Chapter 6 Initial Environmental Examination

6.1 Introduction

The items of Initial Environmental Examination (IEE) are shown below.

Table 6.1.1 Initial Environmental Examination

Socioeconomic environment	Natural environment	Environmental pollution
– Resettlement – Economic activities – Traffic and public facilities – Cultural property – Waste	– Topography and Geology – Soil ecology – Ground water – Hydrological situation – Flora and Fauna – Climate – Landscape	– Air pollution – Water pollution – Soil contamination – Noise and vibration

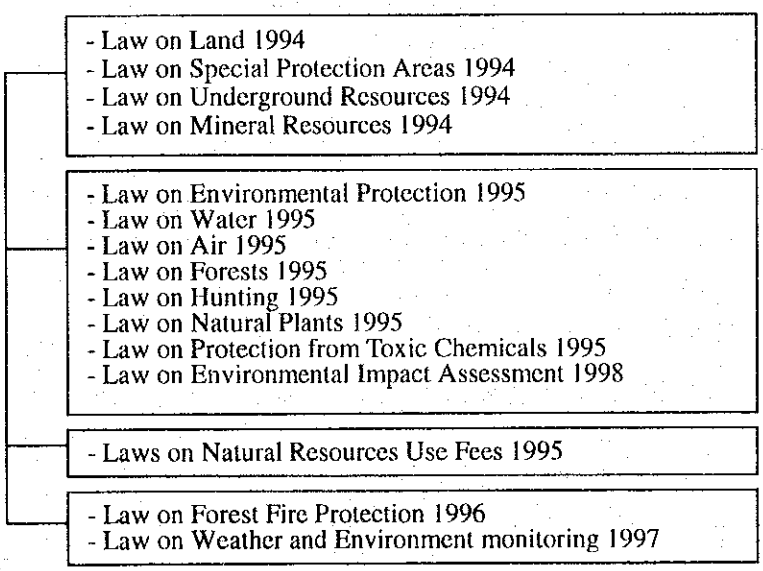
The IEE study covered collection of basic data, which are related to environmental problems and useful for an estimation of the environmental impact caused by the urban transportation projects. Based on the IEE, Environmental impact assessments of those items will be conducted as necessary when roads are improved with bypass, widening, surfacing and other improvements. Natural environmental conditions are described in Chapter 3.

6.2 Legislation

6.2.1 Laws

Historically, Mongolia has adopted and ensured the implementation of several environmental laws as shown in Figure 6.2.1.

Figure 6.2.1 Basis Structure of Environmental Laws in Mongolia



6.2.2 Environmental Impact Assessment (EIA) Law

The Environmental Impact Assessment Law based on the Mongolian Constitution, the Law on Environmental Protection and relevant laws have established the procedures for EIA Main statements of which are as follows:

1) Screening of the Projects

a) New projects as well as renovation and expansion of existing production or services and construction activities and use of natural resources are subject for Screening.

b) The Screening shall be done prior to implementation of the Project.

c) The project proponent (legal person or economic entity who shall be responsible for project implementation) shall submit project description, pre-feasibility, feasibility or technical project documentation and other related documents to the State Administrative Central Organization in charge of Nature and Environment (SACO N&E) or Local Government (LG) for Screening according to the Screening Criteria

d) The SACO N&E shall adopt Screening Guidelines.

e) The Experts appointed by the SACO N&E or LG shall do Screening of project within 12 working days after the request for screening is received, and issue one of the following statements:

- not required detailed EIA
- on condition
- detailed EIA required

2) Detailed Environmental Impact Assessment (DEIA)

a) DEIA shall be conducted by a certified organization, who has a license from SACO N&E.

b) The certified organization shall develop DEIA Report.

c) The DEIA report shall include the following:

- Environmental baseline data and indices
- Project alternatives
- Recommendations for mitigation of potential and significant adverse impacts
- Analysis in extent and distribution of adverse impact and its consequences
- Risk assessment
- Environmental protection plan
- Environmental monitoring program
- Opinion of local residents
- Other issues with regard to the project's specification

d) The draft of the DEIA report shall be officially submitted to the project proponent.

e) The certified organization that have conducted DEIA shall keep the original paper and reports of experts and to develop 3 copies of the DEIA report for SACO N&E and project proponent and those who have equal legal rights.

3) Decision on the DEIA Report

a) The certified organization, which has conducted the DEIA shall submit DEIA Report and related documents to state or local organization who has performed the Screening.

b) The experts in government organization who have received DEIA Report shall perform review within 18 working days and prepare a review statement.

c) SACO N&E shall take decision on implementation of the project based on the expert's statement on DEIA Report.

Ministry of Nature and Environment (MNE) is the screening agency for national highway projects and, the Prefecture government/Ulaanbaatar City for local road projects.

Although Ulaanbaatar City is responsible for local road projects, the EIA for projects/studies sponsored by foreign agencies (such as this Study) is under the charge of the Ministry of Nature and Environment.

6.2.3 Environmental Quality Standards in Mongolia

In July of 1998, new standards on air and water quality were enacted. The air standards are shown in Table 6.2.2. There are no national standards on soil and noise pollution. However, norms currently practiced in other countries such as Malaysia, Thailand etc. are used to assess and regulate sanitation condition of soil and acceptable level of noise in the housing area.

Table 6.2.1 Environmental Air Quality Standard, July 1998

Substance	Environmental Conditions	Measurement Unit	Permissible level		Survey method
			A	B	
SO_2	Maximum	$\mu g/m^3$	500	500	UST 0017.2.5.12-88
	Daily average		30	70*	* Pulse UV fluorescence
CO	Maximum	Mg/m^3		8	NDIR and gas correlation
	Daily average			3	
NO_2	Maximum	$\mu g/m^3$	85	150*	UST 0017.2.5.11-88
	Daily average		40	60*	* Chemiluminescence
O_3	One-hour average	$\mu g/m^3$		120	UV photometric method
SPM	Maximum	$\mu g/m^3$	500	500	Weighting method
	Daily average		150	200	Air pumping of maximum volume
Pb	Daily average	$\mu g/m^3$	1.0		Spectrophotometer
B(a)	Daily average	$\mu g/m^3$	0.001		Chromatograph for liquid and gas

Note: A, B – permissible level depending on survey method
* - Permissible level with this symbol corresponds to the survey method with the same symbol.
Source: MNE document, 1998

6.3 Present Situation of the Study Area

6.3.1 Socioeconomic Environment

1) Resettlement

A compensation system for involuntary resettlement is regulated in the Mongolian Law on Land as the following.

Article 27. Land Possession

1. State owned land shall be possessed by citizens, economic entities, and organizations of Mongolia pursuant to contract and the conditions and duration stipulated in this Law.

Article 32. Land Possession Contract and Procedures for its Conclusion

1. Based on the land possession decision, the official appointed by the Soum and Duureg Governors shall enter into a contract on land possession with citizens, economic entities, and organizations, and then grant a certificate and register contract with the State Registry.

Article 36. Changing or Taking Back Land Possessed by Others with Compensation before Contract Term Expiration

1. The authorized government organization may recommend that the Government change or take back, in part or in whole, with compensation, the land possessed by citizens, economic entities, and organizations for State special need prior to expiration of the contract term and after agreement with the land possessor.

2. Upon consideration of authorized government organization's recommendation on changing or taking back, in part or whole, with compensation, the land possessed by others and

agreement with the land possessor, the Government shall make an appropriate decision on the issue.

Since the Law on Land was enacted in 1994, no rates have been formulated for compensation amount by the Land Department of UB City. However, UB City has started admitting use of the land with people by issuing certificate and registration. At present, most households traditionally living in ger area do not have such certificate nor registration.

2) Economic Activities

Of importance is the power industry represented by 3 large-scale thermo-power plants in the city. The building industry is active in speculative private housing, and private offices and hotels are under construction, those activities are strengthening the role of UB as the country's prime focus for financial and other services. Private establishments have grown rapidly in field of trade and service. The number of kiosks, shops, hotels, restaurants, bars and disco clubs has increased significantly in recent years. Since 1997, greenization has been activated in Mongolia, and with some support from Government areas of agricultural field for UB City households have increased.

3) Traffic and Public Facilities

For road development, it is important to have information on public facilities related to road itself, such as vehicle's stops, footpaths, crossings and other facilities for pedestrians. There are few data available for commonly used public facilities and their locations In road development projects, schools, kindergartens, hospitals, living areas and other public places should be considered with more attention. Since transition to the market economy started, small kiosks along the streets and in public places have increased dramatically, as shown in Table 6.3.1. Most of these kiosks are located along the roads in short distance from the carriageway. Since these kiosks are the only source for a household income, resettlement of these kiosks is afraid to affect their income and conditions. Therefore, road improvement may raise problems not only in road improvement but also in economic impacts to those owners of kiosk and their customers.

Table 6.3.1 UB Statistics on Local Communities

	Unit	1992	1993	1994	1995	1996	1997
Grocery stores	Number	149	171	230	276	355	484
Industrial goods stores	Number	52	51	55	58	68	133
Market	Number	0	2	4	12	13	22
Restaurant	Number	23	41	65	87	138	149
Kiosks	Number	0	255	521	1,085	2,324	2,500
Bars	Number	18	46	79	100	135	306
Secondary schools	Number	115	112	109	107	109	109
Primary schools	Number	5	6	5	5	8	9
Kindergarten	Number	173	152	146	144	151	150
Hospital	Number	21	21	22	22	25	21

Source: UB City Statistics, April 1998

4) Cultural Property

Mongolian Law on Protection of the items of the historical and cultural value protects the property and its place that is significance of the science, history and culture of Mongolia. There are 11 items (such as monuments, temples, tombs and gates) under state protection, 18 items under UB city protection, and 22 items under Duureg protection. Name of state protected items are listed in Table 6.3.2. Among them there are major temples, monuments, and stone images and writings.

Table 6.3.2 List of Historical and Cultural Items under State Protection

No:	Items	Location
1	Gandantegchilen monastery	Bayangol duureg
2	Geser temple	Bayangol duureg
3	Megjid Janraisag temple	Bayangol duureg
4	Dari Ekh temple's 2 stone columns	Bayanzurkh duureg
5	Gachuurt ocher image stone	Bayanzurkh duureg
6	Green palace of Bogd Khan	Khan-Uul duureg
7	Ikh Tenger valley image art and stone inscription	Khan-Uul duureg
8	Choijin Lama temple	Sukhbaatar duureg
9	Dambadarjaa monastery	Sukhbaatar duureg
10	Ger form wooden temples	Sukhbaatar duureg
11	Sukhebaatar monument	Sukhbaatar duureg

Source: Information from UB City Municipality & City Museum

5) Solid Waste

Waste amounts and types: Urbanization department of UB City prepares quarterly and monthly reports on solid waste throughout the Ulaanbaatar city area. The latest report gives the information in Table 6.3.3.

Table 6.3.3 Average Monthly Volume of Removed Wastes

(unit:thousand m^3)

Year	House -hold waste	Ger areas waste	Waste from roads and squares	Waste from institutions	Waste from unknown sources	Total volume of waste thousand m^3
1997-1998	9.0	11.4	2.7	43.1	3.1	40.6

Source: Quarterly and monthly reports of UB City Municipality

Most of the waste is disposed at three central dumpsites:

1. Dari Ekh, located in north-east of the city
2. Ulaanchuluut, located in north-west of the city
3. Morin Davaa, located in south-west of the city

The disposal is performed by the NUUTS company. NUUTS registers all incoming waste at the dumpsites and collects a fee of 50 Mongolian tugric per cubic meter of waste. NUUTS operates an excavator used for coverage of waste with soil. From 3 dumpsites, only Morin Davaa has proper coverage. The District Construction and Service Companies (DCSCs) are able to obtain permission to dump certain wastes, especially construction waste, outside the three dumpsites; most often, it is done at the roadside.

Construction wastes: Waste from construction and demolition processes is dumped either at the central dumpsites or along the roads. Recycling is limited and not organized at all.

Waste collection and Transportation system: The DCSCs mainly perform waste collection. Due to the diversified dwelling situation in different parts of UB there exists several approaches in waste collection and transportation. Waste collection and disposal are mainly financed by a waste fee paid by the households and from contracts with the institutions.

6.3.2 Environmental Pollution

1) Air Pollution

The most significant sources of air pollution in Ulaanbaatar are listed below:

1. Three thermal power stations produce over 2,500 million kW of electricity and burn nearly 5.0 million tons of coal annually. The power stations' ash-basin occupies an area of 65 hectares.
2. More than 30 thousands of vehicles discharge noxious gases into the atmosphere.
3. Twentyeight thousands gers and thousands of dwellings contaminate the atmosphere in burning annually over 260 thousand tons of coal and 180 thousand cubic meters of wood.
4. Over 250 large and small steam boilers designed for heating and production purposes consume all together 400 tons of coal per year.

The major pollutants are sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO) and dust. Concentrations of sulfur dioxide and nitrogen dioxide in UB atmosphere often exceed the permissible level. Air pollution in winter is 3-5 times more than in summer.

Source: The Central Monitoring Laboratory of the MNE

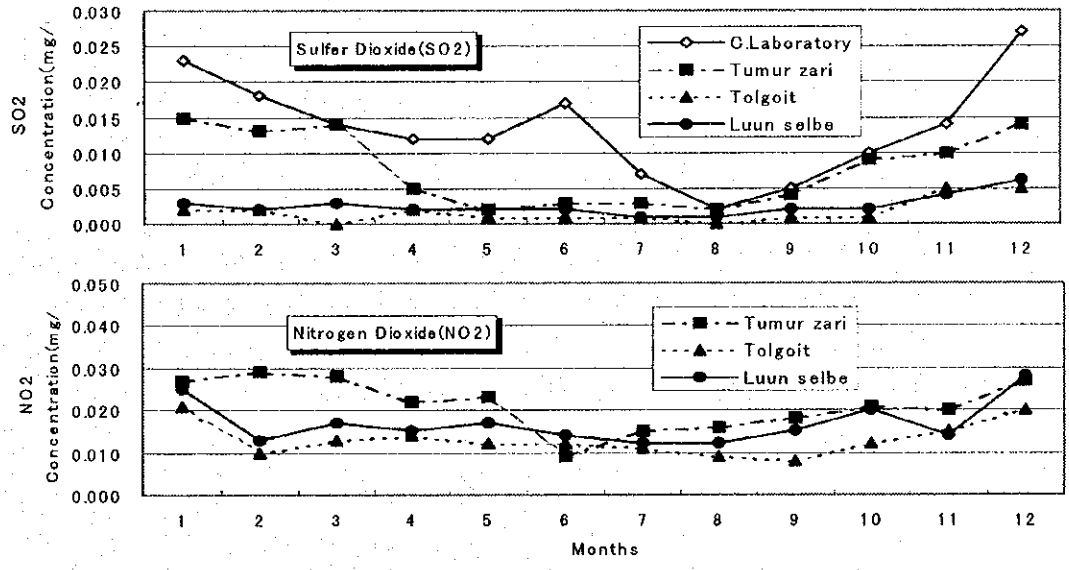


Figure 6.3.1 Monthly Average Content of SO_2 and NO_2 in Ulaanbaatar, 1997

According to Ch. Gurbadam, "Way of air pollution reduction in ger areas of Ulaanbaatar" (The Thermal Engineering, Industrial Ecology Institute of Technical University) Ulaanbaatar's air pollution consists as follows;

About 20%	from power stations, which are operating by coal
Over 30%	from exhaust gas of vehicles
Over 40%	from ger areas

2) Water Pollution

The Tuul river: The water quality of the Tuul River has been monitored in Table 6.3.4. The level of BOD (Biochemical Oxygen Demand) ranges between 0.08-10.5 mg/l. The water quality in upstream and downstream from the point of wastewater discharge has different seasonal variation. At the upper stream the parameters such as NO_2-N, NO_3-N, PO_4-P, NH_4-N increase in summer (or during high water period) and decrease in winter (or during low water period) due to the melting snow and rainfall. In the downstream, the concentrations of the above parameters decrease during summer and increase in the winter.

Table 6.3.4 Water Quality of The Tuul River, 1986-1993

Stations	BOD	COD	NH_4	NO_2	NO_3	P	O_2 DO	Mn	Det.
	MgO/l		mgN/l			mgP/l	mg/l		
Ulaanbaatar	2.5	5.5	0.37	0.01	0.21	0.02	9.2	0.06	0.05
Songino	4.4	5.7	4.81	0.14	0.75	0.32	8.4	0.19	0.08

The Dundgol river: The concentrations of TDS (Total Dissolved Solids) in the range of 180.8-380.9 mg/l reaches the maximum in the end of spring flood due to the melting snow. The oxygen and pH are 9.0-11.6 mg/l and 7.4-8.6 respectively. The most polluting parameter is the ammonium and nitrite exceeding their maximum acceptable concentration by 1.28-2.26 and 1.1-6.42 times.

The Selbe river: The Selbe river has moderate mineralized water with TDS concentration of 145.6-242.6 mg/l. The value of pH is 7.2-8.4. The average value of annual ammonium concentration is 0.38-0.64 mg/l.

3) Soil Contamination

The most polluted soil in the UB City is located along the railway. The pollution is caused by emission of gas and water from industrial area along the railway. The concentration is high in the southern and central areas of the city. Radiation of heavy metal and toxic gas from power stations is occupying its surroundings. Data are shown in Table 6.3.5. Due to air distribution the heavy metal components have increased in the central and western parts of the city.

Table 6.3.5 Heavy Metal Content of Soils in Ulaanbaatar

Unit: ppm

	Pb	Mn	Sn	Ni	Cr	Mo	Cu	V
Average	4.3	308	7.2	**2.6**	2.5	2.1	4.6	5.7
Maximum	50	1124	25.1	35.5	9.9	4.6	105	9.5

Source: Nature and Environment in Mongolia, 1996

4) Noise and Vibration

Noise level in the large cities has steadily increased in the world. There are many sources of environmental noise and vibration in UB, including factories, power stations, other production, vehicles, trains, airplanes, commercial facilities such as markets, bars, construction work, etc.

Standards on noise and vibration: Mongolia has not adopted standards on noise and on vibration, but uses former Soviet Union standards. Both the environment and traffic volume is now changing dramatically, indeed it is required to establish national standards on noise level and vibration. As an example of such criteria, standards for noise and vibration in Japan are shown in Tables 6.3.6, 6.3.7 respectively.

Table 6.3.6 Environmental Standards for Noise in Japan

Unit:LAeq(dB)

Category of Areas	Area Affected	General Areas		Roadside Areas		
		Hours		No. of Lanes	Hours	
		Daytime (6.00-22.00)	Nighttime (22.00-6.00)		Daytime (6.00-22.00)	Nighttime (22.00-6.00)
AA	Areas which require particular quietness. For instance, areas where medical facilities are concentrated.	50 or less	40 or less	Same as for General Areas		
A	Residential areas	55 or less	45 or less	1	Same as for General Areas	
				2	60 or less	55 or less
B	Commercial and quasi industrial, and industrial areas	60 or less	50 or less	2	65 or less	60 or less
				Arterial roads	70 or less (45 or less)	65 or less (40 or less)

Note: ( ) - indoor

Table 6.3.7 Vibration Request Limit for Roads Side Areas in Japan

Unit: L10 dB

Classification of District	Daytime	Nighttime
Residential Districts & Non-Zoning Areas	60	55
Commercial & Quasi-Industrial and Industrial District	65	60

Field survey of noise and vibration: During the IEE study there were measured Leq, Lmax, L_{50} of noise and Leq, Lmax, L_{10} of vibration at 8 roadside sites in UB City. Measurement was done by Vibration level meter VM-52A, and Integrating Sound level meter NL-06. Results of the measurement are given in Table 6.3.8. Noise level near the medical facilities such as Ray Therapy Hospital and Maternity Home No.1, were higher than Japanese standard. Vibration levels at most sites were considerably smaller than figures in Table 6.3.7 and were below threshold of vibration sensation.

