown in the following Table 14-5-1.

Table 14-5-1 Summary of Environmental Impact Assessment of the EAR Projec

No	Environmental items	Number of total impacts	Negative impacts			Positive impacts			Assessment
			Intensive	Moderate negative	Low negative	High positive	Moderate positive	Low positive	
1	Socio-economic/ urbanized environment	12	1	2	1	3	5	0	Special importance, low negative impact
2	Air & Noise	5	0	0	3	2	0	0	Low negative impact
3	Hydrology/ quality of surface water	11	3	2	3	1	2	0	Moderate negative impact
4	Permafrost	3	0	0	3	0	0	0	Low negative impact
5	Geography and landscape	7	1	2	0	0	4	0	Moderate negative impact
6	Soil	9	2	3	1	3	0	0	High importance, moderate negative .impact
7	Vegetation/Flora	4	0	0	1	2	1	0	Low negative impact
8	Fauna	20	4	1	10	3	1	1	Low negative impact
9	SPA, natural and historical place	3	0	0	2	1	0	0	Low negative impact
10	Quarry sites	11	4	2	2	0	3	0	Intensive negative impact
11	Solid Waste	6	0	3	1	2	0	0	Low negative impact
Total		91	15	15	27	17	16	1	-
Weight		1	0.16	0.16	0.30	0.19	0.18	0.01	-
Total assessment results		Based on the weight of the impacts assessment of the project, it is assessed that the general EIA of the EAR project is “moderate negative” impact.							

14.5.2 Final Conclusion of the EIA on the EAR Project

(1) Conclusion

In the framework of detailed evaluation on the impacts of the EAR to the environment, the assessment results conclusion is as follows:

“ The project of construction of the Eastern Arterial Road “ is moderate negative impact.

During implementing the project, more attention should be paid to the possible negative impacts of the project; It is especially important to take measures to decrease intensive and medium impacts.

1) During implementing the project, it is necessary to set up protection management for the social and natural environment to completely reduce negative impacts.
2) In the implementing the EAR construction project, it is imperative to follow the control and monitoring program in detail, to know differences between comparative measures and control index and to report these results along with suitable countermeasures.

(2) Major Recommendation

In the implementation of the project of EAR, it is vital to pay more attention to the issues of reducing negative impacts, and consider the following instructions:

1) To provide adequate signs and information as well as warnings at the crossing points in order to avoid possible traffic accidents and risks for drivers and passengers, and also children, elderly people when they cross the road.
2) To organize constant public relations with community people, drivers and passengers about safe use of the road during the construction and operation period.

14.5.3 Environmental Management Plan and Monitoring Program on the EAR Project

To proceed with environmental mitigation measures on the EAR construction project, both environmental management plan and monitoring program are the definitely important to secure environmental conditions of socio-economic and natural environment as well as control pollution to maintain diversified natural resources during the construction period. Also it is vital to have secure construction activities and workers as well as drivers and travelers along the EAR.

The following Tables 14-5-2 to 14-5-6 show environmental management plans for each major category of the environment; the same categories in the environmental monitoring program are shown in the Tables 14-5-7 to 14-5-11.

Table 14-5-2 Management Plan on Atmospheric Air and Noise
Main Objectives: Limitation Control, Reduction of Pollutants

No.	Work items	Requirements	Period	Locations and area, Necessary items	Required costs thousand Tg.	Standard, criteria and order to be applied
1	Study for planting trees along the road and implementation of possibility in order to reduce negative impact of air pollution and noise.	Dust and noise in the surrounding atmosphere. The exhausted gas from diesel engine originates temporary air pollution.	2003-2006	Along 250 km, Erdene to Undurkhaan .	8,000 Incl.const.cost	The permitted rate of air pollution in the settlement's area. (According to 2nd appendix of general sanitary inspector's order approved in November. 1989)
2	Provision of buffer at the rocky side of high mountain pass for protect the road from strong wind in spring. autumn and snow covering in winter.	Main objectives is to reduce traffic accident and to keep the road surface and embankment in stable condition.	From 2003	The total length of 6 km requires proper buffer system.	Incl.const.cost	The traffic control and rules. /Mongolian Parliament-1996 /4/ 30. Government's resolution-1996 /9/ 21./
3	Operated quarry sites and earthwork areas may generate polluted air and dust. So that trucks and operation machines shall be equipped proper exhaust gas control and spray water on the earth for dust control.	Measures are to be taken for reduction of air pollutants, dust and toxic substances in the air.	From 2003	At the construction area and quarry sites	4,000 Incl.const.cost	
4	Remove humus soil layer before operation of new quarry site and area under the road, and prepare special reserved dump for these soil . It shall be utilized for recovering the damaged surface at quarry sites and earth surface of the construction site.	Requirement of removal of fertile soil layer and reutilize for recover of surface at quarry sites and other construction sites.	From 2003	13 sites will be used for quarries (about 30 ha), and the road area will be about 370 ha.	Incl.const.cost	

Table 14-5-3 Management Plan on Soil Cover
Main Objective: Limitation Control, Reduction and Neutralization of Soil Pollution and Erosion Sources

No.	Work items	Requirements	Period	Locations and area, Necessary items	Required costs thousand Tg.	Standard, criteria and order to be applied
1	After use of quarry sites they must recover as to adjust moderate slope, edge and recover soil surface. (no less 15 cm thick).	Quarry sites operation, temporary roads and transportation activities of the materials will give damages to plants and soil cover.	After quarries operation.	Quarry site, temporally road (Total fertile soil will be nearly 29.2 thousand m3.)	Incl.const.cost	The requirements will be decreed in according to MNS 4916:2000
2	Measures to be taken for protect against soil pollution by diesel oil, fuel materials, asphalt, bitumen and chemical substances.	Construction machines and heavy duty vehicles, gasoline and other fuels, materials storages in operation will become main sources of soil pollution.	From 2003	To prepare facilities for gas stations, storage for materials in order to avoid wastes into the ground.	5,000 Incl.const.cost	Prohibition of pollution of soil onto ground with diesel oil, pollutants and various chemical substances.

Table 14-5-4 Management Plan on Surface and Underground Water:
Main Objective: Limitation Control, Reduction and Refreshment of over Ground and Underground Water against Soiling

No.	Work items	Requirements	Period	Locations and area, Necessary items	Required costs thousand Tg.	Standard, criteria and order to be applied
1	Measures to be taken pollution into rivers and underground water resources. Prohibition on use of chemical poisonous substances.	Control water use and consumption in accordance to the balance flow regime. Measure against pollution and urgent recover must be taken if in the case of polluted.	2003-2006	River crossing areas and others	By the real cost Incl.const.cost	MNS-900-92 The quality of fresh water, Joint resolution on protection of water resources from ground, issued by Minister of Nature and Environment and Minister of Health and Social Welfare. /1997.10.21, N143/a/352, Resolution on reform of the river bed/ 1994/03/11. N32
2	Temporary water conduct facilities of the road shall be considered off stream and provide free flowing water flows through the river bed.	Measures to be taken an important protection for water resource and its proper use and reduction of deterioration of the quality.	From 2003	Work and camp sites Provide water supply system to sites.	Incl.const.cost	Law on water Chapters 13, 14, 15
3	Consideration must be taken on stability of rivers and dry beds at the road cross pints, Also an additional measure to be taken if necessary.	Reduction of impacts on water recourses, deterioration and probable direct damage to the water when construct protective levee, also stabilization of river bed and water regime.	From 2003	River crossing areas	Incl.const.cost	"Location of purification facilities of waste water with requirements of quality standard" by standard MNS 42888-95 of Mongolia.
4	Calculation of water demand for the constructing use in detail and preparation for contract with local administration.	According to the chapter 7 of the Law on water, water consumption will be paid 1 to 5Tg for surface water use, 1 to 20Tg for under-ground water use.	From 2003	Location and water volume of to be used for construction is clarified.	By local administrative	"A short-term criteria of water consumption" (153 order of Minister of Nature and Environment in 1993) "Percentage and amount of bill for water consumption" (154 resolution of the Government in 1994)

Table 14-5-5 Management Plan on Natural Resources Use
Main Objective: Use of Resources, Reduction of Waste Products and Introduction of New Technology

