3.3 Population and Water Demand Forecast

3.3 POPULATION AND WATER DEMAND FORECAST

3.3.1 Population Forecast

(1) Introduction

Forecasting the population growth in the city has been delayed due to pending official announcement of the new capital development plan. JICA Study Team found, though, that legislation of the land ownership law, the water right law and introduction of the wider capital area has been languishing in the parliament.

Hence a more generic approach is adopted in making population forecast, namely, based on the analysis of a growth trend availability in the published statistics.

The future population is projected until 2010, the target year of this master plan.

(2) National Trend

Population section of the statistical year book 1993 of World Resource Institute (WRI) is studied. The figures are given below.

Population in Mongolia

Item	unit	1950	1975-85	1985-90	1990	1995	1995-00	2000	2000-25	2025
Number	thousand	760			2190	2500		2840		4830
aagr*	%		2.78%	2.74%	2.68%	2.68%	2.57%		2.15%	2.22%

* aagr= average annual growth rate , Source: WRI '93 T.16.1

The table shows that the average annual growth rate among 1950 and 1990 is 2.68 %. With gradual decrease in growth rates in sight (2.57 % a.a.g.r. between 1995 and 2000, and 2.15 % a.a.g.r. between 2000 and 2025), the future population of Mongolia in 2025 is predicted to be 4,830,000.

(3) Trend in the Capital City

The given data sources are investigated to get the following table.

Population and its Distribution

-- ULAANBAATAR --

	Unit	1985	1990	1991	1992
Mongolia					
population	thousand	1,910	2,190	2,250	2,810
aagr*-1	%	2.76	2.74	2.68	2.58
Ulaanbaatar					
Population	thousand	503	575	579	590
aagr*-1	%	3.60	2.70	0.70	1.90
Central System Area *-3	thousand	-	321	332	314
pr *-2	%	-	55.8	55.6	53.3
Ger Area *-3	thousand	-	254	257	276
pr *-2	%	-	44.2	44.4	46.7
U/M	%	26.3	26.3	25.7	25.6

(Note) *-1aagr : average annual growth rate
*-2pr : population rate
*-3 : The population of "Central System Area" and "Ger Area" give a breakdown of population in Ulaanbaatar City.
* U/M = Ulaanbaatar/Mongolia in terms of population
Source : D.Dashjav, Ulaanbaatar Xotwin Xun Am, 1993,

The table shows that an annual average growth rate of population in the city in 1985 is around 1 % higher than that of Mongolia, which shows that the social inflow into the capital was happening. Then the rate had been decreasing all along and in 1990 net social inflow of population to the capital stopped. (This may suggest a trickled social inflow with decreased urban fertility rate.)

Figures in both 1991 and 1992 reflect break-down of the USSR in general, evacuation of Russian staff, close-down of factories and a mine in particular.

(4) Forecast

From the above-mentioned trends, a prediction for the future population in Ulaanbaatar and its major distribution pattern are conducted. The forecast is given in the following table.

Population Forecast

		1985	1990	1995	2000	2005	2010
Mongolia	mil.	1.91	2.19	2.50	2.84	3.20	3.59
	aagr	2.76%	2.74%	2.68%	2.58%	2.43%	2.29%
Central System Area	'000		321	358	406	458	513
			55.8%	55%	55%	55%	55%
Ger Area	'000		254	293	332	375	420
			44.2%	45%	45%	45%	45%
Ulaanbaatar	'000	503	575	650	738	833	932
U/M		26.3%	26.3%	26%	26%	26%	26%

The forecasted population of Mongolia conforms with the one predicted by the WRI. Its long-term forecast relies on the existing trend from 1950 onward. In its table some of the average annual growth rates calculated for every five years are given. Growth rate during M/P period is shown in the table.

Statistics on the urban population growth in 1991 and 1992 may be regarded as anomalies in terms of growth rates as well as distribution ratio because of the reasons mentioned above. We have presumed that apparent net social inflow to the city will be zero, namely, the urban growth rates will be kept equivalent to those of the nation with a concentration ratio of 26 %. A distribution ratio of population between the central system area and the Ger area is set at 55 % and 45 % throughout the M/P period.

A report on the future city plan prepared by the USSR in 1987 predicted that population in 2000 is 700 thousand, and set population distribution ratio between the central system area and the Ger area is 49 % and 51 % respectively. Though we believe the set distribution ratio is supported by the contemporary data and observation of general life-style then prevalent to be lasting, and the data in 1990 is used as the base of the prediction. At the moment housing development is taking place in the Micro-Region (MR) No.4 where Ger area is converted into the central system area. Effort would be focused, otherwise, on the restructuring of the existing central area such as MR No.3, 14 where efficient use of existing infrastructure can be attained cheaper than the expansion of the central system area. Farther expansion is planned after 2000 in the north-west region.

3.3.2 Population Served and Service Area in 2010

Population served and service area from the central water supply system by USAG in 2010 have been estimated based on the population forecast and the future plan of urban development.

Future service area is proposed after the discussion with the Town Planning Department as shown in Fig 3.3.1.

In the year 2010, the water supply system by USAG will be established at the part of District No.1 including Nalaih and Gachuurt where water is not supplied at present .

Population Served and Service Area from Central Supply System in 2010 are shown below

[Unit : Person]

No	Districts	Apartments	Ger	Total
1	Central City Area	450,774	330,335	781,109
2	Nalaih	9,005	26,777	35,782
3	Gachuurt	0	5,275	5,275
	Total	459,779	362,387	822,166

Note: (1) Central City Area consists of six districts as follows;
Han-Uul, Bayanzurh, Suhbaatar, Chingeltei, Bayangol, Songinohairhan
(2) Central water supply system does not supply the water to Nalaih at present.
However, the pipeline from the Upper Water Source to Nalaih district was already installed.
In 2010, the water will be supplied to Nalaih district by the existing pipeline.
(3) In Gachuurt district, there is no water supply from the Central water supply system at present.
In 2010, the water from the Lower Part of Nalaih newly developed can be easily supplied to Gachuurt, because the distribution reservoirs of the Lower Part of Nalaih will be installed next to the Gachuurt Ger area.

3.3.3 Water Demand Forecast

Water demand is forecasted on the basis of present water balance, population forecast and proposed service area.

(1) Unit Water Consumption Rate in the Apartment Buildings and Ger Area

Apartment Dwellers

The unit water consumption at present is estimated to 420 l/person/day including 30% of leakage of water based on the survey results of Ministry of Communities in 1988 and JICA Study Team in 1994.

In the apartment buildings, actual usage capacity will be increased, due to the change or improvement of life style. However, the present capacity of wastage is considered to be too much* and it should be decreased as much as possible.

The decrease of leaked water and increase of water consumption will be forecasted an offset each other, and the results of discussions, the unit water consumption rate of 430 l/person /day is adopted for the basis of water demand forecast from the year 2000 up to 2010. In this case, the actual water consumption and the percentage of leakage of water will be estimated 390 l/p/d and 10% respectively.

Ger Dwellers

Unit water consumption in Ger areas will also be increased. However, the increasing ratio is not considered to be so high, keeping in view the general life style of the area. It is estimated to be 10 l /person/day from the year 2000 up to 2010.

* Which is caused by damage of water taps and low consciousness of consumers in saving water.

(2) Water Usage in Industrial Factories and Other Consumers

Water demands for industrial factories and other consumers in 2010 were studied. Water demand for industrial factories has been forecasted after consulting with the Ministry of Infrastructure Development. Water demand for other consumers has been calculated considering the same increasing ratio as the total population.

The results of the forecast of water usage for industrial factories and other consumers are shown below.

Water Usage in Industrial Factories and Other Consumers

[Unit : m3/day]

Year	Factories	Others	Total
1994	11,452	8,100	19,552
2000	20,500	10,500	31,000
2005	32,000	11,850	43,850
2010	42,500	13,300	55,800

Note: 1) The future demand of others is assumed same as growth rate of population .

(3) Water Demand in 2010

Total water demand in 2010 supplied from USAG is estimated as follows.

Water Demand in 2010 [Unit : m^3/day]

No	Item	Water Demand
1	Apartment dwellers	197,700
2	Ger dwellers	3,600
3	Industrial factories	42,500
4	Other consumers	13,300
5	Loss (10 %)	28,600
	Total	285,700

The future water demand curve is shown in Fig. 3.3.2.

(4) Other Water Demand

Power stations in Ulaanbaatar City have their own wells. Their intake water capacity are forecasted until 2010, as mentioned below.

Other Water Demand (Intake Water Capacity)

(unit m3/day)

No	User	1994	1995	2000	2005	2010
1	Power Station No1	-	-	-	-	-
2	Power Station No2	4,815	7,000	-	-	-
3	Power Station No3	29,280	35,000	35,000	35,000	35,000
4	Power Station No4	16,190	25,000	48,000	48,000	48,000
	TOTAL	50,285	67,000	83,000	83,000	83,000

Note: 1) Intake water capacity in 1994 is an actual water usage .
2) No 2 Power Station will be closed on 1997 or 1998.
3) Data Source : Town Planning Department on July 1994.