Table 6.3.8 Noise and Vibration Measurement Data, Ulaanbaatar, July 1998

Location	Date	S.Time 10min.	Noise level (dB)			Vibration Level Vertical-dir. (dB)			Traffic volume 10min.	
			L_{Aeq}	L_{Amax}	L_{A50}	L_{Veq}	L_{Vmax}	L_{V10}	Small	Large
Teeverchid Str. Park of Children & Youth	20.7.98	16:50	72	88	67	41	53	45	85	14
Lenin Ave. On the Enkhtaivan bridge	20.7.98	17:30	75	88	72	(67)	(82)	(69)	301	28
Sambuu Str. In front of Lenin museum	25.7.98	11:20	66	87	65	32	36	36	180	21
Denjiin myanga	25.7.98	11:40	70	82	69	27	36	30	282	21
School No.17	25.7.98	12:10	70	86	68	27	42	32	142	28
Ray therapy Hospital	25.7.98	15:00	64	81	55	19	38	30	62	3
Teeverchid Str. Park of Children & Youth	25.7.98	15:20	68	83	60	38	56	42	57	5
Lenin Ave. Bayangol Hotel	25.7.98	15:35	68	82	65	32	52	35	134	17
Enkhtaivan Ave. Maternity Home No.1	25.7.98	15:55	68	81	66	23	34	26	173	27
Average			69	84	65	34	48	38	157	18

6.4 Screening / Scoping

Screening/Scoping checklists are evaluated in accordance with the JICA Guideline and in consideration of conditions specific to Mongolian environment such as severe climate, permafrost and localized torrential downpour. as shown Tables 6.4.1 and 6.4.2 respectively. Checklists were evaluated by the experts working in field of socio-economic and natural environment, and discussed at roundtable meetings. The experts recommended an adding of four other items such as flood, permafrost, severe climate and earthquake into the initial JICA form of Screening checklist. These items are under 24, 25, 26 and 27 in the checklist.

Table 6.4.1 Screening Checklist

Environmental items		Content	Evaluations	Remarks (Basis)
A. Socio-economic environment				
1	Resettlement	Resettlement of occupants from proposed land (removal of rights of residence and land ownership)	YES/~~NO~~/~~UN~~	Residences exist in the project area.
2	Economic activities	Loss of a productive opportunity such as land, and change of economic structure	YES/~~NO~~/~~UN~~	Roads and traffic will change the economic activities.
3	Traffic and public facilities	Influence of existing traffic such as congestion, accidents on schools and hospitals	YES/~~NO~~/~~UN~~	Public facilities such as the big market, hospital and school exist in the project area.
4	Split of communities	Split of communities by obstruction of traffic	~~YES~~/NO/~~UN~~	Split of community by construction will not occur.
5	Cultural property	Loss of cultural property and falling of value	YES/~~NO~~/~~UN~~	Historical and cultural properties under state, city and duureg protection exist in the city.
6	Water right and right of common	Obstruction of fishing rights, water rights, common rights of forest	~~YES~~/NO/~~UN~~	No impact on water rights
7	Health and sanitation	Deterioration of a hygienic environment by production of refuse and noxious insects	~~YES~~/NO/~~UN~~	Lots of refuse will not be produced
8	Waste	Occurrences of waste dumps and solid waste	YES/~~NO~~/~~UN~~	Lots of waste dumps will be produced by road construction.
9	Hazards	Increase of possibility of danger of landslide and accident	~~YES~~/NO/~~UN~~	Sections of project are mainly plain.
B. Natural environment				
10	Topography and geology	Change of valuable topography and geology by excavation or fill	~~YES~~/NO/~~UN~~	Valuable change in topography and geography do not exist.
11	Soil erosion	Flow of surface soil by rainwater after land development and forest felling	~~YES~~/NO/~~UN~~	Forest and slanting surface do not exist in the project area.
12	Groundwater	Pollution by drainage or leach water by excavation construction	YES/~~NO~~/~~UN~~	Ground water will not be pumped, but proposed alignment will pass through the intake field of ground water.
13	Hydrological situation	Change of flux and riverbed by reclamation and inflow of drainage	YES/~~NO~~/~~UN~~	Construction is on riverbank. In case of bridges, construction in rivers.
14	Coast and sea area	Change of beach erosion and vegetation by a change of reclamation or sea condition	~~YES~~/NO/~~UN~~	There are no sea areas.
15	Flora and fauna	Breeding obstruction and extinction of species by a change of an inhabitable condition	~~YES~~/NO/~~UN~~	Habitat of valuable flora and fauna do not exist in the city area.
16	Climate	Change of temperature and wind conditions by the large-scale land development and architecture	~~YES~~/NO/~~UN~~	Large-scale felling and construction of high buildings is not planned.
17	Landscape	Change of topography by land development and harmonious obstruction by structural objects	YES/~~NO~~/~~UN~~	Landscape of important area with cultural properties exists. New road will change natural landscape.
C. Environmental Pollution				
18	Air pollution	Pollution by emission gas and dust from vehicles	YES/~~NO~~/~~UN~~	Impact by emission gas from increasing car use is anticipated.

19	Water pollution	Pollution by inflow of earth and sand and industrial water waste	YES/~~NO~~/~~UN~~	Constructions in rivers may contaminate the water.
20	Soil contami-nation	Pollution by dust and asphalt emulsion	~~YES~~/NO/~~UN~~	Construction site can be managed not to create such pollution.
21	Noise and vibration	Occurrence of noise and vibration by vehicles	YES/~~NO~~/~~UN~~	Impact by noise and vibration by vehicles is anticipated.
22	Ground subsidence	Subsidence by change of ground and fall of groundwater level	~~YES~~/NO/~~UN~~	Construction causing ground subsidence will not occur.
23	Offensive odors	Occurrence of exhaust gas and offensive odors	~~YES~~/NO/~~UN~~	There is no factor of producing offensive odors nor gas.
D. Other environmental factors related to the regional specific condition.				
24	Flood	Damage on road construction stability	YES/~~NO~~/~~UN~~	Existing roads are damaged by flood frequently. A system for removal of rainwater from road should be properly designed and constructed.
25	Permafrost	Damage on road construction stability	YES/~~NO~~/~~UN~~	Planned road will cross the seasonal permafrost area. Permafrost should be locally studied and considered jointly with ground water level in designing and construction of roads.
26	Severe climate	Ice and snow coverage occurrence is common in winter. Changes in temperature are substantial, causing expansion and shrinkage of road construction materials.	YES/~~NO~~/~~UN~~	Ice and snow cover the road during the 3-5 months in cold season. In the city, air temperature may reach 35°C in summer, -44°C in winter, and ground surface temperature may reach 65°C in summer and –58°C in winter.
27	Earthquake	Earthquake will occur.	YES/~~NO~~/~~UN~~	Construction of bridges is planned in the area of 7-8 Richter scale earthquake. Impact should be studied in the area of planned bridges, and properly considered in design and construction.
Comprehensive assessment: Is it necessary to implement on IEE or EIA for the development project?			YES/~~NO~~/~~UN~~	

Note: UN: Unknown

Table 6.4.2 Scoping Checklist

Environmental items		Evaluation	Grounds
A. Socio-economic Environment			
1	Resettlement	B	Resettlement will occur due to construction of new roads.
2	Economic activities	B	Rehabilitation and Construction of new roads will cause changes of economic activities.
3	Traffic and public facilities	B	There is necessity of consideration for better public facilities, specifically in districts of schools and hospitals in UUB.
4	Split of communities	D	Split of community will not occur.
5	Cultural property	B	Care should be paid in selecting routes in UUB.
6	Water rights and right of common	D	Water rights and right of common do not exist.
7	Health and sanitation	D	Large amounts of refuse will not occur.
8	Waste	B	Waste produced by constructions should be properly disposed of.
9	Hazards	D	Development on a sloping surface will not be planned.
B. Natural Environment			
10	Topography and geology	D	Valuable topography and geography do not exist.
11	Soil erosion	D	Large-scale changes of lands will not be planned.
12	Groundwater	B	Construction causing contamination of groundwater will not be planned, but care should be paid in the intake field of groundwater.
13	Hydrological situation	B	Effect of construction in riverbank and in river should be studied.
14	Coast and sea area	D	There is no sea area.
15	Flora and fauna	D	Valuable flora and fauna do not exist in the city area.
16	Climate	D	Large-scale felling/construction of high building are not planned.
17	Landscape	B	Harmony with surrounding nature and environment should be considered.
C. Environmental Pollution			
18	Air pollution	B	Air pollution level may be lightened by traffic control and by the reduction of traffic congestion, but affect of increase in traffic volume should be studied.
19	Water pollution	B	Constructions in the river may contaminate natural water temporarily.
20	Soil contamination	D	There will be no action, which causes soil contamination.
21	Noise and vibration	B	Noise level may be lightened by the reduction of traffic congestion, but impact of noise and vibration during and after construction should be studied.
22	Ground subsidence	D	Construction causing ground subsidence will not be involved.
23	Offensive odors	D	There is no factors producing offensive odors.

Classification of evaluation:

A- Serious impact will be anticipated.
B- Impact will be more or less anticipated.
C- Unknown (it is necessity of investigation)
D- No impact will be anticipated.

Chapter 7 Socioeconomic Framework

7.1 Outline

The outline of the procedure to set up the socioeconomic framework is categorized in four steps as follows. Figure 7.1.1 shows step with annual ratios of increase.

1. Trend analysis of a population and GDP in the past
2. Forecasting population, GRDP and GRDP/capita up to 2020.
3. Confirming consistency with the national policy/target and regional development strategies
4 On the above procedure, the socioeconomic framework of the study area is determined as follows,

	Short Term (2005)		Mid Term (2010)		Long Term (2020)	
Population	2.1%	725,000	1.7%	790,000	1.6%	925,000
GRDP/Capita (Tug)	2.5%	207,000	2.5%	234,000	2.6%	302,000
GRDP (billion Tug)	4.6%	150	4.3%	185	4.2%	279

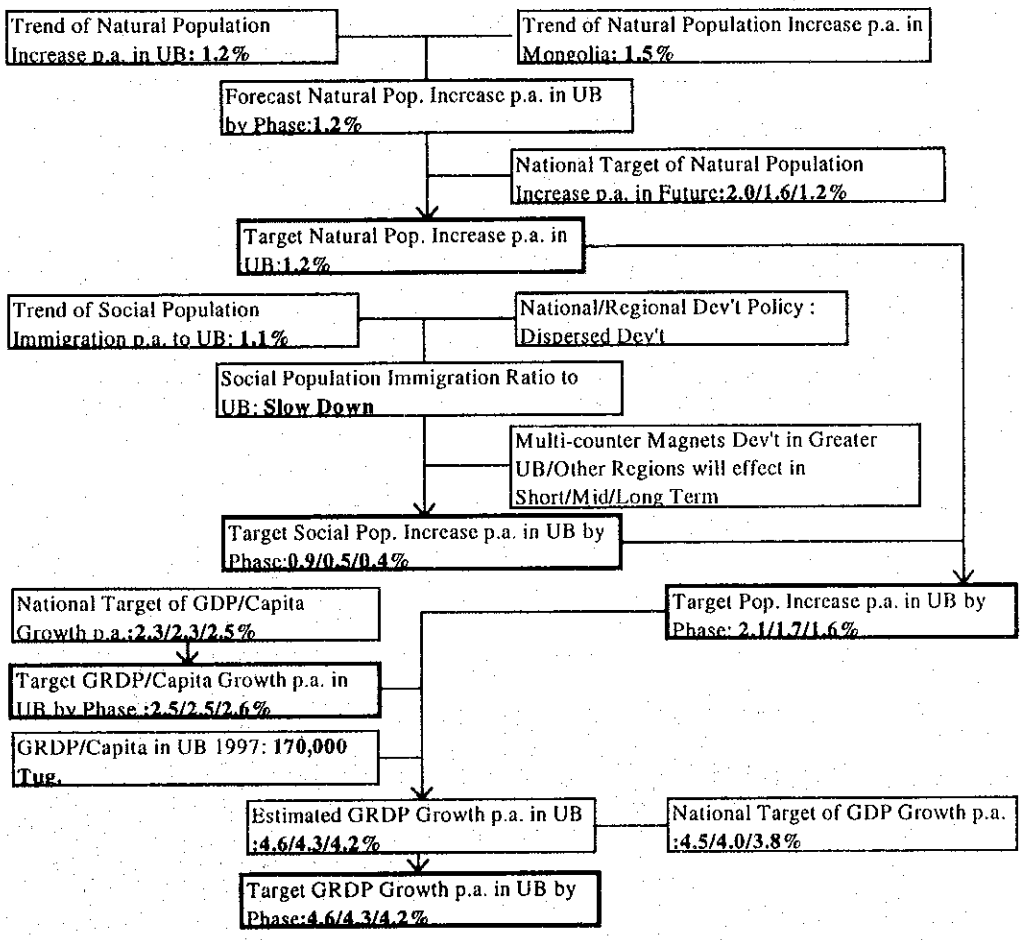


Figure 7.1.1 Target Population and GRDP in Future

7.2 City Master Plans

7.2.1 87MP, 93MP and 99MP

The City Master Plan of UB was established in 1987 with the assistance of USSR (hereinafter called as 87 MP). The 87 MP covered almost the same area as this JICA study. It covered 5 urbanized districts (Suhbaatar, Chingeltei, Bayangol, Bayanzyrh and Khan Uul) and Nalaih district. Its detailed city plan for the urban area was proposed on the map in the scale of 1:10,000 to 1:25,000 for the UB basin.

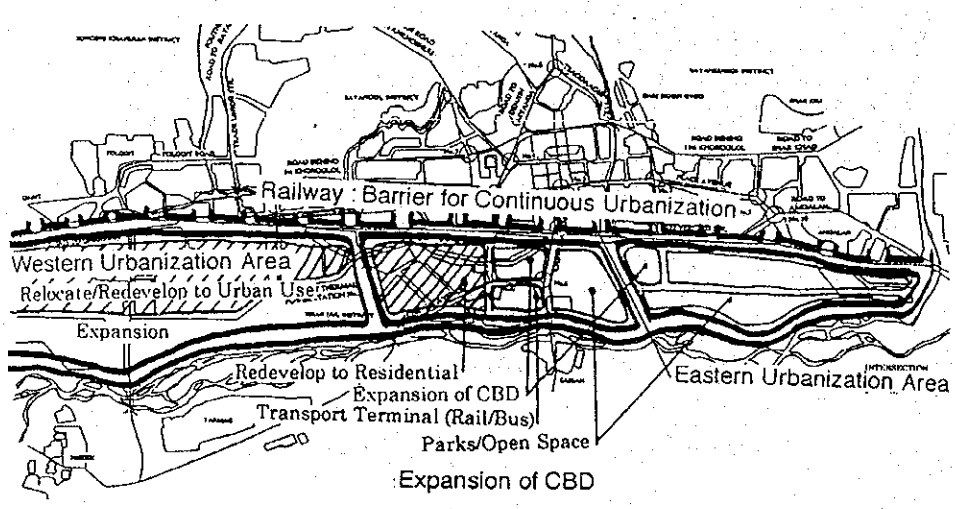
The review of the plan in 1993 (93 MP) was conducted only for the development of city road network especially for public transportation system in the present urbanized area. However it is proposed without analysis of forecasting of future traffic. While the government of Ulaanbaatar city are under summarizing a new city master plan (99 MP). The 99 MP will be drafted in the mid-1999.

7.2.2 87MP

Basic ideas for UUB of the 87 MP were as follows:

1) South side of the railway should be the large scale industrial zones and water resource areas.
2) North side of the railway should be developed as residential and business areas.
3) A new large scale power plant should be located at the north east side of the city.
4) Road network plan was as follows:

in UUB	in GUB
· Grid pattern roads	· A large ring road around Bogd Khan Mountain
· Bypass on the dike of Tuul River in the super long-term plan after 2010	· Connection of the road to the south of Bogd Khan mountain with the Argalant area
· Branch roads in the northern ger area	· A smaller-scale ring road in the western area



5) The development of the satellite towns and villages was assumed as follows:

	Population in 2010	For reference Actual Population in 1997
Argalant	33,000	
Nalaikh	25,000	25,000
Poultry Firm	18,000	2,000
Bio-Combinart	12,000	3,200
Jargalant	7,000	6,000
Gachuut	5,000	4,000
Ulzit	(out of scope)	3,600

Note : Argalant area planned to be developed seems on the east side of "Som" Argalant where a vast prairie is spreading. However some of them belongs to swampy area and not suitable to develop. The current settled population in this area is only 100 near small station of "Emeelt".

6) The population frameworks of 87MP were as follows:

Table 7.2.1. Comparison of Population Framework of 87 MP and Actual Growth

	87MP	Av. annual growth. rate	Actual	Av. annual Growth rate
1986	492,900		503,000	
1992	-			
1995	625,000	2.67%	616,900	2.29%
1997	-		571,700*	
2000	700,000	2.29%		
2010	800,000			
	(700,000*)			

Notes: * means for UUB only

After the restructur of socioeconomic system in the year 1990, the national population growth ratio was dramatically slowed down. The annual growth rate was 2.9 % in the 60's, 2.5 % in the 80's and down to 1.4 % per annum in 1997.

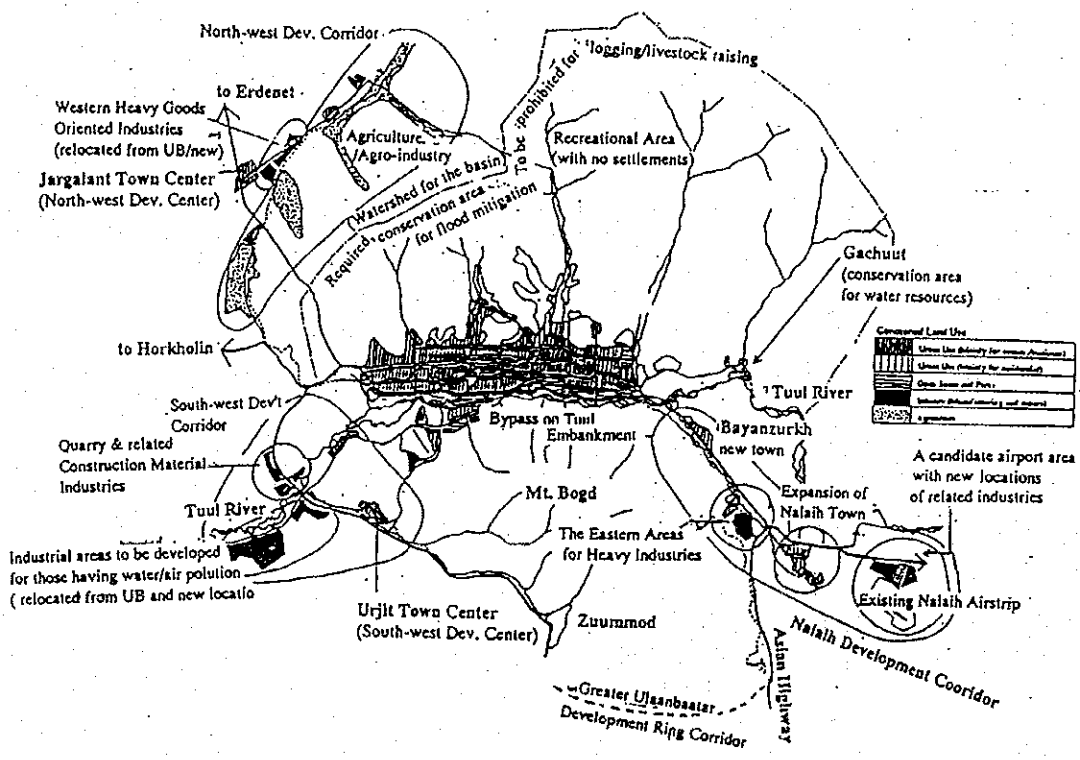


Figure 7.2.1 Conceptual Land Use and Transportation Network in Long Term

7.3 Future Population Framework

The average annual population growth ratios in Ulaanbaatar were higher than the national average. After 1990, the population increase ratio in Ulaanbaatar has fluctuated. However, actual population growth from '92 to '97 registered a 3.4 % per annum in average. At present, population in Ulaanbaatar is around 650,000 which are more than 27 % of the national population. Population statistics since 1960 are in Table 7.3.1.

