

No.

**BASIC DESIGN STUDY REPORT
ON
THE PROJECT FOR IMPROVEMENT
OF WATER SUPPLY FACILITIES
IN
ULAANBAATAR
IN
MONGOLIA**

December 2003

**JAPAN INTERNATIONAL COOPERATION AGENCY
NJS CONSULTANTS CO., LTD**

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PREFACE

In response to a request from the Government of Mongolia, the Government of Japan decided to conduct a basic design study on the Project for Improvement of Water Supply Facilities in Ulaanbaatar and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Mongolia a study team from 2nd June to 12th July 2003.

The team held discussions with the officials concerned of the Government of Mongolia, and conducted field study at the study area. After the team returned to Japan, further studies were made. Then, a mission was sent to Mongolia in order to discuss a draft basic design, and as this result, the present report was finalized.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Mongolia for their close cooperation extended to the team.

December 2003

Kunimitsu Yoshinaga
Vice-President
Japan International Cooperation Agency

December 2003

LETTER OF TRANSMITTAL

We are pleased to submit to you the basic design study report on the Project for Improvement of Water Supply Facilities in Ulaanbaatar, Mongolia.

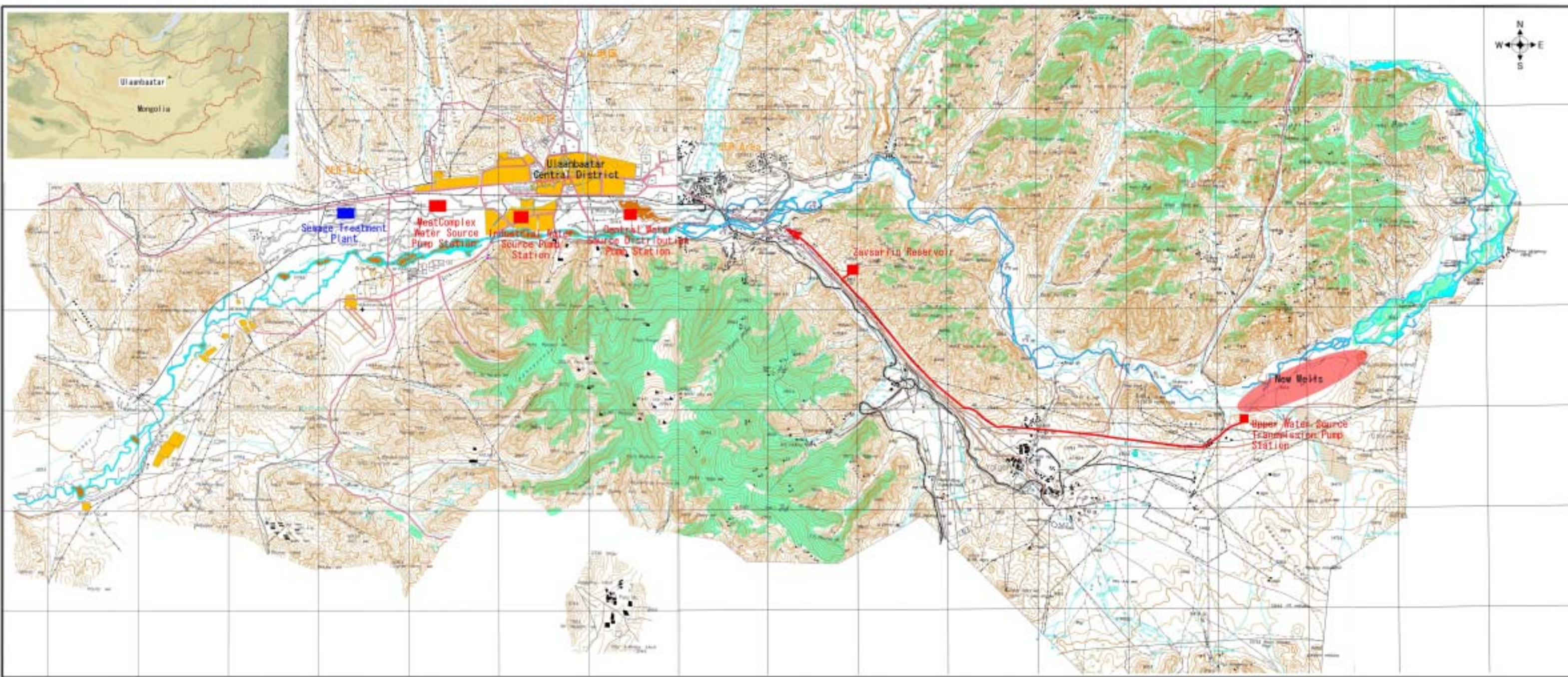
This study was conducted by NJS Consultants Co., Ltd., under a contract to JICA, during the period from May to December 2003. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation in Mongolia and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Masanobu Ishioka
Project Manager,
Basic Design Study Team on
the Project for Improvement of Water Supply Facilities in Ulaanbaatar,
Mongolia

