It is estimated that Selbe River sediment is formed of alluvium layer some where in between GL-3 m to 5 m, and the boundary between alluvium layer and diluvium is not clear.

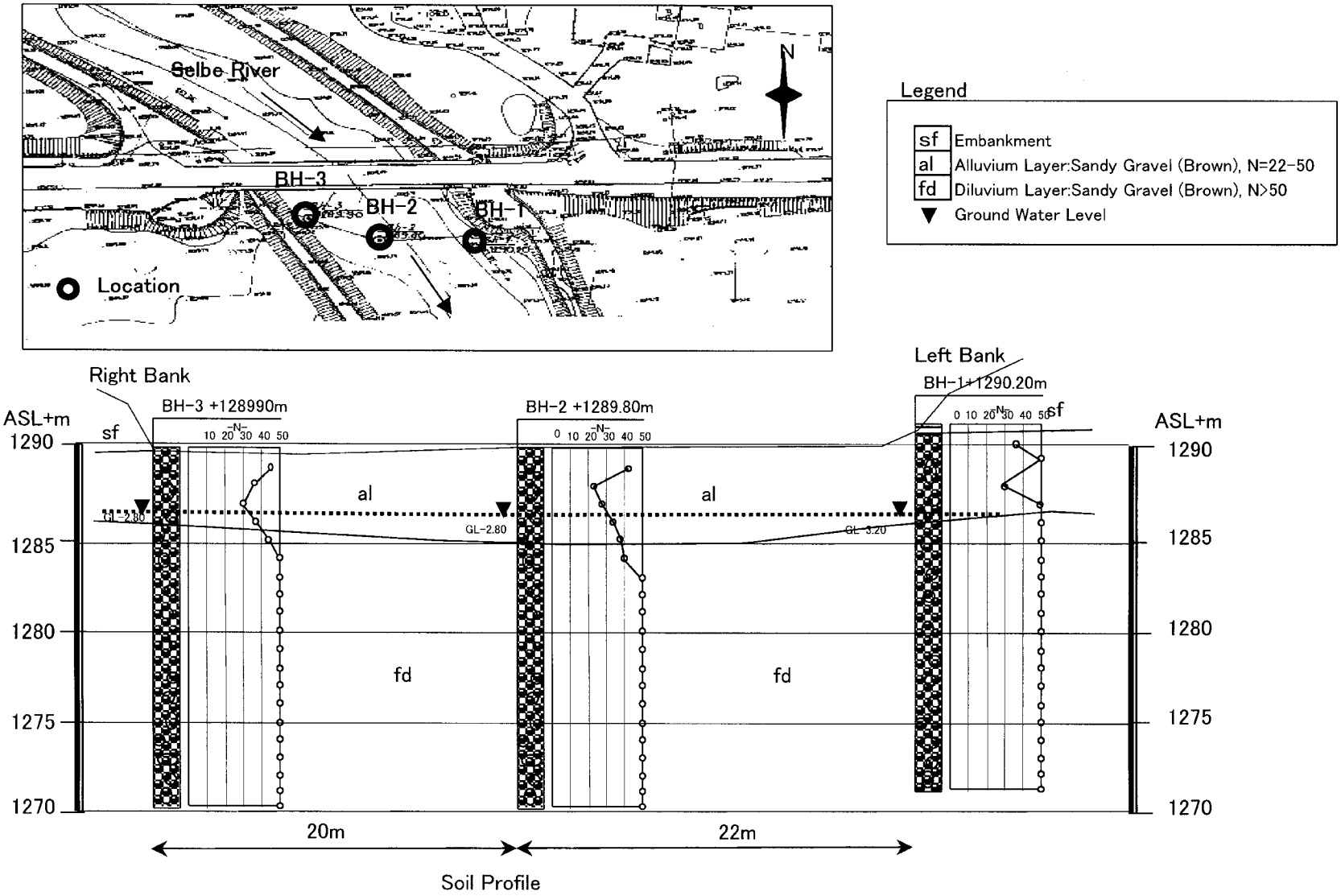
The size of gravel ranges from 3 to 7 cm with texture, and gravel consists of sandstone and shale. Even though there are partial thin sand layers and places that contain cohesive soil, there is no continuity.

The ground water level was surveyed up to GL-2.8 m. The ground water level depends on water level of the river and the rainfall pattern, and it varied from GL-0.5 m to -2.8 m during this investigation period. Although the ground water level of GL-5 m or lower is reported by the obtained data, it is necessary to examine carefully the seasonal change in the detailed design, as it has an effect on excavation planning. It has to be noted that this investigation was conducted under the condition that there was no water flow in the river. The Soil Profile is shown in Fig. 2-3-4, and Boring Log are shown in Appendix 6-3.