Table 7.3.1 Population of Nation and Ulaanbaatar, 1960-1997

	Nation		Ulaanbaatar		
year	Pop.	a.g.*	Pop.	a.g.*	share/Nation
1960	968,100		152,200		15.7%
1970	1,265,400	2.7%	294,400	6.8%	23.3%
1980	1,682,000	2.9%	415,800	3.5%	24.7%
1985	1,900,600	2.5%	485,300	3.1%	25.5%
1990	2,149,300	2.5%	555,200	2.7%	25.8%
1991	2,187,200	1.8%	562,600	1.3%	25.7%
1992	2,215,000	1.3%	575,000	2.2%	26.0%
1993	2,250,000	1.6%	594,000	3.3%	26.4%
1994	2,280,000	1.3%	608,600	2.5%	26.7%
1995	2,317,500	1.6%	616,900	1.4%	26.6%
1996	2,353,300	1.5%	629,200	2.0%	26.7%
1997	2,387,100	1.4%	649,800	3.3%	27.2%

Source : Statistical Year book Mongolia (SSOM.1998)

The trend of social immigration to the capital city of Ulaanbaatar was more than 3 % per annum in the 1960s. In the 70s and '80s, social immigration was controlled to less than 1 % per annum by the government. However, after the year 1990, social immigration to Ulaanbaatar was free and these social immigrations fluctuated as shown in Figure 7.3.1. The average annual social immigration ratio in the past 7 years was 1.1 % per annum.

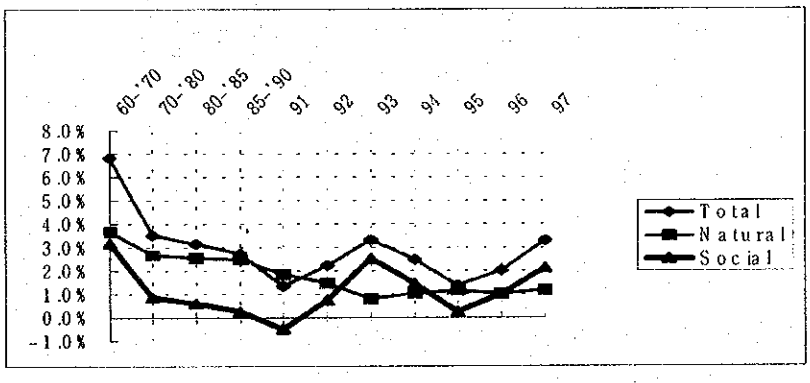


Figure 7.3.1 Population Growth Ratios of Ulaanbaatar, 1960-1997

The natural population increasing ratio per annum in GUB is forecasted 1.2 %. While the social migration will slow down to 0.9 % - 0.4 % under the national policy of dispersed development. Target population increasing ratio per annum in GUB is forecast to be 2..1%,. 1.7% and 1.6 %

respectively, for the phase 1(-2005), phase 2 (-2010) and phase 3 (-2020). Population forecasts are shown in Table 7.5.1 afterward.

7.4 GDP

7.4.1 GDP in the Nation

Before the restructuring of socioeconomic system, the economic growth trends in Mongolia had slowed down from 6 % of the average annual growth ('85-88) to 4 % growth ('88-89). After the restructuring, economic development dropped into the minus growth trend. However, the minus growth trend hit bottom in the year 1993. After '93, economic trend turned to growth and showed more than 6 % annual growth in '95. The amount of 185 billion Tug of GDP in the year '96 are still 86 % of 214 billion Tug in the year '89 in terms of prices in 1993. Those changes in GDP, 1985-1996 are shown in Figure 7.4.1. The national target of annual economic growth rate until the year 2000 was identified to be the minimum 5 % per annum by the government in 1996.

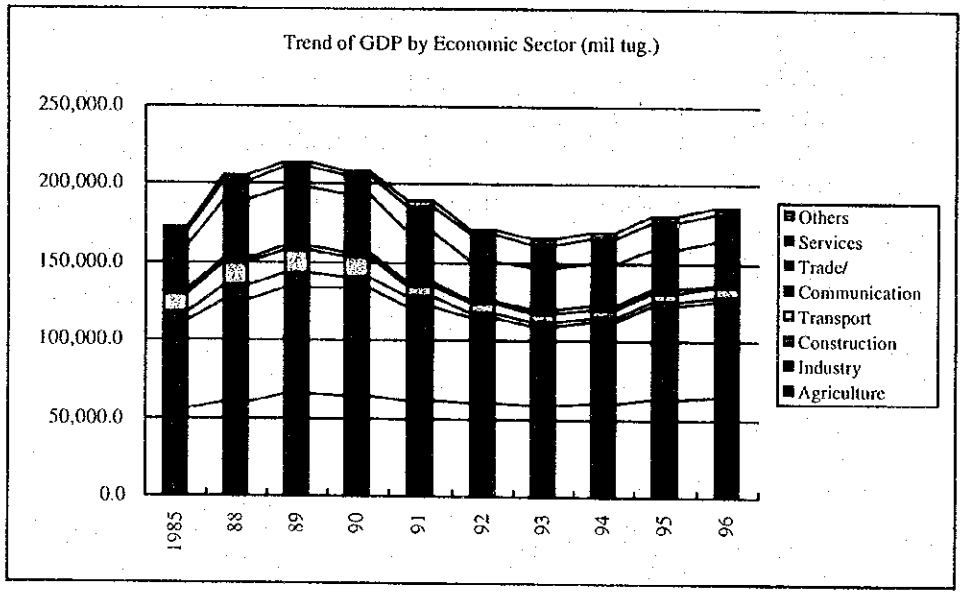


Figure 7.4.1 Changes in the GDP and Share of Sectors, 1985-1996

7.4.2 GDP of Economic Sectors

The followings are selected findings during the year 1985-1996. Table 7.4.1 shows statistics by the sector in the same period.

agricultural sector	shared around the one third of GDP which is one of leading economic sectors in Mongolia
service sector	maintained annual growth trend of more than 5 % during the past 11 years. 17 billion Tug in GDP in '96 are the 1.7 times of the value in '85.
industry sector	Growth ratio in the past 11 years was less than 1 % per annum.

includes mining and quarry	'96 was around 60 billion Tug which was still about 87 % of that in '90.
commercial and trade	'96 was around 17 billion Tug which is almost the same amount in 11 years ago and at a level of 73 % of the one in '89.
construction and transportation sector	Around 3.5 billion Tug in '96 which was about 60 % of the one in '85 and 37 % of the one in '89.
transportation sector	Around 6 billion Tug in '96 which was also 50 % of the one in '85 and 40 % of the one in '88.

Table 7.4.1 Changes in the Share of Sectors in GDP, 1985-1996 (1993 prices)

	1985	88	89	90	91	92	93	94	95	96
Agriculture	55,718	60,287	64,909	64,045	61,235	59,958	58,335	59,911	62,454	64,800
Industry	56,398	65,578	69,111	69,337	60,701	54,812	51,308	52,175	59,914	60,213
Construction	5,812	9,141	9,476	7,144	5,967	3,251	2,725	3,011	3,329	3,508
Transport	11,605	14,785	13,770	12,596	7,159	5,955	5,391	5,398	5,284	5,854
Comm.	2,341	3,191	3,268	3,495	2,693	2,139	2,322	2,141	2,166	2,396
Trade/	28,388	36,430	37,651	37,134	32,594	25,205	26,537	26,533	26,564	27,313
Services	9,891	13,098	12,821	12,113	15,986	16,499	15,799	16,484	16,573	17,229
Others	2,585	2,929	3,022	2,777	3,014	3,546	3,802	4,389	4,492	4,231
Total GDP	172,737	205,440	214,028	208,642	189,349	171,365	166,219	170,042	180,775	185,544
a.g.rate		5.95%	4.18%	-2.52%	-9.25%	-9.50%	-3.00%	2.30%	6.31%	2.64%
Population (000)	1901	2044	2095.6	2149.3	2187.2	2215	2250	2280	2318	2353
GDP/capita	90,886	100,509	102,132	97,074	86,572	77,366	73,875	74,580	78,004	78,844
a.g.rate	0	3.41%	1.62%	-4.95%	-10.82%	-10.63%	-4.51%	0.95%	4.59%	1.08%

7.4.3 GDP per Capita

Growth trends of GDP/capita in Mongolia decreased from 3.5 % per annum to 1.6 % from '88 to '89 as shown in Figure 7.4.2. After the restructuring of socio-economic system, growth ratio heavily dropped into more than minus 10 % in '91 and hit bottom in the year 1993. After '93, GDP/capita growth changed to increase. 79,000 Tug/capita GDP in the year '96 was still at a level of 78 % of 102,000 Tug/(GDP per capita) in the year '89. (all in 1993 prices).

	1985	88	89	90	91	92	93	94	95	96
GDP/capita	90,886	100,509	102,132	97,074	86,572	77,366	73,875	74,580	78,004	78,844
a.g.rate		3.4%	1.6%	-5.0%	-10.8%	-10.6%	-4.5%	1.0%	4.6%	1.1%

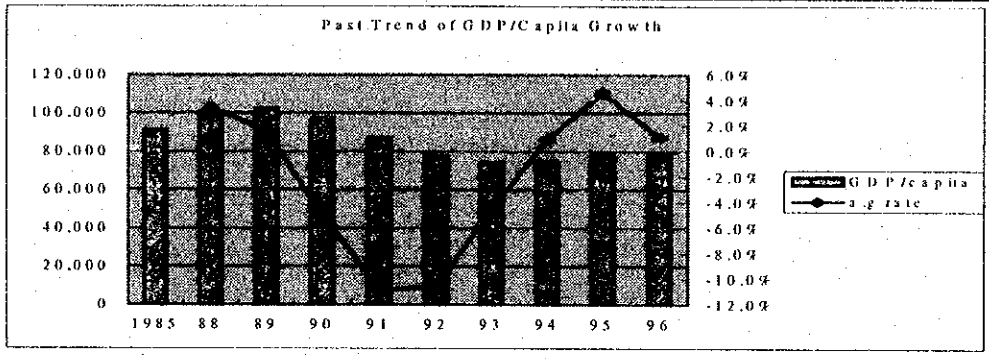


Figure 7.4.2 Changes in GDP per capita, 1985-1986 (In 1993 prices , Tug)

7.4.4 GRDP in the City Ulaanbaatar

GDP indices in the nation and the capital city of Ulaanbaatar are shown in Table 7.4.2

Table 7.4.2. GDP Indices of Nation and UB

	Nation '96	Ulaanbaatar '97	
GDP (mil tug.)	185,544	104,198	56% of the nation
GRDP/capita (tug.)	78,844	169,629	215% of the nation

However, the 630,000 population in Ulaanbaatar shares 27 % of the national population in the year '96. On the above condition, GRDP/capita in Ulaanbaatar is around 170,000 Tug which are more than 2 times of the national average GRDP/capita being shown in Figure 7.4.3.

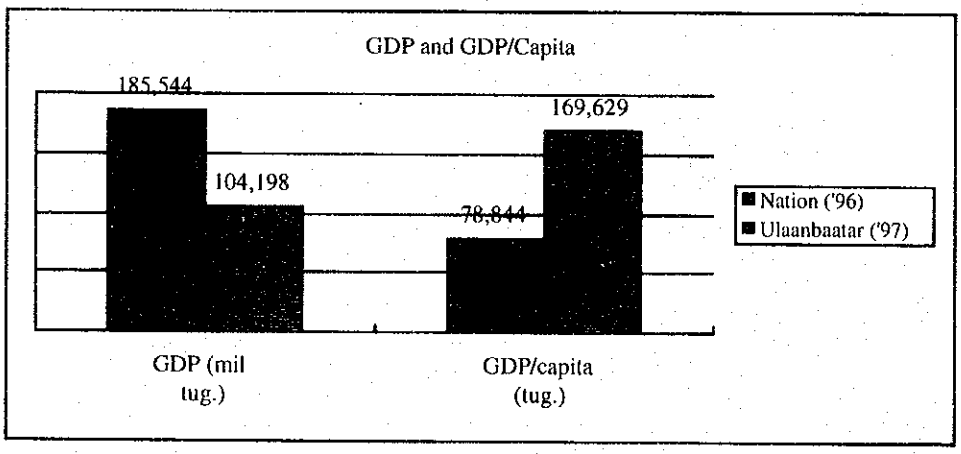


Figure 7.4.3 GDP per Capita, Nation and Ulaanbaatar, 1997 (In 1993 prices, Tug)

7.5 Future Socio-economic Framework

Socio-economic framework of the study area was examined in alternative cases of development. The Mongolian side and the JICA study team agreed in March 1998 to determine the overall framework in terms of population, GRDP per capita and GRDP for future years as shown in Table 7.5.1.

Table 7.5.1 Socio-Economic Framework of the Study Area

	1998	2000	2005	2010	2020
Population	617,500	655,000	725,000	790,000	925,000
	-	2.2%	2.1%	1.7%	1.6%
GRDP per capita	169,629	183,000	207,000	234,000	302,000
		2.5%	2.5%	2.5%	2.6%
GRDP	104,198	120,000	150,000	185,000	279,000
		4.85	4.6%	4.3%	4.2%

Note : GRDP per capita Tug of 1993 prices
: GRDP Million Tug of 1993 prices
: percentages means the average annual growth rate from the previous year

7.6 Land Use Plan

UB city and the study team have discussed development directions of land use up to 2020.

Difficulties in finding suitable land use concept by both parties can be summarized in two points:

a) The study team considers that substantial changes in land use pattern should be incorporated in the plan in order to minimize mal effects on environment of urban. The plan requires large costs. But the team thinks funds should be managed in long term and the plan should be materialized by stages.

b) Mongolian side has been working to determine a long term city development plan. A number of constraints are recognized in planning and implementation:

- Laws and Regulations
- Administrative system and budget
- Development cost scale and funding methods in tax, loans, etc.
- It is too early to show the City's development plan to the team even though it is provisional.

Issues which caused problems during the discussions are shown in the left column and proposed solutions by the Study Team are shown in the right column. The Mongolian side agreed the solutions.

Issues	Proposed solutions by the Study Team
Gers on the northern mountain slopes should be removed to reduce environmental deterioration.	Ger population in zones in the northern slopes are forecast to decrease/constant.
Water resource area in the south-east part of the city occupies about 3,000 ha. It is about 20% of the territory of UUB.	A planned Ring Road should pass its north-west part. Partial development of the area, just inside of the Ring Road, is recommended to ensure the spaces for future development of the city.
2 power stations cause about 20% of air pollution in UUB.	It is desirable to relocate them to Baganur area. However it is not accepted from its huge cost, and expected to keep them at their present locations.
A railway is dividing UUB into 2 separate southern and northern parts. It is now barriers for the development of UUB.	Relocation on the north dike of Tuul river was recommended. But Mongolian side has decided to keep the railway in its present location.
Places to be relocated of the existing factories inside of the city should be developed in order to reduce the environmental deterioration.	As one of the solutions, development of the railway junction in Khonkhor area is recommended. However Mongolian side expected the development should focus in the Nalaikh town.
Current international airport of UB is too near to the city area. Also its topographic conditions are not suitable to manage future demands as an international airport.	Redevelopment of the Nalaikh Airbase is recommended as a New International Airport. Mongolian side explained that they are expecting to develop a new airport to the south-west of Zuunmod. However it is out of scope of works of the Study, and the proposal was not evaluated.

7.7 Zoning

GUB is composed of 9 administrative districts (Duuregs). And it is divided into 111 small districts (Khoroo). Government of Ulaanbaatar defines 99 small districts as UUB as shown in Table 7.7.1.

Table 7.7.1 UB Districts in Study Area

S. No.	Name of District	No. of Blocks(khoroos)	No.of Khoroos in UUB
1	Bayangol	19	19
2	Chingeltey	18	17
3	Sukhbaatar	16	16
4	Bayanzurkh	19	18
5	Khan Uul	13	9
6	Songino	21	20
7	Naraikh	5	
	GUB Total	**111**	**99**
8	Baganur		Separated district
9	Bagahangai		

Study team divided GUB to 52 zones to establish the future socio-economic framework for each zone. Fig 7.7.1 presents the zoning of GUB.

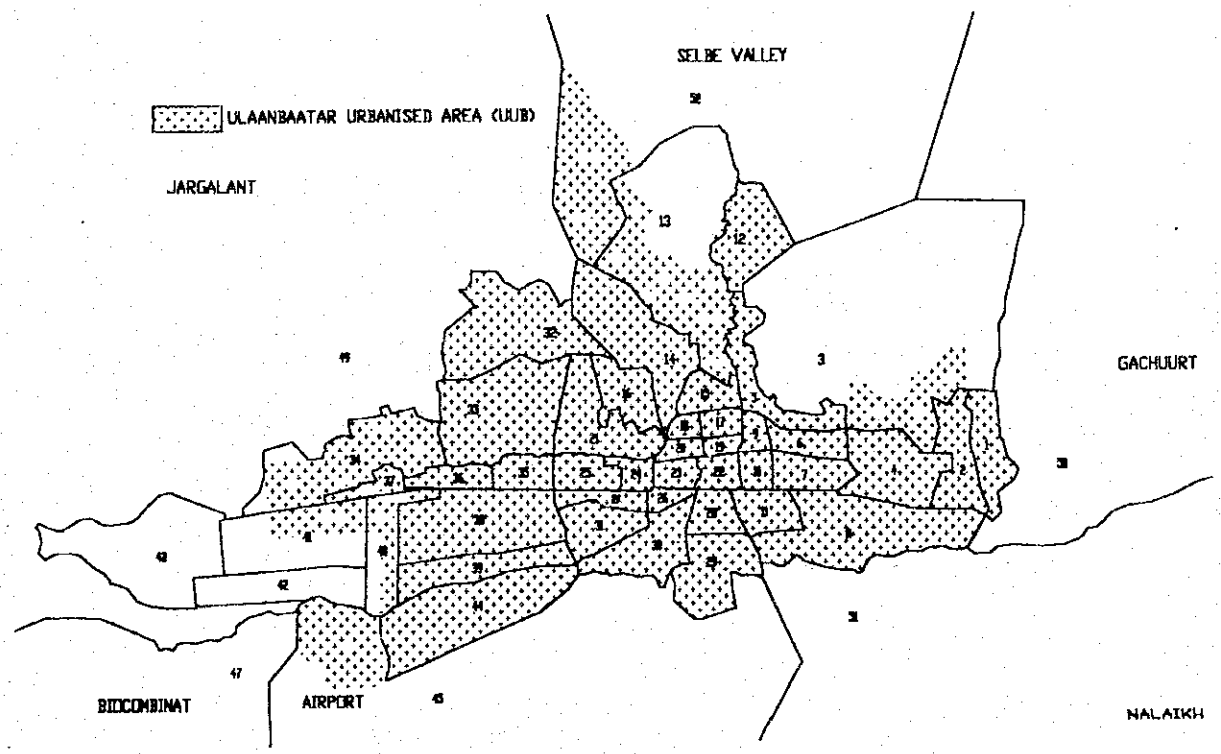


Fig 7.7.1 Zoning of GUB

Table 7.7.2 Final Socio-Economic Framework Used in Study (New SE 2)