NJS Consultants Co., Ltd.



LOCATION MAP



THE BASIC DESIGN STUDY ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY FACILITIES IN ULAANBAATAR IN MONGOLIA

Summary

Summary

Mongolia has a territory of 157,000 km², approximately four-times the territory of Japan, of which 79% is occupied by a plain. Residential areas are concentrated in the highland with average elevation of 1,500 m. There are the mountain ranges of Artai in southwest with an elevation of 4,000 m and Hangai in mid-west with an elevation of 3,000 m. A forest area with many inland lakes is located in northwest and vast Gobi desert is situated in south.

The current national population is approximately 2.4 million and per capita Gross National Income is approximately 390 US\$. Although much infrastructure had been developed through the support of ex-USSR, sound operation and maintenance (O & M) activities have been interrupted due to the commercial disorder resulting from the collapse of ex-USSR. Development of commercial and social infrastructure has been nominated as one of the priority projects to be implemented through the bilateral aid.

The study area is Ulaanbaatar City with elevation ranging from 1,200 m to 1,500 m. The climate is continental, having large seasonal and hourly temperature fluctuations. Annual rainfall is only 260 mm and is concentrated during May to September. Since the average temperature falls below zero during winter season from November through March, outdoor works shall be implemented during summer time. According to a City Census conducted in 2002, the population of the city is about 847,000. The city is the center of political, economic and cultural activities. Although water supply facilities were constructed between 1950 and 1960 through the support of ex-USSR, after the collapse of ex-USSR, appropriate O&M activities has suffered from an insufficient supply of spare parts. This has resulted in system capacity deterioration.

In view of the above mentioned circumstances and a request from the Mongolian Government, the Japanese Government undertook a social development study called “The Study on Water Supply System in Ulaanbaatar City and Surroundings” in 1993 to 1995, focusing on water supply system improvement and water source development. The recommendations proposed in study report, “The Emergency Rehabilitation of Water Supply Facilities in Ulaanbaatar City”, were implemented between 1996 and 1997 through a Japanese Grant in Aid to restore the capacity of the existing water supply system and to develop additional water sources.

Nevertheless, a serious water shortage in Ulaanbaatar City is still anticipated considering water demand growth that is expected to occur, due to the following:

- Population influx to the city area from rural areas
- Amelioration in living environment by urbanization

Since water is supplied directly to the apartment areas through pipelines, the water supply status in these areas is relatively satisfactory. On the other hand, in the case of the Ger area, water is supplied by reservoirs located within the area and available amount of water is quite limited. As unsanitary water, such as groundwater or spring water is exploited in some areas, outbreaks of water-borne diseases are also observed. Most of water supply equipment is ex-USSR manufactured. Because of the age of the equipment, inferior operational efficiency and poor availability of spare parts; unstable water supply and uneconomical system operational costs have become a serious managerial

problem.