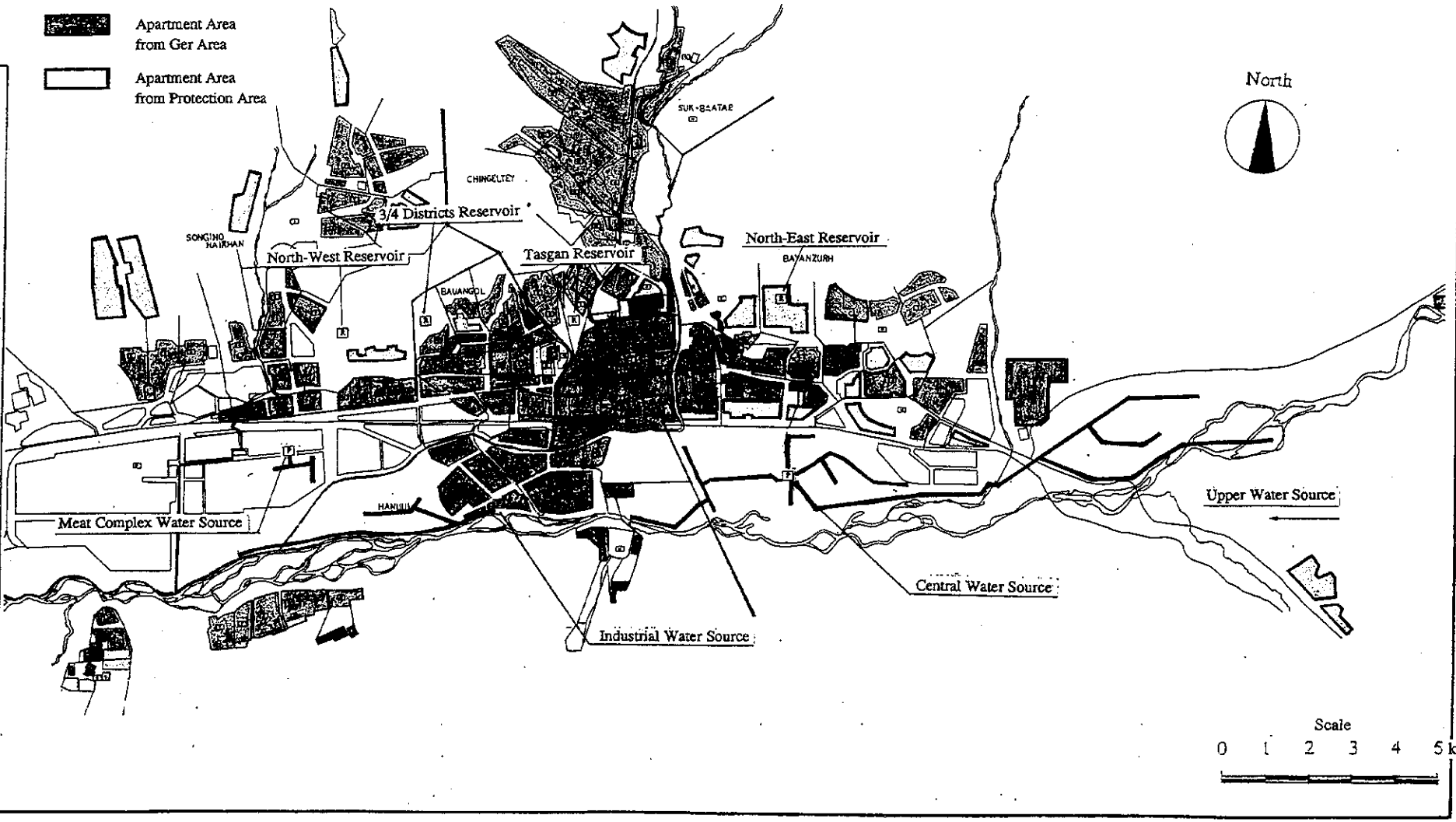

Fig. 3.3.1 Service Area by USAG in 2010

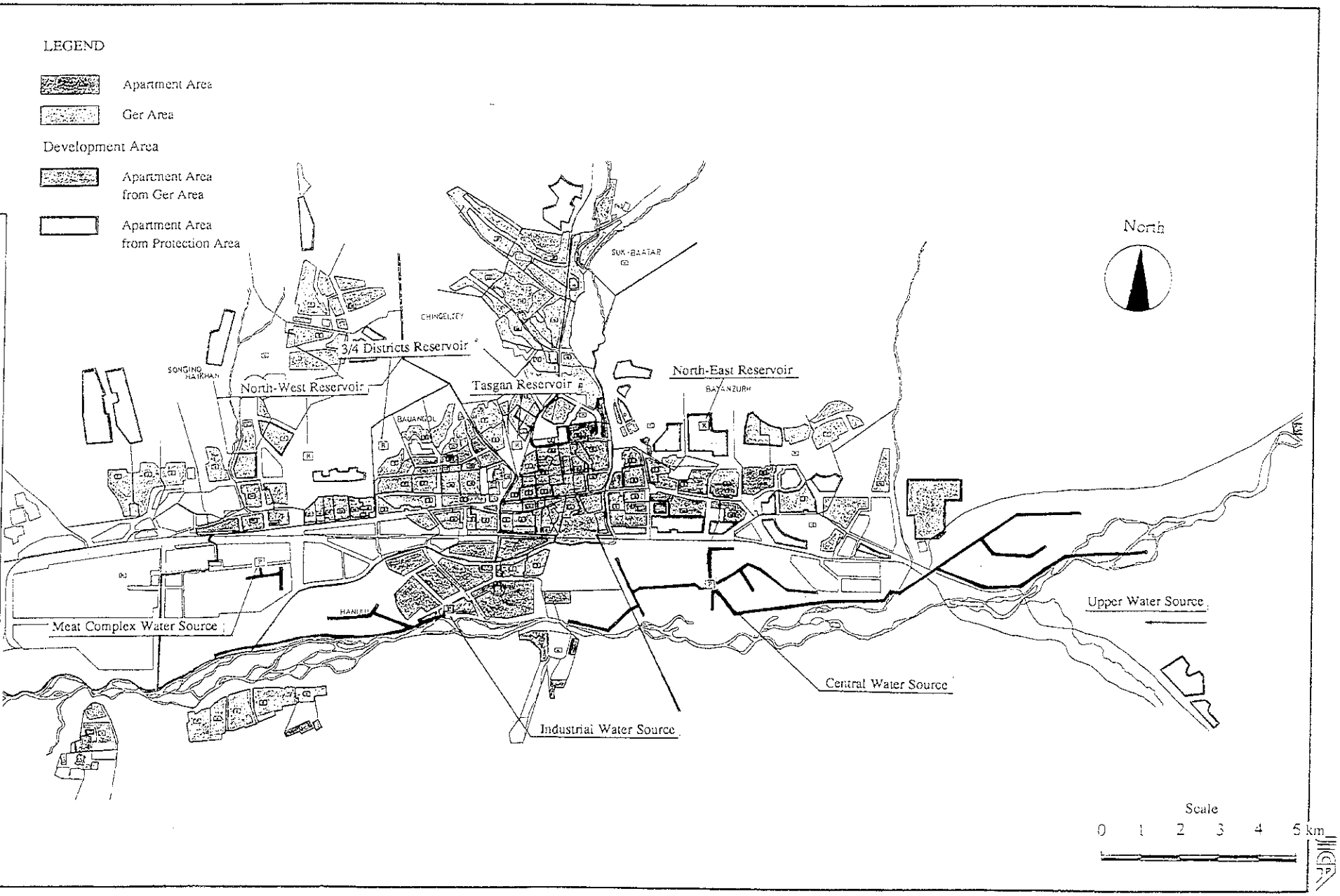

Fig. 3.3.1 Service Area by USAG in 2010

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THE FUTURE WATER DEMAND FORECAST UNTIL 2010

Year	Apartment Dwellers			Ger Dwellers			Industrial	Others	Loss	Total
	Unit Demand	Population	Sub-total	Unit Demand	Population	Sub-total	Factories			
	l / p / day	persons	m3/day	l / p / day	persons	m3/day	m3/day	m3/day	m3/day	m3/day
1994	420	290,609	122,056	7.4	216,065	1,600	11,452	8,100	22,096	165,304
2000	430	376,715	161,988	10.0	280,084	2,801	20,500	10,500	21,754	217,543
2005	430	425,150	182,815	10.0	316,095	3,161	32,000	11,850	25,536	255,362
2010	430	459,779	197,700	10.0	362,387	3,600	42,500	13,300	28,600	285,700

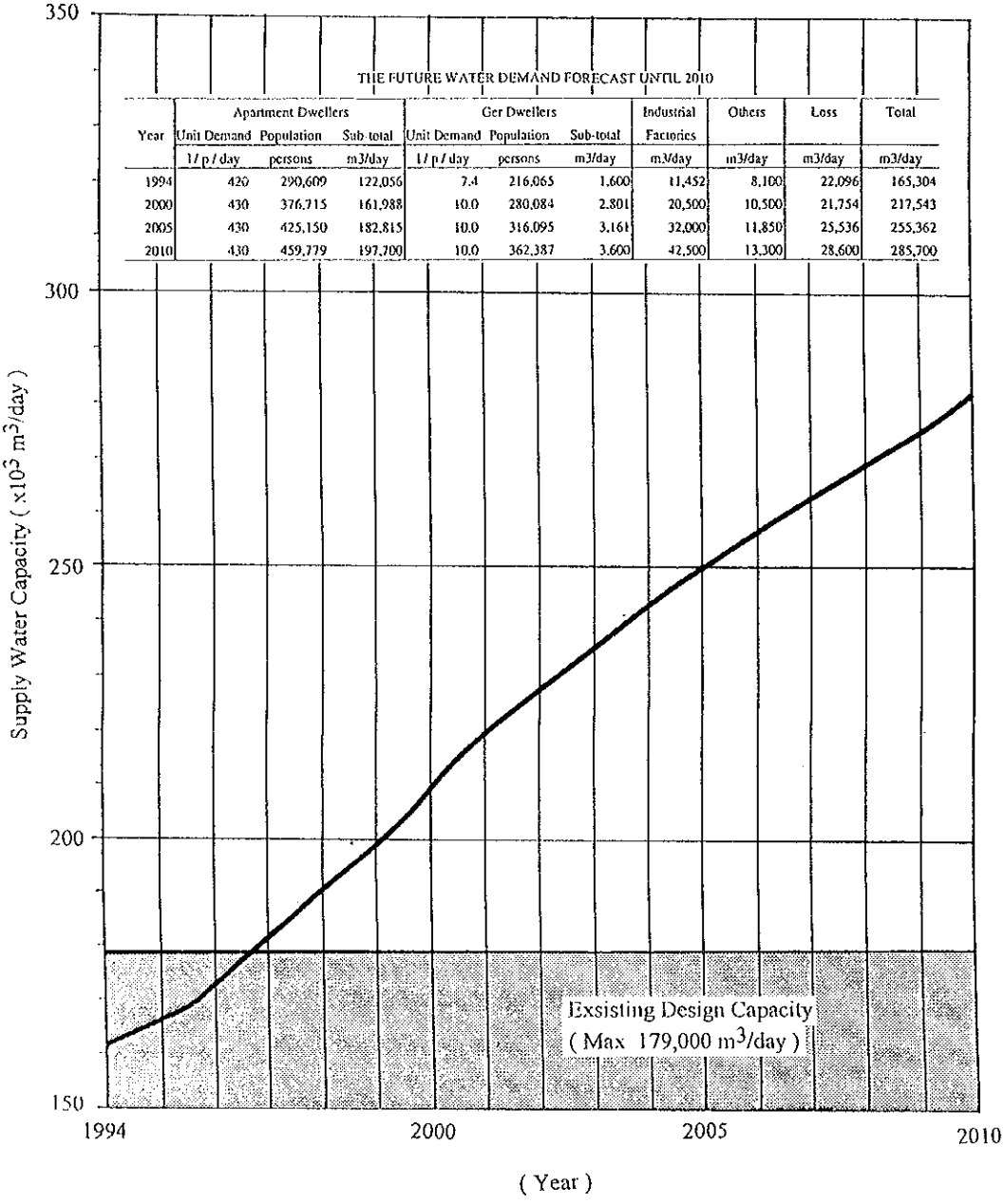

Fig.3.3.2 Future Water Demand Curve

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3.4 Basic Concept for the Water Resources Development

3.4 BASIC CONCEPT FOR THE WATER RESOURCES DEVELOPMENT

3.4.1 Development Capacity

The future production demands of central area and suburbs area of the City are estimated to be 285,700 m^3/day for the year of 2010.

On the other hand, the existing production capacity in 1994 is estimated to be 179,000 m^3/day. Then the additional production capacity of 106,700m^3/day shall be developed in the year of 2010.

(Unit : m3/day)

	Item	production capacity
A	Future production demand	285,700
B	Exiting production capacity	179,000
	Central Source	max. 97,000
	Industrial Source	max. 43,000
	Meat Complex source	max. 15,000
	Upper Source	max. 24,000
C	Future development capacity (= A-B)	106,700

3.4.2 Development Alternatives

The following water sources are available to expand and or develop for the water supply development of Ulaanbaatar.

- Expansion of Upper Water Source
- Expansion of Central Water Source
- Development of New Water Sources (refer to 3.1.2)
  - Lower Part of Nalaih
  - Lower Part of Power Plant
  - Downstream area of Ulaan Hujiriin Bulan and Urahiin Bulan

(1) Expansion of Upper Water Source

Upper Water Source has the potential of more than 90,000m^3/day. This source has yielded an average of 24,140m^3/day in the year of 1994. It is available to expand the water supply capacity of more than 66,000m^3/day.

(2) Central Water Source

According to the review of data, this water source has the potential of 114,300m^3/day. This is the safe yield confirmed by the groundwater simulation. Central Water Source has

yielded an maximum of 97,000m^3/day in 1994. It is available to expand the groundwater production about 17,300 m^3/day.

(3) New Water Sources

Lower Part of Nalaih is comparatively good water resource from the economical, hydrogeological, and water quality points of view. The construction and running cost of Lower Part of Nalaih is expected to be cheaper comparing with the other new water resources.

3.4.3 Basic Concept for the Water Resources Development

Future development capacity of water is estimated to be 106,700m^3/day.

(1) Future development capacity is available to be yielded by the groundwater without the development of surface water.

(2) Existing water sources, namely Upper Water Source and Central Water Source, have the capacity enough to spare for an additional development. Besides, these water sources are located in near by the Ulaanbaatar City. Consequently, these water sources shall be utilized efficiently its remaining groundwater.

Considering the facilities required to increase the capacity which will be easily increased up to 72,000 m^3/day in Upper Water Source.

(3) Future development of the groundwater resources shall be planned at the Central Water Source and Upper Water Source in connection with the Lower Part of Nalaih.

3.4.4 Selection of the Priority Project

Considering the above mentioned criteria such as groundwater potential, water demand, and economic criteria, priority project for the development of water supply system in Ulaanbaatar is recommended below.

Priority project is the combined development of existing groundwater source and new water resource : the expansion of Upper Water Source and Central water source, and new development of Lower Part of Nalaih. The combination between two existing water sources and new water resource shall be examined in an implementation design in the feasibility study.

3.5 Initial Environmental Examination

3.5 INITIAL ENVIRONMENTAL EXAMINATION

(1) General

New water source, namely Lower Part of Nalaih was selected for the examination.

Central Water Source and Upper Water Source have been developed and assessed. Additional development of these two existing water sources do not affect the sustainable development.

On the other hand, Lower Part of Nalaih is the undeveloped area. It is required to assess the natural and social environment due to the development.

This section aims to realize the environmental impact on the natural and social environment due to the groundwater resources development and the construction of water supply facilities. Examination consists of the collection and review of existing environmental data, law, and guidelines, and field reconnaissance.

(2) Scope of the Examination

This Initial Environmental Examination (hereinafter called "IEE") was conducted in the stage of Master Plan Study. IEE shall be carried out to clarify the environmental impacts that may be generated by this project on the basis of existing information and data in a short period at a low cost. IEE has the following two objectives:

- to evaluate whether Environmental Impact Assessment (hereinafter called "EIA") is necessary for the project and, if so, to define its contents and
- to examine, from an environmental viewpoint, the measure for alleviating the effects of the project which requires the environmental consideration but not a full-scale EIA.

Preliminary environmental examination as a component of IEE, was already conducted in the stage of the Preparatory Study, suggested that this project does not effect the serious environmental impact on the natural and social environment.

If IEE shows the serious impact on the existing environment, EIA should be conducted in the stage of Feasibility Study.

(3) Examination Area

Examination area is limited in the priority project area, namely " Lower Part of Nalaih" where intake wells, pipelines, and pumping station may be installed (refer to Fig. 3.5.1).

(4) Project Description

This project consists of the groundwater resources development in Tuul River basin, the installation of underground conveyance pipeline, and the construction of pumping station near Gachuurt valley. The length of pipeline is estimated about 20 kilometers and pumping station is planned to cover an area of 20,000 m^2. These are to supply the drinking water to Ulaanbaatar City where the population is expected to be about 932,000 in 2010 year. This project does not include the construction of purification facilities and distribution facilities.

(5) Site Description

The proposed groundwater resources will be determined in Tuul River basin where the River is about 1 to 2.5 kilometers of width and about 32.2 kilometers of length. Alluvial deposits are distributed about 15 to 30 meters of thickness, and composed of sand and gravel with rarely clay which have sufficient rechargeable groundwater with high permeability. The pipeline from production wells to pumping station will be installed underground on the gentle slope of flood plane of river, terrace, and alluvial fan. The pumping station will be located on the gentle slope of alluvial fan near the Gachuurt River. Ground is covered by the grass with rarely tree.

(6) Environmental Law of Mongolia and Executing Agency

Data Collection

JICA Study Team collected the following data.

- Environmental Law and Executing Agency (from Ministry of Nature and Environment - hereinafter called "MNE")
- Map of national natural park (from MNE)
- Vegetation map (from Water Policy Institute)--1/500,000 and 1/3,000,000 (refer to Fig. 3.5.1)
- Distribution Map of Animals (from MNE)--1/500,000 and 1/6,000,000
- Red data book (from MNE)

Environmental Law of Mongolia

Mongolia has environmental laws as mentioned below.

- Water Law (established in 1974)
- Forestry Law (1974)
- Hunting Law (1974)
- Law on Underground Natural Resources (1989)
- Air Quality Protection Law (1989)
- General Environmental Law (1990)

- Draft Land Law (1991)

There is not Guidelines of EIA, and environmental conservation is controlled on the basis of these seven environmental law. This project is related to Water Law, Forestry Law, and Hunting Law.