Zone	Area	1998			2005			2010			2020		
	(ha)	Pop.	Emp (R)	Emp(W)	Pop.	Emp (R)	Emp(W)	Pop.	Emp (R)	Emp(W)	Pop.	Emp (R)	Emp(W)
1	321.2	1,066	235	350	1,100	300	500	1,100	300	600	1,100	300	800
2	376.2	4,266	939	840	4,700	1,200	700	4,800	1,300	600	5,300	1,500	500
3	4365.5	12,855	2,708	1,928	16,200	3,900	1,800	18,100	5,000	1,600	22,050	6,100	1,500
4	543.5	18,819	4,606	5,578	26,400	7,600	5,400	27,300	8,000	4,800	30,000	9,200	4,500
5	379.7	7,495	1,487	1,124	9,800	2,300	1,700	11,000	3,000	2,000	13,800	3,900	2,800
6	188.1	19,507	7,199	4,641	25,000	7,500	5,200	30,000	8,000	5,500	33,410	9,000	6,100
7	231.9	6,842	1,714	2,853	16,800	4,400	4,500	22,700	7,000	6,000	34,800	10,100	7,600
8	1001.4	0	0	100	0	0	100	0	0	100	0	0	100
9	89.9	11,005	3,437	4,022	11,000	3,300	5,100	11,400	3,200	6,000	11,700	3,100	7,000
10	114.1	18,458	5,209	4,558	23,000	7,500	7,000	25,400	8,000	9,000	29,600	8,800	10,000
11	228.6	0	0	500	0	0	500	100	100	500	215	100	500
12	469.7	10,867	2,590	1,630	9,000	2,400	1,700	8,000	2,200	1,800	7,600	2,000	2,100
13	1911.8	44,383	10,079	6,657	40,000	9,600	6,200	34,000	8,900	5,600	31,100	8,500	4,600
14	816.1	20,050	4,887	3,008	17,000	4,500	2,800	15,000	4,000	2,600	14,035	3,500	2,100
15	184.2	16,135	4,943	3,630	18,000	5,500	4,600	20,000	5,900	5,400	24,700	6,800	7,000
16	302	14,020	3,135	3,138	12,000	3,000	2,900	10,000	2,800	2,500	9,800	2,700	2,200
17	98.2	16,704	3,754	5,991	16,000	3,700	7,300	14,500	3,700	8,000	12,700	3,700	8,800
18	67.4	9,986	3,475	2,980	9,400	3,000	6,400	8,900	2,500	7,000	7,900	2,200	10,500
19	61.2	5,911	2,416	14,160	5,900	2,300	13,200	5,900	2,200	12,000	5,900	2,000	11,000
20	79.1	21,384	4,669	8,057	21,300	4,800	8,400	21,300	5,000	8,800	21,300	5,500	10,800
21	525.8	71,799	22,512	11,672	71,700	22,000	12,100	71,700	21,000	11,600	71,700	19,800	13,200
22	128.1	3,510	1,083	3,711	3,600	1,100	5,300	3,700	1,100	7,000	3,800	1,100	8,300
23	116.5	21,393	5,495	5,943	21,400	5,500	6,300	21,400	5,500	6,500	21,400	5,500	7,000
24	131.7	19,105	5,784	4,299	20,000	5,900	6,500	21,000	6,100	8,000	23,600	6,500	10,000
25	199.3	22,526	8,161	5,803	27,000	8,200	6,100	27,000	8,300	6,400	29,500	8,500	6,600
26	72.2	0	0	900	2,000	700	900	3,000	1,300	900	6,200	1,800	1,000
27	108.9	0	0	1,700	0	0	1,700	0	0	1,600	0	0	1,500
28	181.5	0	0	200	0	0	300	0	0	400	0	0	500
29	470.2	2,600	630	1,763	2,800	700	1,500	2,900	800	800	3,000	800	300
30	437.8	18,495	5,333	6,376	21,000	6,000	7,100	24,000	6,700	8,000	27,700	7,600	10,100
31	295.2	255	57	4,033	4,400	1,200	3,300	6,700	2,100	2,500	11,800	3,400	1,200
32	924.1	25,435	5,493	3,815	27,000	7,500	3,600	28,000	8,500	3,000	30,500	9,200	2,600
33	966	19,680	4,880	4,139	23,500	6,400	4,200	25,600	7,400	4,300	30,300	9,200	4,400
34	948.5	20,184	5,861	5,098	27,800	7,600	7,500	32,100	9,000	9,000	41,400	12,500	11,400
35	179.5	39,670	13,403	6,637	40,000	12,600	6,800	41,000	12,000	7,000	43,400	11,800	8,000
36	161	9,900	3,200	3,741	13,100	4,000	4,300	14,900	4,500	4,500	18,800	5,500	5,000
37	125.8	6,400	2,100	1,130	8,600	2,700	2,100	9,900	3,000	3,000	12,600	3,700	3,700
38	876.3	0	0	2,149	9,000	1,000	2,500	16,000	3,000	3,100	23,300	6,400	4,000
39	396.9	0	0	0	0	0	0	0	0	0	0	0	0
40	384.9	0	0	1,137	13,000	3,000	3,600	19,000	5,000	5,200	32,000	9,000	8,800
41	789.5	0	0	150	0	0	400	0	0	700	0	0	1,000
42	479.9	0	0	0	0	0	0	0	0	0	0	0	0
43	1093.7	0	0	0	5,000	700	1,000	10,500	3,000	1,400	19,170	5,000	2,900
44	951.1	20,854	5,785	3,128	21,000	5,800	3,100	21,000	5,900	3,000	21,500	5,900	3,000
45	18038.4	8,678	2,592	2,148	10,800	2,700	3,000	12,800	3,200	3,400	16,700	3,600	4,800
46	11132.9	3,620	114	132	9,000	2,800	2,000	17,100	5,000	4,500	30,000	9,400	7,700
47	10757.7	3,286	740	1,150	4,100	1,200	3,600	4,500	1,400	5,000	5,500	1,600	8,000
48	7782.1	3,250	550	756	4,300	1,200	2,400	4,800	1,500	3,400	6,100	1,700	5,700
49	114320.5	6,039	896	896	13,300	3,500	3,400	18,000	4,000	6,800	25,000	6,900	11,000
50	75099.7	4,004	1,000	1,000	4,000	1,100	1,000	4,000	1,100	900	4,000	1,100	900
51	109998.9	25,162	3,692	7,637	33,000	7,600	8,100	38,000	9,000	8,400	47,120	15,000	8,600
52	26538.9	1,927	434	289	2,000	500	300	1,900	500	300	1,900	500	300
T	396443.3	617,525	167,277	167,277	725,000	200,000	200,000	790,000	221,000	221,000	925,000	262,000	262,000

SE 1 : Socio-Economic Framework – Alternative 1; Zones with major changes in future land use have been shaded.
Pop. : Resident Population of Zone
Emp (R) : Employed Population out of the Resident Population
Emp (W) : Persons having Work Place in the Zone

Chapter 8 Travel Demand Forecast

8.1 General

To formulate the long-term road network, traffic forecasts were carried out for the year 2020. The JICA STRADA program was used for this purpose. The study area was divided into 52 traffic zones considering the existing and future land use. The formulation of these traffic zones and their socio-economic data are discussed in Chapter 7. Results of traffic surveys were used as the basis for making traffic forecast as shown below in Figure 8.1.1.

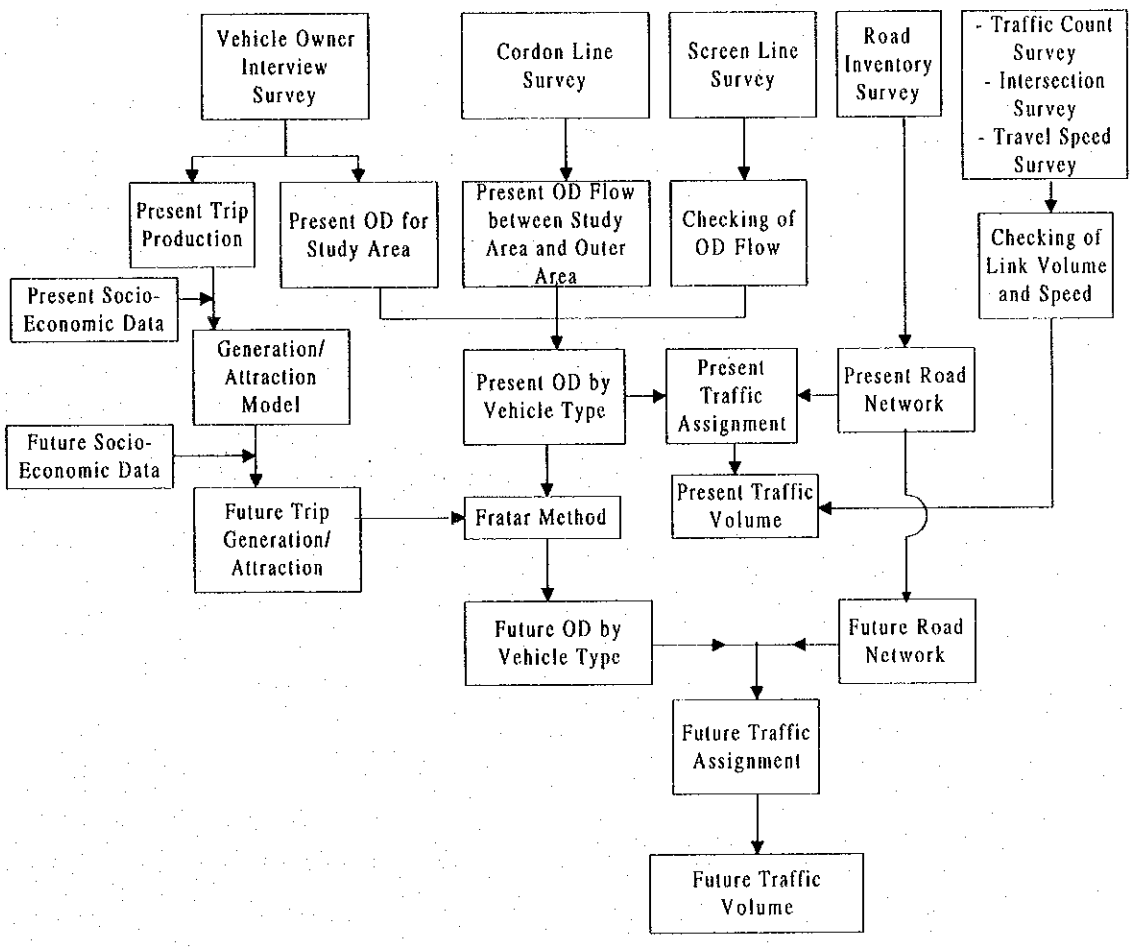


Figure 8.1.1 Flow Chart for Traffic Demand Forecast

8.2 Trip Generation/Attraction

8.2.1 Model Building

Trip generation/attraction models were built for car and truck trips by using the data collected from the vehicle owner interview survey. Multiple linear regression models were built as follows.

T = a*Pop + b*Emp(W)

T = Vehicle trips per day by mode (Generation or Attraction)

Pop. = Resident Population of Zone

Emp(W) = Number of persons having work place (i.e. employed) in Zone

a, b = Model parameters

The model parameters were obtained by calibrating the model with year 1998 trip data as dependent variables and 1998 Pop and Emp(W) data as independent variables. They are shown in Table 8.2.1. The calibrated model shows a strong fit with multiple correlation (R) for car trips around 0.92 and for truck trips around 0.83. This model is considered sufficiently accurate and is used for estimating trip generation and attraction for future years.

Table 8.2.1 Parameters of Trip Generation/Attraction Model

Mode		Parameter		Multiple Correlation (R)
		Pop (a)	Emp(W) (b)	
Car Trips	Generation	0.1147294	0.137748	0.92597
	Attraction	0.1147562	0.137647	0.92604
Truck Trips	Generation	0.0164525	0.091576	0.83174
	Attraction	0.0164150	0.091845	0.83215

8.2.2 Adjustment for New Central Market

The existing central market in zone 14 is planned to move to a new site in zone 7. This new central market is now under construction and is expected to be open in 1999. It is expected to attract about 50,000 to 100,000 visitors on weekdays and about 100,000 to 200,000 visitors on holidays. About 4,500 people are estimated to work in the new central market. The number of visitors was estimated from discussions between study team, city officials and officials related to the new central market.

Because of the large number of visitors, it was considered necessary to take this into account in preparing traffic forecasts. Assuming that the total number of visitors to the new central market on a weekday is 75,000 of which 25% will use cars and the remaining 75% by bus, the number of visitors by cars will be about 20,000 and by bus about 55,000. The 20,000 visitors by cars are equivalent to about 5,000 car trips, for car occupancy rate of 4 persons per car (20,000 persons * 4persons/car = 5,000 car trips per day).

In addition to car trips, it is estimated that about 1,500 trucks will come to the market daily. This additional generation of 5,000 car trips and 1,500 trips were added to the trip generation of zone 7 for future years.

For buses, it was assumed that all mini bus routes to the existing market would be changed to the new market. The estimation of bus trips and their routes are given in Chapter 9.

8.3 Modal Split

8.3.1 Present and Future Car Ownership

The total number of passenger cars in Ulaanbaatar City has drastically increased in recent years Table 8.3.1 shows the number of registered vehicles for the past 5 years from 1994-1998. The average annual increase in cars is about 21%. This increase rate is very high and cannot be expected to continue till year 2020. So the forecast of cars was based on growth of per capita GRDP by referring to similar studies in other cities. The car ownership (i.e. cars per 1000 persons) shows a strong relationship with per capita GRDP. Table 8.3.2 shows this relationship for some cities. This relationship was used to forecast car ownership rates for Ulaanbaatar city. The estimated future car ownership rates and number of cars are shown in Table 8.3.3.

Table 8.3.1 Registered Vehicles in Ulaanbaatar City

Mode	Year					Annual Change
	1994	1995	1996	1997	1998	94-98
Car	11,564	13,621	17,735	21,440	25,145	21%
Truck	7,035	6,801	7,278	6,797	8,835	6%
Bus	1,442	1,768	2,598	2,613	3,075	21%
Tanker	729	631	669	553	-	-
Special	889	796	946	861	676	-7%
Total	22,294	24,304	30,130	33,268	37,731	14%

Source : Traffic Police Records

Table 8.3.2 Relationship between Car Ownership and per capita GRDP

City	Cars/1,000 per.	Per Capita GRDP(US$)
Cairo	59	540
Tegushicarupa	41	525
Guatemala	86	830
Bangkok	63	840
Hanoi	11	170
Dailan	20	335
Manila	36	930
Ulaanbaatar	**41**	**209**

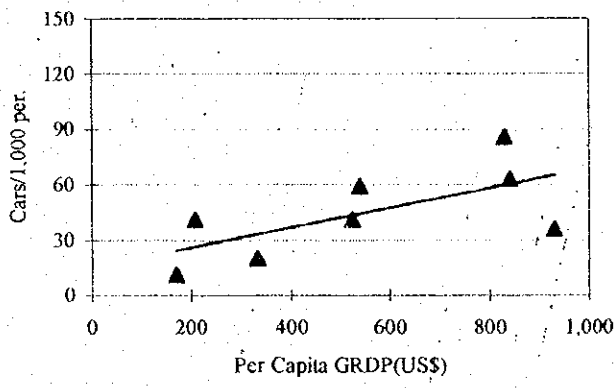


Table 8.3.3 Car Ownership Rates in Ulaanbaatar City

Year	Per capita GRDP (Tg)	Cars/1000 per.	Increase · Index	Cars
1998	169,629	41	1.00	25,145
2005	207,000	50	1.22	36,216
2010	234,000	56	1.38	44,611
2020	302,000	73	1.78	67,413

8.3.2 Modal Split

Public transport is the main mode of travel in Ulaanbaatar City. From the traffic survey results, it was known that at present (i.e. 1998) the modal share of car and bus is around 19% and 81% respectively. The total passenger demand and modal split for future years are shown in Table 8.3.4. The share of car passenger trips is estimated to increase from 19% in year 1998 to 25% in year 2020 and correspondingly the share of bus passenger trips to reduce from 81% to 75% between the same years. The details of modal split and public transportation are given in Chapter 9.

Table 8.3.4 Present and Future Modal Split in Ulaanbaatar City

Item/Year	1998	2005	2010	2020
Population	617,525	725,000	790,000	925,000
Pass. Trips/day (total)	1,160,900	1,377,500	1,516,800	1,905,500
Pass. Trips/day (car)	225,570	229,070	270,010	429,640
Pass. Trips/day (bus)	935,330	1,148,430	1,246,790	1,475,860
Pass. Trips (car %)	19%	21%	23%	25%
Pass. Trips (bus %)	81%	79%	77%	75%

8.4 Trip Distribution

To forecast future traffic volumes, it is first necessary to know the pattern of distribution of vehicle trips in the study area (i.e. traffic among the traffic zones). This pattern of distribution is generally represented by OD tables. To account for traffic flow between the study area and outside area, 4 external zones were established.

The OD table for year 1998 was prepared from the results of vehicle owner interview survey. OD tables were prepared by vehicle type for car and truck trips. The OD tables for future years were prepared by expanding the present OD table by the Fratar method which is included in the "OD Matrix Manipulator" of the JICA STRADA program. The share of through traffic was found to be almost negligible.

8.5 Traffic Assignment

In traffic assignment, OD trips are assigned on the road network to estimate traffic volumes. The incremental assignment method of JICA STRADA was used. This method is based on the criteria of minimum travel time in which traffic selects the shortest possible route between OD pairs. The process of traffic assignment by incremental method is shown in Figure 8.5.1.

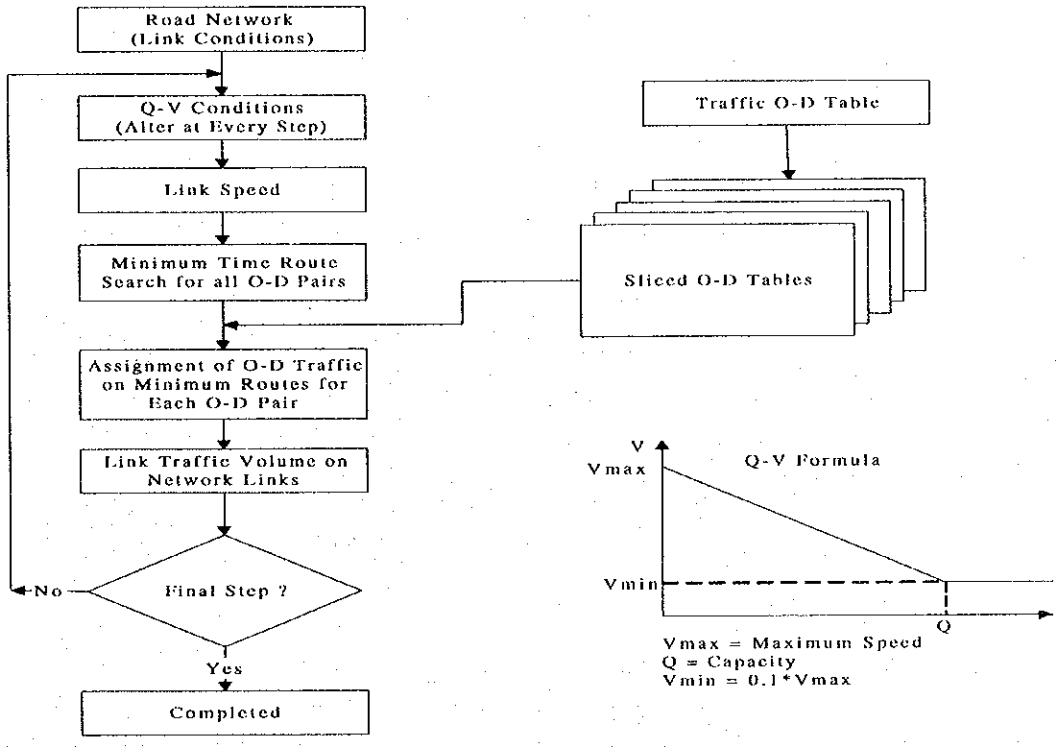


Figure 8.5.1 Flow Diagram for Traffic Assignment Method

The road network data such as length of links, number of lanes etc. was taken from the road inventory survey. The travel speed and capacity data used for traffic assignment are shown in Table 8.5.1 and Table 8.5.2 respectively.

At present there are 8 trolley bus routes which all together make about 780 trips daily. The traffic capacity of roads with trolley bus routes is generally lower that those without trolley bus because of the obstruction caused by them to traffic flow due to their low speed and relatively fixed right of way. To take this into account, the capacity of roads with trolley bus was adjusted as follows by applying the method contained in the "Traffic Capacity Manual – Japanese Standard".

$A = 100/[(100-T)+Et*T) = 0.89$

A = Adjustment Factor

T = % of trolley bus = about 2.4%

Et = 3.0 (for trolley bus)

The adjustment factor comes to 0.89 (or 89%) which means that the capacity of roads with trolley bus is about 89% of capacity of road without trolley bus. PCU factor of 1, 2 and 3 was taken for cars, trucks and buses respectively.

Table 8.5.1 Maximum Travel Speed (in km/hr)

Road Surface Condition		Road Type	
		City Roads	Regional Roads
Paved Roads	Good	60	80
	Fair	50	70
	Poor	40	
	Bad	30	
Unpaved Roads		20	

Note : Regional roads are roads connecting Ulaanbaatar city with satellite towns.

Table 8.5.2 Traffic Capacity of Roads

Carriageway Width (m)	Equivalent no. of lanes	Maximum Capacity (in pcu/day)	
		Without Trolley Bus	With Trolley Bus
6.0 ~ 9.0	2	9,000	8,010
>=9.0 ~ 12.0	3	11,000	9,790
>=12.0 ~ 18.0	4	37,000	32,930
>=18.0 ~ 25.0	6	56,000	49,840

8.6 Results of Traffic Assignment

Figures 8.6.1 - 8.6.3 show the results of traffic assignment. Both, traffic volume and traffic congestion are shown in these figures. Traffic volume (in pcu) is shown by the width of link and traffic congestion by VCR (i.e. Volume Capacity Ratio). Fig 8.6.1 shows the simulated traffic flow for year 1998. As can be seen from this figure that at present no link is congested i.e. VCR is less than 1.00 for all links. This was confirmed during field observation, as no road with traffic congestion was observed.