Ulaanbaatar City established a comprehensive city development plan called, “Ulaanbaatar City Master Plan 2020,” with a target year of 2020 that was approved by the Cabinet in May 2003. Construction of apartment buildings, power supply facilities, factories and water supply facilities were selected as priorities for development. Also, augmentation of water supply capacity to cope with water demand growth caused by population increase was identified as major need. The Government of Mongolia prepared a plan for the development of an additional water source in the Upper Water Source Area in the Tuul River basin and water supply system improvements to ensure sufficient potable water in the future. The Government of Mongolia requested assistance from the Government of Japan for project implementation through a Japanese Grant in Aid. The contents of their original request and the above-mentioned master plan are shown in the table below:

Contents of the Request and Master Plan

Original Request (2000)	Master Plan
1. Rehabilitation Works (1) Pump Equipment in Upper Water Source: 6 sets 1,000 m ³ /h x 6 (3 for stand by) Capacity: 3,000 m ³ /h = 72,000 m ³ /day (2) Transmission Main Pipeline: 5 km (3) Valves: 40 items	1. Rehabilitation Works (1) Pump Equipment in Upper Water Source: 5 sets 1,900 m ³ /h x 2 (1 for stand by) 950 m ³ /h x 3 (1 for stand by) Capacity: 3,800 m ³ /h = 90,000 m ³ /day (2) Pump Equipment in Central Water Source: 2 sets
2. Construction Works (1) Well Pumps - Upper Water Source Area: 20 units - Nalaih Water Source Area: 10 units (2) Surge Tanks: 2 units (3) Reservoir: 1 unit	2. Construction Works (1) Well Pumps - Upper Water Source Area: 16 units (2) Pressure Tank (Surge Vessel)
	3. Equipment Procurement (installation works shall be covered by Mongolian side) (1) Pipeline insulation for Intake Pump Stations in Upper Water Source Area

Based on the request of the Government of Mongolia, the Japanese government decided to undertake the Basic Design Study on the Project for Improvement of Water Supply Facilities in Ulaanbaatar. JICA dispatched the Study Team for basic design study in June 2003 and for presentation of a summary of the Basic Design Study in September 2003.

The water demand, considering population growth and water consumption increase, is projected to exceed the existing water source capacity in 2006 to 2007. In 2010, the target year, a shortage of 18,000 m³/day is projected. Considering the potential development capacity, groundwater quality in the water source areas and the capacity of the existing transmission pipelines, development of an additional water source in the Upper Water Source Area is necessary to meet the projected demand. The number of additional wells and capacity and number of pumps that will be required to provide an additional water volume of 18,000 m³/day were determined.

The existing transmission pump station in Upper Water Source has deteriorated. As a result, the actual pumping is much lower than the design capacity. Furthermore, major spare parts are not available. Thus, rehabilitation of this pump station is regarded as indispensable. The capacity of the existing six pumps is the same, which results in uneconomical

operation due to fluctuations in water demand. Installation of two large pumps and three small pumps is recommended to supply water economically under varying demand conditions.

Pressure tanks are recommended as a countermeasure for water hammer^{*1)}. Surge vessels^{*2)}, located within the pumps stations, are recommended to allow for O&M activities during winter season.

In addition to the above, the following two items were requested and included because these items will reduce the power requirements:

- Replacement of two pumps in Central Water Source Distribution Pump Station (heavily deteriorated)
- Pipeline insulation for Well Pump Station in Upper Water Source Area

Replacement of trunk transmission pipeline and valves is excluded from scope of this project, since they have improvements have already been implemented through the support of World Bank.

*1) Water hammer: Radical in-pipe pressure fluctuation caused by the sudden pump operation suspension due to power failure, etc. If in-pipe pressure exceeds the proof stress of pipe, pipe will collapse.

*2) Surge Vessel: Tank contains water and compressed air. If in-pipe pressure drops rapidly, water is poured into pipeline to mitigate the in-pipe negative pressure.