- Water Law prescribes the standards of water quality and scope of management.
- Forestry Law regulates the deforestation of small forest covered an area of less than 100 hectares and the forest around an oasis in Govi desert.
- Hunting Law prohibit the hunting for 17 species of animals, 2 species of fish, and 8 species of birds (refer to Table 3.5.1). It also prescribes the following prohibitions :

    · chasing the nonresistant animals,
    · destruction of the nest,
    · capture of baby animals and eggs, and
    · hunting in the conservation area.

Mongolia participates as the following two convention:

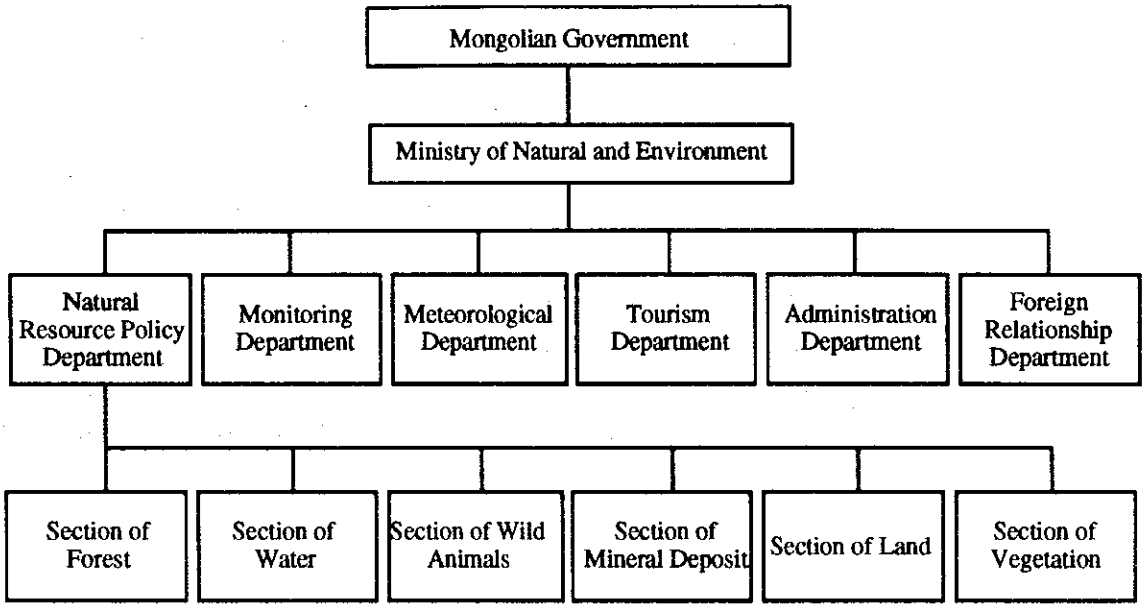
- Convention for the Protection of World Cultural and Natural Heritage
- Basel Convention.

There is no listed cultural and natural heritage in Mongolia. Basel convention was established in 1992 for the protection of environmental pollution in developing countries.

Executing Agency

Ministry of Nature and Environment (MNE) has the responsibility for the investigation, monitoring, conservation, and protection of the natural and social environment. On the other hand, development projects are controlled by the State Committee for Environmental Control (hereinafter called "SCEC") organized by the intellectuals and Minister.

Executing Agency in Mongolia



(7) Field Investigation

Collected data of Vegetation map and Distribution map of animals are not sufficient scale (1/500,000) to investigate and understand the present condition of the project area. Accordingly, JICA Study Team carried out the field investigation to clarify the present condition of natural and social environment at the project site.

Red Data Book listed the endangered, vulnerable, and rare species along Tuul River. But, it did not indicate in detail, field investigation is required to clarify the detail distribution of these species (refer to Table 3.5.2).

1) Confirmed Species at the Site

JICA Study Team confirmed the existence and distribution of following fauna (refer to Figure 3.5.2) and flora in the site.

the Mammalia ; ground squirrel

the Birds ; corvus dauuricus, motacilla alba, parus montanus, pica-pica, circus aeruginosus

the Tree ; populus tremula of europe, salix subfragili anders, cedrus hopatmn heer, betula platyophylla, getula, ermanii, ribes rubrum

the Grass ; sanguisorba officinalis, inula salicina L, agrostis clavata, trinius, pennisetum, gentiana zollingeri, potentilla fruticosa,

taraxacum officinala, leontopodium alpinum, carduus cirsium/ onopordon

2) Traces

Footprint of wolf was confirmed on snow near Ih Huandii River.

(8) Conclusions

1) Animals

Living bodies listed species in Red Data Book, even their nest and traces were invisible in the project area on the basis of field investigation and hearing. This project does not include the large reclamation of land. The collection pipe line continued from intake wells to pumping station shall be installed under the ground in order to prevent the freeze. Consequently, if these species existed in the project area, this pipe line does not affect the mobilization of animals.

2) Vegetation

Red Data Book listed Pharagrnites Cornmunis Trim, Hippophae Rhamnoides Linnaues, and Adonis Siberica Patrin ex Leded in the project area, but these species are not existing along the River and pumping station based on the field investigation. Besides, the collection pipe line shall be planned to run parallel to the existing road. Even if these species existed in the project area, no impact is expected.

3) Others

Other environmental items without above-mentioned items were investigated. The results are shown in Tables 3.5.3 for groundwater resources development and Table 3.5.4 for water supply. No impact is expected for all items including the groundwater which is assessed and described in 4.2.3.

Above mentioned investigations, Environmental Impact Assessment is not necessary to conduct in the Feasibility Study.

Table 3.5.1 Listed species in Hunting Law and study result

Category	Mongolian name	English name	Scientific name	listed in the study area	Field investigation
Animals	Mazaalai	Gobi Bear	Ursus pruinosus Blyth	X	X
	Tahi	Wild House	Eduus przewalskill Poliskov	X	X
	Havtgai	Wild Camel	Camelus ferus Przewalskii	X	X
	Har suult zeer	Gazelle	Gazella subgutturosa Guldenstaedt	X	X
	Altain argal	Argali sheep	Ovis ammon ammon Linnaeus	X	X
	Mongol hulan	Wild ass	Equus hemionus Pallas	X	X
	Irves	Snow Leopard	Uncia uncia Schreber	X	X
	Haliu	Otter	Lutra Linnaeus	X	X
	Suusar	Marten	Martes foing Erxleben	X	X
	Aziin ming	Beaver	Castor fiber birulai Serebrennikov	X	X
	Buga	Deer	Capredus capredus Linnaeus	O	X
	Handgai	Moose	Alces alces Linnaeus	O	X
	Huder	Musk deer	moschus moschiforus Linnaeus	X	X
	Manuul	Wild cat	Felis mounul Pallous	X	X
	Jangir	Ibex	Capra aegagrus	X	X
	Oin tsaa buga	Reindeer	Rangifer tarandus valentinas Flerov	X	X
	Tsoohomdoi	Sand (duue) cat	Felix lybica Forster	X	X
Fish	Hilim	Sturgeon	Acipenser baeri baicalensis	X	X
	Hovsgoliin omol	Ornul	Coregonus autumnalis	X	X
Bird	Borthgor hoton	Pelican	Pelecanus crispus Bruch	X	X
	Gurguul	Pheasant	Phasianus colchicus Linnaeus	X	X
	Huruut hun	Swan	All species of Cygnus	X	X
	Usnii tsagaan suult burged	Hawk	Haliaeetus albicilla Linnaeus	O	X
	Tsasnii hajir	Condor	Gyps himalayensis Hume	X	X
	Uuli	Owl	All species of Asio	X	X
	Togoruu	Crane	All species of Grus	X	X
	Heeriin gluu	Wild goose	All species of Anser	O	X

O...Existence is expected on "Distribution Map of Animals."

X...No existence is expected.

Table 3.5.2 Listed species in Red Data Book along Tuul River

Classification	Category	Mongolian name	Scientific name	Study result		Evaluation
				Red Data Book	Project area	
Animals	(V) and (R)	Zuun sibiriin handgai	Alces alces pfizenmayeri Zukoyski	Listed	No existence	X
Leptiles	(E)	Sibiriin gulmer	Hynobius Keyserlingii	Listed	No existence	X
Peptilia	-	-	-			
Fistis	-	-	-			
Birds	(E)	Tsagaan togoruu	Grus leucogeranus Pallas	Listed	No existence	X
	(R)	Halbagan hoshuut	Platalea leucorodia Linnaues	Listed	No existence	X
		Har orovtas	Ciconira nigra Linnaues	Listed	No existence	X
		Hoshuu galuu	Anser cygnoides Linnaues	Listed	No existence	X
		Javlag sar	Pandion haliaetus Linnaues	Listed	No existence	X
		Usnii tsagaan suult togoruu	Haliaeetus albicilla Linnaues	Listed	No existence	X
		Hurgan tutgaljin	Numenius minutus Gould	Listed	No existence	X
Plants	(E)	Huls	Phragmites commmunis Trin	Listed	No existence	X
	(R)	Chatsargana	Hippophae rhamnoides Linnaues	Listed	No existence	X
		Sibiri hundgana	Adonis sibirica Patrin ex Leded	Listed	No existence	X

Categories

(Ex) : Extinct species and subspecies

(E) : Endangered species and subspecies ; This category will become "Ex" on the present condition.

(V) : Vulnerable species and subspecies ; This category will become "E" on the present condition.

(R) : Rare species and subspecies ; This category will become "V" due to the change of present condition.

(Lp) : Local population

Evaluation O... Impact is expected

? ... Unknown

X ... No impact is expected

Table 3.5.3 Format for Screening (Groundwater Development)

No.	Environmental Item	Description	evaluation	Remarks (Reason)
Social Environment				
1.	Resettlement	Resettlement by land occupation (transfer of rights of residence, land ownership)	[Y](N)[?]	No residence
2.	Economic Activities	Loss of production base (land, etc.) and change of economic structure	[Y](N)[?]	No activity
3.	Traffic and Public Facilities	Impacts on existing traffic, schools, hospitals, etc. (e.g., traffic jam, accidents)	[Y](N)[?]	No existence
4.	Split of Communities	Separation of regional communities by hindrance of regional traffic	[Y](N)[?]	No residence
5.	Cultural Property	Loss or deterioration of cultural properties, such as temples, shrines, archaeological assets, etc.	[Y](N)[?]	No existence
6.	Water Rights and Rights of Common	Obstruction of fishing rights, irrigation and water rights	[Y](N)[?]	No regulation
7.	Public Health Condition	Worsening of health and sanitary condition due to generation of garbage and appearance of harmful insects	[Y](N)[?]	No facility to generate
8.	Waste	Generation of construction waste, surplus soils, sludge, domestic waste, etc.	[Y](N)[?]	No facility to generate
9.	Hazards (Risk)	Increase in risk of cave-ins, ground failure and accidents	[Y](N)[?]	No facility to generate
Natural environment				
10.	Topography and Geology	Change of valuable topography and geology due to excavation and earthfill	[Y](N)[?]	Local reclamation
11.	Soil Erosion	Topsoil erosion by rainfall after land reclamation or deforestation	[Y](N)[?]	Local reclamation
12.	Groundwater	Lowering of groundwater table due to overdraft and turbid water caused by construction work	[Y](N)[?]	Management for suitable pumping rate
13.	Hydrological Situation	Change of discharge and water quality due to reclamation and drainage	[Y](N)[?]	Local reclamation
14.	Coastal Zone	Coastal erosion and sedimentation due to change of littoral drift and reclamation	[Y](N)[?]	No distribution
15.	Fauna and Flora	Interruption of reproduction or extinction of species due to change of habitat condition	[Y](N)[?]	No valuable species in the project area
16.	Meteorology	Change of micro-climate, such as temperature, wind, etc., due to large scale reclamation and construction	[Y](N)[?]	Local reclamation
17.	Landscape	Deterioration of aesthetic harmony by structures and topographic change by reclamation	[Y](N)[?]	Local reclamation
Pollution				
18.	Air Pollution	Pollution caused by exhaust gas or toxic gas from vehicles and factories	[Y](N)[?]	No facility to pollute
19.	Water Pollution	Water pollution of river and groundwater caused by drilling mud and oil	[Y](N)[?]	No facility to pollute
20.	Soil Contamination	Contamination caused by discharge or diffusion of sewage or toxic substances	[Y](N)[?]	No facility to pollute
21.	Noise and Vibration	Generation of noise and vibration due to drilling and operation of pumping machines	[Y](N)[?]	No facility to generate
22.	Land Subsidence	Deformation of the land and land subsidence due to lowering of groundwater table	[Y](N)[?]	Good soil condition
23.	Offensive Odor	Generation of offensive odor and exhaust gases	[Y](N)[?]	No facility to generate
Overall Evaluation; EIA is necessary for the project implementation?			[Y](N)	

Table 3.5.4 Format for Screening (Water Supply)