Fig 8.6.2 shows the traffic flow for year 1999 (i.e. after opening of new central market). As expected, the traffic volume on links around the new central market (esp. Teerverchid Street and the Ikh Toyruu Street) will increase although no traffic congestion will take place.

Figure 8.6.3 shows traffic flow on the existing road network for year 2020. This can be termed as the "Without Project Case" or "Do Nothing Case". From the figure, it can be seen that traffic congestion will be seen in the western and the southwestern parts of the city. This can be explained by the fact that most of the future development is proposed to take place in the western part of the city as per the socio-economic framework for year 2020. Roads in the southwestern part will get congested because of the development of the satellite town of Ulziit.

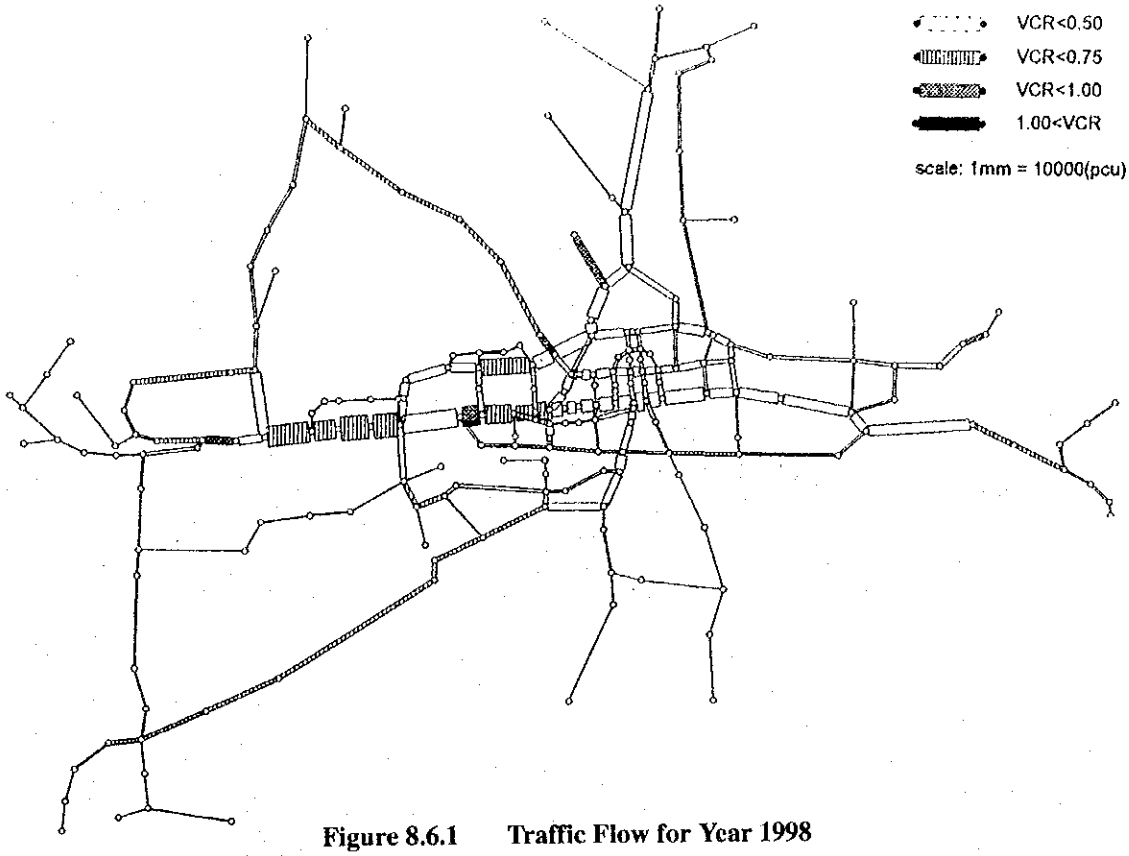


Figure 8.6.1 Traffic Flow for Year 1998

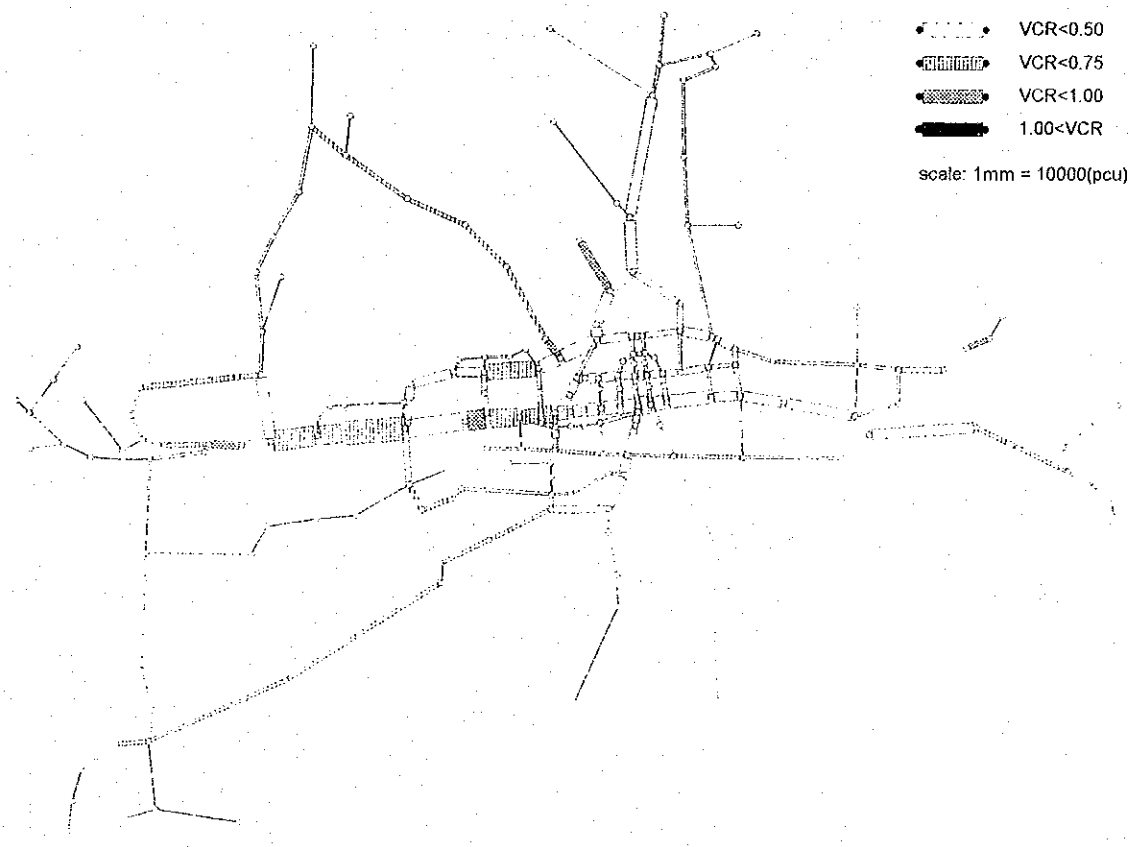


Figure 8.6.2 Traffic Flow for Year 1999

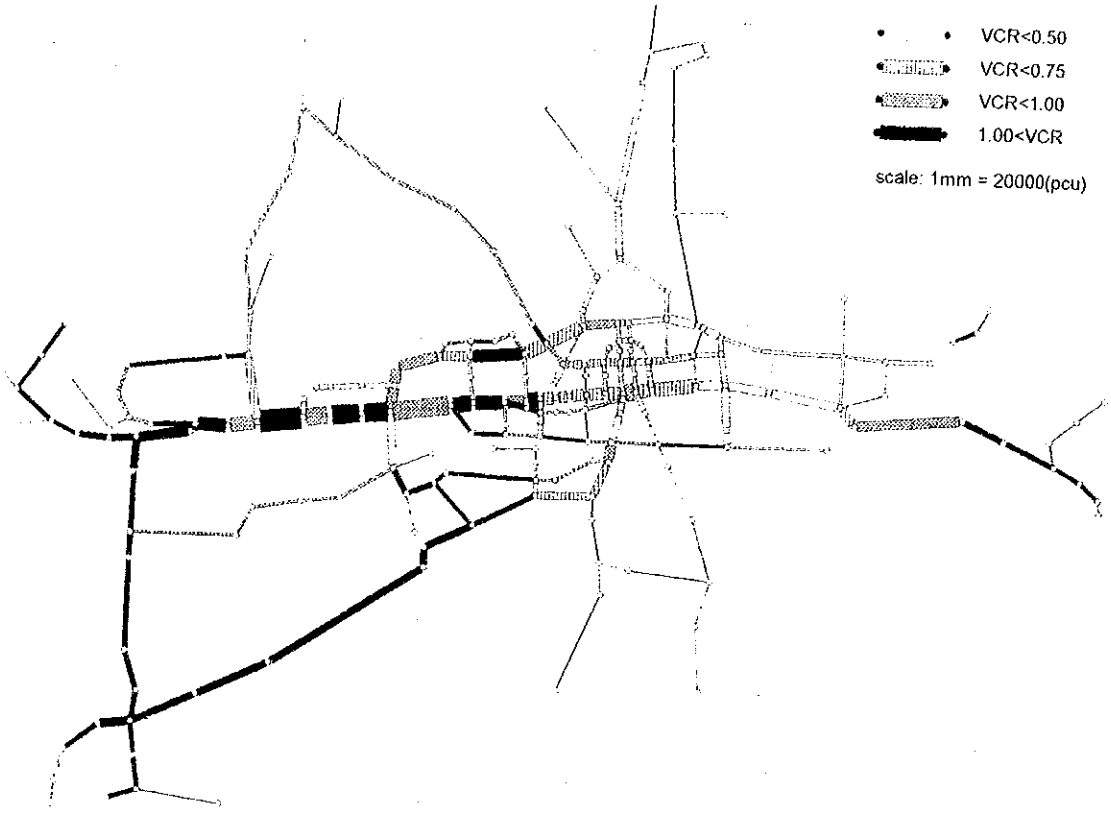


Figure 8.6.3 Traffic Flow for Year 2020 (Without Project)

Chapter 9 Future Public Transport

9.1 Problems in Public Transport

(1) Vehicle age

Vehicles classified in use ages are shown in Table 9.1.1. There are 17 buses and 32 trolleys, which have been used more than 9 years up to 1997, according to the data. Within a few years the number of vehicles to be removed from service is certain to increase. If they are not replaced by new ones, public service will be deteriorated where demand is forecast to grow steadily in the coming years.

Table 9.1.1 Buses and Trolleys in Use Years

Corp	Yr 1-2	Yr 3-4	Yr 5-6	Yr 7-8	Yr 9-10	Yr 11-	Total
Company 1	100						100
Company 2	13	49	32	34			128
Company 3	9	18	43	11	7	10	98
Trolley	3	9	41	49	32		134
Total	125	76	116	94	39	10	460

Source: produced from original data provided from TCD and companies (August, 1998) (Edited in years up to 1997)

(2) Used up electric facilities of trolleys

Power is supplied through overhead lines of about 40km length after converting to 600v from 6,000v through 13 transmission stations. They were constructed in 1987, and have been used for more than 10 years, but no sufficient renewal works have been conducted. In the mean time road surface has been poorly maintained. It is known certain portions of the lines need be replaced or they will cause cut down of the line and service.

(3) Trolleys versus city buses

Operation data of bus and trolley and the result of travel speed survey indicated lower efficiency of trolleys than city buses. Traffic survey in May 1998 shows the travel speed of city buses at 24.5 km/hr and that of trolleys at 18.4 km/hr. Traffic conflicts on roads caused by slow movement of trolleys are specifically pointed out by traffic policemen in various opportunities. The plan to convert trolleys to buses by stage is discussed in meetings with Mongolian side at various opportunities including a meeting with the steering committee in late August 1998. The Mongolian side agreed the plan of trolley phase out with a note that the trolley routes in north and Bayankhoshuu districts should be carefully studied.

(4) Revenue shortages

The companies produced the total of deficits at Tug 1,079 million ($ 1.3 million at $ 1.00 = Tug 838.46) in the first six months. Records of revenue and cost during the first half year of 1998 are shown in Appendix Table 5.2.7. Problems were once pointed out in the study in "Transport Rehabilitation Project" (IDA& CIE, May 1997), although vigorous actions have not been implemented in recent months. The study team finds that some recommendations are worthy for

immediate actions by bus corporations, while others are rather in basic principles which may need action programs. Also some would require legal authorization in parliament or city assembly. A financial restructure proposals are discussed in 9.5 of this chapter with a hope that they should be implemented urgently both by companies and the city.

9.2 Demand Forecast

9.2.1 Teavel Demand

Forecast of the overall growth of public transport demand in the study area is determined by assuming the factors in Table 9.2.1. They are a) population, b) gross regional domestic product (GRDP), d) person trips per capita and f) a share of public users in person trips.

- Total person trips will increase 2.06 times from 1,160,900 (1998) to 1,905,500 (2020).
- The share of the public transport person trips will go down from 81% (1998) to 75% (2020).
- Of public person trips, the trips can be divided into those on city bus, mini buses and satellite village bus in g-3, g-4 and g-5 in the table.
- School attendants are assumed at 10% of the total, being shown in g-2 in the table.
- Ratios of increase from 1998 to 2020 are:

- person trips per capita	2.06
- city bus passengers	1.54
- Total public transport passengers	1.58

Table 9.2.1 Growth of Overall Person Trips, 1998-2020

Item	1998	1999	2005	2010	2020
a. Population Note 1)	617,500	617,500	725,000	790,000	925,000
b. GRDP per capita Note 2)	169,600	169,600	207,000	234,000	303,000
c. Average growth Ratio of a & b above	1.00	1.00	1.20	1.33	1.64
d. Person trips per capita	1.88	1.88	1.90	1.92	2.06
e. Total person trips Note 3)	1,160,900	1,160,900	1,377,500	1,516,800	1,905,500
f. Share of public users Note 3)	81%	81%	79%	77%	75%
g. Public person trips Note 3)	935,330	996,390	1,148,430	1,246,790	1,475,860
g-1 City bus	808,570	808,570	946,030	1,034,970	1,245,200
g-2 Students	80,000	80,000	93,600	102,400	123,200
g-3 Total in number & in ratio	888,570	888,570	1,039,630	1,137,370	1,364,900
	1.00	1.00	1.17	1.28	1.54
g-4 Minibus Note 4)	40,940	102000	102000	102000	102000
g-5 Satellite villages	5,820	5,820	6,800	7,420	8,960

Study team (August 1998)

Notes: 1) & 2) Socio-economic framework of the study area
2) In terms of constant Tugruk of 1993.
3) For 1998, results of the survey in 1998. For other years they are calculated by using relevant indices
4) Provisional estimates. But restructuring of routes of city bus and minibus are necessary before the new market is completely functioning.

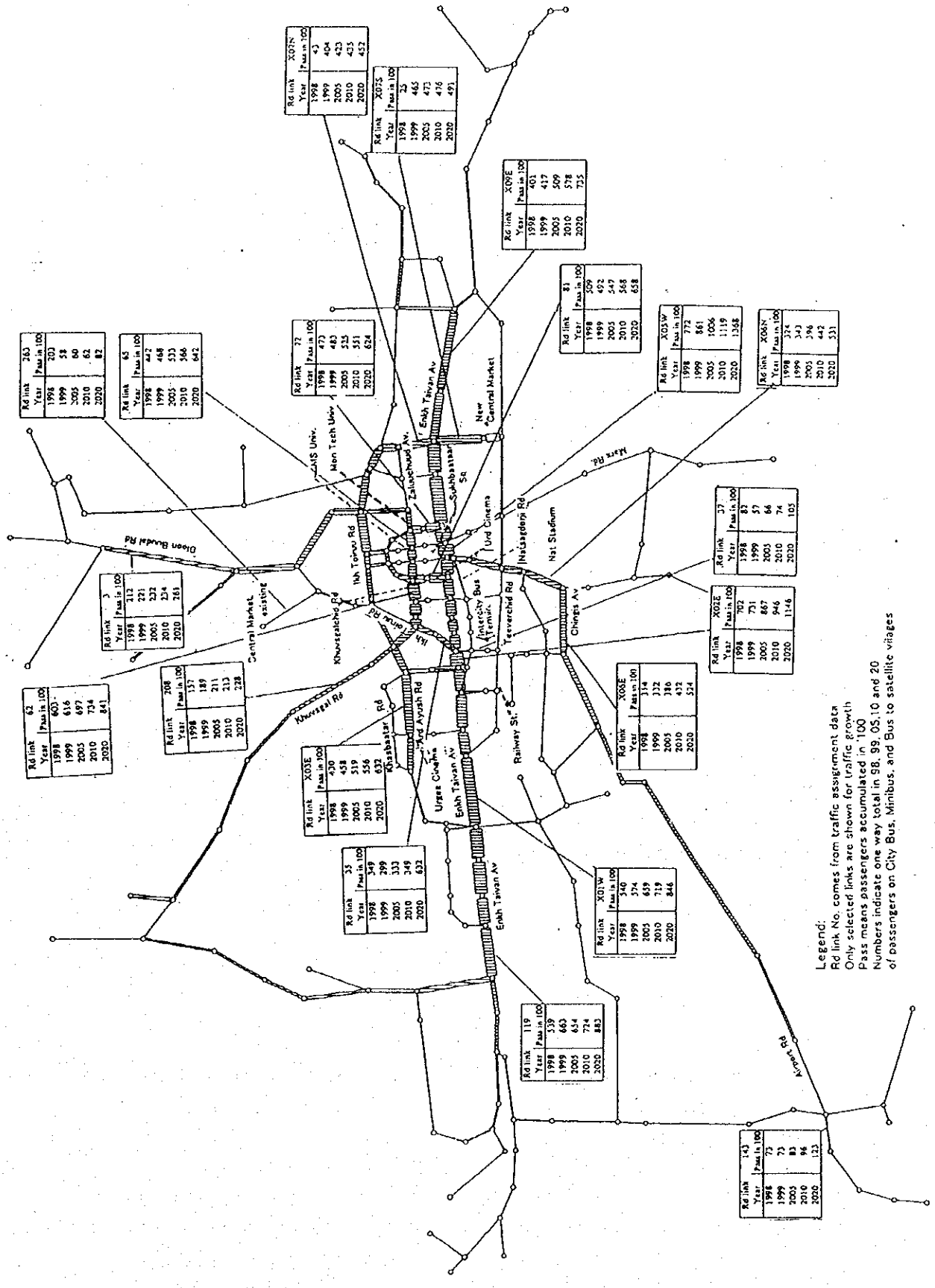


Fig. 9.2.1 Accumulated Public Transport Passengers on Roads

9.2.2 Demand Growth by Route

(1) Population Growth

Each bus route has its zones of influence along the route. Population growth in influence zones of each route of city buses from 1998 to 2020 are used for the calculation of demand growth. Appendix Table 9.2.1 shows the influence zones, the total of population of the zones of each route in 1998 and 2020, and the ratio of increase of trips of each route from'98 to '20.

(2) Trips and Passengers in Future

Calculation of bus trips and passengers using the population growth ratio for each route is summed up of all routes which are then adjusted to have the ratio of 1.54 from 1998 to 2020. Zone-wise data of trips and passengers are in Appendix Table 9.2.1 also.

(3) Passenger Volumes on Roads

Accumulated passengers of all bus routes on their road sections in one way per day are shown in Figure 9.2.1. In the Figure, volumes are for 98, 99, 05, 10 and 20. The volumes in 1998 are based on flows with the existing Central Market, while those in '99 are based on the volumes with minibus services to the newly opened Central Market in terms of the traffic in 1998. Those minibus passengers are assumed not increasing during those 22 years.

Growth ratios of passengers accumulated by road section from '98 to '20 are 1.4 to 1.8 on Enkh Taivan Avenue, where ratios are larger on the eastern side because of passengers to the new Central Market. Other sections in Figure seem to have modest growth ratios in 1.2 to 1.5 over the 22 years.

9.3 Alternative Plans of City Bus Development

9.3.1 Conditions

There are conditions assumed in order to formulate different development plans of city buses, which should be assessed by economic viewpoints. Assumed conditions are described below:

(1) Bus routes

It is found that the routes of city bus connect among major suburban points and the city center covering most parts of inhabited areas.

