Chapter 1 Background of the Project

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Located in the center of the Central Asia, Mongolia borders with Russia on the north, China on the east, west and south. Its vast territory covers an area of 1.57 million km^2, with a population of only 254 million.

Ulaanbaatar City (hereinafter referred to "UB"), the capital city and the hub of commerce and administration of Mongolia, is located at an average altitude of 1,350 m having 780,000 population in 1999. The urbanized area forms a narrow strip of 5 km wide and 30 km long extending east and west. Nearly 31 % of Mongolian population lives in Ulaanbaatar City, accounting for 56 % of national GDP. Urban transportation mainly depends upon road and the total road length in the city is 418 km. Although a railway is passing through the center of the city, it is not used for urban transport but for long-distance transport.

Car ownership increases rapidly as the economic activities are accelerated and the population increases in the city after the transition to market-oriented economy since 1990. It marks an average growth rate of 7 % per annum. In the present situation, economic activities was hindered because of inveterate traffic congestion and frequent traffic accidents, moreover, roads were deteriorated and traffic was obstructed because of insufficient maintenance due to the shortage of budget and severe conditions against pavement structure due to repeating action of freezing and thawing. Therefore, it was urgently necessary to establish improvement and rehabilitation plan of road network in Ulaanbaatar City because of solution of such problems.

High priority projects were selected through the Master Plan Study on Improvement and Rehabilitation of Road Network in Ulaanbaatar conducted by PCI/YEC in 1998 (hereinafter referred to "the Master Plan Study"). Although the state financial resources of the Government as well as of UB city is still limited and severe, the Mongolian side recognized the importance of good maintenance of city roads and allocated 1.1 million US dollars from State Road Fund in 1999 as proposed by the Master Plan Study.

However, the Mongolian Government still can not develop or improve the high priority projects due to the shortage of required budget. And, only strengthening of existing road maintenance is insufficient for traffic demand.

In May 1999, the Government of Mongolia made a request for grant aid assistance to the Government of Japan, for the Project for Improvement of Road in Ulaanbaatar

which comprised the improvement of roads and intersections and the procurement of equipment.

Chapter 2 Contents of the Project

CHAPTER 2 CONTENTS OF THE PROJECT

2-1 Objectives of the Project

The objective of the Project is to improve road transportation networks in Ulaanbaatar City in order to facilitate economic development and enhance social services.

Namely, The Project consists of following three items. First is improvement of Teeverchid Road, be permitted passing of heavy vehicle and bypass Enkhtaivan Avenue as east-west axis arterial road. Second is improvement of three intersections (East Crossroads, West Crossroads and In front of Geser Temple), accidents are happening often and traffic volume is great in number in Ulaanbaatar City. Last is procurement of equipment for road maintenance comprising twenty five items of eleven types.

The Basic Design Study has the following objectives:

i) To identify and confirm the components of the proposed Project
ii) To coordinate with development plan at national, regional, sectional and other levels
iii) To appraise and evaluate the technical viability of the Project
iv) To appraise and evaluate the economic viability of the Project
v) To make a general layout and basic design
vi) To estimate the cost of the Project and the schedule required for implementing its construction and procurement.

2-2 Basic Concepts of the Project

2-2-1 Description of the Project

(1) Contents of the Request

The contents of the request made by the Mongolian Government envisaged the following development and improvements:

1) Road Construction

a) Teeverchid Road

- Widening 8.4 km

b) Western End of Enkhtaivan Avenue

- New Construction
  - Tolgoit - Sonsgolon Cross 0.413 km
  - South Tolgoit Road 0.346 km
- Widening 1.671 km

c) Improvement of Intersections

- In front of Geser Temple
- West Crossroads
- The Eastern Part of the 3rd District
  (Ard Ayush Rd. - Amarsanaa Rd.)