No.	Environmental Item	Description	evaluation	Remarks (Reason)
Social Environment				
1.	Resettlement	Resettlement due to land occupancy (transfer of rights of residence and land	[Y](N)[?]	No residence
2.	Economic Activities	Loss of production base and change of economic structure	[Y](N)[?]	No activity
3.	Traffic and Public Facilities	Impacts on schools, hospitals, and present traffic conditions, such as traffic jams and accidents	[Y](N)[?]	No existence
4.	Split of Communities	Separation of regional communities by hindrance of regional traffic	[Y](N)[?]	No residence
5.	Cultural Property	Loss or decrease of the value of cultural assets, such as temples, shrines and archaeological assets	[Y](N)[?]	No existence
6.	Water Rights and Rights of Common	Obstruction of fishing rights, water rights, and rights of common	[Y](N)[?]	No regulation
7.	Public Health Condition	Worsening of health and sanitary condition due to the generation of garbage and pathogenic insects	[Y](N)[?]	No facility to generate
8.	Waste	Generation of construction waste, surplus soils, sludge, and domestic waste	[Y](N)[?]	No facility to generate
9.	Hazards (Risk)	Increase in risk of cave-ins, ground failure and accidents	[Y](N)[?]	No facility to generate
Natural environment				
10.	Topography and Geology	Change of valuable topography and geology due to excavation and eartfill	[Y](N)[?]	Local reclamation
11.	Soil Erosion	Topsoil erosion by rainfall after land reclamation or deforestation	[Y](N)[?]	Local reclamation
12.	Groundwater	Exhaustion of groundwater caused by overdraft, and water pollution by leachate	[Y](N)[?]	Management for suitable pumping rate
13.	Hydrological Situation	Changes of river discharge and riverbed condition due to filling work and drainage inflow	[Y](N)[?]	Local reclamation
14.	Coastal Zone	Coastal erosion and change of coastal vegetation due to change of littoral drift and reclamation	[Y](N)[?]	No distribution
15.	Fauna and Flora	Obstruction of breeding and extinction of species due to change of habitat condition	[Y](N)[?]	No valuable species in the project area
16.	Meteorology	Change of micro-climate, such as temperature, wind, etc., due to large-scale reclamation and constructions	[Y](N)[?]	Local reclamation
17.	Landscape	Change of topography and vegetation due to reclamation. Deterioration of aesthetic harmony by structures	[Y](N)[?]	Local reclamation
Pollution				
18.	Air Pollution	Pollution caused by exhaust gas or toxic gas from vehicles and factories	[Y](N)[?]	No facility to pollute
19.	Water Pollution	River and groundwater pollution caused by inflow of drainage and sludge from water treatment facilities	[Y](N)[?]	No facility to pollute
20.	Soil Contamination	Contamination caused by discharge or diffusion of waste water drainage or toxic materials	[Y](N)[?]	No facility to pollute
21.	Noise and Vibration	Noise and vibration generated by vehicles and operation of water treatment plants	[Y](N)[?]	No facility to generate
22.	Land Subsidence	Land deformation and land subsidence caused by the lowering of water table	[Y](N)[?]	Good soil condition
23.	Offensive Odor	Generation of offensive odor and exhaust gas	[Y](N)[?]	No facility to generate
Overall Evaluation; EIA is necessary for the project implementation?			[Y](N)	

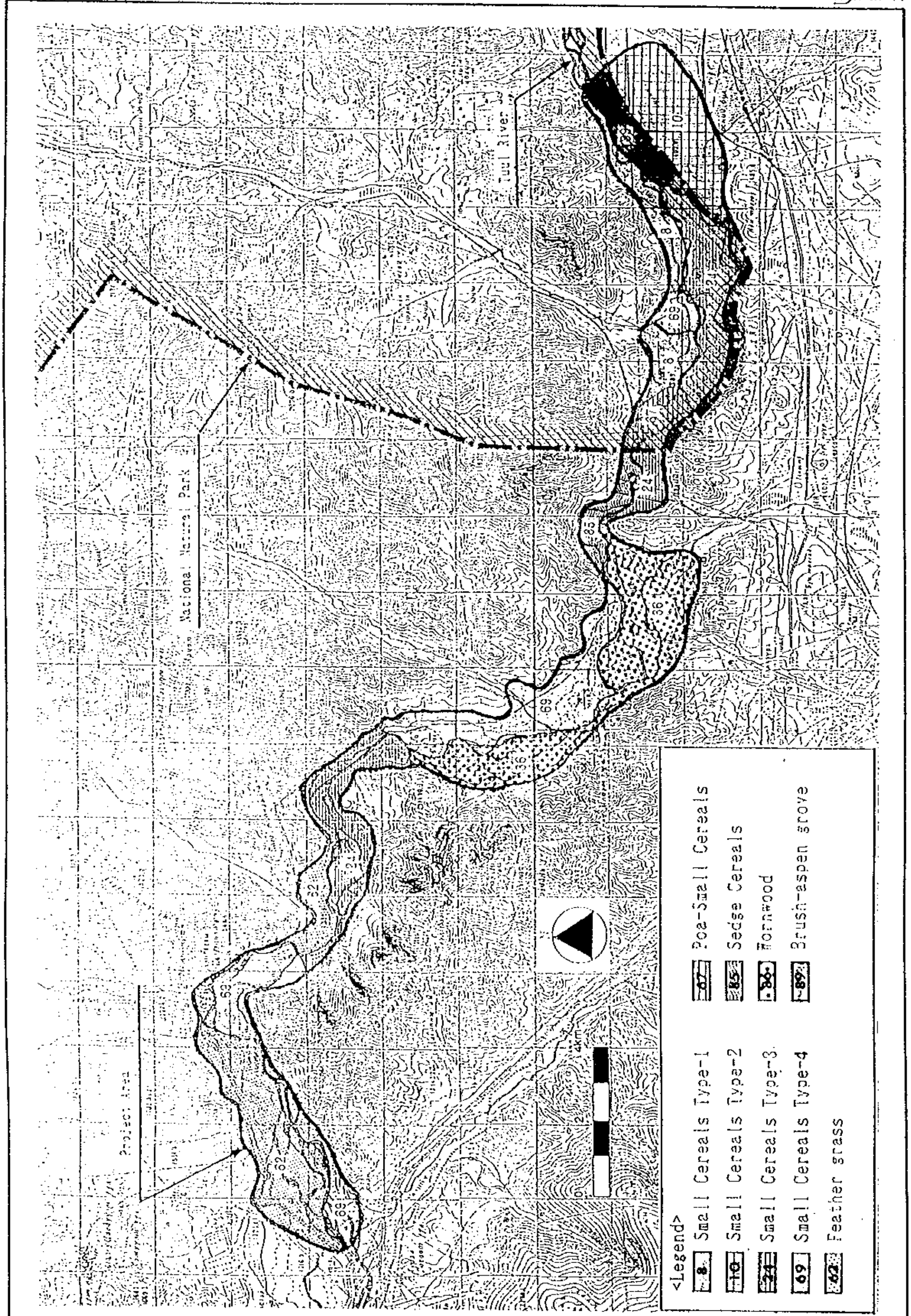


Fig. 3.5.1 Project Area and Vegetation Map

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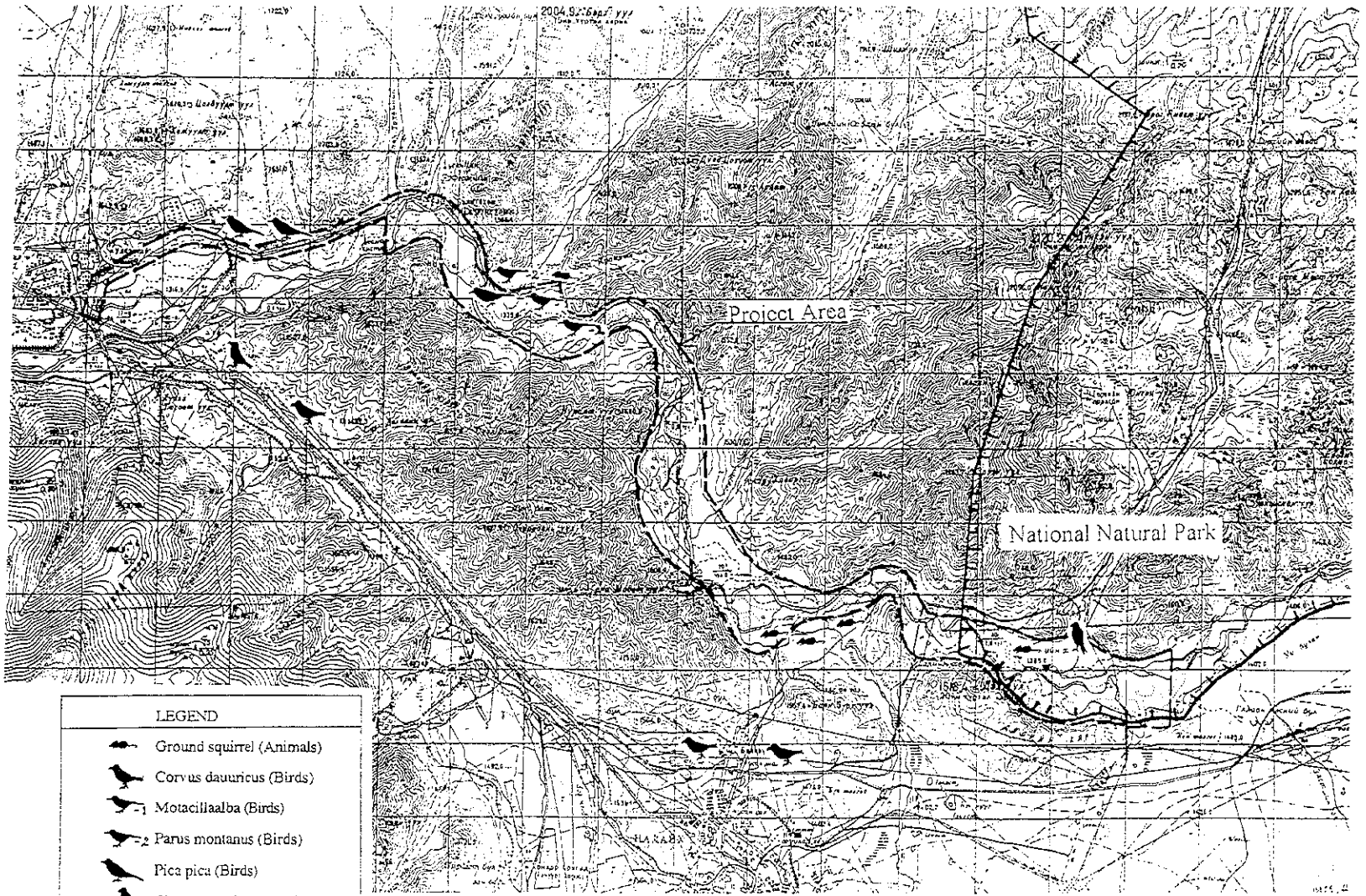

Fig. 3.5.2 Appearance Species (Fauna)

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CHAPTER 4 FEASIBILITY STUDY ON PRIORITY PROJECT

4.1 Planning of Facility

CHAPTER 4 FEASIBILITY STUDY ON PRIORITY PROJECT

4.1 PLANNING OF FACILITY

4.1.1 Design Conditions

Design conditions for the feasibility study on priority project are summarized below. Details are described in chapter 3 of Supporting Report III.

(1) Target Year : 2010
(2) Future population in 2010 : 932,000
(3) Population served and service area

Population Served and Service Area from Central Supply System in 2010

[Unit : Person]

No	Districts	Apartments	Ger	Total
1	Central City Area	450,774	330,335	781,109
2	Nalaih	9,005	26,777	35,782
3	Gachuurt	0	5,275	5,275
	Total	459,779	362,387	822,166

Note: Central City Area include six districts as follows;
Han-Uul, Bayanzurh, Suhbaatar, Chingeltei, Bayangol, Songinohairhan

Service Area is shown in Fig. 3.3.1.

(4) Future water demand in 2010 : 285,700m^3/day
(5) Development capacity : 106,700m^3/day
(6) Water source and its potential :
- remaining volume of existing water source
  Central Water Source ; 17,300m^3/day (developed volume ; 97,000m^3/day)
  Upper Water Source ; 66,000m^3/day (developed volume ; 24,000m^3/day)
- prior development area as for the new water source
  Lower Part of Nalaih ; less than 80,000m^3/day

4.1.2 Water Source

The basic concept of the water resources development are to consider the expansion of Upper Water Source and Central Water Source in connection with the development of Lower Part of Nalaih.

(1) Upper Water Source

This source is far from Ulaanbaatar about 50km and located along the Tuul River. 39 production wells are installed and supply the water of 24,140m^3/day (in average from October

1993 to September 1994) to the City. This water source can be developed 90,000m^3/day in maximum with the following expansion works.

Required facilities to increase the capacity of Upper Water Source

No	Facilities	Case A 72,000 m^3/day	Case B 90,000 m^3/day
1	Additional Facilities		
	Intake Wells 120 m^3/hr x 60 m	not necessary	18 wells
	Distribution Pumps 1000 m^3/hr x 180 m	not necessary	2 pumps
2	Improvement of the Existing Facilities		
	Water level indicator system	4 sets	4 sets
	Chlorination equipment	1 set	1 set
	Telecommunication System	three location (1 set)	three locations (1 set)
	Others (Valves, pipe, pumps)	1 set	1 set

Note 1. According to the USAG, the planned capacity at the construction stage was 90,000 m^3/day
2. Considering the facilities required to increase the capacity, the capacity will be easily increased up to 72,000 m^3/day (Case A).

(2) Central Water Source

This source is located at the south of Ulaanbaatar in the Tuul River basin. Seventy two (72) production wells are installed and supply the water of 97,000m^3/day (in maximum from October 1993 to September 1994) to the City. This water source can be developed 114,300m^3/day in maximum with the following expansion works.

Required facilities to increase the capacity of Upper Water Source

Facilities	Numbers
Intake Wells 120 m^3/hr x 60 m	14
Distribution Pumps	not necessary

4.1.3 Comparison and Selection for Implementation

Each alternative was analyzed in detail and weighted the merits for the purpose of selecting the most suitable alternative for the implementation.

(1) Comparison

Comparative study was conducted for the following four (4) cases including the expansion of the existing water source and the development of new water source.

Case 1: 72,000m^3/day--expansion of Upper Water Source
58,700m^3/day--development of Lower Part of Nalaih
Case 2 : 90,000m^3/day--expansion of Upper Water Source
40,700m^3/day--development of Lower Part of Nalaih
Case 3 : 72,000m^3/day--expansion of Upper Water Source

114,300m^3/day--expansion of Central Water Source
41,400m^3/day--development of Lower Part of Nalaih

Case 4 : 90,000m^3/day--expansion of Upper Water Source
114,300m^3/day--expansion of Central Water Source
23,400m^3/day--development of Lower Part of Nalaih

The result is shown in the following table. Case 3 is better than other cases.