(2) Routes in total

In the formulation of development plan options, totals of vehicle-km and passenger-km of city buses are studied together with use years of vehicles to see the balance in demand and supply through which an investment plan of vehicles in future is determined, but no individual route revision plan is included.

(3) Travel Speeds

Travel speed surveys on main roads conducted by the team in May 1998 showed the average in 24.5 km/h of buses and 18.4 km/h of trolleys. Slow moving trolleys are a cause of traffic conflicts with other vehicles, which reduces the road service capability. In order to reduce conflicts, it is proposed trolleys are phased out by stage.

(4) Bus Route Capacity

A bus has passenger capacity in the range of 90 – 60 persons for boarding. In this study the route capacity in terms of averaged persons per bus is defined at 37 passengers per bus-km. The definition is discussed in Appendix Table 9.2.2.

9.3.2 Alternate Plans

Plans of the public transport system in Ulaanbaatar are figured out by formulating three options: 0) as the case with no investment, 1) vehicle replacement plan under the present fleet composition with bus and trolley and 2) including staged phase out plan of trolleys. Economic comparison is conducted to see differences in cost and benefits in Case 1 and Case 2.

(1) Case 1

Replacement of vehicles (investment in vehicle purchase) is scheduled when they come to the end of use years, based on the same proportion of the existing fleet composition among the corporations. New city buses and trolleys are assumed to run efficiently and at larger capacity with 3 doors for all companies. This means a continued pattern of service supply by the bus/trolley companies in larger capacities. Trip frequency and bus-km may increase with renewed vehicles, and they can meet with growing demand in future.

(2) Case 2

The replacement is assumed with increasing buses but reducing trolleys. Trolley routes would be terminated by stage, in 2002, 2007, and 2014, while passengers on the routes are transported by buses instead. This shift to city buses will enhance productivity of the routes service since buses are traveling at higher speeds and run-km are larger than trolleys.

A gradual phase out of trolleys, which is supposed to have 3 stages, are proposed from the following three practical view points:

1 Experiences in entrepreneur-ship in the market economy are not grown well. It may take another 10 years for the growth of private enterprises in the economy, which may manage well public service as a private business operation. Mongolia has a history of only 10 years since the departure from the socialist control economy, during which the country has been suffering from difficulties in transition to the market economy system. Capability in administration and management of **private** bus companies is a requisite condition.

-2 Sudden and substantial shift of trolleys to buses would cause unemployment and social problem because there prevails already unemployment and under-employment.

-3 Idling of part of existing facilities (workshop, equipment, garages, spare parts) is inevitable because buses depend on combustion engine and trolleys depend on electric motors. Changes in workshop facilities suitable for buses should be managed efficiently. However, restructure of those facilities of four bus companies in a period of 3-5 years seems difficult under the current conditions.

9.3.3 Economic Evaluation

(1) General

The amount of vehicle purchase (the investment cost) and the annual running cost of those vehicles year by year up to 2020 are the cost of the project in economic evaluation. Costs in terms of prices in mid-98 without taxes are tabulated All taxes are exempted for import of vehicles and parts of public transport corporations

Benefits are measured by savings in private car running costs. It is assumed that there would be overflowed passengers because of retired vehicles with no vehicle replacement. Those passengers not able to get on buses would use private cars to arrive at the destination. If new vehicles are put in appropriately, most passengers can use bus/trolleys, not using expensive private cars. The new vehicles can save the cost of the car use, which is called "economic savings or benefits of the investment of vehicle renewal.

Unit vehicle operation cost (VOC) of bus, trolley and private car is estimated respectively by using the soft program of HDM-VOC by World Bank (Chapter 13). Calculated unit VOCs are used together with overflowed passenger volumes, their averaged travel distance of 4.4 km and other factors to determine the travel cost and savings with and without the project.

Changes in congestion on streets related to bus and trolley running is not calculated since they stop at every bus-stop and the travel speed will be rather constant over the route. But difference in the averaged travel speed of bus and trolley is considered in the VOC calculation.

(2) Data

1) Case without investment

a. Vehicles are grouped in several use-years in each company as shown in Table 9.3.1. based on the data provided from TCD in August 1998. The bus-km in each group in each year is tabulated by using Tables 9.4.2.

It should be noted the use years become 6 or 7 years if vehicles run longer distances or on poorly surfaced roads. Table 9.3.2 shows a typical pattern to be used in the analysis. They should be revised in a periodic study of vehicle conditions

The total annual bus-km in each corporation is calculated and the calculated data for all corporations are summed up which result in decreases in bus-km in future because of increases in age of vehicles. In the calculation, tabulated bus-km are converted to the bus-capacity in terms of passenger-km where the conversion used the parameter of 37 persons per bus-km in average as discussed in Appendix Table 9.2.2.

b. Demand in passengers are 888,600 per day both ways. They are thought to increase by 1.97% annually to 2020 based on the growth forecast in Table 9.2.1.

Table 9.3.1 Vehicles by Use Years

Yrs	1-3	4-6	7-9	10-	Total
Co. 1	100				100
Co.2	57	36	20	15	128
C0.3	9	61	11	17	98
Trolley Co	12	25	16	81	134
Total	178	122	47	113	460

Edited from Table 5.2.5

Table 9.3.2 Operation Ratios & Annual Average km

	Existing buses		Buses for the future		Existing Trolleys		Trolleys in future		
Yr	Opera Ratio	Opera km/bus	Opera Ratio	Opera km/bus	Opera ratio	Opera km/bus	Opera ratio	Opera km/bus	Yr
1	0.9	87,030	0.9	87,030	0.9	54000	0.9	54000	1
2	0.9	87,030	0.9	87,030	0.9	54000	0.9	54000	2
3	0.8	77,360	0.85	82,195	0.8	48000	0.9	54000	3
4	0.8	77,360	0.85	82,195	0.8	48000	0.85	51000	4
5	0.7	67,690	0.85	82,195	0.7	42000	0.85	51000	5
6	0.7	67,690	0.8	77,360	0.7	42000	0.85	51000	6
7	0.7	67,690	0.8	77,360	0.6	36000	0.8	48000	7
8	0.6	58,020	0.75	72,525	0.6	36000	0.8	48000	8
9	0.6	58,020	0.75	72,525	0.6	36000	0.8	48000	9
					0.5	30000	0.75	45000	10
					0.5	30000	0.75	45000	11
					0.5	30000	0.75	45000	12
	Sum	647,890	Sum	720,415	Sum	486000	sum	594000	

Source: the Study team by considering data by TCD and corporations, June, 1998

c. The balance b-a above means the excessive demand if the balance is '+', while supply is enough the balance becomes '-'. It is found that the year of 1998 indicates the supply and demand are balanced as a whole in daily, but values will turn to '+' (overflowed passengers) in 1999 and the years beyond.

d. Passengers overflowed the supply capacity are assumed to use cars to go work, school, shopping, etc. Volumes of overflowed passengers decrease when new vehicles are put in service. Travel costs by overflowed persons by private cars are much more expensive than

buses and are considered as the loss of the Mongolia economy. The loss is caused by negligence of appropriate vehicle replacement program.

2) Case 1 Replacement Plan 1

a. Buses and trolleys are grouped by use years in the same manner as above 1). New buses are put in service when each group comes to the last year of use. Since new ones are large in 3 doors and annual run-km is high, they transport much more passengers. In addition another replacement is planned in late years when they are used up for 9 years or 12 years. Demand in passengers are 888,600 per day both ways which can be converted to pass-km and passengers. They are thought to increase by 1.97% annually to 2020 based on the growth forecast in Table 9.2.1.

b The total vehicles purchased are 1070 during the years 1999 – 2020 : which is divided into 814 buses and 256 trolleys

c Supply capacity in seats and run-km are generally larger in new vehicles. It means passengers overflowed supposed to use cars can be reduced, thus loss of the economy is saved when new vehicles are put in appropriate timing. The reduction is the economic savings realized by investment on vehicle replacement.

3) Case 2 Replacement Plan 2 with Staged Reduction of Trolleys

The case 2 assumes phase out of trolleys in stage as reasons were described in 9.1 of Chapter 9. The program is

phasing out routes No.3 and No.6 in 2002,

routes No.1, No.4, No.5 in 2007 and

the remaining routes No.2, No.7, No.8 in 2013.

The first two routes are selected in order to mitigate traffic congestion currently found at the intersection of Enkh Taivan Avenue in front of Central Post Office, and at Enkh Taivan Bridge over the railway which reduces the roadway width into 2 lanes from both approach sections of 4 lanes. The second phase targets to terminate trolley routes in central Enkh Taivan Avenue, and the last one will finish routes in north, west and east sides of the city.

a. Buses are scheduled to be put in service after trolley groups are coming to the last year of the 12 years' use. The average annual run km of bus is larger than trolleys, which results in less number of vehicles to put in service. Even though 2 routes are phased out, trolleys which need replacement in the coming years up to 2005 are 65 since there are 81 trolleys approaching the year of retirement since they were procured in 1987-90 at the beginning years of trolley operation. New purchases estimated in Case 2 are 1027 in total, of which 962 are buses and 65 trolleys during 1999-2020.

b. Those overflowed passengers exceeding supply capacity can be reduced compared to the case of no purchase, where reductions represent economic savings in a similar way but not in the same amount of Case 1.

4) Vehicle Purchase Schedule

Vehicle purchase plans of Case 1 and Case 2 are shown in Tables 9.3.3 (1) and 9.3.3 (2).

Table 9.3.3 (1) Vehicle Purchase Plan (Case 1)

	Co. 1	Co. 2	Co.3	Trolley		Priv.	Total	Trolley	City Bus Public
Phase 1		71	69	81		50	271	81	140
2	100	57	29	53		18	257	53	186
3	100	128	124	122		68	542	122	352
Total	200	256	222	256		136	1070	256	678

Summary from Appendix Table 9.3.1.

Table 9.3.3 (2) Vehicle Purchase Plan (Case 2)

	Co. 1	Co. 2	Co.3	Trolley	Buses forTrol	Priv.	Total	Trolley	City Bus public
Phase 1		71	69	65	15	50	270	65	155
2	100	57	29		36	18	240		222
3	100	128	124		97	68	517		449
Total	200	256	222	65	148	136	1027	65	826

Summary from Appendix Table 9.3.2.

(3) Costs

1) Vehicles

Vehicle purchase cost at Ulaanbaatar are determined as follows by referring to available information in Table 9.3.4 which is supplied by TCD.

Buses 3 doors like Carosa, Check	$100,000 in mid 1998
Trolleys 3 doors like the existing ones, Russia	$130,000 in mid 1998

2) Vehicle operation cost

Bus on roads in current conditions	$0.703 per km including depreciation
	$0.595 per km excluding depreciation
Trolleys on roads in current conditions	$0.803 per km including depreciation
(both include power and line operate cost)	$0.667 per km excluding depreciation
Cars for overflowed passengers	$0.1497 per km including depreciation
	$0.075 per km is used when savings of the project is estimated supposing the car owner picks up passengers on his own trip. A half is for the owner's cost.

3) Power Line

Renewal of trolley wires and poles for 1/2 of the lines after the 2 routes are phased out is estimated by using the data in Table 9.3.5. Some lines have been used heavily and need replacement urgently.

(18 km on roads) in Case 2 $1,427,000

Renewal of trolley wires and poles for 2/3 of the lines,

(30 km on roads) in Case 1 $ 2,378,000

(4) Economic Internal Rate of Return (EIRR)

Reduced overflowed passengers are tabulated from 1998 to 2020 in Appendix Table 9.3.3. Economic cost and benefit analysis of alternative two cases are conducted in Appendix Table 9.3.4 (1) and (2). Streams of costs and benefits are shown there, resulting in the followings

Case 1 EIRR 32% Total vehicle purchase cost at $114.6 million

Case 2 EIRR 34% Total vehicle purchase cost at $104.6 million.

9.3.4. Conclusion

(1) Conclusion

Case 2 of the staged phase out plan of trolleys shows a higher return to the economy of Mongolia. The total investment cost on vehicle purchase during 1999-2020 is less in Case 2. If slow moving trolleys are reduced, other vehicles can move smoothly and the road capacity can be used more efficiently. Consequently Case 2 is recommended.

(2) Subject of Feasibility Study

It is concluded Case 2 plan which says the city bus system is better to phase out trolleys by stages and regular large buses should be replaced for those trolley routes. Vehicle replacement plan in the first stage 1999 - 2005 (the 1st phase) will be taken as the subject of the feasibility study. In the feasibility study vehicle numbers will be refined and economic analysis of the 1st phase alone will be conducted.

Table 9.3.4 Cost of New Buses in Ulaanbaatar

Vehicle	Imported From	Year arrival	Units	Exchange $1.00= Tug	Unit 1) cost in $	Amount $'000	
Buses	Russia	1994	10	410.43	31,506	315,060	
Buses	Russia	1994	7	411.96	31,506	220,542	
Buses	Check	1995	44	471.1	86,000	3,784,00	Loan
Trolley	Russia	1995	9	462.86	110,434	993,906	Loan
Buses	Korea	1996	20	496.64	43,000	860,000	
Trolley	Russia	1996	3	497.8	91,500	274,500	
Buses	Japan Ni	1996	60	497.2	130,055	7,803,30	$1=Y111 Grant aid
Buses	Japan	1997	40	497.2	110,433	4,417,32	$1=Y111 Grant aid

Source: Transport Coordination Dept. (June, 1998)
Notes: Spare parts are not included. Value added tax of 10% is not included

Table 9.3.5 Rehabilitation Cost of Power Lines for Trolley Buses

Material import cost at Ulaanbaatar

	Item	Unit	Cost/unit Tug'000	Rehabilitation District 3, 3 km	Peace Av. 6 km	Cost in Tug'000	
	Copper wires	Km	3,500	12	24	126,000	2)
2	Steel wires	Km	1,200	6	10	19,200	
3	Automatic Adj.	Set	164	10	14	3,936	
4	Cross points	Set	180	2	7	1,624	
5	Slide & holding	Set	25	500	1,200	42,500	
6	Wire holding arm	Set	80	15	20	2,800	
7	Concrete pole 1)	Set	350	75	150	78,750	
8	Curve supports	Set	25	10	20	750	
9	Electric isolation 1200 kg f	Piece	2	1,200	2,000	6,400	
10	" dsp 1700 kg f	Piece	16	260	500	12,160	
11	" ip 0.7 kg f	Piece	3	2,080	3,500	15,066	
12	Loading weight adj.	Set	60	8	8	960	
	Total '000					310,146	
	Assuming $1.00 = Tug.838.46 (July,'98), Tug 310146/838.46=**$388,000**						

Source: Transport Coordination Dept. (June, 1998)

Notes: Costs were estimated by TCD with Russian suppliers in late 1997, but the improvement was suspended because of shortages of funds in the City budget.

1) Poles are assumed to be placed at a 40m interval.
2) Double lines (+,-) per direction, which mean 4* (road length).
3) The cost of direct work force is estimated at 15 % of the above cost which means the cost per road km is 388,000*1.15/9=43000*1.15=$49600 per Rd km.
4) According to "the F/S on Rehabilitation of Mongolian Railway (JARTS & PCI Under JICA, January,'98), the cost of contingencies, overhead, engineering, etc. is estimated at 60% of the direct cost in case bridge repair. 49600* 1.6= $79,300 per Rd km.
5) If 2/3 of the entire wire lines, 30km are rehabilitated in case 1, the cost will be 79300 *30km= **$2,378,000**. If 18km are rehabilitated in case 2, the cost is **$1,427,000**

9.4 Vehicle Replacement Plan in Short Term

9.4.1 Current Situations

(1) Short Term Vehicle Retirement

1) Phase 1 of the long term plan

Vehicle replacement plans for the period 1999-2020 was discussed in 9.3 of this chapter. In order to sustain the public transport in Ulaanbaatar, a staged phase out plan of trolleys was recommended. The feasibility study of the vehicle replacement plan in sort term (Phase 1 period, 1999-2005) of Case 2 is conducted as under. The short term plan has proposed the closure of trolley route 3 and 6 in 2002, instead normal large buses with 3 doors should be supplied on the same routes.

2) Trolley routes3 and 6

The operation data of trolley route 3 and 6 in a weekday of September 18, 1998 are edited in Table 9.4.1, where eight trolleys are assigned on Route 3 and 6, respectively. Appendix Table 9.4.1 and Appendix Table 9.4.2 show hourly changes in trips and travel speeds. The 2 routes are shown in Fig 9.4.1.

Table 9.4.1 Trolley Operation on Routes 3 and 6

(September 18, 1998)

Route	Trolley route 3, 8 vehicles		Trolley route 6, 8 vehicles	
Start/end points	Veh. Repair Entr.--- Baruun Khuree		Veh. Repair Entr.---Officers' Club	
Distance	Oneway, 9 km		Oneway, 8.8 km	
Direction	→	←	→	←
Trips	85	82	100	101
Canceled trips	10	11	10	10
Total	95	93	110	110
Average minutes	29'	29'	29'	24'
Av. Spd km/hr	19.3	19.6	20.6	22.5
	19.5		21.6	
Round trips/veh.	10.4		12.6	

Source: TCD and Trolley Co.(November, 1998). Tabulated from Appendix Table 9.4 1.

Under the authorization of TCD, private 4 buses have joined temporarily in the operation on Route 3 in late September since it was said some trolleys often canceled trips because of mechanical troubles. But operations of those buses are found not constant; they open at 8 o'clock in the morning and close at 20 o'clock in the night with frequent trip cancels, while trolleys open one hour earlier and close one hour later. It seems this private bus company, Muruudliin Buukhia, has not experienced enough in management of regular route operation. They mobilize used buses imported from other countries. It is found that bus operation on Route 3 has the overall average travel speed of 20 km/hr which is the same with that of trolleys. Higher speeds by buses can not be achieved as the route passes through congested sections in the city and interchanges. They need to stop at every stop as trolleys do.

3) Updated data of retirement program

TCD and bus/ trolley companies prepared in November 1998 the annual vehicle retirement plan from 1999 to 2002, based on their assessment of engine and physical conditions in addition to the use years in the past. Vehicles are classified according to the respective year of retirement during 1999-2002 and a group still in operation beyond 2002. Vehicles supposed to retire in those 4 years are 239 (45%) and still in operation beyond 2002 will be 289 (55%). The updated data are in Table 9.4.2.

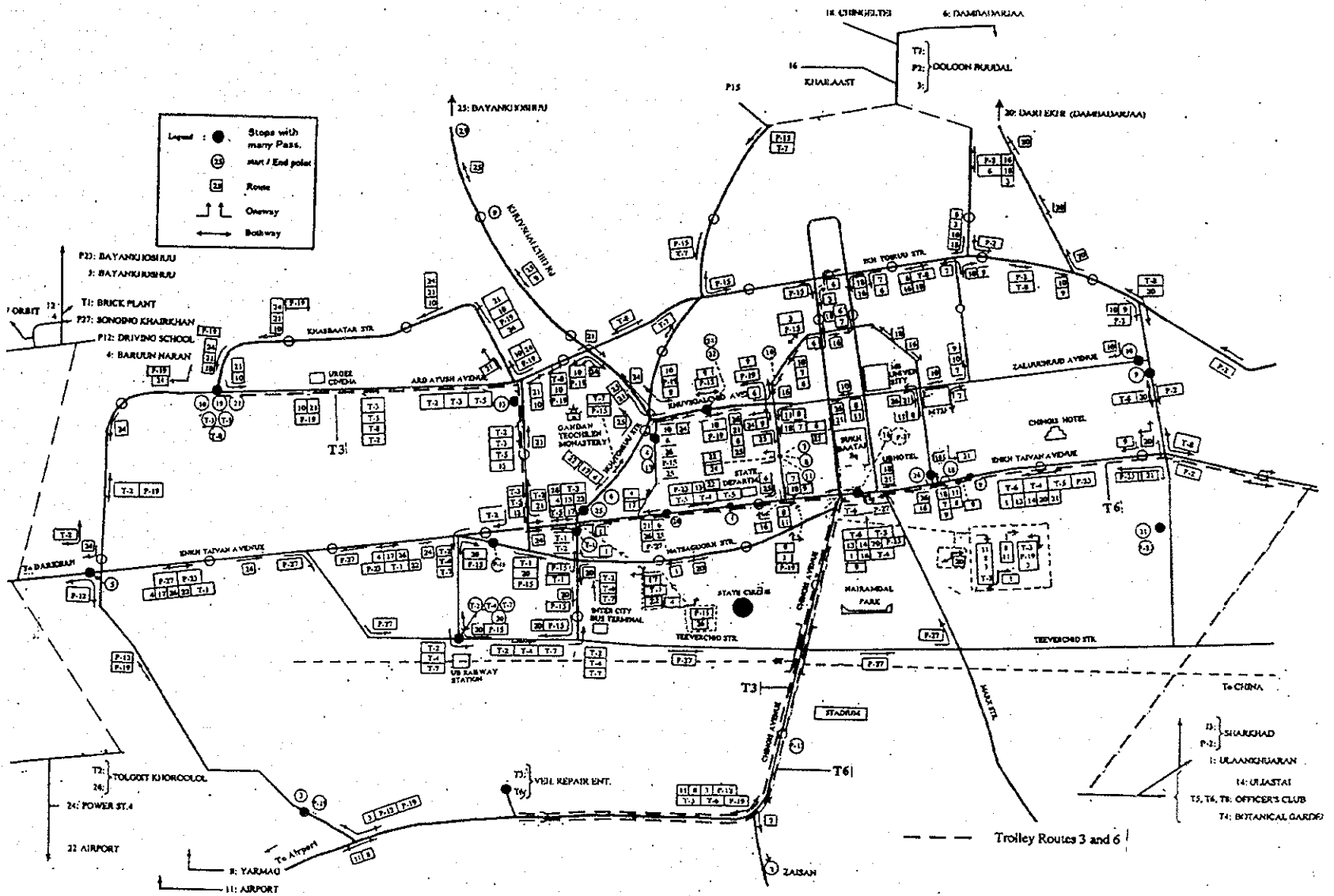


Figure 9.4.1 Trolley Routes 3 and 6

Table 9.4.2 Fleet Retirement Plan during 1999-2002

Company	Existing 1998	Fleet Retirement by Year 1999	2000	2001	2002	Tot 99-02	Operation beyond '02
Co. 1	100						100
Co. 2	128	16	13	18	23	70	58
Co. 3	98	35	13	10	7	65	33
Trolley	134	10	15	14	20	59	75
Sub-total	460	61	41	42	50	194	266
Private [1)]	68	24	9	7	5	45	23
Total	528	85	50	49	55	239	289

Source: TCD and the companies (November, 1998)

Notes: 1) Private vehicles are assumed to have the same ratio of retirement of Co. 3 in those years.