2) Bridge Construction

- East Crossroad Fly-over 1 place
  - Bridge 120 m
  - Approach 280 m

3) Supply of the following Equipment for Road Maintenance;

Table 2-2-1 List of Requested Equipment

Item	Specification	Nos
1 Asphalt Finisher with Controller	-	1
2 Double Cab Pick Up	1 ton	2
3 Asphalt Sprayer	30 lit/min.	2
4 Mini Backhoe	0.1 m^3	1
5 Hand Roller	600 kg	2
6 Plate Compactor	80 - 100 kg	2
7 Asphalt Cutter	30 cm	2
8 Hand Breaker	1.5 m^3/min.	2
9 Compressor	7 m^3/min.	2
10 Marker (Hot type)	-	1
11 Burner	-	2
12 Silo with Hot Elevator for Asphalt Plant	-	1
13 Cargo Truck	2 ton with lifting rear gate	2

(2) Items Requested by the Mongolian Side as recorded on the Minutes of Discussion Dated May 23, 2000

At the beginning of the Study, the Study Team had a series of discussions with the officials concerned and conducted field surveys in May 2000 pursuant to the objectives. The final items requested by the Mongolian side were confirmed as follows;

1) Improvement of Roads

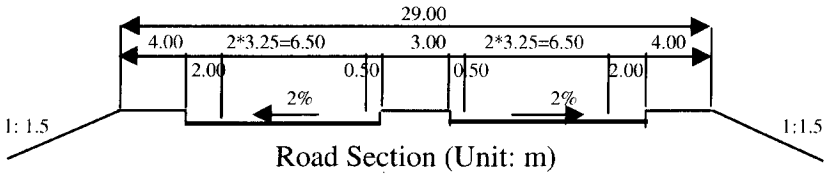
- Teeverchid Road Widening (8.4 km)
- Western end of Enkhtaivan Avenue Widening (1.7 km)
- Tolgoit - Sonsgolon cross New Road Construction (Approx. 0.45 km)
- South Tolgoit Road New Construction (Approx. 0.35 km)
- Three (3) Intersections Improvement (In front of Geser Temple, West Crossroad and East Crossroad)

2) Road Classification and Typical Cross Sections

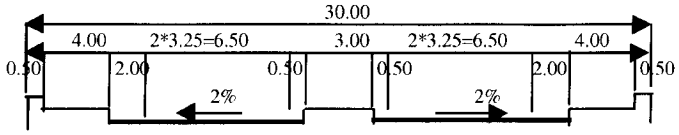
The type of requested road is arterial road and class B for all object roads. And, requested standard of cross sections are as follows.

Road	Classification
- Teeverchid Road Widening	Class B (Primary Road)
- Western end of Enkhtaivan Avenue Widening	Class B (Primary Road)
- Tolgoit - Sonsgolon cross New Road Construction	Class B (Primary Road)
- South Tolgoit Road New Construction	Class B (Primary Road)

Typical Cross Sections



Road Section (Unit: m)



Bridge Section (Unit: m)

Fig. 2-2-1 Final Requested Typical Cross Section

3) Procurement of Equipment

Requested equipment was mainly the equipment for the road construction. However, the request point was mainly the equipment for the road maintenance. Therefore, as the result of discussing with the Mongolia government, Procurement of equipment will be examined not only for road construction but also for road maintenance.

The final requested equipment is shown in the following.

Table 2-2-2 List of Final Requested Equipment

Equipment	Specification	Quantity
1. Road Maintenance Truck	6.5 ton	6
2. Universal Truck	2 ton	6
3. Backhoe Loader	100 HP	9
4. Medium Size Combi Rollers w/ One Vibratory Drum in front and Four smooth tyres at rear/Asphalt Compactor	7 ton	3
5. Asphalt Pavers	6.5 m	1
6. Asphalt Pavers	2 - 4 m	2
7. 4-wheel Drive Forward Tipping	2 ton	4
8. Semi-trailer	35 ton	1
9. Asphalt Plant	60 ton/hr	1
10. Double Cab Pick Up	2000 cc	2
11. Concrete and Asphalt Cutter	30 cm & Floor Saws	8
12. Plate Compactors (Hand)	80 – 100 kg	8
13. Vibratory Rammers	70 kg	8
14. Core Drilling Machine	15 cm dia.	2
15. Marker	Hot type	2
16. Spare Parts		lump sum

It was agreed to examine the following plans for their possibility in the course of the Basic Design Study.