An outline of the proposed water supply system is shown below:

Name of Facilities		Specification	Quantity	Remarks
Intake Facility	Intake Wells	Well depth 30 ~ 45 m, Casing Dia.250 mm	16 units	New
	Intake Pumps	Submersible motor pump 50 m ³ /hr × 65 m	16 units	New
	Electrical Equipment	Power transformer, Starter panel, Instrumentation equipment, Remote control equipment	16 lots	New
	Pump House	Brick wall	16 units	New
	Conveyance Pipe	Steel pipe Dia. 150 mm ~ 500 mm	Approx.13 km	New
Upper Water Source Transmission P/S	Transmission Pumps	Horizontal shaft double suction volute pump 950m ³ /hr × 140m 1,900m ³ /hr × 140m	SB = Stand-by 3 units (1 SB) 2 units (1 SB)	Replacement
	Electric Equipment	Power receiving/distribution equipment, Starter panel, Instrumentation equipment, Remote control equipment for intake pump	1 lot	Replacement New
Central Water Source Distribution P/S	Distribution Pumps	Horizontal shaft double suction volute pump 2,000 m ³ /hr × 100 m	2 units	Replacement
	Electrical Equipment	Power receiving/distribution equipment, Starter panel	1 lot	Replacement
Surge Control Facility for Transmission Main	Surge Vessels (Pressure Tanks)	Steel pressure tank : Capacity 20 m ³ Air compressor	2 units	New
	Electrical Equipment	Starter panel, Water temperature meter at connection pipe	1 lot	New
	Surge Vessel House	Brick wall	1 unit	New
Procurement of Equipment	Pipeline insulation for Intake Pump at Upper Water Source Area	Pipe heater	55 units (39 units + new 16 units)	Installation shall be covered by Mongolian side

To ensure realization of the benefits that are anticipated through the implementation of this project, the following five soft component items are proposed:

- Business structure strengthening,
- Efficiency increase of water supply facilities operation and management,
- Leakage detection,
- Environmental water quality monitoring,
- Public relations improvement.

Due to the scale of the project and restricted working period because of climatic conditions, three years will be required for project implementation. In total, 32.5 months will be required. Detailed design will require 7.5 months. Construction works, construction supervision and soft components will require 22 months. Total project budget is calculated as 1,702 million Yen. Of this amount, 1,685 million Yen will be provided by the Government of Japan and 17 million Yen will be provided by the Government of Mongolia.

Through the implementation of this project, potable water supply volume will be augmented sufficiently to satisfy the future water demand. Rehabilitation of the existing deteriorated facilities will enable stable water supply and improve operating efficiency. Consequently, this project will assist the self-supporting management by USAG by cooperation with other donor agencies, such as World Bank.

The following direct benefits are anticipated to result from project implementation:

- Water supply capacity will be increased from 222,000 m³/day to 240,000 m³/day, an increase of 18,000m³/day.
- By pump replacement in pump stations in Upper and Central Water Source Area, stable water supply capacity of 186,000 m³/day will be enabled and power consumption will also be reduced.

As the benefits of project will extend to all of the consumers in Ulaanbaatar, the beneficiary population will be 990,500, which is the projected population of Ulaanbaatar in 2010.

In the case of Ger Area currently, water is stored in tanks that are supplied periodically by a water tanker. However, since the capacity of water tanks are not sufficient compared with demand in an area, sometimes the tanks become empty and people must wait for a water tanker to arrive to replenish the tank. Upon completion of this project, water will be supplied by pipeline, which will improve the reliability of supply. Further, use of unsanitary water, such as groundwater and spring water will be eliminated and consequently the outbreak of water-borne disease will be eliminated. Women and children are burdened currently the need to fetch water. With this burden reduced, commercial activities within the area will increase.

As mentioned previously, this project will provide significant system improvements and at the same time, it will contribute to the basic human needs of the consumers. Therefore, there is sufficient justification for implementation through a Japanese Grant in Aid. However, since the O&M structure is regarded as insufficient in aspects of staffing and budget, the following items shall be taken into account for effective project implementation:

- USAG must endeavor to secure stable management, adequate human resources and technical level, and effective O&M activities for the water supply facilities.
- Considering the limited water resources, leakage prevention, increasing water-saving consciousness among consumers and effective water conservation shall be fully promoted.