Comparison Table for Future Water Sources
(Except the existing facilities)

No	Item	Unit	Existing	Case I	Case II	Case III	Case IV
1	Supply Water Capacity						
	1) Lower Part of Nalaih	m^3/day	0	58,700	40,700	41,400	23,400
	2) Central	m^3/day	97,000	97,000	97,000	114,300	114,300
	3) Industrial	m^3/day	43,000	43,000	43,000	43,000	43,000
	4) Meat Complex	m^3/day	15,000	15,000	15,000	15,000	15,000
	5) Upper Water Source	m^3/day	24,000	72,000	90,000	72,000	90,000
	Total	m^3/day	179,000	285,700	285,700	285,700	285,700
2	Technical Matter and Others						
	1) Water Development Potential		----	enough	enough	enough	enough
	2) Water Quality		good	good	good	good	good
	3) Water Treatment		unnecessary	unnecessary	unnecessary	unnecessary	unnecessary
	4) Water Rights		good	good	good	good	goo
	5) Land Acquisition		ease	ease	ease	ease	ease
3	Cost (Except the existing facilities)						
	1) Construction Cost	T-US$		69,400	69,500	67,300	68,700
	2) Unit Construction Cost	US$/m^3/d		650	651	631	644
	3) Electricity Cost	T-US$/Y		611	728	663	771
	4) Present Value of Total Cost (between Year 1995 and 2020)	T-US$		54,700	53,300	51,500	52,800
	EVALUATION			NO GOOD	NO GOOD	EXCE-LLENT	GOOD

Note
1) Shaded cells are the existing water supply capacity as of November 1994.
2) Exchange Rate : US$ 1.00 = Yen 100.0 , US$ 1.00 = Tg 400.0
3) Cost : as of December 1994
4) T-US$: Thousand US Dollar
5) Unit Power Rates : 4.4 Yen/kwh (17.6 Tg/kwh)
6) Escalation Rate for present value to be calculated : 7 %/Year
7) Present value of total cost estimated by "Method of Net Present Value "

Implementation of the Case III shall be divided into three stages as follows.

First stage : expansion of the Upper Water Source
Second stage : expansion of the Central Water Source
Third stage : development of the Lower Part of Nalaih

Correlation of supply capacity with water demand in each stage is shown in Fig. 4.1.1.

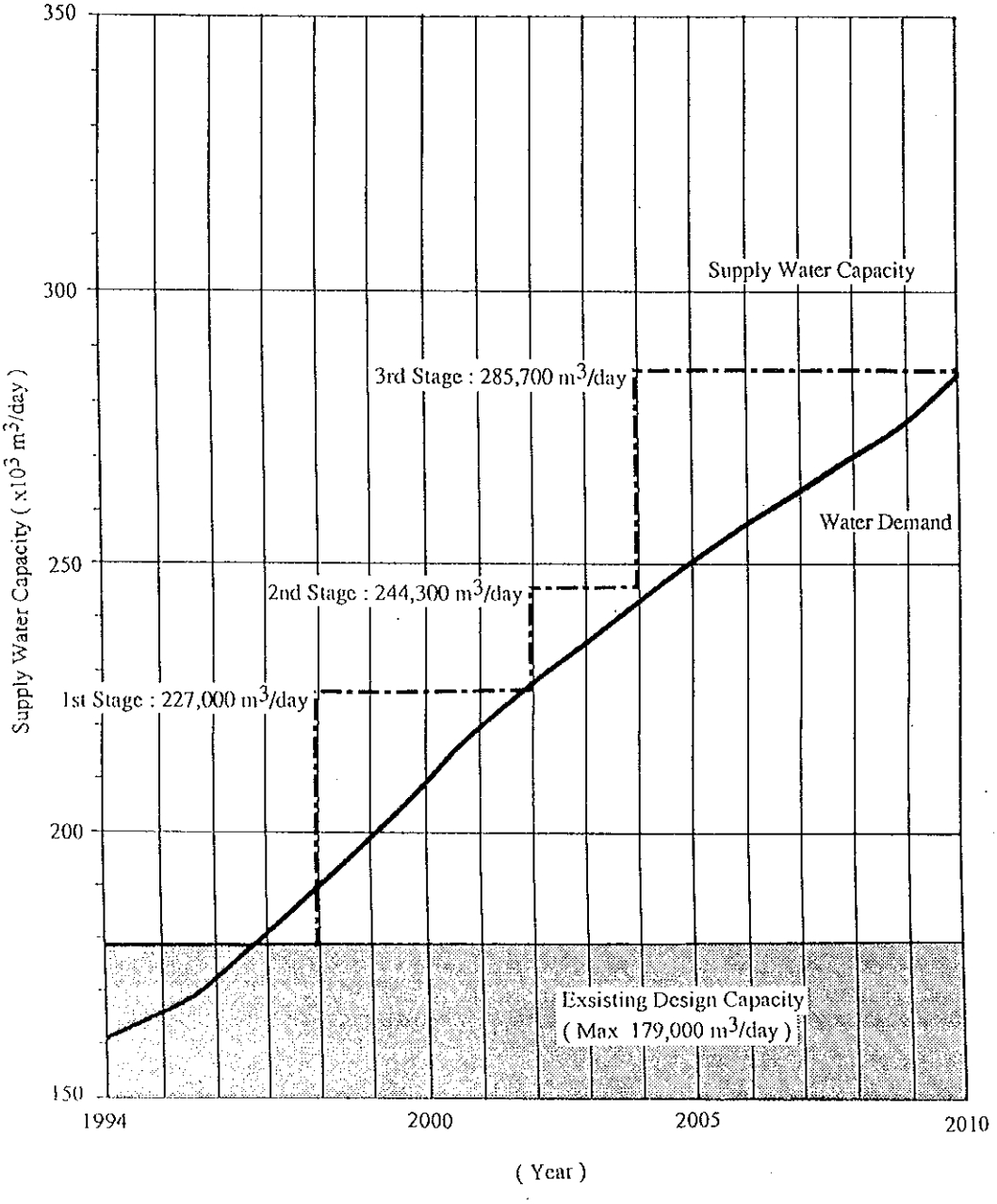

Fig.4.1.1 Future Water Demand and Water Supply Capacity

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4.2 Design of Water Supply Facility

4.2 DESIGN OF WATER SUPPLY FACILITY

4.2.1 Expansion of Upper Water Source in the First Stage

Upper Water Source will be expanded up to 72,000 m^3/day from the existing capacity of 24,000 m^3/day at the first stage.

(1) Intake facilities

Intake wells, pumps, collection pipes, and also storage reservoir have the sufficient capacity and expansion is not necessary in this stage.

(2) Transmission facilities

The transmission pump is not necessary to be constructed in this stage. However, the operation of Zavsariin Reservoir is required, in order to increase the supply water capacity from 24,000 m^3/day to 72,000 m^3/day.

Therefore the equipment required for the operation of Zavsariin Reservoir such as water flow meter, water level meter and temperature meter, etc., shall be installed. And also, the surge protection facilities are necessary to protect the water hammer. The flow diagram for these facilities is shown in Fig. 4.2.1

The transmission main from Central Pumping Station up to Zavsariin Reservoir has the sufficient capacity. However, the supply capacity of distribution pipeline from the Zavsariin Reservoir to the City area, not included in this Study, should be studied before implementation. An additional pipeline work in the distribution line might be required if necessary after the study.

(3) Others

- Four (4) sets of water level meter are necessary to install for the Zavsariin Reservoir and North East Reservoir.
- Chlorination equipment shall be installed at the Zavsariin Reservoir.
- Telecommunication system shall be installed at the Upper Water Source, Zavsariin Reservoir, and North East Reservoir.
- Accessories equipment shall be installed to operate the Zavsariin Reservoir.

4.2.2 Expansion of Central Water Source in the Second Stage

Central Water Source will be expanded up to 114,300 m^3/day from the existing capacity of 97,000 m^3/day at the second stage.

(1) Intake Facilities

Fourteen (14) intake wells (including spare wells of 2) shall be constructed to expand the groundwater of 17,300m^3/day. Auxiliary equipment, such as submersible pump, valves, pipe, flow meter, control panel, heater, light, and stepdown transfer, are included. The location and system diagram of these facilities are shown in Fig. 4.2.2 and 4.2.3. Remote control system is also required to control and operate the intake facilities.

The details are shown below.

Required Intake Facilities of Central Water Source

No.	Item	Number	Specification
1	Wells	14	30 m of depth, 1500m^3/day/well
2	Well Pump and others	14	submersible pumps
3	Remote Control System	1 set	for pumps and motor valves
4	Pump Houses	14	made by brick (5m x 5m x 8m)
5	Collection Main Pipeline	10,500m	DCIP ø 150 ~ 500 mm
6	Power Distribution Line	1 Set	

(2) Distribution facilities

It is not necessary to expand.

4.2.3 Development of Lower Part of Nalaih in the Third Stage

Lower Part of Nalaih, having the capacity of less than 80,000 m^3/day, will be developed in the third stage. The location and system diagram of these facilities are shown in Fig. 4.2.4 ~4.2.6.

(1) Determination of the Number of Intake Wells

The wells of Upper Water Source and Central Water Source are expected to yield an average of 2,000 or more and about 1,500 m3/day respectively. In the Lower Part of Nalaih, it is expected to yield groundwater from a well less than other areas because of hydrogeological condition. On the basis of obtained hydrogeological properties of the aquifer, the water levels in a well were estimated according to various pumping rates. The result is as follows.

The number of wells	Discharge from a well	Total withdrawal	Intervals of wells	Distance from one end to the other	Estimated water level
	(m^3/day)	(m^3/day)	(m)	(m)	(G.L.-m)
37	1350	49950	350	6300	8.64
41	1220	50020	300	6000	8.62
49	1020	49980	250	6000	8.50
61	820	50020	200	6000	8.30

notes:
- "S", storage coefficient is 0.15,
- "T", transmissivity is 520 m^2/day, and
- pumping will continue for 150 days.

The results indicate the economical pumping rate is about 1200 m^3/day in the area. And then 34 wells are required constructing to withdraw 41,400 m^3/day from the area.

Method of estimate

The drawdown "*s*" at the distance "*r*" from a pumped well can be obtained by the Theis non-equilibrium equation.

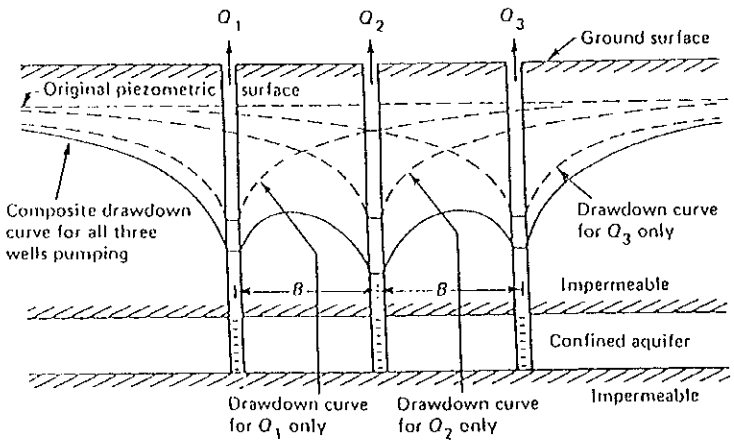
$$s = \frac{Q}{4\pi T}\left[-0.5772 - \ln u + u - \frac{u^2}{2!2} + \frac{u^3}{3!3} - \frac{u^4}{4!4} + \cdots\right]$$

where

$$u = \frac{r^2 S}{4Tt}$$

and "Q"is the pumping rate (m^3/day), "T" is the transmissivity (m^2/day), "S" is the storage coefficient, "t" is the duration time (days).

When wells in an area are pumping up at a time, they are mutually interfering. When two or more wells are mutually interfering, the total drawdown in a well is the sum of the individual drawdowns as shown below.



A composite drawdown is minimized when wells in an area are arranged on a line. And then the maximum drawdown occurs in the well located in the center of a well field.

(2) Intake facilities

Forty one (41) intake wells (including spare wells of 7) shall be constructed. Auxiliary equipment, such as submersible pump, valves, pipe, flow meter, control panel, heater, light, and stepdown transfer, are included. Remote control system is also required to control and operate the intake facilities.

Required Intake Facilities of Lower Part of Nalaih

No.	Item	Number	Specification
1	Wells	41	1,220 m^3/day/well depth of 20m (38wells) & 30m (3wells)
2	Well Pump and Others	41	submersible pumps
3	Remote Control System	1 set	for pumps and motor valves
4	Pump Houses	41	made by brick (5m x 5m x 8m)
5	Collection main Pipeline	10,750 m	DCIP ø 150~800 mm
6	Power Transmission Line	1 set	
7	Power Distribution Line	1 set	

(3) Distribution facilities

- Distribution reservoir shall be located near by the Gachuurt town.
- Chlorination equipment shall be installed adjacent to the reservoir.
- Distribution main shall be installed along the existing road.

Required for Distribution Facilities of Lower Part of Nalaih

No.	Item	Number	Specification
1	Distribution Reservoirs	2	6,900 m^3 x 2 (retention time = 8 hr)
2	Chlorination Equipment	1 set	41,400 m3/day x 1.0 mg/l
3	Distribution Main	21,000 m	DCIP ø 800mm
4	Electrical Equipment	1 set	
5	Buildings	1 set	

4.2.4 Land Acquisition

Land required for the construction of the facilities is described below.

Development Area	Facilities	Required Area (ha)
Upper Water Source	Intake	0
	Transmission	0
	Distribution	0
Central Water Source	Intake	4.0
	Distribution	0
Lower Part of Nalaih	Intake	6.0
	Distribution	9.0
TOTAL		19.0

The intake, transmission and distribution facilities will be constructed in the all government reserved land. The collection pipeline of each water source and distribution main of new water source will be installed parallel with the existing roads.