1) A plan to improve East Cross Intersection by channellization.
2) A plan of grade separation structures (Flyover or Underpass) for railway crossing at Western End of Enkhtaivan Avenue.
3) A plan of widening and improvement in the whole stretch of Teeverchid Road.
4) Procurement plan of equipment not only for road construction but also for road maintenance.

2-2-2 Basic Concepts of the Project

The results of the field survey were analyzed in Japan. After consultation with JICA and concerned parties in Japan, the Study Team made the layout and design of the facilities and equipment, which was incorporated in the scope of the Project.

The scope of the Project are determined based on the following criteria:

i) national and regional development plan;
ii) sector development plan;
iii) financial and operational capability of the executing agency;
iv) urgency and necessity of each component; and
v) number of people who will benefit from the Project.

Table 2-2-3 Comparison of the Request and Japan's Grant Aid

	Mongolian Request	Japan's Grant Aid
Improvement of Roads	1. Teeverchid Road Widening (8.4 km) 2. Improvement Western End of Enkhtaivan Avenue - New Construction • Tolgoit - Sonsgolon Cross • South Tolgoit Road 0.346 km - Widening • South Tolgoit Road 1.671 km 3. Improvement of Intersections - In front of Geser Temple - West Crossroads - The Eastern Part of the 3rd District 4. Bridge Construction - East Crossroad VFly-over 400 m	1. Improvement of Teeverchid Road (8.4 km) - Improvement of 2-Lanes 2.8 km (East and West End) - Widening of 4-Lanes 5.6 km - New Construction of Bridge 51.12 m (Dood Selbe Bridge 4-Lanes) 2. Improvement of Intersections - In front of Geser Temple - West Crossroads - East Crossroads
Procurement of Equipment	Asphalt finisher, Mini Backhoe, Hand Roller and so on. Total 17 Types.	Asphalt plant, Road maintenance truck, Backhoe Loader and so on. Total 11 Types.

(1) Teeverchid Road Widening

Since east-westward heavy traffic is controlled to bypass Enkhtaivan Avenue toward Teeverchid Road and the existing pavement is so deteriorated that traffic safety is hardly secured, the improvement of existing road should be given high priority in the scope of the Project. The improvement of existing road is classified into two types depending upon road condition survey, namely overlay and reconstruction.

The scheme of widening from undivided two lanes to divided four lanes was carefully examined considering traffic volume, traffic movement and land availability along the road. It is concluded that the widening should be done in between intersection at Central Railway Station and the eastern end of New Central Market. Both eastern and western ends of Teeverchid Road should be kept as undivided two lanes road because present traffic is deemed modest and detouring traffic is prevailing.

The section for improvement of pavement should be divided into reconstruction, which rebuilt from the subbase course or overlay, which utilizes present pavement structure maximally from road surface condition survey result.

The section from the railway central station to Narayandar park east intersection includes the part of concrete pavement. And, this section is adopted overlay, because the maintenance condition is better than other sections. The other sections are adopted reconstruction.

The Dood Selbe bridge shall be demolished and replaced by a new bridge with 4 lanes from the view points of total defects, lack of capacity to handle new loading system, projected increase in heavy vehicle use and insufficient river section.

Furthermore, the central market bridge (Khoroolol) shall also be demolished and replaced by raised embankment with 4 lanes because no functional river runs around the large area.