The CBR value of around 2 has been obtained from CB-1, 6 and 9, and soil is determined to be cohesive soil mixed with sand or gravel. Except these three sites, other soils are gravel in nature and it is classified as good soil. In this study, Design CBR of 12 on the sub-grade is deemed applicable.

4) Earthquake

In Mongolia, earthquakes were observed in the northwest but very few were recorded in Ulaanbaatar City and its surroundings (Fig. 2-3-5 for reference). In Mongolia, the seismic intensity zone is divided into 12 classes and no earthquake-resistant design for the structure is considered under Class 6. Ulaanbaatar City is designated as Class 6 to 8, and the Project area is located in Class 8 (Fig. 2-3-6 for reference). However, in Mongolia, a design procedure on seismic factor (kh) is not determined yet and the earthquake-resistant design has not been considered for the Ulaanbaatar City. Under such circumstances, the earthquake lateral seismic factor of kh = 0.1 is adopted as a safe factor as a result of discussion with concerned agencies/institutes in Ulaanbaatar. On the liquefaction of the ground, survey area is of dense Sandy Gravel layer, and the possibility of the liquefaction is little.



Fig, 2-3-4 Soil Profile

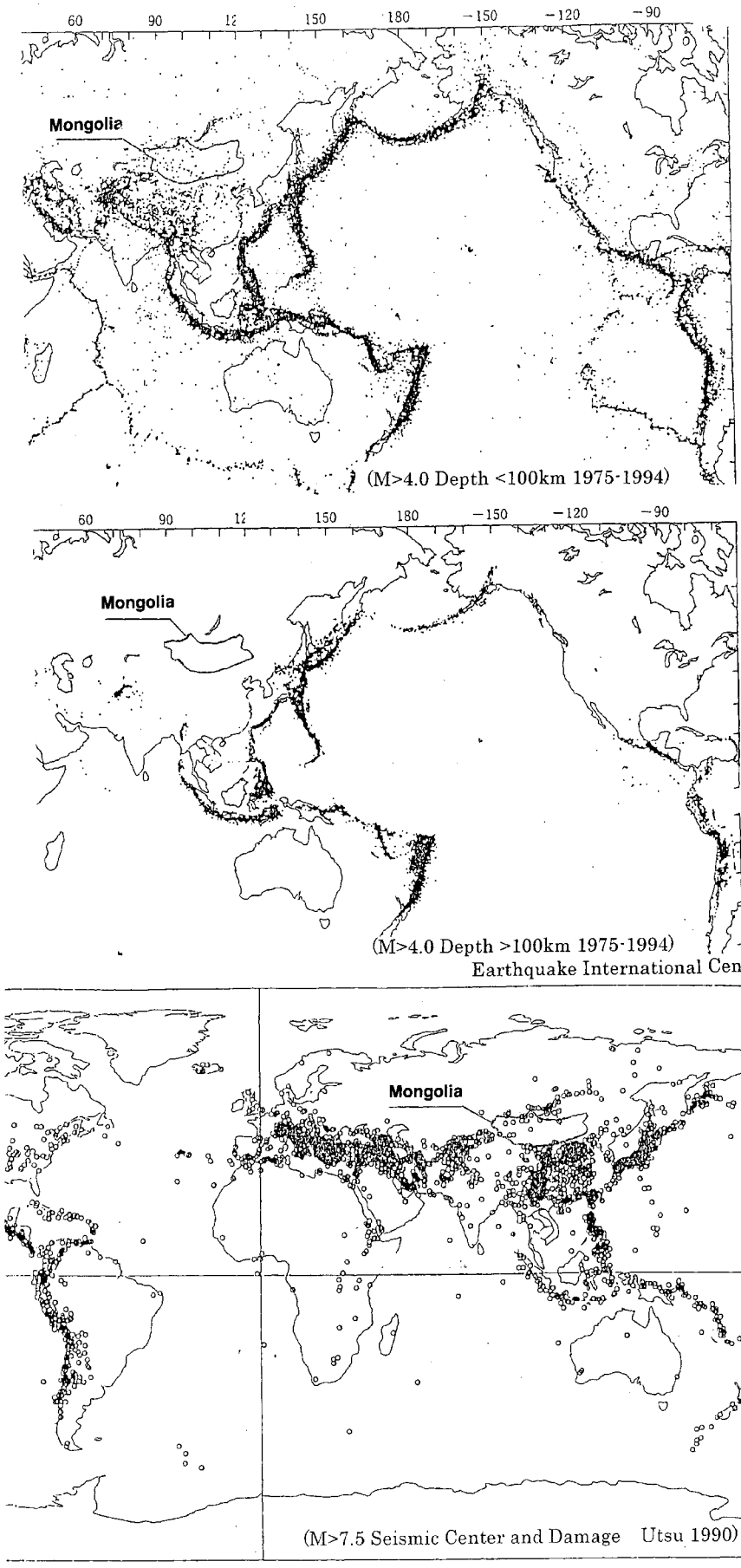
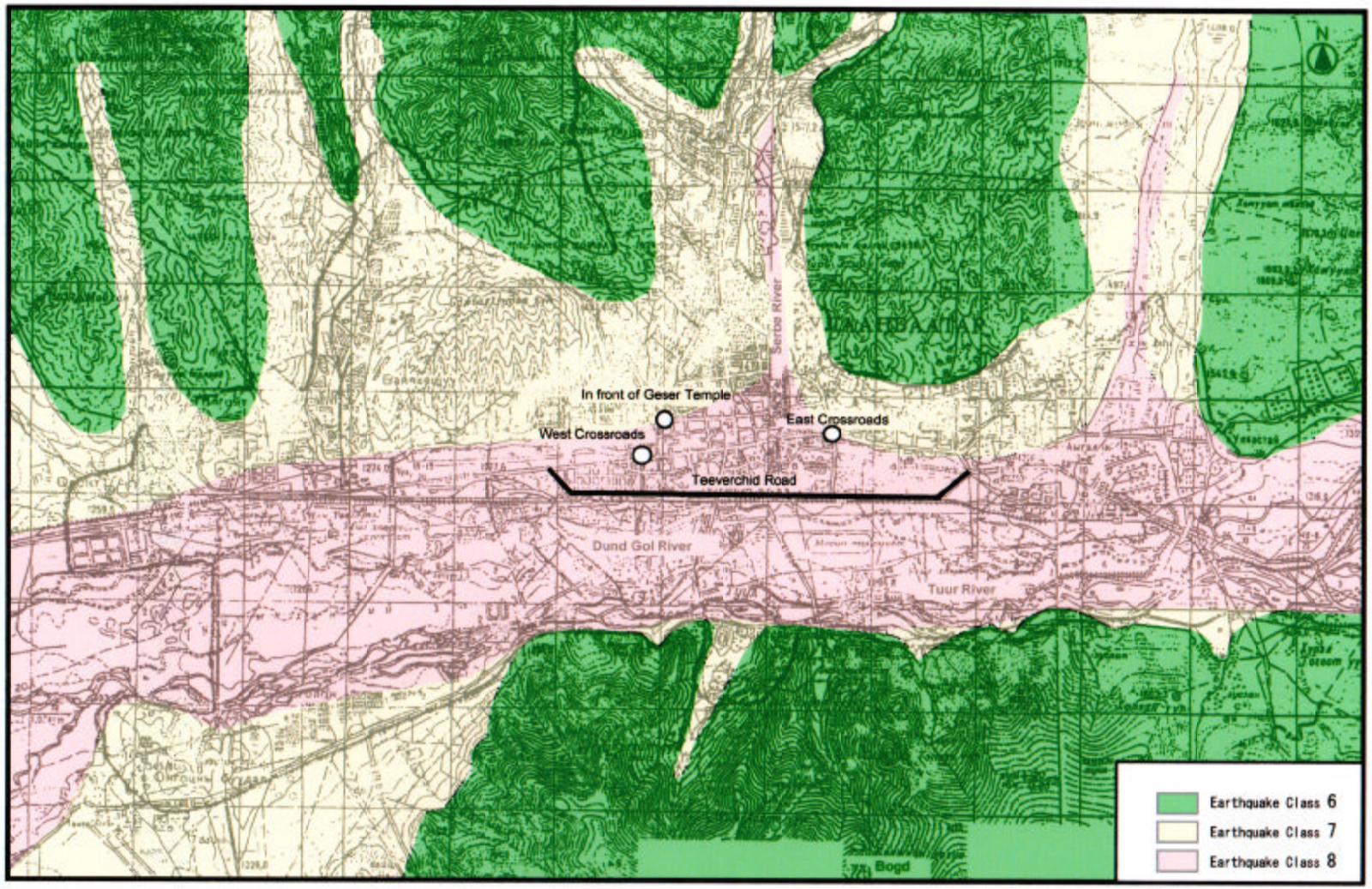


Fig. 2-3-5 Earthquake Distribution Map



Source:Earthquake division of the territory of the UB city.Irkutsk-Ulaanbaatar 1980

Fig. 2-3-6 Sectional Map of Earthquake in Ulaanbaatar

(3) Road Traffic

1) Present Situation of the Project Area

The project area is located in Ulaanbaatar City having 780,000 population that accounts for 31 % of national population. As stated earlier, the components of the Project comprise the improvement of Teeverchid Road and three intersections of East Crossroads, West Crossroads and In front of Geser Temple.