No.	Work items	Requirements	Period	Locations and area, Necessary items	Required costs thousand Tg.	Standard, criteria and order to be applied
1	Selection of quarries, which have less transport costs. Calculation in detail amount of resources for excavation and of environs to be damaged, also roads and routes for transporting. Measures to be taken for all to avoid the natural and environmental destruction.	There are 6 operating quarries and 7 new quarries in the region and more quarries if required.	2003-2006 and further	Quarry sites; Required volume of 28,000 thousand. m3.	Incl.const.cost	
2	Restoration and reservation of fertile soil at special storage yards.	Constant requirement of the restored fertile soil for recovering damaged and spoiled areas area by natural phenomena, soil erosion and some desertification areas.	From 2003	Quarry and construction sites; Approx. 1,071 thousand tones of fertile soil is removed along he road area, and 422 thousand tons at the quarries.	Incl.const.cost	
3	Replanting rare and the rarest plants which found in the area of the project sites.	Prohibition of destroy rare and the rarest plants.	From 2003	Places of rare plant vegetated	Incl.const.cost	
4	Recommendation of use of the waste tin mine heap a road material, aggregates exploited in Tsenkhermandal sum of Khentii province.	Use of stones and aggregates.	From 2003	Tsenkhermandal sum, 2,200 thousand tones of aggregate heap in the tin mine, which might be usable.		It is reuse of natural resources.
5	Measures to be used water economically and properly for the construction sites.	Requirement of economical use of water due to limited water resources in these regions.	From 2003	Construction sites		

Table 14-5-6 Management Plan on the Environmental Management
Main Objectives: Environmental Protection, Appropriate Resource Use, Self–Control System Establishment and Efficient Measure Taking

No.	Work items	Requirements	Period	Locations and area, Necessary items	Required costs thousand Tg.	Standard, criteria and order to be applied
1	Organization establishment for environmental management in activities, also internal rule establishment for responsibility.	Implementation of the plan of Environmental Management and consideration of results	2003-2006			
2	To assign management leader and organizing the environmental issues.	Assignment of response management leader who has proper knowledge of environment and decision makes during the construction period.	From 2003 constantly	appointment of management leader	4000.0 per year Incl.const.cost	Responsible person for every construction activities.
3	To conduct training on environmental protection before the construction, 1 to 2 training held every year to secure the activity.	Public relation on environmental protection to be held for specific related information's. It helps for smooth implementation of the works.	From 2003 every year	In the project office; 16 hours training schedule for 30 to 50 workers in practices.		
4	Annual report making on the environmental protection to the Ministry of nature and Environment and Local Governors office.	Annual report is to be submitted to the local government and Central Administrative organization.	From 2003 every year	Preparation of annual schedule and reporting on results with data and photos.		Appraisal of work plan of proceeded year and reporting the previous year work
5	To conduct an agreement in cooperated with local hospitals and clinics due to secure health condition of workers when in the cases.	Establishment of measures for prevention of accident, disaster and dangerous disease for workers, and information plan making.	From 2003 every year	Set up an emergency fund and introduce the rules to use the fund.		The fund shall be ready to establish and in case of not use then save for the followed year.
6	Establishment of measures on fire extinguish with full organization. Provision of proper training on fire fighting.	Establishment of measures against possible fires at daily operation in dry season. Preparation for fire fighting and fire extinguishers and training.	From 2003 each year	Install of fire extinguishers at proper places and preparing manual in workers camp and		“Fire preventive instruction”

Monitoring program

Required work on following table, detail collaboration is needed with Natural and Environmental Offices of Tuv and Hentii provinces and report to the Ministry of Nature and Environment on whole results of monitoring in 15 November annually.

Table 14- 5-7 Monitoring Program on Atmosphere and Air

No.	Parameters for monitoring	Work items	Sampling location	Monitoring period	Permitted rate kg\m3	Approximate cost thousand Tg.	Required standard
1	Total suspended particles. mkg/m3	1) Sampling 2) Laboratory testing	Sampling and testing on road sections located at quarry sites with in 1 km from the community and construction site	Twice a year in spring and autumn	150	204	Resolution to provide a quantity of town and settlement UST 12.2.3.16-80Requirement to establish standard of atmosphere. UST 3384-92 Ways to determine the unity of sulphur into the atmosphere USTSS3298-83, USTSS3600-83
2	Carbon dioxide mkg/m3	Same	Construction site	1 to 2times during construction	3	216	
3	Nitrogen dioxide. NO2, gr/m3	Same	Construction site	Same	40	208	
4	Content of sulphur dioxide SO2. Mkg/m3	Same	Construction site	same	50	160	

Table 14- 5-8 Monitoring Program on Surface Water

No.	Parameters for monitoring	Work items	Sampling location	Monitoring period	Permitted rate kg\m3	Approximate cost thousand Tg.	Required standard
1	PH of water	1) Sampling 2) Laboratory testing	Lower and end part of temporary stream may affect heavy rain and snow. Area of flow confluence into Kherlen river.	In time of temporary stream by intensive rain, twice a week during the construction	7.0 to 8.5	204	SS 3534-83. Method on taking a sample for water testing MNS-900-92
2	Iron Fe mg/I	Same	Same location	same	0.5 mg/I	210	
3	Lead Pb mg/l	Same	Same location	Same	0.0002 mg/I	204	
4	Oil products mg/I	Same	Same location	Same	0 mg/I	162	
5	Organic Substances mg/I	Same	Same location	Same	0.01 mg/I	204	
6	BOD mg/I	Same	Same location	Same	8.4-12.4 mg/I	210	
7	Suspended solids mg/I	Same	Same location	Same	20 mg/I	204	
8	Odour	Same	Same location	same	None	60	

Table 14- 5-9 Monitoring Program on Soil Cover

No.	Parameters for monitoring	Work items	Sampling location	Monitoring period	Permitted rate kg\m3	Approximate cost thousand Tg.	Required standard
1	PH of soil	1) Sampling 2) Laboratory testing	In the surrounding areas of the road and quarries.	Twice per year	8	160	SS 32-98-90 "Requirements to take samples of soil for testing" SS 3297-91 "Assessment and Indication of soil hygiene of town and settlement " SS 17.5.1.18 "Classification of destroyed regions which will be restored" SS 17.5.1.19-92 "General requirement for restoring"
2	Oil product mg/kg	Same as above	Same location	Same time	0	160	
3	Thickness of fertile strata, cm	Observation in field	Same location	Same time	-	40	
4	Humus mg/kg	1) Sampling 2) Laboratory testing	Same location	Same time	15 to 20	160	
5	Total carbonate mg/kg	Same as above	Same location	Same time	21	208	
6	Content of nitrogen mg/kg	Same as above	Same location	Same time	5.9	208	
7	Content of Phosphorus mg/kg	Same as above	Same location	Same time	1.8	160	

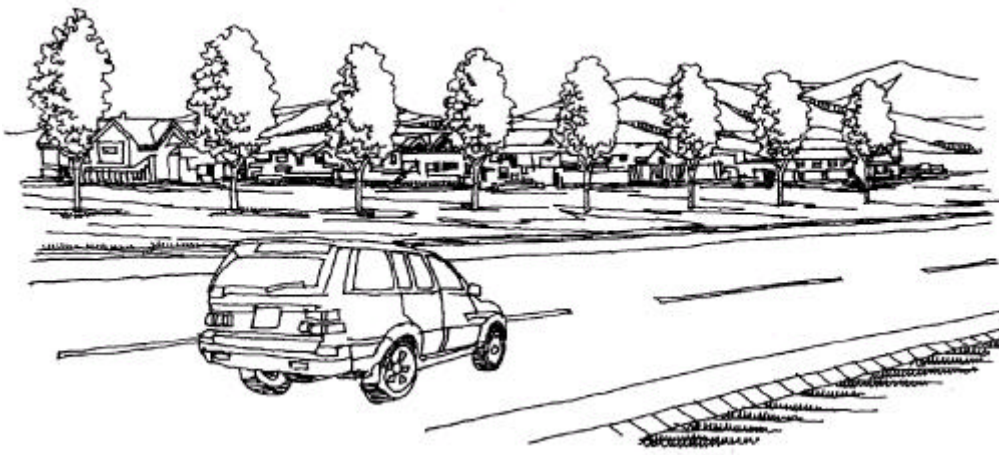
Table 14-5-10 Monitoring Program on Natural Resources Use, Hygienic Condition of Work Site