(2) Three (3) Intersections Improvement (In front of Geser Temple, West Crossroad and East Crossroad)

These three intersections have enough high volume of traffic in Ulaanbaatar City and simultaneously have high rates of traffic accidents. It is obvious that traffic capacity will increase and traffic safety will be secured if they are channellized with traffic signals and street lighting. At-grade intersection will be able to accommodate future traffic for several years if channellized. Accordingly, three intersections are deemed appropriate for the scope of the Project.

The improvement of intersection will able to accommodate future traffic with annual growth rate of 5 % in next five years as shown in Table 2-3-4. As for East Crossroads intersection, the improved intersection will also able to cope with future traffic in next 10 years, even without grade separation structure because the degree of saturation does not exceed 0.9.

(3) Western End of Enkhtaivan Avenue Widening/Tolgoit - Sonsgolon Cross New Road Construction/South Tolgoit New Road Construction

Tolgoit - Sonsgolon Cross New Road together with South Tolgoit New Road and Western End of Enkhtaivan Avenue Widening will form future arterial road network in the western part of Ulaanbaatar City, and it will cope with incremental traffic in future, even though 9,500 veh./day are observed at present on the existing railway crossing of Western End of Enkhtaivan Avenue. However, Tolgoit - Sonsgolon Cross New Road is to cross six rail lines at the planned at-grade railway crossing, and it may bring about certain technical difficulties.

The scheme of grade separation structures is therefore examined to pursue feasibility of technical soundness as well as economical justification. The scheme of flyover has technical superiority but low EIRR of 4.8 % for 20 years analysis, while the scheme of underpass is inferior to all aspects with EIRR of 1.4 %, compared with EIRR of 14.7 % in case of at-grade railway crossing. Accordingly, Tolgoit - Sonsgolon Cross New Road is set aside for the scope of the Project.

Since South Tolgoit New Road and Western End of Enkhtaivan Avenue Widening are planned to connect with Tolgoit - Sonsgolon Cross New Road, they are hardly justified to include in the scope of the Project without Tolgoit - Sonsgolon Cross New Road.

Therefore, Western End of Enkhtayvan Avenue Widening was out of Japan's Grant Aid.

(4) Procurement of Equipment

Procurement plan of equipment is carefully examined and selected based on the following aspects;

i) Equipment shall be utilized to meet actual maintenance practices after it is operated to transfer technology to the Mongolian side during the construction stages of the Project.

ii) Equipment shall supplement and strengthen present executing units within their capability and practicability.

iii) Equipment shall be operated in such a way that not to be a financial burden to the executing body.

iv) Equipment shall be effective in operation to meet the appropriate scope of the Project.

The following equipment is deemed appropriate for the Project, considering maintenance requirements, financial constraints and operation capability of the executing agency.

Table 2-2-4 Equipment Contents of Mongolian Request and Japan's Grant Aid

No.	Equipment	Request		Plan		Reason
		Spec.	Quantity	Spec.	Quantity	
1	Asphalt plant	60 ton/hr	1	30 ton/hr	1	Calculated by required volumes
2	Asphalt testing equipment	-	1 set	-	1 set	No change
3	Asphalt finisher	6.5m	1	-	-	In consideration of work scale
4	Asphalt finisher	2.5 - 4 m	2	2.5 - 4 m	1	Calculated by working volume and existing quantity
5	Vibration roller (combined)	7 ton	3	7 ton	2	Calculated by working volume and existing quantity
6	Backhoe loader	100 Hp	9	100 Hp	6	Calculated by working volume
7	Dump truck	4 ton	4	-	-	In consideration of existing equipment
8	Line marker	10 - 20 cm	2	15 cm	1	Calculated by working volume
9	Core drilling machine	15 cm	2	15 cm	1	Calculated by working volume
10	Trailer	25 ton	1	-	-	In consideration of existing equipment
11	Mobile workshop	13 ton	1	-	-	No need for work in the city
12	Double cab pickup	120 Hp	2	-	-	In consideration of existing equipment
13	Asphalt cutter	35 cm	8	30 cm	4	Calculated by working volume and existing quantity 30 cm blade is enough for work
14	Vibrating plate compactor	80 kg	8	80 kg	4	Calculated by working volume
15	Vibratory rammer	70 kg	8	70 kg	4	Calculated by working volume
16	Road maintenance truck	9 ton	6	9 ton	4	Calculated by working volume
17	Universal truck	9 ton	6	9 ton	-	Duplicate function with other equipment Cleaning, snow removal etc. are not considered as object of the project