Hence, the construction of the above facilities will not require any land acquisition, although some procedure to get approval may be required.

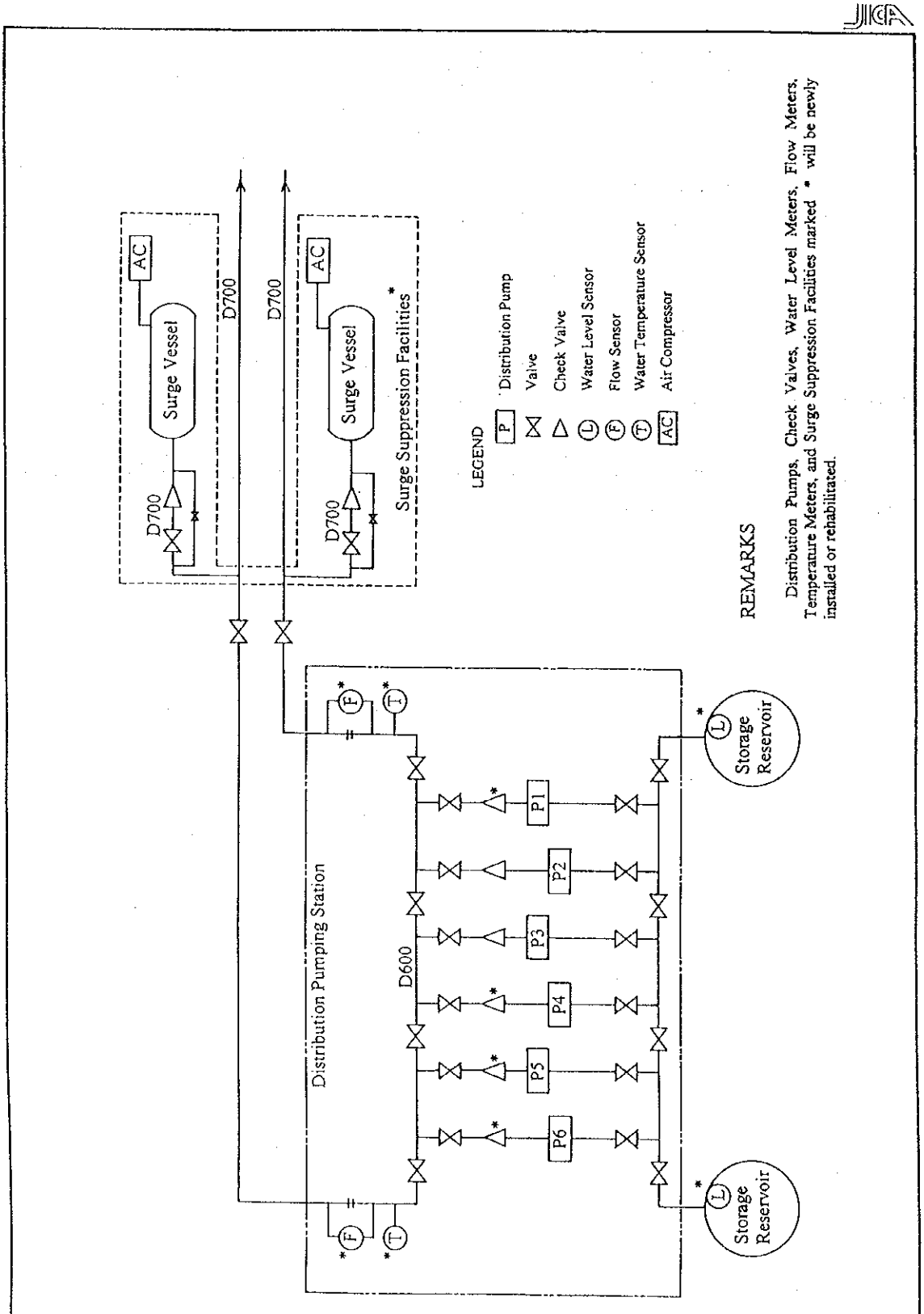


Fig. 4.2.1 Improvement of Pumping Station at Upper Water Source

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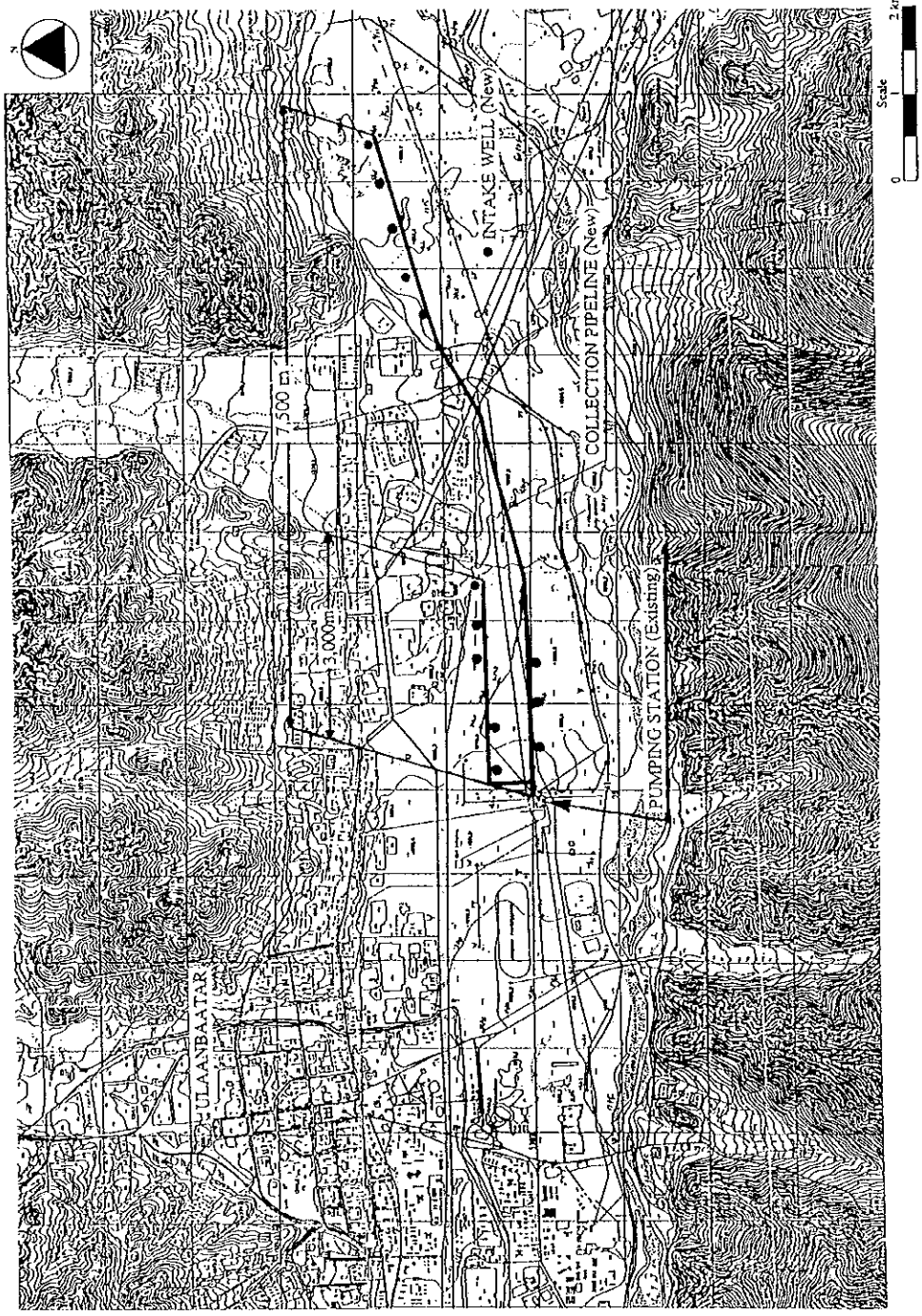

Fig. 4.2.2 Expansion Facilities of Central Water Source

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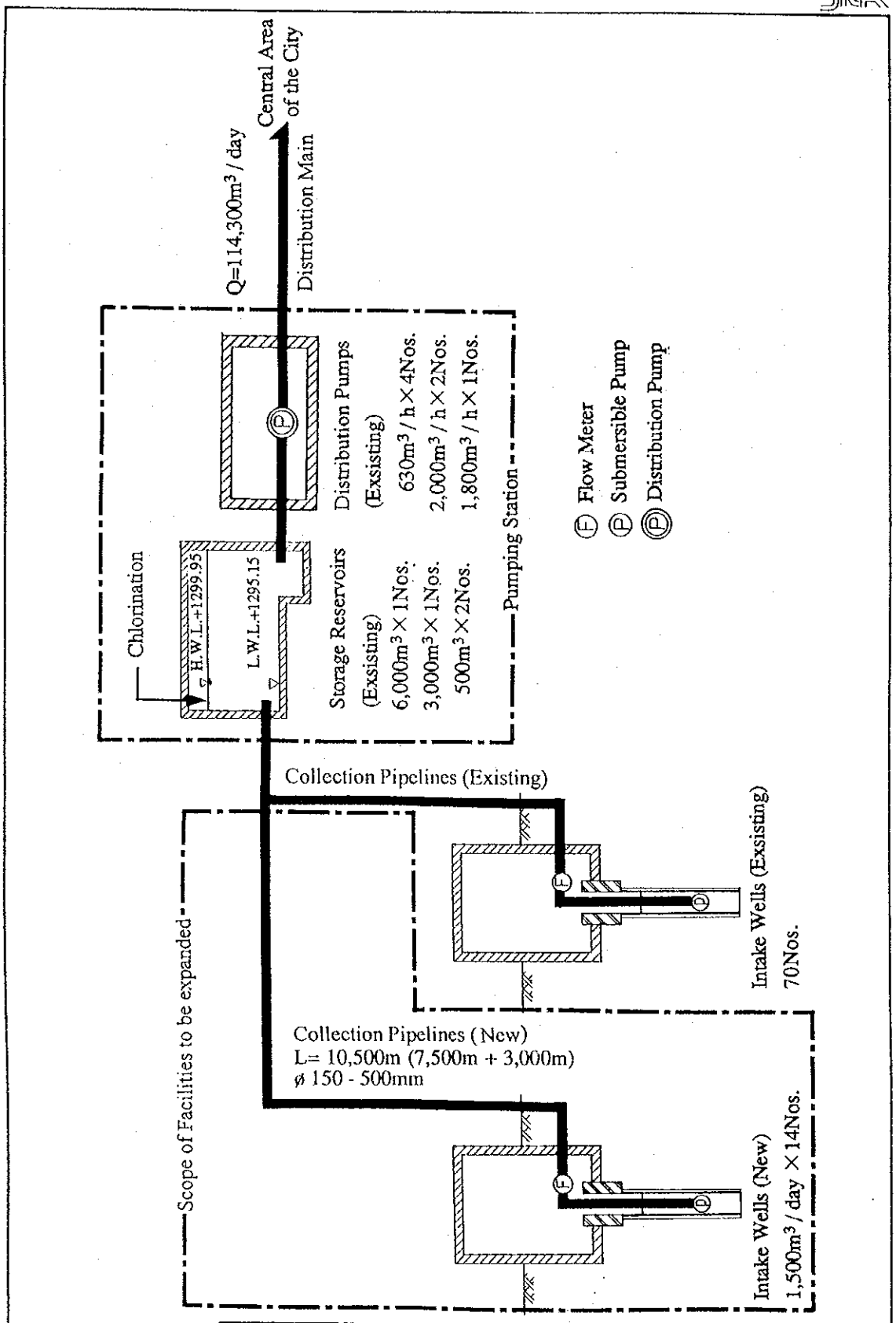

Fig. 4.2.3 System Flow Diagram of Central Water Source

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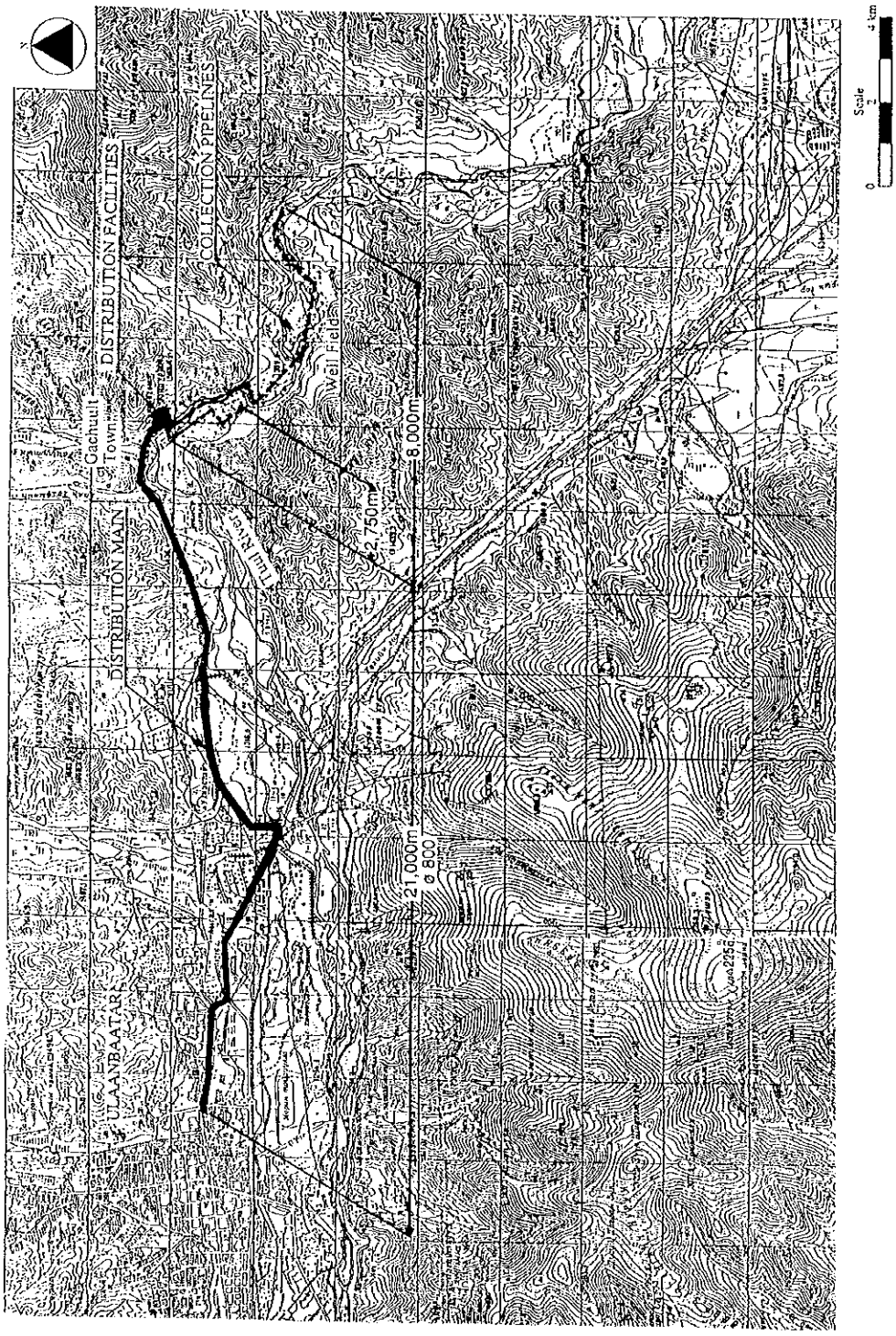