No.	Parameters for monitoring	Work items	Sampling location	Monitoring period	Permitted rate kg\m3	Approximate cost thousand Tg.	Required standard
1	Total water use	Observation	Main stream of water	3 times a year		144	"Resolution on keeping an elementary statistics of water" Appendix of 192 order of Minister of Nature and Environment
2	Material resources	Observation	operated quarry sites	3 times a year	-	144	-
3	Land degradation	Observation	Construction sites, quarry sites, temporary use road	3 times a year	Permitted area	144	Resolution on ground controlling and guarantee

Table 14-5-11 Monitoring Program on Hygienic Condition of Work Site

No.	Parameters for monitoring	Work items	Sampling location	Monitoring period	Permitted rate kg\m3	Approximate cost thousand Tg.	Required standard
1	Condition of work site: Hygiene Lighting Safety management of tools and equipment Risk management Fire escape extinguish Planning of community protective measures	Observation		3 times a year		144	
2	Health condition of workers	Observe workers		Once a year		80	

CHAPTER 15 PROJECT IMPLEMENTATION PLAN



CHAPTER 15 PROJECT IMPLEMENTATION PLAN

15.1 Introduction

The study road comprises the road stretch between Erdene - Undurkhaan, totaling 258.8 km in length. Within the study road, the 37 km long road section between Erdene - Baganuur is being constructed by the Department of Roads using the Government's own fund. The budget is 4.1 billion Togrog, and the construction period is scheduled to be 4 years from 2001 to 2004.

The project implementation plan covers the road stretch between Baganuur - Undurkhaan (hereinafter referred to as "project road" for this Study) totals 221.8 km and excludes the above-mentioned 37 km long road section. However, since traffic demand forecast has been carried out to cover the road stretch between Erdene - Undurkhaan, the project implementation plan is made in recognition of the work to be done on the road stretch between Erdene - Undurkhaan. This is done particularly for the economic analysis based on the estimated benefit to be accrued from the forecasted traffic demand.

The project implementation plan is required to provide the succeeding economic analysis with the proposed time schedule based on due procedures such as detailed design, tendering process and construction works stemming from a study of the expected construction planning. The following objectives are also taken into account:

- to ensure that each construction section keeps harmonious construction planning within the overall implementation plan
- to provide basic data and information for the economic analysis
- to make a reasonable scale of improvement plan to reflect the result of the demand forecast analysis
- to reflect the study results to the conclusion and recommendation

15.2 Construction Planning

(1) Construction Section

There are existing villages such as Tsenkhermandal sum, Jargaltkhaan sum and Murun sum along the route, and there are also connecting roads at Kherlen River East, Jargaltkhaan and Murun West. The study road between Erdene and Undurkhaan, is divided into the following six (6) construction sections based on consideration of the villages and connecting roads.

Section-I: Erdene - Baganuur L=37 km (constructed by DOR and excluded in this construction planning)

Section - II: Baganuur - Kherlen River East L=30.6 km

Section - III: Kherlen River East - Tsenkhermandal L=49.7 km

Section - IV: Tsenkhermandal - Jargaltkhaan L=44.7 km

Section - V: Jargaltkhaan - Murun West L=50.0 km

Section - VI: Murun West - Undurkhaan L=46.8 km

The location of each construction section is shown in Figure 15-2-1.

(2) Component of Construction Planning and Basic Assumptions

The construction planning for the project road is basically covered by the components of road earthwork, pavement works, structural works of bridges/culverts and incidental works. The type of pavement has a few alternative plans, and the evaluation and selection within these alternative plans is not finalized yet. However, no matter which alternative plan is selected, it may be generally accepted that no significant difference is found in the aspect of construction planning at the stage of feasibility study. Accordingly, the following discussion is made on the assumption that all the stretches will be paved by asphalt concrete.

(3) Quantities of Major Construction Works

Construction planning for Sections II to VI is made based on the quantities of each main construction work item and selection of construction methods to suit the site conditions. The quantities of main construction works based on the preliminary design are summarized in Table 15-2-1.