Note: Grayish equipment were excluded from the project as result of the study.

Excluded reasons are as follows.

a. Asphalt Finisher

The asphalt finisher requested is a large sized one, which can possibly pave roads of 6.5 m width. However, many of Ulaanbaatar city's roads can be paved with a finisher of 4m width. Therefore, a middle sized machine with 4 m width is chosen in consideration of the work scale.

b. Dump Truck

Implementing agency possesses the necessary number of units.

c. Trailer

Implementing agency possesses the necessary number of units.

d. Mobile Workshop

Job site of this project is inside of Ulaanbaatar city and it is close to the central workshop. Therefore, a mobile workshop is not necessary.

e. Double Cab Pick-up

The function of this vehicle can be carried out by jeeps and trucks, which implementing agency already possesses.

f. Universal Truck

Equipment for asphalt spraying work, water spraying work etc. would duplicate the function of other machines which the implementing agency has. Moreover, snow removal work and road cleaning work are not the object of the project.

2-3 Basic Design

2-3-1 Existing Conditions of the Project Area

(1) Meteorology and Hydrology

The climate of Ulaanbaatar city and the surrounding area is characterized as continental climate with little rain , extremely cold winter from October to April and hot summer from May to September. The average monthly temperature in January is -21.7 °C (maximum lowest is -39.6 °C) and the average temperature in July of summer season is 17.1 °C (maximum highest is 38 °C) while the

difference between maximum and minimum temperature reaches up to 39 °C. The annual average precipitation is slight 267 mm. The maximum monthly average rainfall is recorded as 74 mm in July. The average annual humidity is 63 % and that in the driest month, May reaches up to 47 %. (see Fig.2-3-1) The annual average wind velocity is recorded as 2.5 m/s, however the maximum wind velocity was recorded at 30 m/s.