8.4 km long Teeverchid Road is located in the built-up area and runs parallel to Enkhtaivan Avenue and railway, which is only one east-westward route for large trucks to pass through. This road is designated as a part of Asian Highway No. 3 in Ulaanbaatar City, and it is also planned to be an integral part of the Southern Route of future road network formulated by JICA Master Plan Study in 1998.
Major three intersections are located on the planned middle ring road, and both intersections of East Crossroads and West Crossroads are also located on Enkhtaivan Avenue.

2) Traffic Volume

Traffic count survey was conducted on Teeverchid Road at seven (7) locations for 16 hours. The survey locations are shown in Fig. 2-3-7. Daily traffic volume of each survey point on Teeverchid Road is shown in Fig. 2-3-8 and that of three intersections is given in Fig. 2-3-9. Based on the survey results at West Crossroads and East Crossroads, conversion factors of 1.214 and 1.217 are used to convert 16 hours traffic into daily (24 hr) traffic for western and eastern sections of Teeverchid Road respectively.

Traffic volume between the western end of Teeverchid Road and the Central Railway Station is 9,700 veh./day, and it is within the traffic capacity of undivided two lanes road (10,000 veh./day).

Traffic volume between the Central Railway Station and New Central Market exceeds the traffic capacity of undivided two lanes road, and accordingly traffic congestion takes place repeatedly.