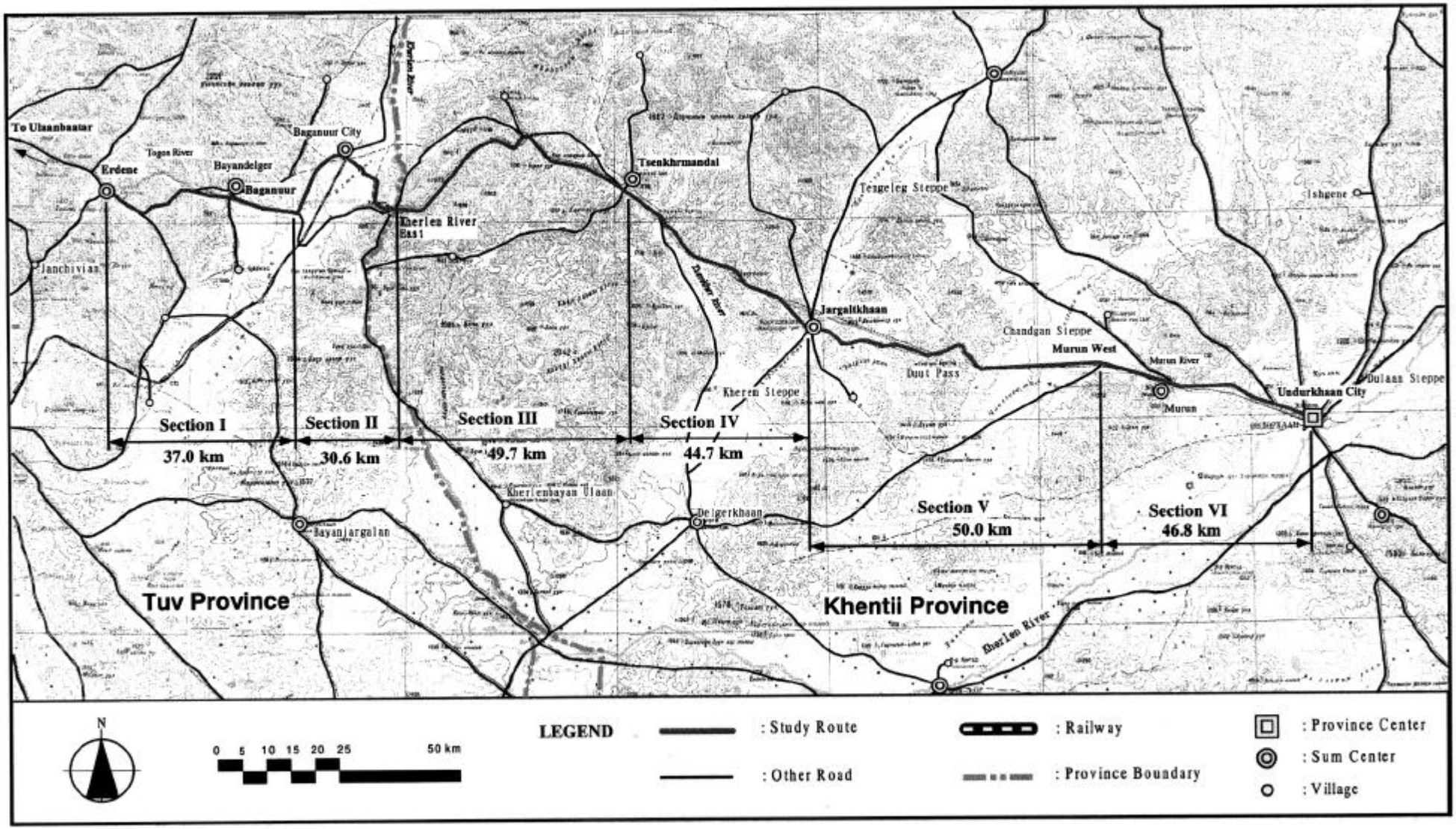


Figure 15-2-1 Location of Each Construction Section

Table 15-2-1 Major Quantities of Eastern Arterial Road Construction

Case - 1 : Aspalt Concrete Pavement at All Sections

			Section II	Section III	Section IV	Section V	Section VI	Total
			Baganuur - Kherlen River East	Kherlen River East - Tsenkhermandal	Tsenkhermandal - Jargaltkhaan	Jargaltkhaan - Murun West	Murun West - Unduurkhaan	Murun West - Unduurkhaan
ITEM No.	Description	Unit	STA. 112 + 127 ～ 142 + 700	STA. 142 + 700 ～ 192 + 400	STA. 192 + 400 ～ 237 + 100	STA. 237 + 100 ～ 287 + 100	STA. 287+ 100 ～ 333 + 949	STA. 112 + 127 ～ 333 + 949
			30.573 km	49.700 km	44.700 km	50.000 km	46.849 km	221.822 km
	Road length	km	30.287	49.700	44.632	50.000	46.796	221.415
	Bridge Length	m	301.3	0	67.5	0	52.5	421.3
1	Clearing and Surface Stripping	m2	186,913	707,411	642,955	659,750	547,165	2,744,194
2	Excavation	m3	2,783	153,479	69,439	197,093	80,708	503,502
3	Embankment	m3	265,894	1,130,071	825,909	777,337	483,183	3,482,394
4	Earth work for raising	m	445	0	0	0	0	445
5	Maintaining hauling route	m2	59655	248,500	223,500	250,000	234,245	1,015,900
6	Subbase	m3	33,317	132,650	108,850	115,550	110,641	501,008
7	Graded Base Course	m3	13,586	69,727	47,156	47,158	35,565	213,192
8	Bituminous Surface Treatment	m2	0	0	0	0	0	0
9	Asphalt Concrete Surface	m2	91,609	377,720	339,203	380,000	355,650	1,544,182
10	Asphalt Concrete Overlay for Ac surface	m2	112,742	0	0	0	0	112,742
11	Asphalt Concrete Overlay for BST surface	m2	14,637	0	0	0	0	14,637
12	Granulaer Shoulder	m2	29,281	119,280	107,117	120,000	112,310	487,988
13	Shoulder modification	m2	54,591	0	0	0	0	54,591
14	Kilometer marker posts	No.	30	50	45	50	46	221
15	Guard post	No.	917	3,302	1,367	865	220	6,671
16	Pavement markings	km	73	119	106	120	113	531
17	Signs	No.	32	23	39	10	11	115
18	Road Station	No.	1	0	2	1	1	5
19	Obsevation Platform	No.	0	1	0	1	0	2
20	Lined Drain	m	2,850	13,645	10,850	6,620	2,000	35,965
21	Culvert Type A (1 @ 1.0m dia)	No.	7	42	23	25	25	122
22	Culvert Type B (1 @ 1.5m dia)	No.	2	16	14	13	12	57
23	Culvert Type C (2 @ 1.5m dia)	No.	1	5	5	6	1	18
24	Culvert Type D (1 @ 2.5m x 2.5m)	No.	0	6	3	1	2	12
25	Culvert Type E (2 @ 2.5m x 2.5m)	No.	0	5	3	2	2	12
26	Culvert Type F (3 @ 2.5m x 2.5m)	No.	0	1	3	1	0	5
27	Culvert Type G (3 @ 3.0m x 3.0m)	No.	0	0	0	0	0	0
28	Bridge Type 1 (l = 15.0m)	No.	1	0	1	0	0	2
29	Bridge Type 2 (l = 17.5m)	No.	1	0	0	0	0	1
30	Bridge Type 3 (l = 35.0m)	No.	0	0	0	0	0	0
31	Bridge Type 4 (l = 52.5m)	No.	0	0	1	0	1	2
32	Bridge Type 5 (l = 70.0m)	No.	0	0	0	0	0	0
33	Bridge Type 6 (l = 268.8m)	No.	1	0	0	0	0	1
34	Environmental countermesure for borrow pit	m2	6,930	39,624	14,962	14,652	712	76,880
35	Environmental conuntermesure for quarry	m2	4,080	10,800	11,820	0	17,940	44,640
36	Slope for domestic animal crossing	No.	3	6	11	3	0	23
37	Planting tree	No.	0	0	150	200	240	590
38	Reinstate of hauling road	km	12	50	45	50	46	203

(4) Construction Time Schedule

The construction time schedule to cover Sections II to VI is shown in Table 15-2-2 and this has been prepared based on quantity of works, considering the following salient features in the project area.

1) Asphalt pavement work is limited to the period of 5 months (May to September) and earthwork is limited to the period of 7 months (April to October).
2) Stockpiling of aggregates, pre-cast concrete structures and other preparatory works are carried out through the year.

The period of 4-year construction to cover 221.8 km long road improvement as shown in Table 15-2-2 may be justified considering the achievements of the following previous projects:

1) ADB first road development (312 km achieved in 5 years)
2) Kuwait funded road project (180 km scheduled in 4 years).
3) Construction schedule of ADB second road development (200 km scheduled in 4 years)

However, planning that all the whole sections be done under one contract seems to make it hard for a Contractor to complete the project within 4 years. This is because as shown in ALT-1 of Table 15-2-2, the surface pavement work should maintain the progress of 98,327 sq.m per month or the equivalent of 13.5 km per month. This may be compared to ALT-2 where a Contractor would keep the progress of 22,353 sq.m per month equivalent to 3.1 km per month.

Table 15-2-2 Construction Planning for Sections II to VI

Case - 1: Whole sections by One Contract
Section: Baganuur～Undurkhaan

		Quantity	Progress Rate		Year One												Year Two												Year Three												Year Four											
					J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
	Road Length （km）	221.4																																																		
	Construction Schedule																																																		
1	Preparatory Works																																																		
2	Earthwork Volume （cu.m）	3,985,896	189,805	m3/month																																																
3	Pavement																																																		
	Surface Course （sq.m）	1,671,561	98,327	m2/month																																															
	Base Course （cu.m）	213,192	9,269	m3/month																																															
	Sub-base Course （cu.m）	501,008	21,783	m3/month																																															
4	Bridge Work																																																		
	N0. of Location	6																																																	
	Total Length （m）	421.3	30	m/month																																															
5	Culverts																																																		
	No. of Location	226																																																
	Total Length （m）	3,164.0	226	m/month																																														
6	Incidental Works																																																		

Case - 2: Each section by One Contract
Section: Jargaltkhaan～Murun West

		Quantity	Progress Rate		Year One												Year Two												Year Three												Year Four											
					J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
	Road Length （km）	50.0																																																		
	Construction Schedule																																																		
1	Preparatory Works																																																		
2	Earthwork Volume （cu.m）	974,430	46,401	m3/month																																																
3	Pavement																																																		
	Surface Course （sq.m）	380,000	22,353	m2/month																																															
	Base Course （cu.m）	47,158	2,050	m3/month																																															
	Sub-base Course （cu.m）	115,550	5,024	m3/month																																															
4	Bridge Work																																																		
	N0. of Location	0																																																	
	Total Length （m）	0.0	0	m/month																																															
5	Culverts																																																		
	No. of Location	48																																																
	Total Length （m）	672.0	48	m/month																																															
6	Incidental Works																																																		

15.3 Project Implementation Plan

15.3.1 Time Requirements

(1) Detailed Design

It is necessary for DOR to procure a consultant who may review the preliminary design and then conduct the detailed design and hold a professional liability for that design. Since tender documents are based on the detailed design, the procurement of consultant should be made prior to starting the pre-qualification process for contractors.

It is indispensable to conduct a detailed design at a certain level of accuracy to prepare following necessary maps and documents;

1) Reconfirmation of construction site after reviewing the centerline of road and required road Right-Of- Way (ROW) that the Study has established;
2) Bill of Quantity of proposed project packages based on the detailed designing works;
3) Tender documents for tendering based on the decision whether the tendering will be carried out by international competitive bidding (ICB) or local competitive bidding (LCB); and
4) Engineer's estimates for fund allocation.