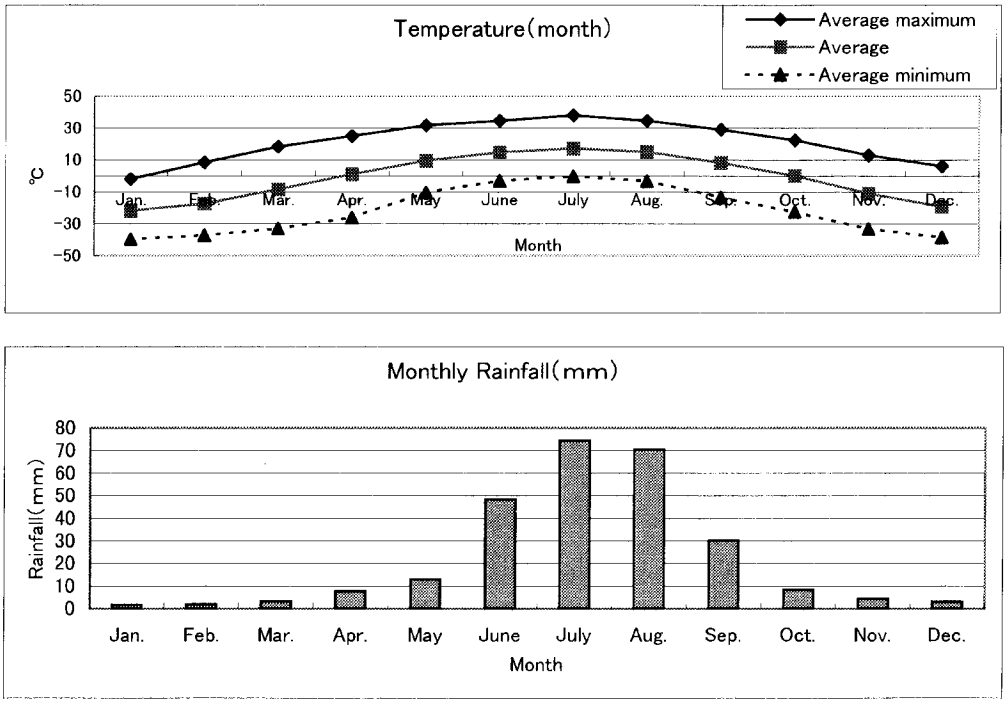


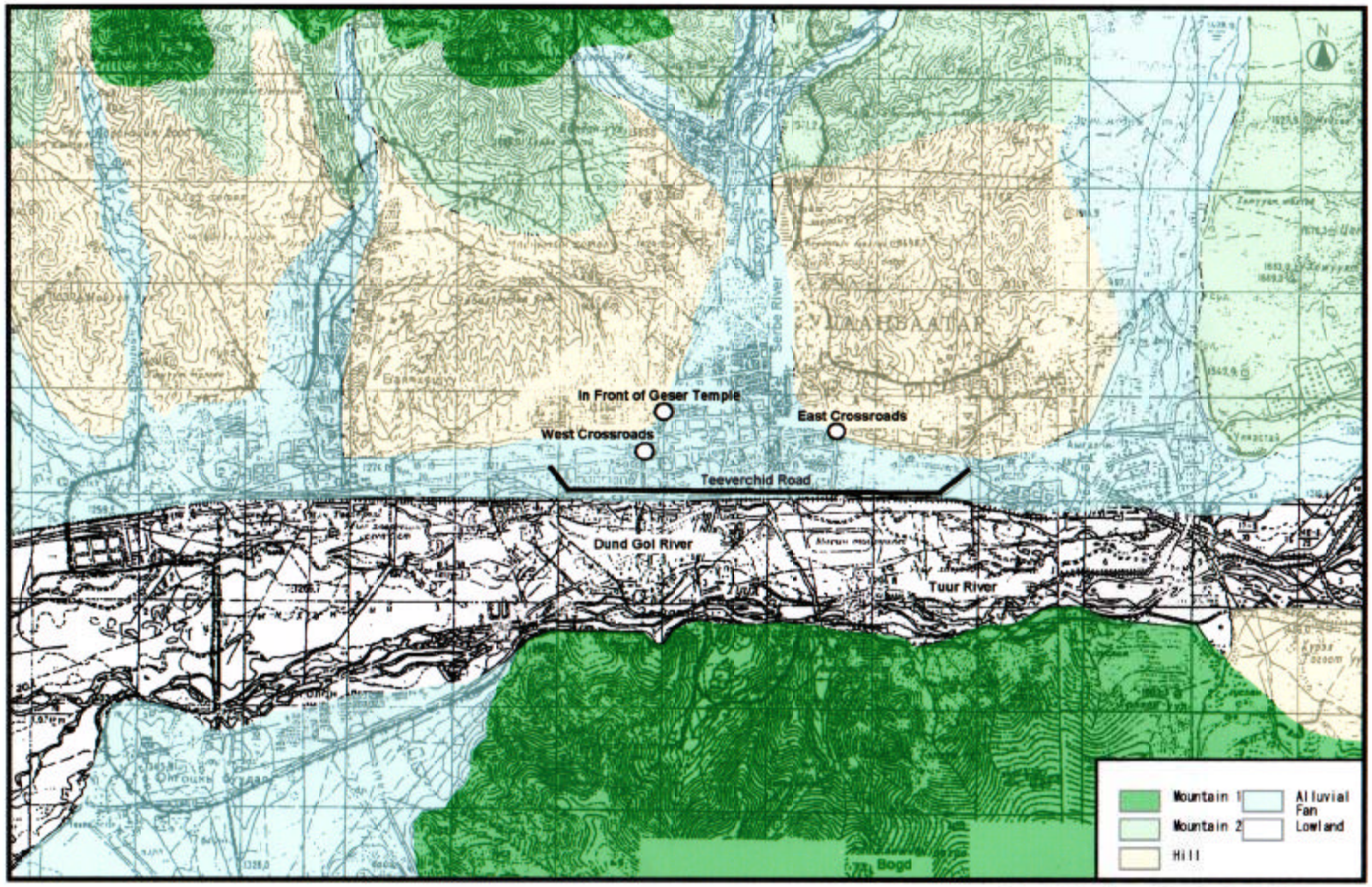
Fig.2-3-1 Temperature and Rainfall

(2) Topography, Geology, Ground Condition and Earthquake

1) Topographic

Ulaanbaatar City has a log and narrow area extending 5 km wide to the north-southward and 30 km long to the east-westward. There is an urban district at an average altitude of 1,350 m, and Tuur River is flowing from the east to west along the foots of Mt. Bogd where exists a conservation region in the south side. The bases of mountain and hill are located in the north side in the city. Two rivers, the Selbe River and the Dund Gol River flow from this south side slope and there is no water flow for 9.5 month in a year.

However, a flash flood sometimes occurs if there is heavy rainfall in treeless mountain and hill. The topographic map of Ulaanbaatar is shown in Fig. 2-3-2.



Source:Engineering geological mapping by G.Lhanaasuren 1964

Fig. 2-3-2 Topographic Map in Ulaanbaatar

Topography of the city is divided into Mountain 1, Mountain 2, Hilly area, Alluvial fan and Lowland as shown in Appendix 4. The mountains are located in the south side and the north side of the city, and the altitude of Mountain 1 ranges from 1,500 m to 2,200 m, that of Mountain 2 is 1,200 m to 1,500 m, with an inclination of 35°, 10° to 35° respectively. Hilly area are located near the peripheral area of these Mountains. It has a loose tilt in the upcountry and shifted to the alluvial fan in lowlands. The alluvial fan forms into Selbe River and the Dunt Gol River basin, from bases of mountain and around the hill area, and there is an urban district in this region. It becomes flood plain of the Tuur River basin in the lowland division.

The surveyed areas of Enkhtaivan Avenue, Western End of Enkhtaivan Avenue and Teeverchid Road are located in the boundary where the alluvial fan shifts to the lowland division and that of intersections is located in the alluvial fan.

2) Geological

Sand stone and shale in Paleozoic Era Carboniferous period and Mesozoic Cretaceous period are distributed in the mountain division. And especially, the granite in Mesozoic Jurassic period is distributed in the south side mountain division. In the surface segment, cracks mainly develop, and the weathering is intense. The alluvial fan has been composed of terrace sediment of the Quaternary period diluvium layer and river sediment of the alluvium layer. The geological map of Ulaanbaatar City and its surroundings is shown in Fig. 2-3-3.

3) Ground Condition

The survey area exists on Teeverchid Road crossing in the Selbe River mouth that flows from the north to south in the city. Soil is composed of mainly yellowish sandy gravel that is terrace sediment.

The soil investigation was carried out at the planned bridge construction sites across the Selbe River. In total, three borings tests were conducted. Standard Penetration Test Value (N) from GL-1 m to -4 m varies from 23 to more than 50 with irregularity, and below GL-5 m the soil is very dense, as N values of more than 50 are observed.