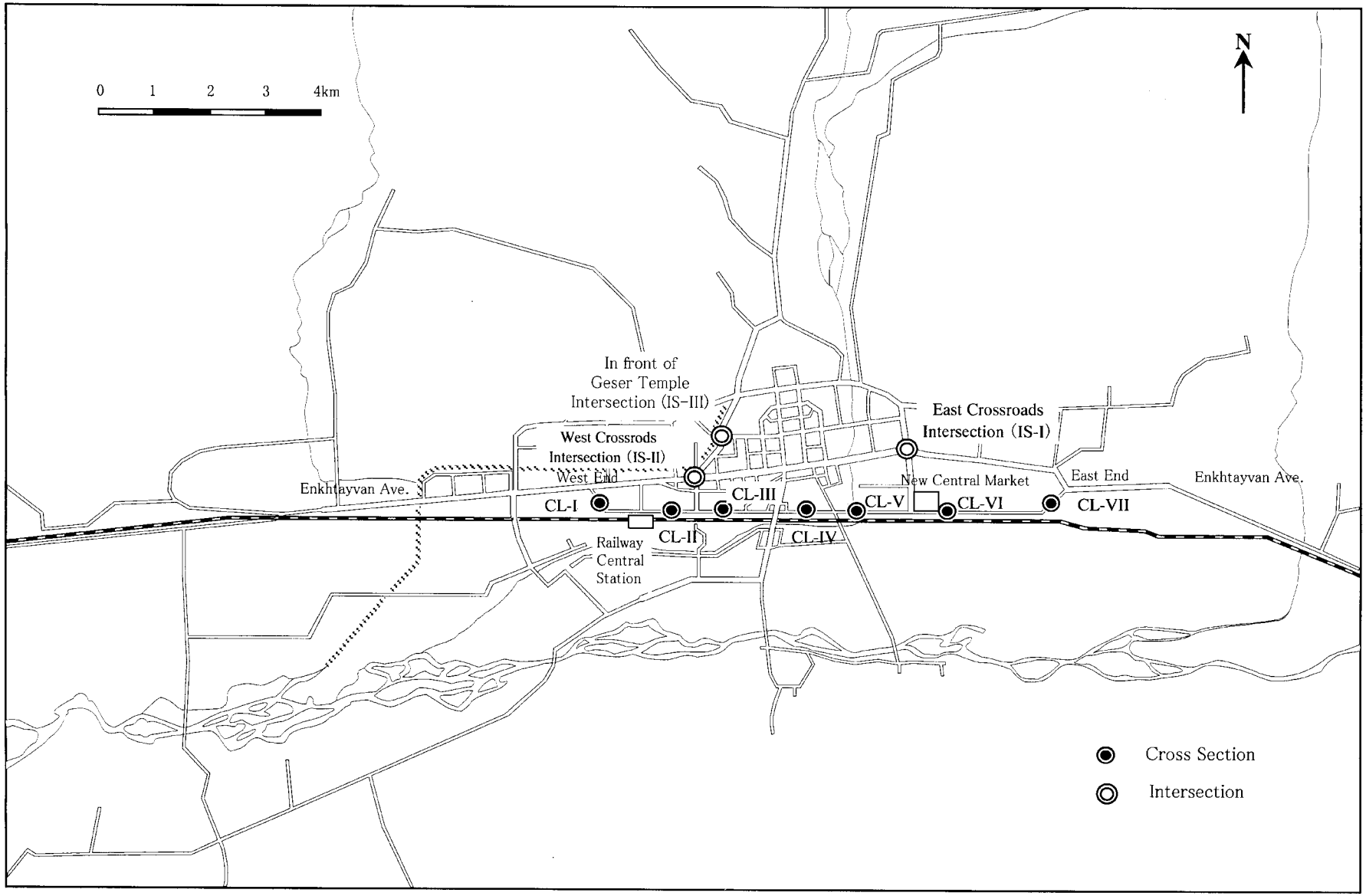


Fig. 2-3-7 Locations of the Traffic Volume Count Survey

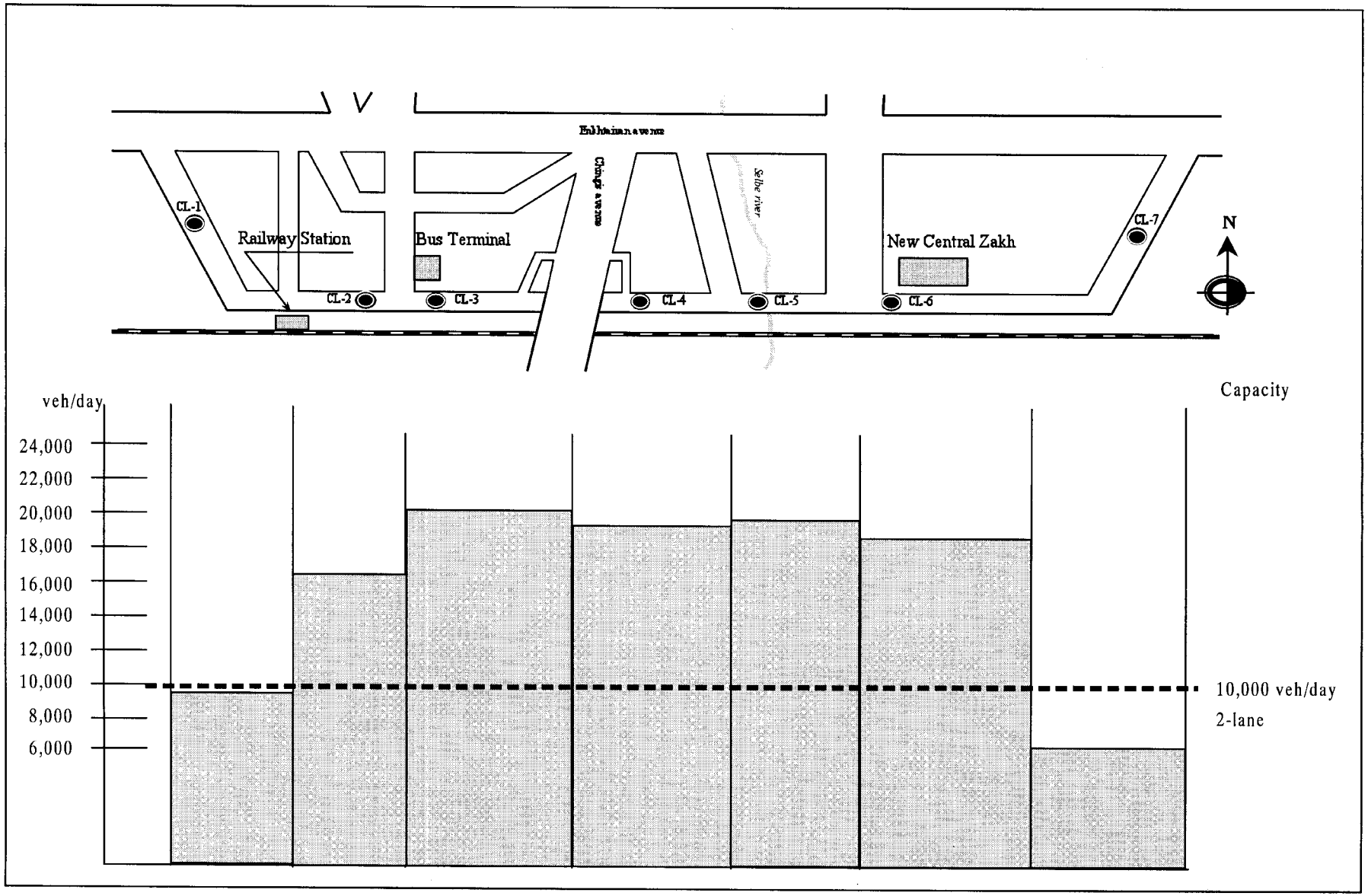
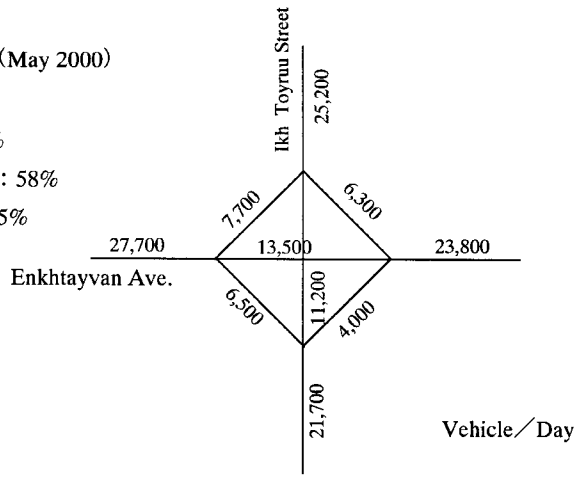