It may take six (6) months after contracting with a consultant to complete the detailed design even though a professional consultant familiar with Mongolian conditions is procured and advanced technology such as computer aided design (CAD) and global positioning system (GPS) are fully utilized.

Since no basis is found in preparation of required fund for detailed design, time requirement between the end of feasibility study and the beginning of detailed design is ignored.

(2) Tendering Process

After the completion of detailed design, sufficient time is required to carry out the due procedures to select a technically responsive contractor by ICB.

It may take six (6) months to complete tendering process from the completion of detailed design.

Since no commitment is found for project implementation, time requirement for funding arrangement is neglected.

(3) Construction Time Schedule

Since construction activities require many preparatory works, a detailed construction planning is vital for smooth execution.

In this Study, it may take four (4) years to complete construction of bridge and road, based on the construction planning as discussed in Section 15.2.

15.3.2 Implementation Plan

(1) Implementation Plan for Sections II to VI

Although the project will be able to implemented by various options as long as required fund is available, the type of project implementation has different features upon the completion. For example, the Chinese contractor procured through ICB to undertake the ADB second road development will construct the road using their own imported equipment and procuring necessary materials, equipment and labor from local markets. Only the constructed facilities will remain in Mongolia upon the completion although some technology transfer should be achieved. On other hand, the State-owned Construction Company "Erdene Zam" is constructing the road section of Erdene - Baganuur on a contract basis, using construction equipment procured under Japan's grant aid. Upon completion, the construction technique will be improved through the implementation, the skills of local engineer's, operators and mechanics will be developed and some revenue accrued from equipment will transfer to the State Property Committee. The former option is adopted because the use of ICB is compulsory under the terms and conditions of the ADB loan, and the in the latter option the Government allocates the fund.

Considering the government's difficult fiscal and budgetary position, two schemes are considered within the project implementation plan:

Scheme-I: Construction by contractor selected through tendering

The highest priority should be given to Section -II (Baganuur - Kherlen River East L=30.6 km) and Section -VI (Murun West - Undurkhaan L=46.8 km) because they are located in the surroundings of urban area and relatively high economic return is anticipated due to the higher traffic volumes. Accordingly, these sections should be implemented by a selected international contractor in a competitive environment utilizing funds and aids of donors.

Scheme-II: Construction by DOR as a pilot model

The remaining sections of Section -III (Kherlen River East - Tsenkhermandal L=49.7 km), Section -IV (Tsenkhermandal - Jargaltkhaan L=44.7 km) and Section -V (Jargaltkhaan - Murun West L=50.0 km) should be implemented by DOR using the proposed road rehabilitation/ maintenance center.

Scheme-I has advantages in the aspects of using effective, efficient and accountable procedures to realize the project by fast track method and with less financial burden

on the government. However, no resource except facilities will be developed and road maintenance on the constructed section may face both technical and financial difficulties.

Scheme-II has the possibility to cope with institutional requirements that are issued in the administration of road. It enables to cope with incremental demand brought about by the government policy of road improvement, especially development of the “Millennium Road” and possible growth of the construction industry through actual practices.

Table 15-3-1 shows the construction time schedule for both Scheme-I and Scheme-II.

Table 15-3-1 Construction Planning for Sections II to VI

Section –II: Baganuur - Kherlen River East

		Quantity	Progress Rate		Year One												Year Two												Year Three												Year Four											
					J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
	Road Length （km）	30.3																																																		
	Construction Schedule																																																		
1	Preparatory Works																																																		
2	Earthwork Volume （cu.m）	268,677	19,191	m3/month																																																
3	Pavement																																																		
	Surface Course （sq.m）	218,988	18,249	m2/month																																															
	Base Course （cu.m）	13,586	849	m3/month																																															
	Sub-base Course （cu.m）	33,317	2,082	m3/month																																															
4	Bridge Work																																																		
	N0. of Location	3																																																	
	Total Length （m）	301.3	27	m/month																																															
5	Culverts																																																		
	No. of Location	10																																																
	Total Length （m）	140.0	13	m/month																																															
6	Incidental Works																																																		

Section –III, IV, V: Kherlen River East - Murun West

		Quantity	Progress Rate		Year One												Year Two												Year Three												Year Four											
					J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
	Road Length （km）	144.3																																																		
	Construction Schedule																																																		
1	Preparatory Works																																																		
2	Earthwork Volume （cu.m）	3,153,328	150,158	m3/month																																																
3	Pavement																																																		
	Surface Course （sq.m）	1,096,923	64,525	m2/month																																															
	Base Course （cu.m）	164,041	7,132	m3/month																																															
	Sub-base Course （cu.m）	357,050	15,524	m3/month																																															
4	Bridge Work																																																		
	N0. of Location	2																																																	
	Total Length （m）	67.5	5	m/month																																															
5	Culverts																																																		
	No. of Location	174																																																
	Total Length （m）	2,436.0	174	m/month																																															
6	Incidental Works																																																		

Section –VI: Murun West - Undurkhaan

		Quantity	Progress Rate		Year One												Year Two												Year Three												Year Four											
					J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
	Road Length （km）	46.8																																																		
	Construction Schedule																																																		
1	Preparatory Works																																																		
2	Earthwork Volume （cu.m）	563,891	40,278	m3/month																																																
3	Pavement																																																		
	Surface Course （sq.m）	355,650	29,637	m2/month																																															
	Base Course （cu.m）	35,565	2,223	m3/month																																															
	Sub-base Course （cu.m）	110,641	6,915	m3/month																																															
4	Bridge Work																																																		
	N0. of Location	1																																																	
	Total Length （m）	52.5	5	m/month																																															
5	Culverts																																																		
	No. of Location	42																																																
	Total Length （m）	588.0	53	m/month																																															
6	Incidental Works																																																		

(2) Implementation Plan for Economic Analysis

The implementation plan for the economic analysis is made to cover the entire road stretch between Erdene - Undurkhaan because it should coincide with the sections set by traffic demand forecast. This will allow comparison of the estimated costs and benefit that will be accrued from forecasted traffic demand. Table 15-3-2 shows the relationship between traffic section and construction section, and the IP section is newly set for the proposed project implementation plan for the economic analysis.

Table 15-3-2 Relationship between Traffic Section and Construction Section

Traffic	Erdene - Baganuur		Baganuur - Jargaltkhaan		Jargaltkhaan - Murun	Murun - Undurkhaan
Construction	Section-I	Section -II	Section -III	Section -IV	Section -V	Section -VI
	Erdene - Baganuur	Baganuur - Kherlen River East	Kherlen River East - Tsenkhermandal	Tsenkhermandal - Jargaltkhaan	Jargaltkhaan - Murun West	Murun West - Undurkhaan
IP Section	IP Section-1		IP Section-2		IP Section-3	IP Section-4

Table 15-3-3 shows the proposed project implementation time schedule for the purpose of economic analysis, including the road section between Erdene - Undurkhaan.

Table 15-3-3 Project Implementation Time Schedule

Major Items	YR 2001				YR 2002				YR 2003				YR 2004				YR 2005				YR 2006			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Feasibility Study																								
Procurement of Consultant						★																		
Detailed Design																								
Pre-qualification of Contractors								★																
Tendering																								
Establishment of RRMC																								
Procurement of Equipment								★																
Construction																								
IP Section-A																								
Section-I Erdene～Baganuur																								
Section-II Baganuur～Kherlen River East																								
IP Section-B																								
Section-III Kherlen River East～Tsenkhermandal																								
Section-IV Tsenkhermandal～Jargaltkhaan																								
Section-V Jargaltkhaan～Murun West																								
IP Section-C																								
Section-IV Murun West～Undurkhaan																								

15.4 Equipment Required for Road Rehabilitation/Maintenance Center

The Equipment required for the road rehabilitation/maintenance center which will construct Sections III, IV and V in the estimated construction period of four (4) years is as shown in Table 15-4-1. The breakdown of these estimated numbers of equipment and its cost are presented in the Appendix.