Fig. 4.2.4 Location of Lower Part of Nalaih

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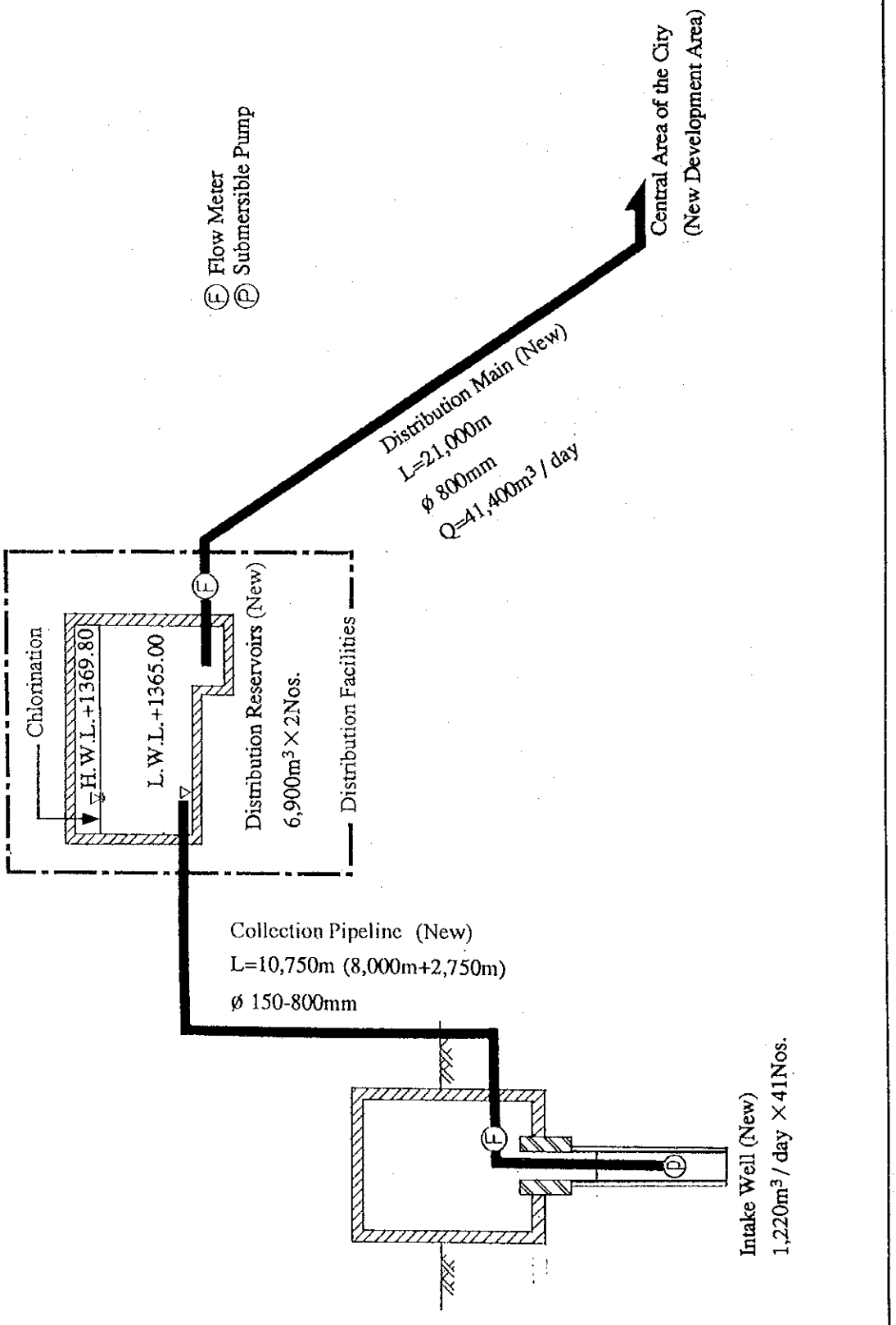

Fig. 4.2.5 System Flow Diagram of Lower Part of Nalaih

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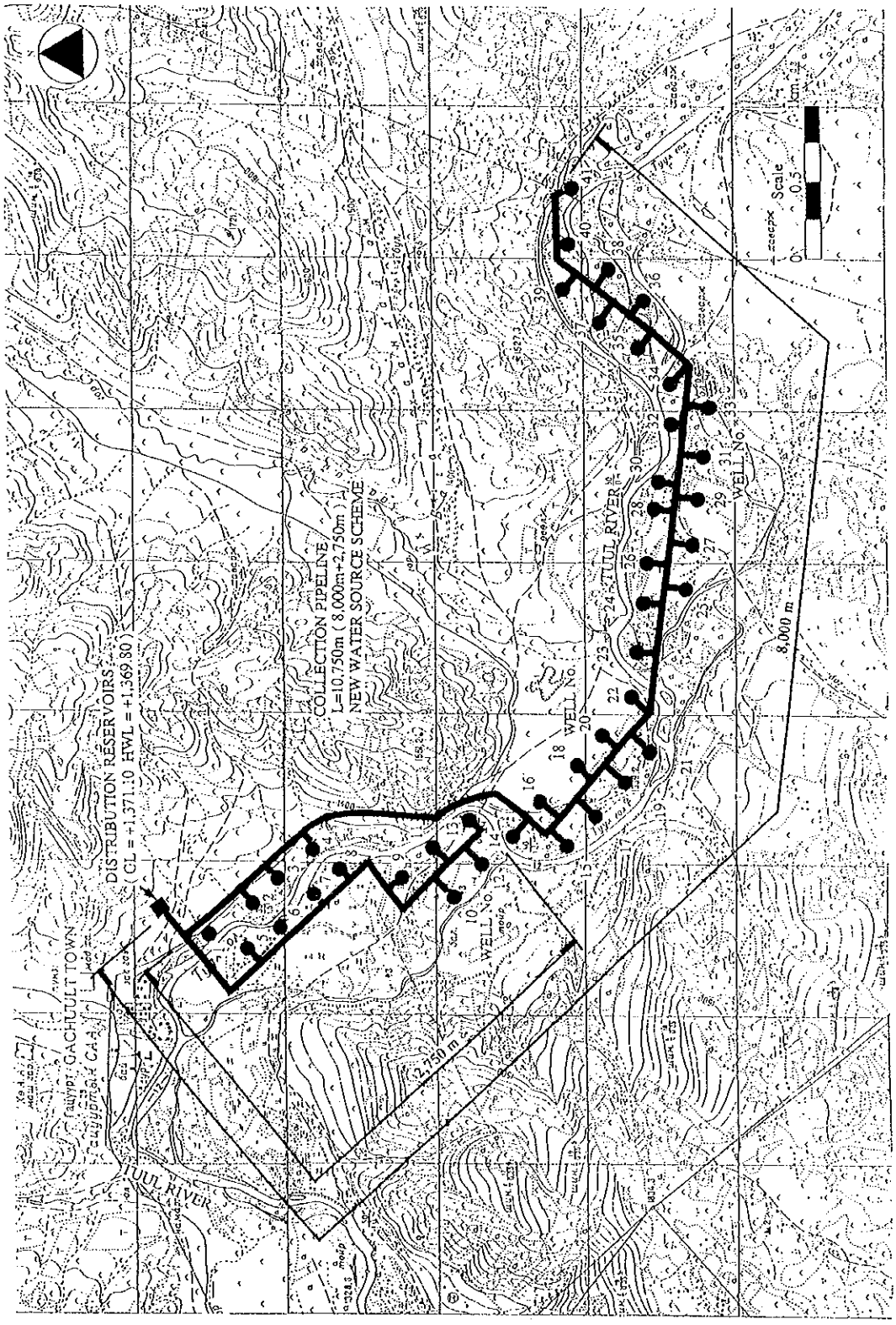

Fig. 4.2.6 Intake Facilities of Lower Part of Nalaih

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4.3 Cost Estimation of the Project

4.3 COST ESTIMATION OF THE PROJECT

The total investment cost amounts to US Dollars 67,335,380 which includes the direct construction cost, land acquisition cost, engineering cost, administration cost, and physical contingency. Its break down is shown below.

Total Investment Cost (December 1994 Price) (Unit : US Dollar)

No	Work Item	1st Stage	2nd Stage	3rd Stage	Amount
1	Direct Construction Cost	1,148,270	8,371,390	46,827,930	56,347,590
-1	Upper Water Source (Expansion of Existing Facilities)	1,148,270	0	0	1,148,270
1)	Transmission Facilities	394,290	0	0	394,290
2)	Others (for Zavsariin reservoir, etc.)	564,640	0	0	564,640
3)	Telecommunication System	189,340	0	0	189,340
- 2	Central Water Source (Expansion of Existing Facilities)	0	8,371,390	0	8,371,390
1)	Intake Facilities	0	8,371,390	0	8,371,390
- 3	New Water Source	0	0	46,827,930	46,827,960
1)	Intake Facilities	0	0	19,762,150	19,762,150
2)	Distribution Facilities	0	0	27,065,780	27,065,780
2	Land Acquisition Cost	0	0	0	0
3	Engineering Cost	492,900	807,800	2,361,900	3,662,600
4	Administration Cost (3 % of 1)	34,448	251,142	1,404,840	1,690,430
5	Physical Contingency (10% of 1)	114,827	837,139	4,682,794	5,634,760
	TOTAL	1,790,445	10,267,471	55,277,464	67,335,380

Note 1) Exchange Rate : US$ 1.00 = Yen 100.0, US$ 1.00 = Tg 400.0

The table of foreign & local currency of total investment cost is shown below.

Foreign & Local Currency of Total Investment Cost (As of December 1994 Price)

(Unit : US Dollar)

No	Work Item	1 st Stage			2 nd Stage			3 rd Stage			Amount		
		Foreign C	Local C	Sub-Total	Foreign C	Local C	Sub-Total	Foreign C	Local C	Sub-Total	Foreign C	Local C	GrandTotal
1	Direct Construction Cost	1,042,020	106,250	1,148,270	6,312,860	2,058,530	8,371,390	34,792,680	12,035,250	46,827,930	42,147,560	14,200,030	56,347,590
-1	Upper Water Source	1,042,020	106,250	1,148,270	0	0	0	0	0	0	1,042,020	106,250	1,148,270
-2	Central Water Source	0	0	0	6,312,860	2,058,530	8,371,390	0	0	0	6,312,860	2,058,530	8,371,390
-3	Lower Part of Nalaih	0	0	0	0	0	0	34,792,680	12,035,250	46,827,930	34,792,680	12,035,250	46,827,930
2	Land Acquisition Cost	0	0	0	0	0	0	0	0	0	0	0	0
3	Engineering Cost	492,900	0	492,900	807,800	0	807,800	2,361,900	0	2,361,900	3,662,600	0	3,662,600
4	Administration Cost [3% of 1]	0	34,448	34,448	0	251,142	251,142	0	1,404,840	1,404,840	0	1,690,430	1,690,430
5	Physical Contingency [10% of 1]	104,202	10,625	114,827	631,286	205,853	837,139	3,479,268	1,203,526	4,682,794	4,214,756	1,420,004	5,634,760
	Total	1,639,122	151,323	1,790,445	7,751,946	2,515,525	10,267,471	40,633,848	14,643,616	55,277,464	50,024,916	17,310,464	67,335,380

Note 1) Exchange Rate : US$ 1.00 = Yen 100.0 , US$ 1.00 = Tg. 400.0

4.4 Implementation Program

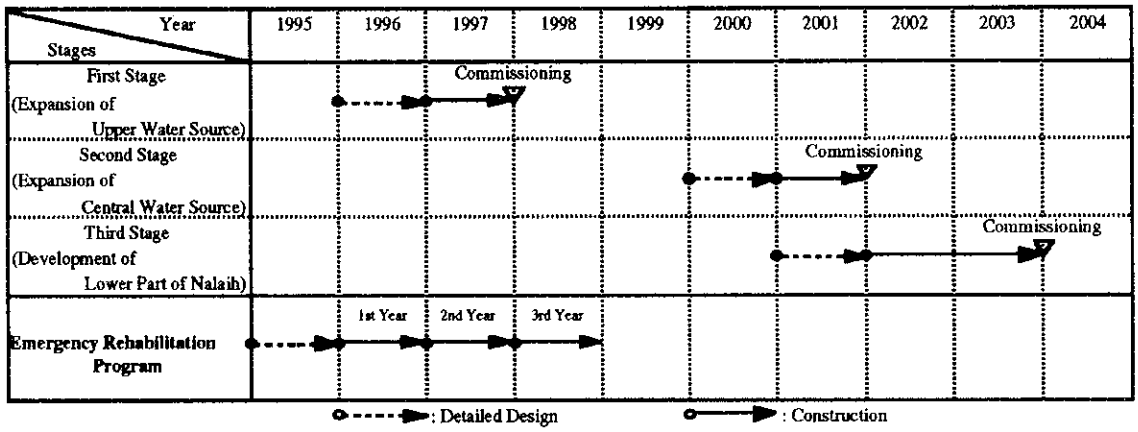
4.4 IMPLEMENTATION PROGRAM

(1) Implementation schedule

On the basis of this study, JICA Study Team proposes that first stage of this project shall be implemented in parallel with "Emergency Rehabilitation Program". It will be executed on three stages based on the future water demands by 2010 year as follows.