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IN MONGOLIA

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ABBREVIATIONS

ADB:	Asian Development Bank
A/P:	Authorization to Pay
B/A:	Banking Arrangement

BHN:	Basic Human Needs
CTP:	Community Heating Center
DSR:	Debt-Service Ratio
EIA:	Environmental Impact Assessment
E/N:	Exchange of Notes
F/S:	Feasibility Study
Gcal/h:	Giga calorie per hour
GDP:	Gross Domestic Product
GNI:	Gross National Income
H-Q curve:	Head-Quantity Curve
IMF:	International Monetary Fund
JICA:	Japan International Cooperation Agency
KN/mm ² :	Kilo Newton per square millimeter
KWH/m ³ :	Kilowatt-Hour per Cubic meter
L/min:	Litter per minute
LWL:	Low Water Level
M/D:	Minutes of Discussion
M/M:	Man Month
Mpa:	Mega Pascal
MW:	Mega Watt
m ³ /hr:	Cubic meter per hour
NGO:	Nongovernmental Organization
OCB:	Oil Circuit Breaker
ODA:	Official Development Assistance
OECD:	Organization for Economic Cooperation and Development
OSNAAG:	Housing & Public Community Authority
PC:	Personal Computer
PLC:	Programmable Logic Controller
STP:	Sewage Treatment Plant
Tg:	Tugrik
VAT:	Value-Added Tax
VCB:	Vacuum Circuit Breaker
VCS:	Vacuum Contactor Switch
UNDP:	United Nations Development Program
USAG:	Water Supply & Sewerage System Co. of Ulaanbaatar City
USD, US\$:	US Dollar
ex-USSR:	ex-Union of Soviet Socialist Republics
WHO:	World Health Organization

Chapter 1.
Background of the Project

Chapter 1. Background of the Project

Although the basic urban infrastructure in Mongolia had been developed through the support of ex-USSR, appropriate O&M activities have suffered because of the economical disorder resulting from the collapse of ex-USSR. Sound advancement of economic/social infrastructure is a high priority of the Mongolian government, to be implemented by foreign assistance.

Ulaanbaatar City, the national capital has a population of approximately 850,000 which corresponds to one-third of the national population. The city has become the political, commercial, and cultural center of Mongolia. Although water supply facilities were constructed between 1950 and 1960 through the assistance of the ex-USSR, after the collapse of the ex-USSR adequate operation and maintenance (O & M) have been constrained by an insufficient supply of spare parts. As a result of inadequate maintenance, the system capacity has deteriorated significantly.

In view of the above mentioned circumstances and a request from the Mongolian Government, the Japanese Government undertook a social development study called “The Study on Water Supply System in Ulaanbaatar City and Surroundings” in 1993 to 1995, focusing on water supply system improvement and water source development. The recommendations proposed in study report, “The Emergency Rehabilitation of Water Supply Facilities in Ulaanbaatar City”, were implemented between 1996 and 1997 through a Japanese Grant in Aid to restore the capacity of the existing water supply system and to develop additional water sources.

Nevertheless, a serious water shortage in Ulaanbaatar City is still anticipated considering water demand growth that is expected to occur, due to the following:

- Population influx to the city area from rural areas
- Amelioration in living environment by urbanization

The Government of Mongolia prepared a plan for development of an additional water source in the Upper Water Source Area in Tura River basin and water supply system improvements to ensure sufficient potable water in the future. The Government of Mongolia requested assistance from the Government of Japan for project implementation through a Japanese Grant in Aid. Contents of their request are as follows:

- Facility Rehabilitation
Rehabilitation of the existing transmission pump station (6 units), replacement of transmission main (5 km), replacement of valves (40 units)
- Facility Construction
Construction of well pump station (30 units: Upper Water Source Area x 20 units and Nalaih Water Source Area x 10 units)
- Construction of pressure tank (2 units) and reservoir (1 unit)