The above new data can be compared with that of the initial classification used in the long term master plan study 1999-2020, which is shown in Table 9.4.3 (1) and (2). While, Table 9.4.3 shows the comparison of two data.

Table 9.4.3 Vehicle Retirement by 2002

Item	Phase 1 plan from the master plan,August '98			TCD and Companies (November 1998)		
	Bus	Trolleys	Total	Bus	Trolleys	Total
Finish the service in 2002	140	81	221	135	59	194
Still in operation after 2002	186	53	239	191	75	266
Total	326	134	460	326	134	460

The November data of vehicle retirement is 27 less than the master plan study, but the retirement may increase in the Phase 2 period. When the economic rate of return is recalculated with the new November data for the long term plan of 1999-2020 in Case 2, the EIRR became 33%, less by 1% from the initial 34%. The new data is found little influence for the economic indicator, i.e. the recommendation of Case 2 is valid although new retirement program for short term period is incorporated in.

(2) City Buses

The service life before retirement was assumed 9 years for buses and 12 years for trolleys, which were determined in discussions with TCD in August 1998. The following is the required number of purchase in the short term period (phase 1) of Case 2 as copied from Table 9.3.3 (2).

Year	Co.1	Co.2	Co.3	Bus for Trolley	CityBus	Trolley	CityTotal	Priv.	Total
2002	-	71	69	15	155	65	220	50	270

The retirement plan by the updated data in Table 9.4.2 indicates the renewal program with a total of 248 as shown hereunder. The fewer number by 22 means that the retirement vehicles may increase in Phase 2.

Year	Co. 1	Co.2	C0.3	Bus for Trolley	City Bus	Trolley	CityTotal	Priv.	Total
2002	0	70	65	15	150	53	203	45	248

Of those purchases, private vehicles are included in this feasibility study. Their renewal program is based on their judgment on market opportunity, having no relation wilt the city budget. After estimating the EIRR including private ones of Phase 1 period, the cost burden by the city and public bus companies without private buses are described in the subsection below.

9.4.2 Economic Evaluation

(1) Conditions

In the economic evaluation of the investment in vehicle replacement program for the short term period, the following conditions are assumed

1) The evaluation period

The period of analysis in cost and benefit streams for the Phase 1 is set from 1999 to 2014, since the use of new 53 trolleys purchase in 2003 will terminate their service in that year.

2) Demand and benefits

Passenger demand and benefit estimates in this period are same as the forecast in the long term master plan from 1999 to 2020, being shown in 9.4 of Chapter 9.

3) Cost

The cost are estimated in economic terms and unit values of vehicles and vehicle operation are same as those discussed in the long term program. Replacement vehicles in Phase 1 is revised to the total of 248 vehicles.

(2) EIRR

Economic rate of return (EIRR) of Phase 1, in which two trolley routes are terminating operation while buses are put in. EIRR is calculated as under. Costs and benefits are in Appendix Table 9.4.3. The calculated return presents a value close to 34% of Case 2 of the long term plan. Appendix Table 9.4.4 presents service km and effects of Phase 1 in Case 2.

Phase 1 EIRR 32%, B/C ratio at 10 % rate 1.39

(3) Conclusion

The high return means the public transport system is vital to the development of economy and community of Ulaanbaatar. It is worthy to be sustained with an appropriate vehicle replacement program, since there is no alternate public rail transit in the city. The cost of vehicle replacement in the short term period (Phase 1) is

Buses of City	150	vehicles	$15,000,000
Trolleys of City	53	trolleys	$ 6,890,000
Power lines of trolleys on roads	18	km	$ 1,427,000
Total economic cost			$23,317,000

It is urgent necessity to determine funding sources for this amount as well as a plan of financial restructure of the bus system.. It is recommended city bus companies, City and TCD, and Government of Mongolia should behave jointly to solve this funding matter immediately.

9.5 Other Recommendations

9.5.1 Restructure of Organizations

Existing four public corporations were separated from the UB city, without no private fund participation. The all assets provided by the city in 1996 were as under:

Total Assets in 1996

(Tug million in prices of mid-1996)

Company 1	5029
Company 2	2295
Company 3	262
Trolley	865
Total	8451

Although their assets have increased in the past few years, vehicles, routes and workshop facilities are not balanced among the companies, restructure and merger of those companies will be necessary along with the gradual phase out of trolleys

9.5.2 Bus Qualities

Different sizes of bus, such as use of mini and medium buses should be considered on selected routes. Low floor buses, which will be beneficial particularly for aged personsfor on and off, is worthy to consider for using although the cost is higher by 30-40%.

9.5.3 Changes in Service

- Express/Shuttle Buses

Currently no shuttle bus service is provided. But, Route No 13 and No.10 are operated with many frequencies in central area of the city. When demand increases much more in the future, other shuttle service need be supplied in other roads. Express service should be considered also hopefully with a higher fare..

- Monthly pass and discount tickets

The monthly pass is applied for university students in a fixed price of Tug3000 per month excluding the vacation period. Loss of the revenue is partly compensated by the City. The similar monthly pass system should be extended to daily commuters if they use public bus/trolley daily. If a passenger changes to another route he has to pay another Tug 100 on the second route. It is considered better to study the application of multi-ride ticket system.

9.5.4 Financial Restructure

The deficit in the first half of 1998 was Tug 1078 million ($0.78 million) in the total of four corporations. Loan agencies of World Bank and others would not supply funds to sustain city bus corporations, if there are no immediate actions by the city and the government to reduce deficits in financial terms. The following points should be reminded in increasing revenues.

(1) Revenue Generation

1) Conductors

Number of conductors on the bus should be increased to collect the fare at every door side. It is said non-qualified free riders including children are 20% or more of daily passengers. Conductors should be empowered legislatively to delete those non-qualified passengers.

There are pocketing a part of the collected revenue by conductors. They should be strictly controlled and inspected frequently to recover lost revenues.

2) Aged and handicapped persons

There are aged, handicapped persons and others who would be covered by the welfare policy of the city for free rides. They carry ID card issued by TCD in using the bus. They are around 10% of daily uses. Bus companies should be compensated by the city for those qualified free passengers.

3) Campaigns through news media

News media of TV, radio, newspaper, etc. should be utilized to know the bus fare should be paid when people use the bus. A market system that users must pay the tariff whenever they receive a transportation service should be known thoroughly.

(2) Tariff Revision

Bus fares should be increased periodically. An example plan is to increase the fare Tug 100 to Tug 150 in 2000, and again to Tug 200 in 2006. This revision together with other actions for revenue generation will improve the financial position of the companies. (22.1.3 in Chapter 22)

9.5. 5 Bus Terminals

All buses are parking in the garage of each company after terminating their operation at 10 p.m. for the day. And they are mobilized at 6.30 am from the garage to each route. In daytime buses are seen resting for a while on certain road sides or open spaces, while some go back to their garages. They come back to routine operation after certain hours. It seems reasonable manner of resting in daytime at those places under the current level of road traffic. It is considered not necessary to construct bus parking areas for resting in the central part of the city.

Chapter 10 Future Road Network Plan

10.1 Classification of Roads

The future road network is formulated based on comprehensive evaluation of the present condition of roads, forecast of future traffic volume and forecast of number of passengers using public transport. At first, the roads were classified into 5 categories with consideration of their role and design standards. They are in in Table 10.1.1.

Table 10.1.1 Comparison of Road Classification by Design Standards

Proposed Standards			
Category of Road	Design Speed	No. of Lane	Width
S: Asian highway (Inter state highway)	120	4,6,8	3.75
A: Regional road	80	2,4	3.5
B: Primary road (City Trunk road)	60	2,4	3.25
C: City road (Major network road)	60	2,4	3.25
D: Residential road (Minor network road)	40	2,1	3

Mongolian Standards			
Category of Road	Design Speed	No. of Lane	Width
Trunk roads :			
-for high speed	120	4~8	3.75
-with regulated speed	80	2~6	3.5
Trunk streets :			
-of city importance	100, 80	4~8	3.75, 3.6
-of regional import.	70, 50	2~4	3.5, (4.1)
Streets & roads of local importance :			
-in residence area	40, 30	2~3	3
-in industrial area	50,40	2~4	3.5
-Park road	40	2	3
Access roads :			
-main	40	2	2.75
-Secondary	30	1	3.5

Conceptual illustration of the above proposed classifications is shown in Figure 10.1.1. and the proposed definition of roads is shown in Table 10.1.2.

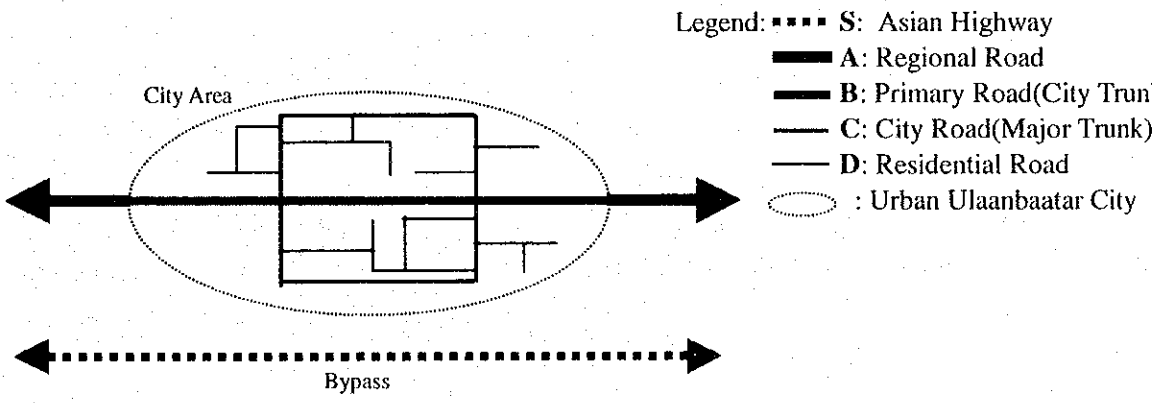


Figure 10.1.1 Definition of Roads and Streets

Table 10.1.2 Definition of Proposed Road Classification

Road Name	Function	Design Speed Km/hr	Restriction on Entry/Exit	Length/Area for plan
S : Asian highway (Inter state highway)	Long term plan through Mongolia No-passing urban area	120	Partial	
A: Regional road	Connecting between urban & district, region (low capacity)	80	No	
B : Primary road (City trunk road)	Passing urban area connecting between city center (high capacity)	60	No	4km/km2
C: City road (City net road)	Vehicles in/out of city, urban area	60	No	2km/km2
D: Residential road (Minor net road)	Connecting between residence, house (out of scope of project)	40	No	

10.2 Scope of the Study

In the study of the long term road network plan , category A, B, C roads are considered in the study, and S, D were decided to be out of the scope of the study for the following reasons:

Category S Asian highway Asian highway is an inter city road and its exact location for passing UUB area has not been fixed. Study team proposed an alternative idea of the location on the North dike of Tuul river however, these types of huge project study wwere expected to be conducted as an independent project.

Note: Two alternative locations are proposed at the northern or the southern dike to avoid the traffic congestion of urban roads. In case of northern route , the highway shall be constructed on the super dike with a wide width of 100m or so. The super dike can protect the city area from the flooding of the Tuul river, but the cost for the drainage gate needs a large amount of financing. While, in case of the southern route, it shall pass the edge of the Bogd mountains and the total cost is expected to be more than northern route for the bridges and tunnels.

Category D Residential roads Residential roads are well developed in UUB. Total length of residential roads is more than 67 km. (Table 4.1.1) They have many problems now due to the lack of maintenance. However it will be solved easily, if there are sufficient budget. Technical study will not be important for this category.

10.3 Policy for Establishing Future Road Network Plans

Study team introduced two kinds of policies,

Target area	Basic Policies
Road Network for GUB (Greater Ulaanbaatar)	Long term road net work was established with consideration of roads connecting 6 satelite towns. At that time these roads are not dead end roads but as ring roads. 4 ring roads out of 5 were excluded from the long term road network plan as premature ones. Thes 4 ring roads should be studied separately for the establishment of a plan after 2020.
Road Network for UUB (Urbanized Ulaanbaatar)	● Maximum utilization of existing road takes into account the following survey results: -Existing Condition of Roads and Budget -Traffic survey results with the traffic congestion check -Forecasting of future traffic demand on the existing road network ● Destruction to environment is to be minimized ● Coordination between aesthetic view and cost for construction/ maintenance shall be considered

Actual concepts to reduce the future traffic congestion in urban area road network are as follows:

Places where congestion is expected	Measures for solution	Necessary works
Enkh Taivan Avenue	Cross point with railway and the road at west part shall be improved. (Central route)	Improvement- expansion at the west end of Enkh Taivan Avenue in connection with regional roads
Road parallel to Enkh Taivan Avenue	It shall be improved as a bypass. (called Northern route)	New construction/improvement- the west side of Enkh Taivan Avenue to the third district of Northern route extention
Road to the northern ger settlement	The restriction of farther development prevents the negative environmental effect. (Maintenance of the existing roads should be continued.)	
Road to airport	The widening of the existing bridge on Tuul river is difficult in terms of cost. Alternative route shold be considered.	
Enkh Taivan Bridge	By withdraw of trolley bus, traffic flow is more smooth.	
Teeverchid road due to opening new central market	It is expected to be widened. Connect to the south side of railway through new fly-over.	New construction/improvement of missing sections of Southern route and widening of the existin road
City center area	Middle ring road is required for dispersing traffic from the city center area.	New construction- missing sections of Ring route and two fly-overs

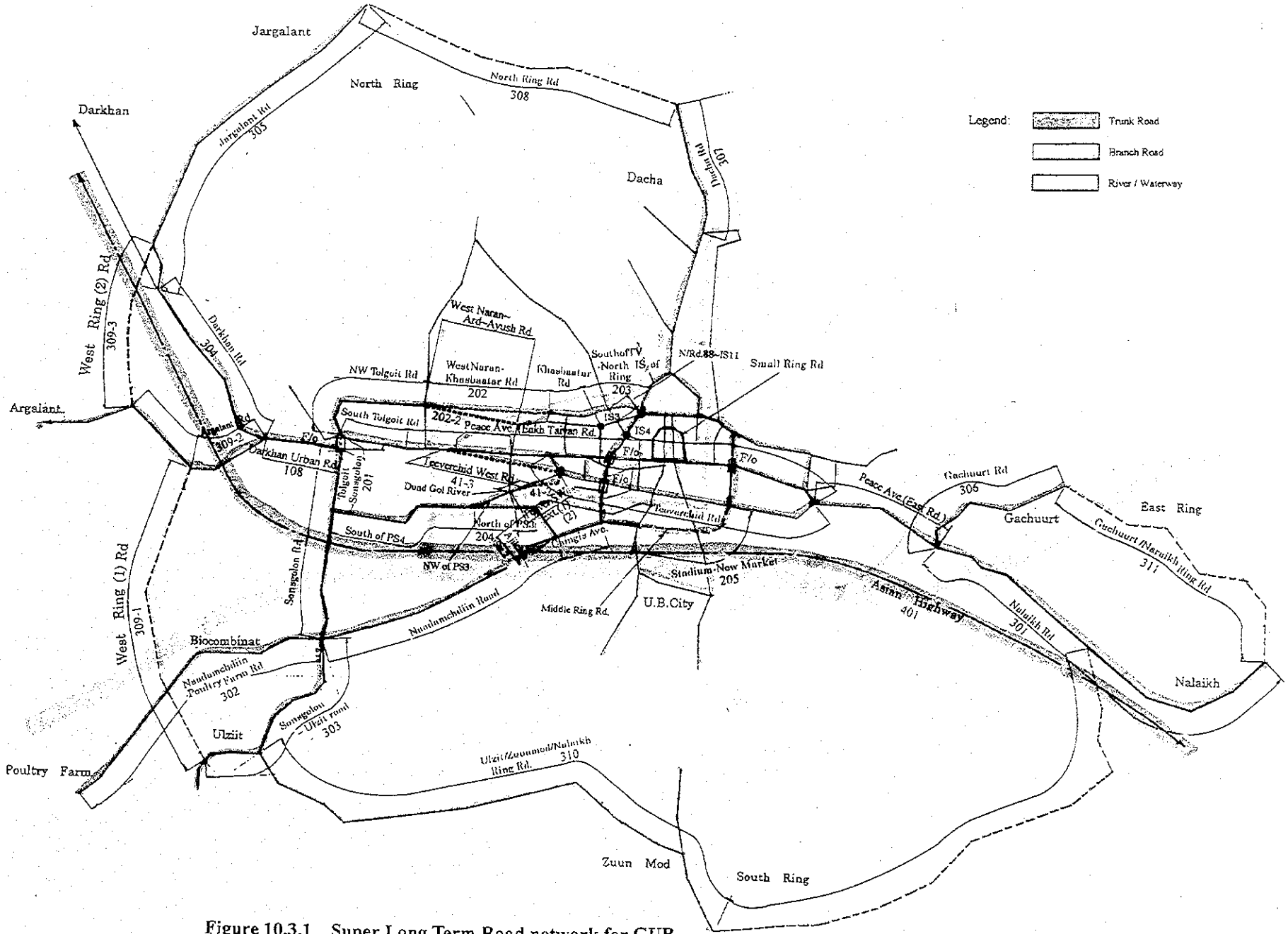


Figure 10.3.1 Super Long Term Road network for GUB

Conceptional expression of the above mentioned networks is shown in Fig. 10.3.2 as below.

Table 10.3.1 shows the details of the roads to be studied.