Fig. 2-3-8 2-Lane Traffic Capacity and Existing Traffic Volume on Teeverchid Road

Ease Crossroad

Exsiting Traffic Volume（May 2000）

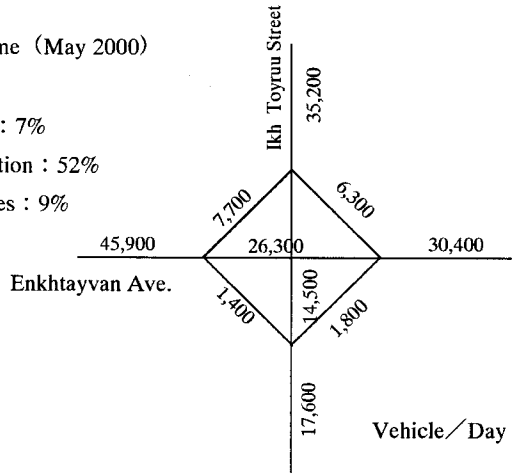
Peak Rates of Flow：7%
Directional Distribution：58%
Heavy Vehicles Rates：5%



West Crossroad

Exsiting Traffic Volume（May 2000）

Peak Rates of Flow：7%
Directional Distribution：52%
Heavy Vehicles Rates：9%



In front of Geser Temple

Exsiting Traffic Volume（May 2000）

Peak Rates of Flow：8%
Directional Distribution：60%
Heavy Vehicles Rates：8%

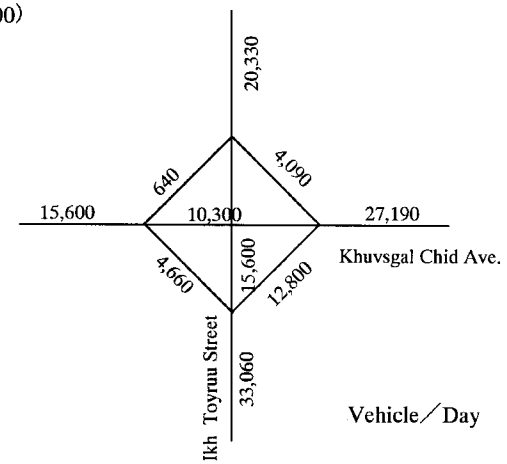


Fig. 2-3-9 Existing Traffic Volume at Each Intersection

Traffic volume between New Central Market and the eastern end of Teeverchid Road is 6,100 veh./day, which is within the traffic capacity of undivided two lanes road.

Three intersections have large number of traffic, which are between 45,000 and 20,000 veh/day at cross section.

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.

Table 2-3-1 Degree of Saturation

	East Crossroads	West Crossroads	In front of Geser Temple
5 years	0.662	0.767	0.821
10 years	0.845	-	-

(4) Road and Intersection

1) General

Road length under different classifications in Ulaanbaatar City is shown in Table 2-3-2.