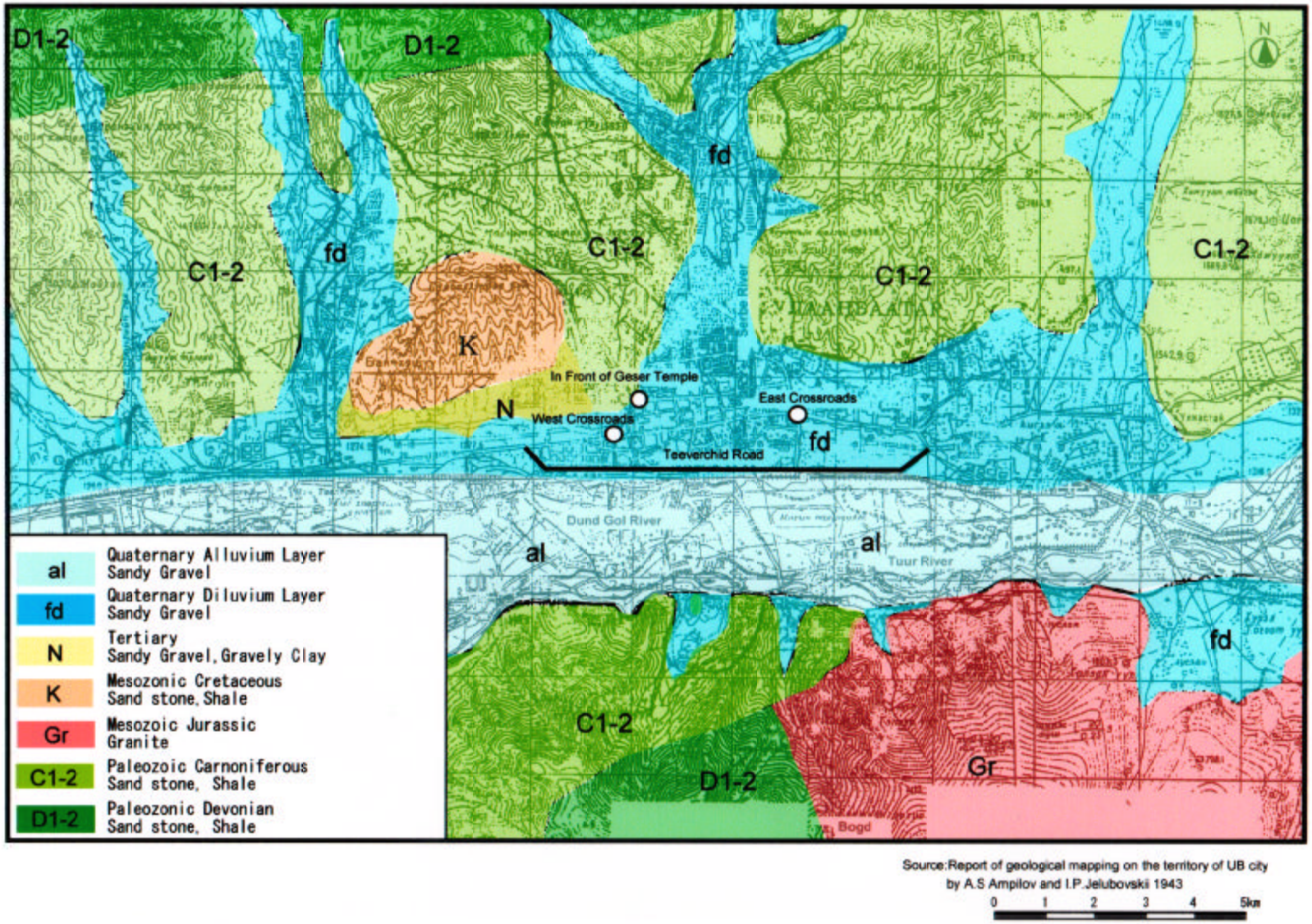


Fig. 2-3-3 Geological Map in Ulaanbaatar