Table 15-4-1 Required Equipment List for Road Rehabilitation and Maintenance Center

Item	Description	Specification	Quantity	Remarks
1	Bulldozer	28 ton	3 units	Construction
2	Bulldozer	7 ton	2 units	ditto
3	Hydraulic Excavator	0.7 m^3	4 units	ditto
4	Wheel Loader	2.1 m^3	5 units	ditto
5	Wheel Loader	1.3 m^3	2 units	Construction/Maintenance
6	Dump Truck	11 ton	33 units	Construction
7	Motor Grader	3.7 m	9 units	Construction/Maintenance
8	Vibration Roller	10 ton	5 units	ditto
9	Tire Roller	10 ton	1 unit	ditto
10	Asphalt Finisher	4 m	1 unit	ditto
11	Asphalt Plant	60 ton	1 unit	ditto
12	Water Tanker	8000 liter	1 unit	Construction
13	Asphalt Sprayer	1500 liter	1 unit	Construction/Maintenance
14	Chip Spreader	Vessel mount type	2 units	Construction/Maintenance
15	Tractor Head with Trailer	35 ton	1 unit	Construction
16	Crusher Plant	Jaw 60t & Cone 49t	2 units	Construction
17	Asphalt Cutter	-	2 units	Maintenance
18	Air Compressor	180 PSI	2 units	Construction/Maintenance
19	Plate Compactor	60 kg	8 units	ditto
20	Pnuematic Breaker	30 kg	8 units	ditto
21	Dump Truck	4 ton, 4 x 4	4 units	ditto
22	Truck with 3 ton Crane	5 ton	1 unit	ditto
23	Road Patrol Car	4 x 4	1 unit	Maintenace
24	Double Cab Pick-up	4 x 4	2 units	Construction/Maintenance
25	Line Marker Truck	-	1 unit	Construction/Maintenance
26	Mobile Workshop	GVW 13 ton, 4 x 4	2 units	Maintenace
27	Rotary Snow Remover	Unimog type	2 units	Maintenace
28	Asphalt Testing Equipment	-	1 lot	Construction/Maintenance
29	Radio Communication	Base / Mobile	1 lot	Construction/Maintenance
30	Road Measure (wheel type)	5 digits	1 set	Maintenace

CHAPTER 16 ECONOMIC AND FINANCIAL ANALYSIS

CHAPTER 16 ECONOMIC AND FINANCIAL ANALYSIS

16.1 General

The economic analysis was conducted based on a comparison of the with- and without-project scenarios. The total length of the Project road is 258.8 km, divided into four sections: Erdene - Baganuur 67.6 km (IP Section 1); Baganuur - Jargaltkhaan 94.4 km (IP Section 2); Jargaltkhaan - Murun 50.0 km (IP Section 3); and Murun - Undurkhaan 46.8 km (IP Section 4). Under the without-project scenario the existing earth road would continue to result in high vehicle operating costs (VOCs). Under the with-project scenario the asphalt concrete pavement would result in reduced VOCs.

To calculate the economic internal rate of return (EIRR), benefit streams were estimated for a twenty-year period (2006-2025). The construction costs, including detailed engineering and supervision services, were spread over a six-year implementation period (2001-2006). The year 2001 was included to reflect that construction of Section I started in that year. Costs and benefits were estimated after taking out taxes and duties and were then converted into economic prices. The economic costs and benefits are expressed in constant 2002 prices. The construction periods, section by section, are shown below.

Table 16-1-1 Construction Period by Each Section

Section		Road Length	Construction Period
IP Section 1	Erdene-Baganuur	67.6 km	2001-2005
IP Section 2	Baganuur-Jargaltkhaan	94.4 km	2003-2006
IP Section 3	Jargaltkhaan-Murun	50.0 km	2003-2006
IP Section 4	Murun-Undurkhaan	46.8 km	2003-2005

For the purposes of each scope of works, each section has been discussed individually in associated chapter, namely traffic demand forecast in Chapter 3, construction cost estimates in Chapter 12 and implementation plan in Chapter 15. The following table gives the relationship among them.

Table 16-1-2 Relationship between Traffic Section and Construction Section

Traffic	Erdene - Baganuur		Baganuur - Jargaltkhaan		Jargaltkhaan - Murun	Murun - Undurkhaan
Construction	Section-I	Section -II	Section -III	Section -IV	Section -V	Section -VI
	Erdene - Baganuur	Baganuur - Kherlen River East	Kherlen River East - Tsenkhermandal	Tsenkhermandal - Jargaltkhaan	Jargaltkhaan - Murun West	Murun West - Undurkhaan
IP Section	IP Section-1		IP Section-2		IP Section-3	IP Section-4

The financial analysis was conducted on the assumption that the Road Fund would increase the revenue from the proposed toll levying from Kherlen River Bridge and equipment leasing at the proposed road rehabilitation/maintenance center after the completion of construction work.

16.2 Economic Analysis

16.2.1 Costs

The economic costs include the capital and maintenance costs of the Project valued in economic prices. To determine the appropriate economic costs, goods and services to be used in Project implementation were divided into tradable and non-tradable groups. The financial costs of the non-tradable were converted into economic costs by using the standard conversion factor of 0.88. Under the without-project scenario, it was assumed that there would not be any maintenance as very little maintenance is presently being carried out. Under the with-project scenario, maintenance was defined to include routine maintenance (ditch clearing, culvert and bridge cleaning and repair, shoulder maintenance and other routine activities) and periodic maintenance (overlay every 7 years). These financial maintenance costs were adjusted to economic costs in the same manner as specified above.

16.2.2 Benefits

The source of quantified benefits from the Project is savings in VOCs (normal traffic only). To be conservative, benefits attributable to generated traffic and savings in travel time were not considered. In estimating economic benefits, financial benefits were coverted to economic benefits by using the same approach as specified in the previous paragraph. The VOC estimates are based on the Roads Economic Decision VOC model developed by the World Bank. The VOC savings for normal traffic (in 2002 economic prices) reflect the traffic forecasts specified in Chapter 3. Five vehicle types were used: car, bus, small truck, medium truck and large truck. The VOC savings will accrue primarily from an improved road surface (from earth to asphalt concrete), and improvements in horizontal and vertical alignment and average vehicle speeds. Various categories of road users will benefit from the Project. Business in towns in the Project area will have cheaper access to the market and the capital city; farmers and tradesmen will have better access to markets; and local people will enjoy better access to social services and local growth centers.

Based on recent government initiatives (namely, Ministry of Infrastructure Development Order No. 100 April 2001 and Department of Roads Order No. 62 May 2001), it is envisaged that local people along the Project route will be able to participate in routine maintenance activities by providing labor and light equipment such as animal carts. This would generate employment and help to reduce poverty in the Project area.

In the without-project scenario, it has been assessed that the international roughness index (IRI) for the earth road would be 14. In the with-project scenario, the IRI is considered to be 3. Based on these assumptions, VOC costs and savings by vehicle type (in $ per vehicle km) are shown below.

Table 16-2-1 Vehicle Operating Costs in $ per vehicle km

Vehicle type	IRI 14 without	IRI 3 with	VOC saving
Car	0.234	0.100	0.134
Bus	0.654	0.504	0.150
Small Truck	0.222	0.095	0.127
Medium Truck	0.723	0.445	0.278
Large Truck	0.770	0.498	0.272

16.2.3 Results of Economic Analysis

The economic analysis is conducted in the following two alternative options:

ALT-1: The project will pave the whole stretch of road by asphalt concrete. The routine maintenance of asphalt concrete pavement and reinforced concrete bridges will be carried out according to the DOR normative unit costs and then the periodic maintenance will be done by overlay at seven years interval.

ALT-2: The project will pave the road stretch up to Tsenkhermandal by asphalt concrete and the remaining road stretch by bituminous surface treatment. The routine maintenance will be carried out according to the DOR normative unit costs of asphalt concrete pavement, bituminous surface treatment and reinforced concrete bridges, and then the periodic maintenance will be done by overlay in asphalt concrete pavement at seven years interval and by surface dressing in bituminous surface treatment at three years interval.

The results of the economic analysis are summarized below - firstly for the base case and secondly for a range of sensitivity tests. More details are provided in the Appendix.