Table 2-3-2 Road Length in Ulaanbaatar City

Unit: km

Classification	Ulaanbaatar City	Mongolia (Reference)	Remark
National Highway	76.5	11,063	
Prefectures Highway	78.0	38,187	Regional Highway is classified in country
City Road	168.8		
Ward Road	94.9		
Service Road (336,362m^2)	(67.3)		
Unpaved Road	(35.5)		
Total	418.2	49,250	Excluding Parenthesis

The rate of paved road is less than 2.6 % in Mongolia. But, Roads in Urbanized Ulaanbaatar (UUB) area, are paved with cement concrete or asphalt concrete. Its were constructed under State Socialist Economic

The natural environment is harsh, as the temperature varies from -40°C in winter to 40°C in summer, making an absolute difference of about 80°C. Therefore, pavement is always subject to repeated constriction and expansion, and consequently affects its structural stability.

On the other hand, road maintenance have not been sufficiently made because of resource constraints in budget and equipment.

The number of vehicles has increased at about 70 % after Mongolia started implementing its political and economical reform in 1990. The trend is reflected in Ulaanbaatar City, also, as the number of vehicles has increased by 10 % from 1997. Under this situation, the conditions of pavement becomes worse day by day.

2) Road Surface Condition

Road Surface Conditions along Teeverchid Road were surveyed. For this, Teeverchid Road was divided into seven parts as shown in Fig. 2-3-10. The result of this survey are shown in Table 2-3-3. And, the result of JICA Master Plan Study (1998) are shown in Table 2-3-4 for comparison.

A comparison and quantitative analysis between these two studies reveal that the road surface of Teeverchid Road has become worse during these years.

Pavement structure of Teeverchid Road is unsuitable for heavy vehicle due to low cost road pavement. Therefore, cracks and gaps spread out over the road. Moreover, it is frequently observed that damage of pavement reaches to base course due to lack of maintenance.

However, Sections C, D and E including concrete pavement are relatively better than the others as they are maintained very well. And, fast deterioration isn't observed as a comparison between these two studies.

The reconstruction is a necessary level generally under evaluation rank of 2.5. Though the evaluation rank is an index. And, as a synthetic judgment, the reconstruction of whole section is not to the necessity.