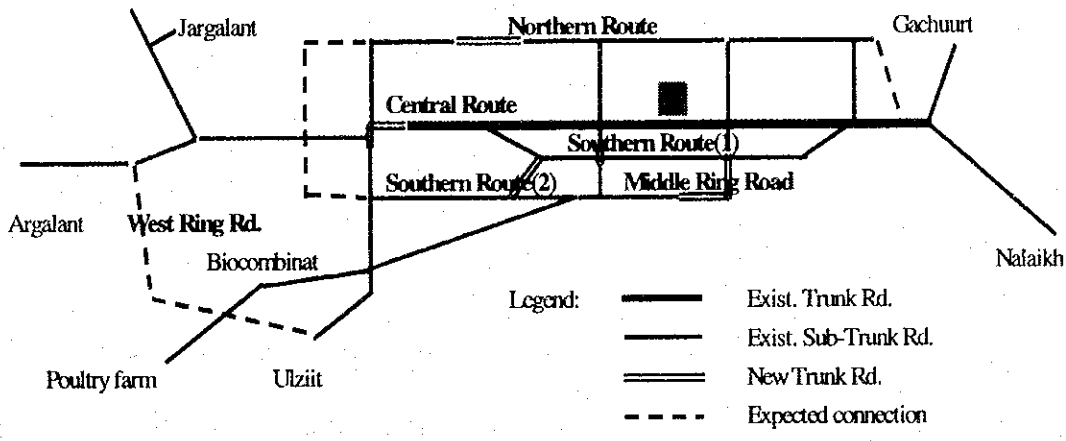


Figure 10.3.2 Basic Trunk Road Network plan in UUB

Table 10.3.1 Route for Future Road Network

Route	Name of Road	Number of Road(UB)	Road Length	Existing Lane No.	Future Lane No.	Recommended Section Type(see Chapter11)
North Route through East-West	Darkhan Urban Rd	108	3.5 km	2	2/4	F,G
	N/W Tolgoit Rd	82/84/85	3.6 km	2	2/4	F,G
	Tolgoit~Sonsgolon	201	0.8 km	none	2/4	B,B'
	Khasbaatar Rd	37/95	1.5 km	2	2/4	F,G
	WestNaran-Khasbaatar Rd	202	3.7 km	none	2/4	B,B'
	WestNaran-ArdAyush Rd	202-2	3.1 km	none	2/4	B,B'
	SouthofTV-North IS of Ring (TV-N/Rd.88)	203	1.3 km (0.4)	none	2/4	B,B'
	N/Rd.88~IS11	88	0.4 km	2	2/4	F,G
South 1 Route	Teeverchid Rd	41	8.5 km	2	2/4	E,F
	Teeverchid SW Ext.	41-2	0.6 km	none	2/4	B,B'
	Dund Gol Riverside Rd.	117	1.1 km	2	2/4	E,F
	Teeverchid West Rd.	41-3	3.5 km	none	2/4	B,B'
South 2 Route	Sonsgolon Rd	76	5.5 km	2	2/4	E,F
	South of PS4	39	5.1 km	2	2/4	E,F
	North of PS3	204	1.7 km	none	2/4	B,B'
	North-West of PS3	39	0.9 km	2	2/4	E,F
	Ajilchin Str.2	71/72	1.1 km	2	2/4	-
	Chingis Ave.	2	1.4 km	4	2/4	-
	Stadium-New Market	205	3.3 km	none	2/4	B,B'
	Naadamchdiin Road	104/105	7.6 km	2	2/4	E,F
Central Route	South Tolgoit Rd	82/84/85	2.0 km	2	2/4	E,F
	Peace Ave.	5/4/3/1	13 km	6/4/2	4/6	-
	(Enkh Taivan Rd)					-
	Peace Ave.(East Rd.)	1	4.5km	4/2	2/4	E,F
Ring Road	Middle Ring Rd	6/12/97/205/2/ 32/70/34	13.0 km	4	2/4	
	Small Ring Rd	14/3/1	3.5 km	4	4	
Intersection	Geser Temple	IS4				
	Ayush-Amarsanaa Str	IS3				
	Khuvsgalchid~ArdAyush	IS11				
Flyover	East Cross Rd	IS7	0.3 km		(2)	
	West Cross Rd	IS2	0.3 km		(2)	
	Bus terminal-Engel str over railway	32/34/70	0.5 km		(2/4)	
	Tolgoit-Sonsgolon over railway	82/84/85/76	0.5 km		(2/4)	
Satellite to UB Route	Nalaikh Rd	103/301	28.0 km	2	2/4	D,E
	Naadamchdiin-Poultry Farm Rd	104/105/302	24.0 km	2	2/4	E
	Sonsgolon-Ulzit road	76/303	15.0 km	2	2/4	D,E
	Darkhan Rd	108/304	20.0 km	2	2/4	E
	Jargalant Rd	305	17.0 km	2	2/4	E
	Gachuurt Rd	306	11.0 km	2	2/4	E
	Dacha Rd	307	10.0 km	2	2	E
	North Ring Rd	308	20.0 km	none	2	A'
	West Ring Rd.(1)	309-1	18.0 km	none	2	A'
	Argalant Rd.	309-2	4.5+6.0 km	2	2	E
	West Ring Rd.(2)	309-3	13.5 km	none	2	A'
	Ulzit/Zuunmod/Nalaikh Ring Rd	310	62.0 km	none	2	A'
	Gachuurt/Naraikh ring Rd	311	27.0 km	none	2	A'
Interstate	Asian Highway	401		none	2/4/6	-

10.4 Selection of Alternative Road Network Plans in 2020

Based on the above concept, six alternative long-term road networks for year 2020 (coded as R2 to R7) were formulated by changing lane number and route. (R1 is the existing road network without change). Table 10.4.1 shows the future traffic lane numbers of each alternative.

Following table is the summary of comparison of 6 alternatives called as R2 to R7.

	Outline	Environmental affect and Resettlement	Financial cost (MUS$)	Benefit-Cost Ratio B/C
R2	Principal road network plan for long term period by 2020 All main roads are expanded to be 4 lanes	D	D 246	D 1.311
R3	Reduced the northern route as 2 lanes. New road at the south side of TV stations. Improvement of Rd No 88 about 0.4 km	B	B 228	B 1.396
R4	Reduced the southern route as 2 lanes.	A	B 229	B 1.402
R5	Reduced the Naadamchidiin road as 2 lanes	C	C 231	D 1.336
R6	Reduced the Naadamchidiin road as 2 lanes Northern route will connect from west Naran to Ardayush by 4 lanes. Expand Teeverchid street to Peace avenue at the west end. The roads of South of PS4 and PS3 are 2 lanes	C	D 237	C 1.374
R7	Modification of R6 Khasbaatar road shall be 2 lanes	B	A 225	A 1.423

Note of the above table : Rank , A; Good, B; Fair, C; Poor, D; Bad

In terms of traffic flow (i.e. average speed and VCR), no substantial difference was found among the 6 alternatives of R2 to R7, so the criteria of traffic flow was not considered for evaluation.

From the above evaluations, R7 is selected as the best alternatives because of cost and B/C ratio, and Figure 10.4.1 shows its routes. Traffic forecasts were carried out for all the alternative networks. Figure 10.4.2 shows traffic flow for year 2020 for the future road network (R7). This can be termed as "With Project Case". It can be seen from this figure that the construction of new routes will contribute to the reduction of the traffic congestion, especially in the western part of Peace avenue.

Table 10.4.1 Traffic Lane Number for Future Road Network R1-R7 in 2020

Route	No.	Name of Road	Road Length	Existing Lane No.	R1 SI.T	R2	R3	R4	R5	R6	R7	F/S	N/W /I	Br. No.	Sectio nType
North Route Through East-West	1	Darkhan Urban Rd	3.5 km	2	4	4	4	4	4	4	4				
	2	N/W Tolgoit Rd	3.6 km	2	4	4	2	2	4	4	4	4	W	2/N	F
	3	Tolgoit~Sonsgolon	0.8 km	none	4	4	2	2	4	4	4	4	N		B
	4	Khasbaatar Rd	1.5 km	2	4	4	2	2	4	4	2				
	5	WestNaran-Khasbaatar Rd	3.7 km	none	4	4	2	2	4	0	0	0			
	5'	WestNaran-ArdAyush Rd	3.1 km	none						4	4	4	N	6/N	B
	6 (6')	SouthofTV-North IS of Ring (TV-N/Rd.88)	1.3 km (0.4)	none	4	4	(2)	2	4	4	(2)	(2)	(N)		B'
	6'	N/Rd.88~IS4'	0.4 km	2			2				2	2	I		
South Route Through East-West	7	Sonsgolon Rd	5.5 km	2	4	4	4	4	4	4	4				
	8	South of PS4	5.1 km	2	4	4	4	4	4	4	4	4	W	1/N	F
	9	North of PS3	1.7 km	none	4	4	4	4	4						
	9'	North-West of PS3	0.9 km	2	2					4	4	4	W		F
	10	Ajilchin Str.2	1.1 km	2	4	4	4	4	4	2	2	2	R		-
	11	Chingis Ave.	1.4 km	4	4	4	4	4	4	4	4				
	12	Stadium-New Market	3.3 km	none	4	4	4	4	4	4	4	4	N		B
	13	Naadamchdiin Road	7.6 km	2	4	4	4	4	2	2	2				
Central 1st Route	14	South Tolgoit Rd	2.0 km	2	4	4	4	4	4	4	4	4	NW		B/F
	15	Peace Ave. (Enkh Taivan)	13 km	6/4/2	6/4	6/4	6/4	6/4	6/4	6/4	6/4				
	16	Peace Ave.(East Rd.)	4.5km	4/2	4	4	4	4	4	4	4				
Central 2nd Route through East-West	17	Teeverchid Rd	8.5 km	2	4	4	4	4	4	4	4	4	W	1/W	F
	17'	Teeverchid SW Ext.	0.6 km	none	4						4	4	N	1/N	B
	17"	Dund Gol Riverside Rd.	1.1km	2	4						4	4	W		F
	17"'	Teeverchid West Rd.	3.5 km	none						4					
	17""	Ajilchin Bridge(L=30m)	(0.3km)							4					
Ring Road	18	Middle Ring Rd	13 km	4	4	4/2	4/2	4	4/2	4/2	4/2				
	19	Small Ring Rd	3.5 km	4	4	4	4	4	4	4	4				
Intersection	20	Geser Temple	IS4									yes	I		
	21	Ayush-Amarsanaa Str	IS3									yes	I		
	22	Ayush-Khuvsgal	IS11									yes	I		
Flyover	23	East Cross Rd	0.3 km	none	(2)	(2)	(2)	(2)	(2)	(2)	(2)	No2		1/N	
	24	West Cross Rd	0.3 km	none	(2)	(2)	(2)	(2)	(2)	(2)	(2)				
	25	Bus Terminal-Engel str over railway	0.5 km	none	(4)	(2)	(4)	(4)	(2)	(2)	(2)	No1		1/N	
	26	Tolgoit-Sonsgolon over railway	0.5 km	none	(4)	(4)	(2)	(2)	(4)	(4)	(4)				
Satellite to UB Route	27	Nalaikh Rd	28 km	2	4	2	2	2	2	2	2				
	28	NaadamchidPoultryFarmRd	24 km	2	2	2	2	2	2	2	2				
	29	Sonsgolon-Ulzit road	15 km	2	4	4	4	4	4	4	4				
	30	Darkhan Rd	20 km	2	2	2	2	2	2	2	2				
	31	Jargalant Rd	17 km	2	2	2	2	2	2	2	2				
	32	Gachuurt Rd	11 km	2	2	2	2	2	2	2	2				
	33	Dacha Rd	10 km	2	2										
	34	North Ring Rd	20 km	none	2										
	35	West Ring Rd.(1)	18 km	none	2	2	2	2	2	2	2				
	36	Argalant Rd.	4.5+6km	2	2	2	2	2	2	2	2				
	37	West Ring Rd.(2)	13.5 km	none	2										
	38	Ulzit/Zuunmod/Nalaikh Ring Rd	62 km	none	2										
	39	Gachuurt/Naraikh ring Rd	27 km	none	2										
Interstate	40	Asian Highway		none	4										

Notes: N/W/I: N=new, W=widening, I=improvemet, R=repair, Br.No.: 2W=2 bridge widening, 4N=4 bridge new.
F/S: Execution of Feasibility Study Project

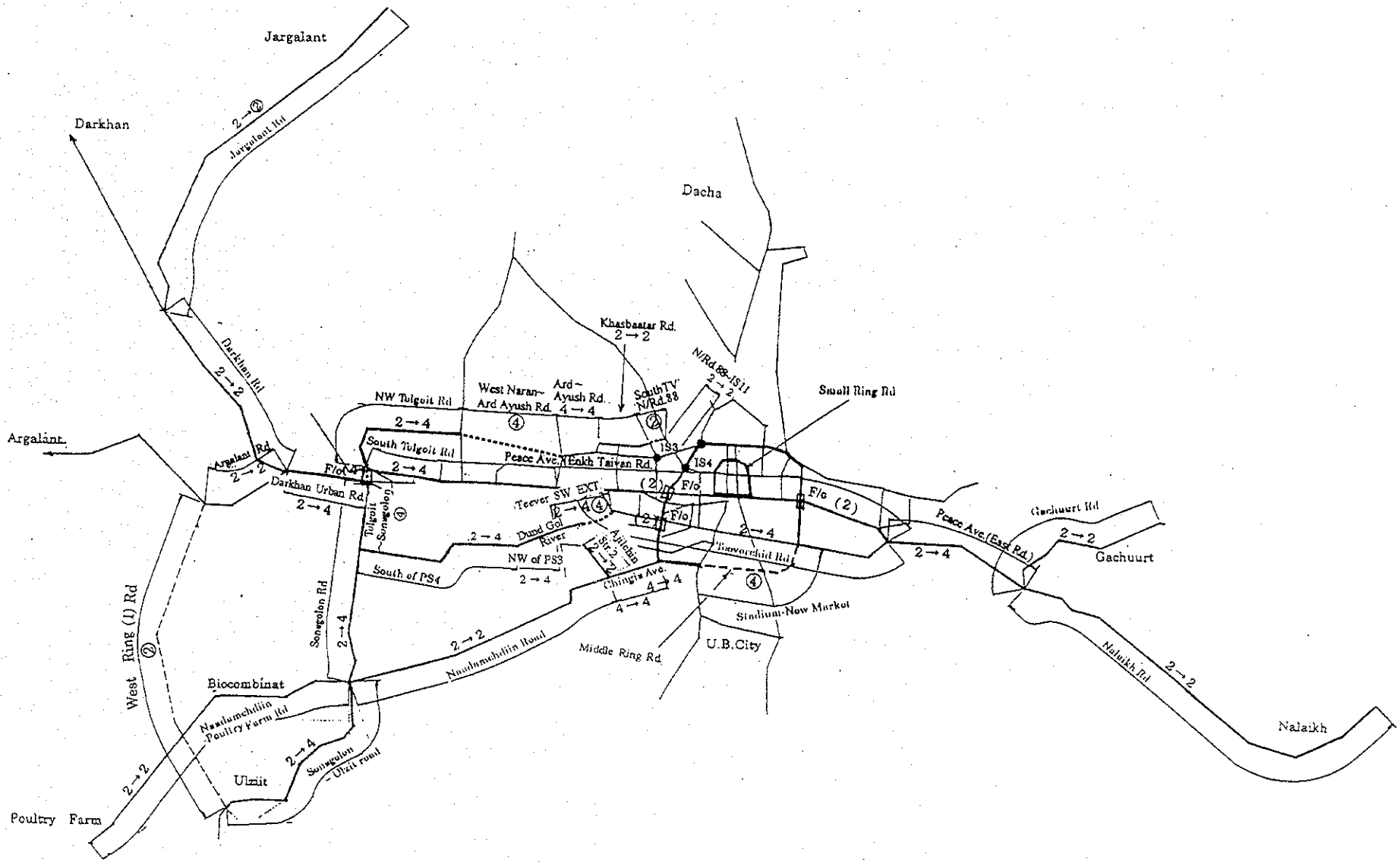


Figure 10.4.1 Required Traffic Lane for Best Alternative R7 of Future Road Network in 2020

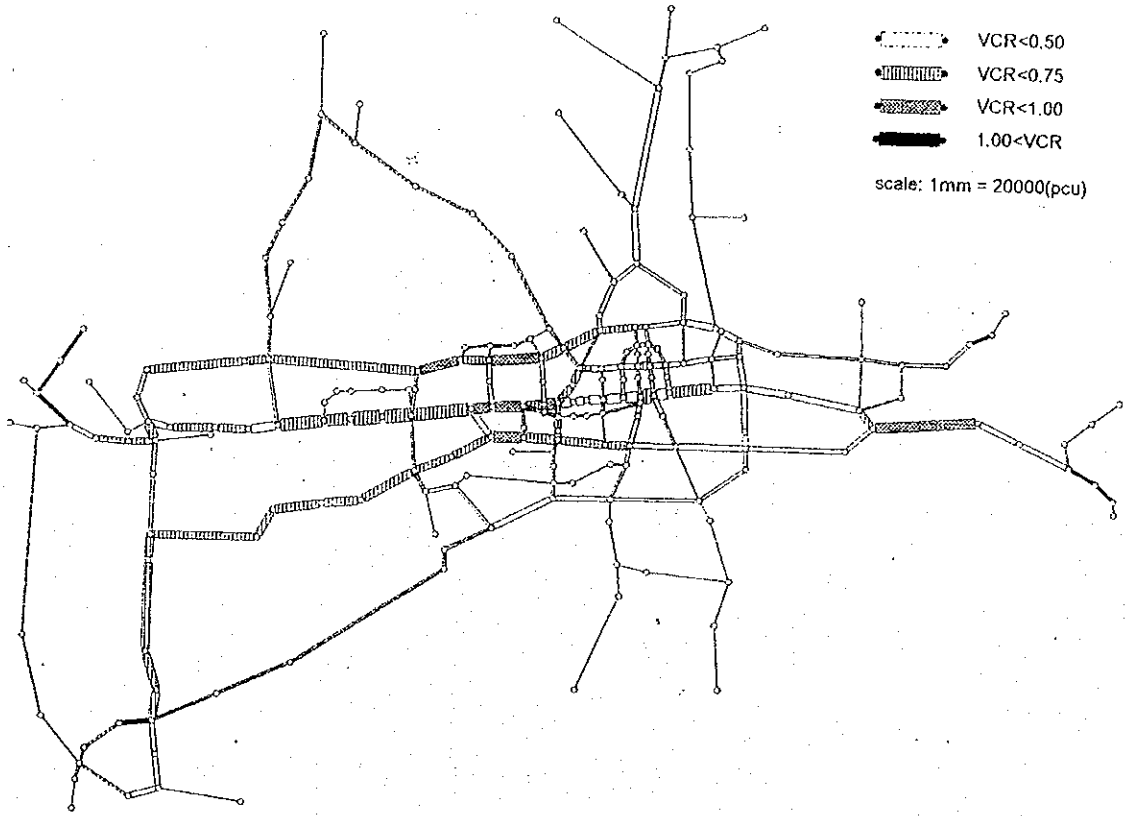


Figure 10.4.2 Traffic Flow for Year 2020 (With Project - R7)

10.5 Related Facilities to the Network

Elevated intersections are expected to be developed at the following places:

(1) Intersection between Peace avenue and New road to new Market. (so called East intersection)

(2) Intersection between Inner ring road and Railway (Tevelchid street)

(3) West end point of Peace avenue at Railway crossing.

(4) West part of (3) where three east-west transverse roads will meet.

Repairing of existing road shall be selected from the rating 1 roads shown in Figure 4.2.2. Repair of Manhole should be considered by selecting about 20 from the bus routes.

Pedestrian crossing (Under ground or over bridge) is scheduled to be studied at the following places (1) Near bus station of Tank square of Chingis Avenue (2) Place from Serbe river to New market street of Peace Avenue (3) Crossing point of Peace Avenue and the west of small ring road (Existing Bus Terminal) However it is agreed at the steering committee on Aug 31 pedestrian crossings will be deleted from the short term project studies.

Pedestrian sidewalks have been developed at the trunk roads. Improvement of the sidewalk may be effective from the points of business center and tourism at Tudarudany street in front of Lennin Museum and streets around Chotunclum temple. However they are not included in the road designing.

Development of cycling roads is requested for cycling and from the aspect of environmental matters, but their priority is low considering the low cycling population and cold winter seasons.

Drainage facilities will be proposed based on standard design, however the detailed design for the each road or sections will not be conducted in this study. The calculation of water flow of each river will be done for the design of a bridge.

Signal, traffic signs, road markings and road lighting are not in satisfactory condition. Considering the frequent electrical shut off, it is desirous to develop the facilities such as chatter bar on the road surfaces, white lines and plates showing traffic manner or regulation.

Shortage of parking lots is now a serious problems in UB. The study team has taken them into consideration except in residential districts. In residential districts, it should be solved by revising the architectural regulation, such as existing parking spaces at ground floor or underground floor of each apartment. The parking spaces at business areas and shopping streets will be studied. Public parking spaces shall be developed by the Government and private one shall be prepared by each building.