Table 16-2-2 EIRR Base Case

Section		Road Length	ALT-1	ALT-2
IP Section 1	Erdene-Kherlen River East	67.6 km	17.3%	17.3%
IP Section 2	Kherlen River East - Jargaltkhaan	94.4 km	9.4%	10.6%
IP Section 3	Jargaltkhaan-Murun West	50.0 km	17.6%	19.0%
IP Section 4	Murun West -Undurkhaan	46.8 km	23.2%	25.6%
Total Section	Erdene- Undurkhaan	258.8 km	15.7%	16.8%

Table 16-2-3 EIRR Sensitivity Tests: Total Section of ALT-1

Test	Result - EIRR %
1. Costs plus 10 %	14.4 %
2. Benefits minus 10 %	14.3%
3. Combination of tests 1 & 2	13.0 %

16.3 Financial Analysis

The total project cost rises up to US$ 50 million (equivalent to Tg 55 billion), including on-going road construction of the section between Erdene and Baganuur, and it is obvious that it will be heavy financial burden to the Government, compared with total investment to the road sector of 53.1 billion during the past five years of 1996 to 2000. Moreover, upon the completion of the project in case of ALT-1, the routine maintenance will require Tg 489 million every year according to the DOR normative unit costs, and the periodic maintenance will require approximately Tg 5 billion every 7 years. Even the costs of road maintenance will be heavy burden to the Government, compared with the budgetary level that the total Road Fund is reported Tg 11 billion in 2000 to maintain all the state roads.

Therefore, in order to secure the annual fund required for road maintenance, it is necessary to increase the Road Fund by strengthening road user cost recovery practices and to draw up a long-term strategy for cost recovery from road users.

For example, the revenue from the proposed toll levying from Kherlen River Bridge is estimated as shown in Table 16-3-1, and it seems to contribute to increasing the Road Fund considerably.

Table 16-3-1 Estimated Revenue from Kherlen River Bridge

at 2002 constant price

Toll	Tg per trip	500	1,000	1,000	2,000	2,000	
	Unit	Car	Bus	S-Truck	M-Truck	L-Truck	Total Revenue (M. Tg)
Traffic in 2005	Veh. / day	323	117	19	137	54	
Yearly Revenue	M.Tg / yr	59.0	42.6	6.9	100.3	39.5	248.4
Traffic in 2010	Veh. / day	462	173	28	195	76	
Yearly Revenue	M.Tg/yr	84.3	63.2	10.4	142.1	55.3	355.3
Traffic in 2015	Veh. / day	679	268	39	297	110	
Yearly Revenue	M.Tg/yr	123.9	97.8	14.2	216.7	80.2	532.8

The following points should be taken into consideration:

1) Kherlen River Bridge is the best place to capture long-distance road users because no alternative bridge exists and the river is wide enough to avoid escape.

2) Since the tollgate is located at nearby Baganuur, non-motorized traffic and pedestrian who are usually short-distance road users should be exempted from toll.

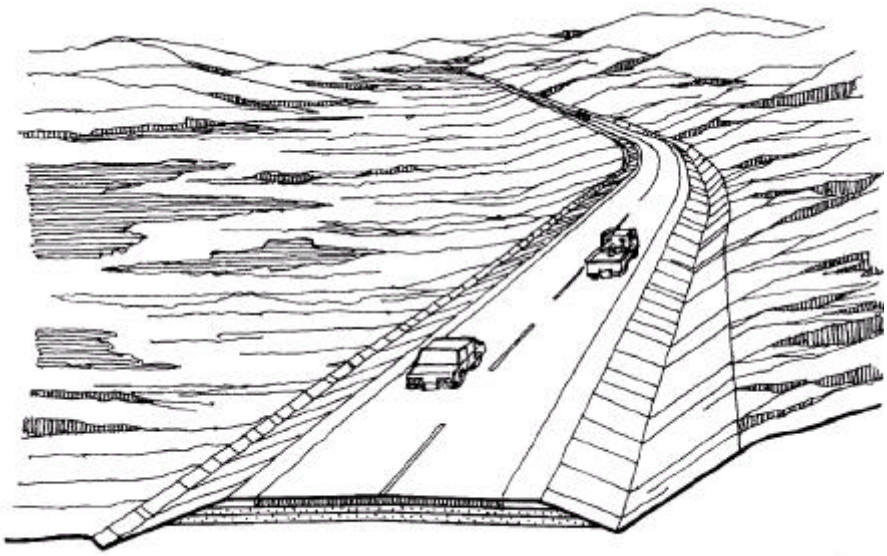
On the other hand, equipment leasing at the proposed road rehabilitation/maintenance center after the completion of construction work is also studied, and it is estimated to earn Tg 424 million annually at most. However, the estimate is made as followings:

1) The maximum revenue is assumed to amount as much as half of annual depreciation because equipment will be used for operator training at the centre in winter or during waiting time.

2) Even though DOR will use equipment for the road rehabilitation and maintenance by themselves, it is regarded as the revenue because of saving from the Road Fund.

It will be possible to envisage that these two schemes will be able to cover annual required fund of Tg 489 million for road maintenance according to the DOR normative unit costs**.**

CHAPTER 17 CONCLUSION AND RECOMMENDATIONS



CHAPTER 17 CONCLUSION AND RECOMMENDATIONS

17.1 Justification of the Project

17.1.1 Development Potential in the Eastern Region

The project will directly improve an arterial road located in about half of the eastern part of the country. The area influenced by the project are the four eastern provinces of Tuv, Khentii, Dornod and Sukhbaatar including the Kherlen River basin as well as the city of Ulaanbaatar. This has a population of 1,086,000 and it accounts for more than 45% of the national population.

The influenced area has high development potential in terms of domestic production/ consumption as well as international trade/investment. There are about 120 deposits of mineral resources along the study road, and they include fluorspar, crude oil, lead, tungsten, molybdenum, gold, coal, construction material and salt. Furthermore, the Kherlen River basin in the Khentii province is productive for cereals, potatoes, vegetables, fodder crops and wheat, and these are transported to Ulaanbaatar, Baganuur and Undurkhaan which are the major consuming centers. Dornod/Sukhbaatar provinces are in a similar situation, especially for livestock. High potential of vehicle growth is anticipated once the study road is improved and it stimulates the development potential within the influence area of the study road.

17.1.2 Expected Roles and Functions of the Study Road

The major issues impeding exploitation of the development potential are in general as follows:

(a) Poor infrastructure system and low efficiency of transport means/facilities results in high transport costs due to the combined effect of a large landlocked country with a low population, vast distance between population centers, heavy dependence on coal-based energy production as well as imports of goods and very limited gateways to neighboring countries.

(b) Extremely severe climatic conditions such as sharp fluctuation of temperature, very small but concentrated precipitation and extreme low temperature necessitate unique in-situ techniques to develop roads against freeze-thaw cycle of frost susceptible soil and cold weather-induced cracking of the pavement.

Under such circumstances, the Government of Mongolia has exerted great efforts to improve the arterial road network and construct bridges to connect Ulaanbaatar with the rest of the country. These efforts can be seen in several strategic road network development plans such as Medium-term Road Master Plan supported by ADB technical assistance and “Millennium Road Plan” approved by the Government of Mongolia.

These superordinate road development plans strategically target to strengthen east-west transport axis to connect with the existing north-south transport axis, envisaging not only the improvement of road transport in Mongolia, but also the enhancement of regional cooperation with Russia, China and other surrounding countries.

The study road is identified as the priority section by both superordinate plans, and its expected roles and functions are as follows:

(a) to secure traffic safety and conserving environment by changing multiple shifting tracks to one paved road to an all-weather standard;

(b) to stimulate economic and social development by connecting villages to provincial center/major cities to provide better market accessibility for more competition and low prices as well as to increase job opportunities for the poor; and

(c) to strengthen linkages between producing and consuming centers and between exploiting resources and trading gateways by the improvement of arterial road to an international standard. This will serve to encourage the development of the market economy.

17.2 Feasibility of the Project

17.2.1 Technical Feasibility

Technical risks of the project have been minimized to the extend possible by having a technical design based on various engineering site surveys, full-scaled natural condition surveys and social/environmental surveys. Such technical design and associated cost estimates are based on results from a series of meetings with DOR technical committee, presentation/workshops and individual discussions with the agencies concerned. Emphasis was given to the route selection at three alternative sections where adverse environmental and social impacts were carefully examined. Due study and consideration was also given to the selection of crossing point at the Kherlen River; the type of bridge superstructure to meet with international standards; the location of borrow pits/quarry sites; and the selection of pavement type. The Appendix includes all of the backup data which has been properly studied and also some official confirmation letters which have been obtained from agencies concerned in the course of the Study.