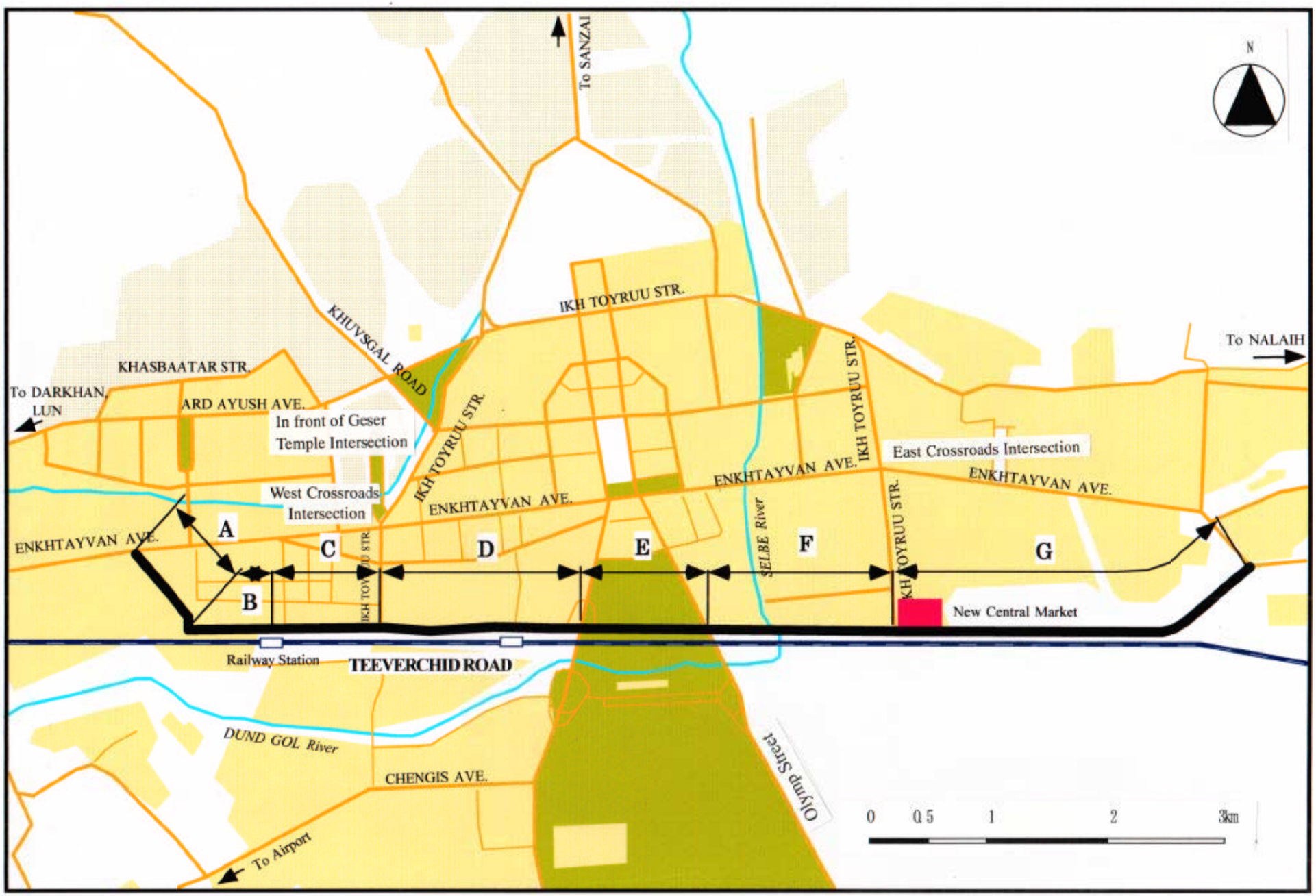


Fig. 2-3-10 Intersection for Road Conditions Survey

Evaluation rank of other sections is under 2.2. The deterioration of pavement is intense, and the reconstruction seems to be the necessity, since the smooth traffic flow is prevented. Especially, on Section A, the rainfall is easy to do the flooding, and it becomes that the surface layer comes off and that the subbase course begins to peel it.

Three intersections will basically be improved by overlay because of the observations that they are maintained very well.

The detailed data are shown as Appendix 6-4.

Table 2-3-3 Results of Road Surface Condition Survey (2000)

No	Item	A	B	C	D	E	F	G	Average
11	Length	0.63	0.50	0.86	1.54	0.81	1.29	2.76	8.40
21	Flatress/Roughness	1	2	2	2	2	2	2	2
22	Cracks	1	1	2	2	2	1	1	1
23	Ratting	3	2	3	3	3	3	2	3
25	Gaps	3	3	3	3	3	3	3	3
27	Damage at Basecourse	2	2	3	3	3	3	3	3
29	Visual Degree	2	2	2	2	2	2	1	2
Evaluation Rank		1.8	2.0	2.4	2.4	2.4	2.2	1.9	2.1

Table 2-3-4 Results of Road Surface Condition Survey (1998)

No	Item	A	B	C	D	E	F	G	Average
11	Length	0.63	0.50	0.86	1.54	0.81	1.29	2.76	8.40
21	Flatress/Roughness	2	2	2	2	3	3	4	3
22	Cracks	3	3	3	3	3	3	3	3
23	Ratting	3	3	3	3	3	3	3	3
25	Gaps	3	3	3	3	3	3	3	3
27	Damage at Basecourse	2	2	2	2	3	3	3	2
29	Visual Degree	3	3	3	3	3	3	3	3
Evaluation Rank		2.5	2.5	2.5	2.5	3.0	3.0	3.4	2.9

(Source: JICA Master Plan Study 1998)

Table 2-3-5 Criteria for Road Surface Condition Survey

No.	Item	1	2	3	4
21	Flatress/Roughness	Bad	Poor	Rough	Smooth
22	Cracks	50% or more	30% or more	10% or more	None
23	Ratting	50mm or more	30mm or more	10mm or more	None
25	Gaps	30mm or more	20mm or more	10mm or more	None
27	Damage at Basecourse	Many	1 point/10m^2	Few	None
29	Visual Degree	Dangerous	Bad	Poor	None

3) Intersections

- East Crossroad

  East Crossroad is located in between Ikh Truu Road and Enkhtayvan Avenue. At the intersection, the center line of Ikh Truu Road is in discordance. And, Guide Signs are not enough to regulate traffic direction.

  The number of accidents occurred at this section is 28 in 1999, same as one in 1998.

- West Crossroad

  West Crossroad is located in between Ikh Truu Road and Enkhtayvan Avenue. In the intersection, also Guide Signs are not enough to regulate traffic.

  The number of accidents is 93 in 1999, while more than one is reported to be occurred in 1998.

- In front of Geser Temple

  The intersection in front of Geser Temple is located on Ikh Truu Road. The curves of center line turn over at the intersection. Kuvusugal Road is connected to the intersection by an acute angle.

  Total number of accidents reported in 1999 are 86 in 1999, to be more than one in 1998.