Accordingly, the technical feasibility for the project is confirmed from all aspects.

17.2.2 Environmental and Social Impact

No significant adverse social impact is expected because the project only involves the improvement of existing roads and no additional land acquisition for road right-of-way is required.

In the course of the Study, the EIA report was prepared based on the result of IEE in accordance with the environmental rules and regulations of Mongolia as well as environmental guidelines of JICA. Appropriate mitigation measures on environmental impact are incorporated in the design such as adequate drainage system, crossing facilities/approach slope for pedestrian and domestic animals and planting trees along the road in the vicinity of villages.

DOR as the executing agency for the project has submitted the application of environmental clearance to MONE based on the EIA report, and due procedure was carried out in February 2002. MONE has issued an Environmental Clearance Certificate (ECC) to the project, and DOR is now trying to obtain the concurrence from Ulaanbaatar City Government, Tuv and Khentii provinces based the ECC. Therefore, it is obvious that environmental justification for the project will be confirmed officially by all remaining parties in a short time.

17.2.3 Economic Feasibility

The major quantifiable benefits accruing from the project are mainly savings of transport cost for existing and future traffic in the eastern part of the country, especially between Ulaanbaatar and Baganuur/Undurkhaan. The economic analysis includes such benefits comprised from generated and induced traffic that are forecast in the future socio-economic framework. The annual traffic growth rate in the planning period is forecast to be 7.7% as a whole. The base EIRR for the project is 16%, with various sensitivity scenarios giving results that range from 13% to 14%.

Therefore, high priority should be given to the implementation of the project because the project will promote economic and social development and shows expectation of a high economic return. The project will also contribute to reduce poverty in the eastern region through increased employment opportunities both during and after construction, accelerated agricultural and pastoral development induced by lower transport costs and improved accessibility of goods and people to markets.

17.2.4 Road Maintenance Capability

Road construction and maintenance in Mongolia is heavily mechanized because of the low density of population and long distances to be covered. It is therefore necessary to strengthen the capability of road repair and maintenance by adequately re-structuring the present road maintenance system and this can aided by the procurement of modern equipment. The proposed road rehabilitation/maintenance center that will undertake actual practices as a pilot model to train operators, mechanics and managers will contribute to deliver effective construction equipment and to strengthen road maintenance capability by such trained skills. The growth in the ability of the road rehabilitation/maintenance center will cope with the incremental demand.

17.2.5 Financial Analysis

Since the project development cost of US$ 50 million and annual required fund for road maintenance of Tg. 489 million are a heavy financial burden compared with the present fiscal and budgetary position of the Government, they will not develop or improve this high priority project by themselves due to the shortage of fund. The project implementation will be realized provided that the Government is required to input only the provision of adequate counterpart funds to bilateral ODA or loans from a multi-lateral lending agency.

However, in order to secure the annual funds required for road maintenance, it is necessary to increase the Road Fund by strengthening road user cost recovery practices and to draw up a long-term strategy for cost recovery from road users.

17.3 Conclusion

The EIA concluded that there are no substantial or irreversible adverse environmental and social impacts arising from the Project.

The project will realize the strategic transport axis in the eastern part of the country as a part of the “Millennium Road Plan” by construction of arterial road to an all-weather international standard.

The significant benefits of the project are summarized as the enhancement of traffic safety and environmental conservation by well-designed paved road; the integration of producing and consuming centers in terms of regional context; and the reduction of transport cost to provide better market accessibility for more competition, low prices and to increase job opportunities for the local poorespecially in the development corridor between Ulaanbaatar and Baganuur/Undurkhaan. It is also anticipated that local people will have better access to social facilities including schools, hospitals and communication centers.

The project will also stimulate the development of the “Millennium Road Plan” so as to induce incremental demand of domestic freight as well as international cargo to China.

Such transformation will accrue considerable degrees of both direct and indirect benefits in the eastern region of the country, especially by reducing transport costs, relieving transport constraints such as severance by river and traffic accident, and strengthening social and cultural links between the country’s diverse population groups.

Accordingly, it may be concluded that the institutional arrangement for project implementation should be undertaken without interruption.

17.4 Recommendations

The following recommendations are made for the implementation of the project:

(1) Implementation of the Project

1) It is recommended that Section -VI (Murun West - Undurkhaan L=46.8 km) be given the highest priority in the implementation plan due to its necessity and urgency together with high feasibility. This section is located in the surroundings of urban area and relatively high economic return is anticipated due to the higher traffic volumes.

2) Section -II (Baganuur - Kherlen River East L=30.6 km) involves the construction of Kherlen River Bridge of which the superstructure type is designed PC girder totaling 268.8m (span 8@ 33.6m) in length. It is recommended that this section should also be given the highest priority in the implementation plan due to its necessity and urgency together with high feasibility.

3) It is recommended that Section -III (Kherlen River East - Tsenkhermandal L=49.7 km), Section -IV (Tsenkhermandal - Jargaltkhaan L=44.7 km) and Section -V (Jargaltkhaan - Murun West L=50.0 km) be implemented by MOI/DOR using the proposed scheme of the scheme of road rehabilitation/ maintenance center. It enables to cope with incremental demand brought about by the government policy of road improvement, especially development of the "Millennium Road" and possible growth of the construction industry through actual work.

(2) Recommended Type of Pavement

It is proposed that the project road should be implemented by the recommended alternative of ALT-1: the whole of the project road paved by asphalt concrete. Asphalt concrete pavement has many advantages compared to bituminous surface treatment in the following aspects:

1) It is concluded that both alternatives are economically viable based on the economic analysis, and 1% difference of IRR is deemed negligibly small in terms of project feasibility.

2) Asphalt concrete (AC) pavement has the advantage of strength and durability to have a longer design life of 10 years in general. Bituminous surface treated (BST) pavement is less strong and durable and it results in applying a shorter design life of 3 years in most cases. BST pavement has vulnerable points of progressive loss of cover aggregate and deepening and expanding potholes. Accordingly, the financial constraint will cause delay of timely repairs and it will lead to aggravating situation. BST pavement is qualitatively inferior in Mongolia because of high risk of road maintenance.

3) Both pavements of AC and BST suffer by a financial constraint in general. However, BST pavement requires labor-based technology in particular and lack of skilled and unskilled labors is crucial in Mongolia having salient features of low population and vast distance between population centers. Therefore, BST pavement is not suitable in this Study.

(3) Countermeasure against Fund Requirement for Road Maintenance

It is crucial for MOI/DOR to levy a toll on Kherlen River Bridges and charge the private sector for the privilege of utilizing the roadside spaces to cope with the increased fund requirement and alleviate the financial burden of the Government. Furthermore, MOI/DOR should seize the initiative to withhold the revenues from equipment leasing at the proposed road rehabilitation/maintenance center and earmark them for road maintenance.

(4) Control of Development along the Route

It is important that the development within and along the proposed route should be effectively controlled to prevent indiscriminate development and to facilitate the realization of road and road related facilities such as road stations and observation platforms.

(5) Appropriation for Road Development Fund

It is recommended that the Government request a donor country to assist in the realization of the project including procurement of equipment at the proposed road rehabilitation/maintenance center, using bilateral ODA or loan from a multi-lateral lending agency so as to alleviate the financial burden of the Government.

(6) Strengthening of Road Rehabilitation/Maintenance Centers

The scheme of road rehabilitation/maintenance centers aims to establish personnel training with construction equipment and machinery required for the road development within AZZAN in an effort to restructure the existing organization. It is recommended that the Government request a donor country to assist in the strengthening of a road rehabilitation/maintenance centers by utilizing the scheme of technical cooperation in the fields of road maintenance.

(7) It is desirable that a feasibility study on the eastern section from Undurkhaan to the eastern border be implemented to catch up with the implementation time schedule of the “Millennium Road Plan”.