This implementation schedule of "Emergency Rehabilitation Program" is studied assuming that rehabilitations is to be done by three years from 1996.

Implementatiion Schedule



(2) Disbursement Schedule

The proposed disbursement schedule of the project is shown in Table 4.4.1.

Table 4.4.1 Disbursement Schedule of Investment Cost
(As of December 1994 Price)

(Unit : US Dollar)

No	Work Item	1 st Stage		2 nd Stage			3 rd Stage		Amount
		1996	1997	2000	2001	2001	2002	2003	
		Design	Construction	Design	Construction	Design	Construction	Construction	
1	Direct Construction Cost	0	1,148,270	0	8,371,390	0	23,411,000	23,416,930	56,347,590
	Upper Water Source (Expansion of Existing Facilities)	0	1,148,270	0	0	0	0	0	1,148,270
	Transmission Facilities	0	394,290	0	0	0	0	0	394,290
	Others (for Zavsariin reservoir,etc.)	0	564,640	0	0	0	0	0	564,640
	Telecommunication System	0	189,340	0	0	0	0	0	189,340
	Central Water Source (Expansion of Existing Facilities)	0	0	0	8,371,390	0	0	0	8,371,390
	Intake Facilities	0	0	0	8,371,390	0	0	0	8,371,390
	New Water Source	0	0	0	0	0	23,411,000	23,416,930	46,827,930
	Intake Facilities	0	0	0	0	0	9,881,000	9,881,150	19,762,150
	Distribution Facilities	0	0	0	0	0	13,530,000	13,535,780	27,065,780
2	Land Acquisition Cost	0	0	0	0	0	0	0	0
3	Engineering Cost	325,000	167,900	391,000	416,800	850,000	755,950	755,950	3,662,600
4	Administration Cost [3% of 1]	17,448	17,000	125,142	126,000	468,000	468,420	468,420	1,690,430
5	Physical Contingency [10% of 1]	0	114,827	0	837,139	0	2,341,400	2,341,394	5,634,760
	Total	342,448	1,447,997	516,142	9,751,329	1,318,000	26,976,770	26,982,694	67,335,380

Note
1) Exchange Rate : US$ 1.00 = Yen 100.0 , US$ 1.00 = Tg 400.0

4.5 Operation and Maintenance

4.5 OPERATION AND MAINTENANCE

4.5.1 General

Daily operation and maintenance has been conducted by USAG. The expanded facilities of Upper Water Source and Central Water Source shall be managed by the existing organization in the USAG. On the other hand, the developed facilities in Lower Part of Nalaih will be operated and maintained by the new organization that will be established in the USAG.

4.5.2 Operation and Maintenance Costs

Annual O/M costs consist the following items :

- electric consumption,
- chemical consumption,
- personal,
- repairing, and
- replacement cost.

The annual maximum O/M costs after the completion of each construction works without replacement cost (as of 1994) are estimated below.

(Unit : US Dollar)

Item		1st Stage	2nd Stage	3rd Stage
(1)	Electric Consumption Cost	354,605	129,508	179,436
(2)	Chemical Consumption Cost	420	101	242
(3)	Personnel Cost	0	0	37,800
(4)	Repair Cost	11,483	83,714	468,279
Total Annual O&M Cost		366,508	213,323	685,756

The equipment shall be periodically replaced at the end of its life span. The details of replacement cost are shown in the following table.

Replacement Cost
(Price of December 1994) (Unit US Dollar)

No	Item	Unit	Life Span	1st Stage	2nd Stage	3rd Stage	Total
1	Intake Facilities			0	8,371,390	19,762,150	28,133,540
	(1) Intake Wells	Year	15	0	1,302,000	2,673,000	3,975,000
	(2) Pump House	Year	40	0	875,000	2,562,500	3,437,500
	(3) Intake Pumps	Year	15	0	326,000	1,022,780	1,348,780
	(4) Other equipment	Year	20	0	2,550,090	6,793,070	9,343,160
	(5) Collection Pipe	Year	40	0	3,318,300	6,710,800	10,029,100
2	Distribution Facilities			1,148,270	0	27,065,780	28,214,050
	(1) Reservoirs	Year	40	0	0	750,000	750,000
	(2) Other equipment	Year	20	761,630	0	1,033,900	1,795,530
	(3) Chlorination Equipment	Year	15	386,640	0	343,680	730,320
	(4) Buildings	Year	40	0	0	1,208,200	1,208,200
	(5) Distribution Main	Year	40	0	0	23,730,000	23,730,000
3	Total of Replacement Cost			1,148,270	8,371,390	46,827,930	56,347,590
	every 15 Years			386,640	1,628,000	4,039,460	6,054,100
	every 20 Years			761,630	2,550,090	7,826,970	11,138,690
	every 40 Years			0	4,193,300	34,961,500	39,154,800

The more detailed description of annual O/M costs and replacement costs are shown in Table III.3.8 of Supporting Report III.

4.6 Project Evaluation

4.6 PROJECT EVALUATION

4.6.1 General

Raw ground water for the water supply system of Ulaanbaatar has been withdrawn from four water source along the Tuul River. An emergency rehabilitation programme, that is detailed in the Appendix in this report, will restore the production to its original design capacity. Then this project will expand the capacity of two out of four water sources and will develop the new water source area.

The principal aim of this analysis is to know the viability of the water use development scenario provided by the project. It will estimate the efficiency of the capital investment to the project.

One of the major tangible and estimable benefits that would be derived from the project is the increase in the production of drinking water. We count that value as the benefit of the project.

Table 4.6.1 shows the correlation between demand increase and possible supply increase by the proposed project implementation up to 2010. The difference between total volume of demand and the existing supply capacity is the increased volume of billed water to be attributed to the project.

EIRR has been used as an criterion to judge the efficiency of capital use. As the first step, an aspect of "An affordability" is discussed in 4.6.2, then the EIRR is estimated in 4.6.3. Table 4.6.2 gives the flow of costs and benefits.

Other major benefits include improving of the public health standard. Safe drinking water is essential for securing urban life against the water-borne epidemics. Value added to land may be counted as benefit after land ownership law is promulgated (This was one of 29 items which were on the agenda for the last parliament held in September 22, 1994.).
Finally, the financial implications for the future of the project are investigated in 4.6.4. First, the FIRR is calculated, the table of which is given in Table 4.6.3. Then the financial statements of the project with the proposed disbursement schedule of capital investment are estimated. The statements are given in Table 4.6.4 in a simplified form.

4.6.2 Affordability

(1) Domestic Users

Following table gives an idea of average monthly earnings of a family in different years.

Average monthly salary (Unit: Tg.)

		1989	1990	1991	1992	1993
National Enterprise	Tg.	539			5,845	8,000
	$	180			146	23
USAG	Tg.				2,000	7,365
	$				50	21
General*	Tg.		541		1,069	
	$		116		27	
Exchange Rate Tg./$		3	4.67	25.86	40	350

*1992 : Urban

Source : EIU. Country Profile, Mongolia (1993/94), calculation from USAG data.

A unit water rate is set as follows:

for domestic users ; Tg.34/m^3 (US$0.097 at an exchange rate of 350Tg./$ in 1993).

Average monthly earnings of both apartment and Ger dwellers have increased more than 10 times from 1989 to 1992 and 1.38 times from 1992 to 1993. It will be estimated to increase 40,000Tg. in 1998 at the same increasing rate of 1.38 times considering with the recent high infration rate.

Water tariff in 1998 ; 4.7persons/family x 0.43(0.01)m^3/person/day x 30days x Tg.34/m^3 =Tg.2,060(48)/family/month. Monthly earnings ; 40,000Tg.

Water tariff amounts to 5.1% of monthly earnings (water tariff of Ger dwellers amounts to 0.1% of monthly earnings). The weighted average of it is less than 2.6%. Considering a rapid growth of earnings in recent years in Mongolia, the percentage (5% of earnings) is forecasted to be decreasing in the year of implementation of the project.

The present water tariff will also support the possibility of future water tariff of which 5% of earnings can be spent for drinking water as the following reason.

The present percentage of drinking water tariff in the monthly earnings is estimated below :

apartment dwellers ; 2.1 % (4.7persons/family x 0.15m^3/person/day x 30days x Tg.8/m^3 =Tg.169.2/family/month ; Monthly earnings = 8,000Tg.)

Ger dwellers ; 5.3-7.9 % (4.7persons/family x 0.0074m^3/person/day x 30days x Tg.400-600/m^3 =Tg.420-630/family/month ; Monthly earnings = 8,000Tg.)

Ger dwellers, which occupy about 45% of population in Ulaanbaatar City, have been spending about more than 5% of earnings in drinking water.

Reference

Present water tariff (1993) is set as follow.

Apartment dwellers ; Tg.8/m^3 x 150 l/p/d, uniform water tariff

Ger dwellers ; Tg.400/m^3 and Tg.600/m^3, specific water tariff

Industry and others ; Tg.39/m^3, specific water tariff

(2) Industry and others

A unit water rate of Tg.100 (US$0.286 at an exchange rate of 350Tg./$ in 1993) is taken as a unit price for industry and others. A unit water rate of Tg.39/m^3 (US$0.112 at an exchange rate of 350Tg./$ in 1993) of piped water supply for industry and other uses in the present water rate is too cheap to make this proposed project to be viable (EIRR=-0.01%). A unit water rate of Tg.100 is for industry and other users who come to a service station to buy water using their own transport. In exceptional cases some users pay a unit price of Tg.600 in water cart supply area.

4.6.3 Economic Internal Rate of Return (EIRR)

(1) General Presumption in the EIRR Calculations

Basic assumption in doing this analysis including conversion of the financial values into economic ones are as follows.

1) The financial values of commodities are set as that of 1994. Therefore 1994 price of US dollar is used for calculation.
2) With no restriction in exchange of foreign currencies, the shadow exchange rate is set at 1. This means we could assume that the standard conversion factor to be 1.
3) Economic value of labor as well as commodities are set at their financial prices. (This project may require no land acquisition.)
4) The project life is set to be 40 years after the completion of the water supply works from the new water source in 2004.
5) The increase of billed water which is to come from the project can be calculated by subtracting the existing and near-future volume for which the facilities have been built or being built from the volume of average consumption (refer to the Table 4.6.1).
6) A unit rate per cubic meter for domestic users is set at US$0.097, and that for industry and other users is set at US$0.286.
7) Replacement and residual costs are placed in the schedule according to the useful lives of the facilities.

8) O & M costs are regarded as the variable costs when we estimate the costs before the installed capacity is fully used. (Personnel cost occupies 5.5 per cent of the total O & M costs only in the third stage, otherwise no personnel cost is involved.)

(2) Economic Internal Rate of Return (EIRR)

The EIRR of the project is estimated to be 3.5 % (refer to Table 4.6.2). Considering the socio-economic condition of Mongolia, it is desirable to improve living foundation for the reconstruction and growth of the national economy, which is accompanied by the shift to the market economy system since 1990.

Moreover, compared with the other sectors in Mongolia, the water supply project is situated at the order of the high priority from " Basic Human Needs" point of view. It can't be judged by Opportunity Cost of Capital. Therefore, the project is considered fairly viable.

(3) Sensitivity Analysis

We have considered two cases for sensitivity analysis. One, a case with financial efficiency at the level of 95 %. The resulted EIRR is estimated to be 3.0 %. The other, a case with 10 % increase of costs. The resulted EIRR is estimated to be 2.5 %.

4.6.4 Financial Internal Rate of Return (FIRR)

(1) General

We have calculated a FIRR of the project and made a trial forecast of the financial implications in this section. Table 4.6.3 shows a sample of financial statements of the USAG in simplified form from the commencement of the project, 1998 to 2021. The statements do not depict the total system of the USAG with existing facilities but only the capital investments made by the project and corresponding income and O/M costs.

It is quite clear from the estimate of EIRR (where ability is substituted by willingness) that a higher unit water rate than the present ones is required to meet the costs of introducing this new water production system. The unit price used for the calculation of benefit in the EIRR (US$ 0.097) is about twice as much as the Marginal Unit Cost (MUC) of present USAG operation (US$0.049), which is further twice as much as the unit domestic water rate used in the water tariff revised in Sep.1993. Therefore we are not able to make a future financial scenario based on the present water rate.

(2) Assumptions for estimating the FIRR

The following are assumptions made for the calculation of the FIRR.

1) The unit prices of domestic users and industrial and other users are set at US$0.09 and 0.27 respectively, taking USAG's financial efficiency of 95 % into account.
2) The government tax of 4 % is levied to represent all the transfer items.

(3) Financial Internal Rate of Return (FIRR)

The FIRR of the project is estimated at 2.6 % (see Table 4.6.3).

(4) Assumptions for focusing future financial statement

The following are assumptions we have made for the forecast.

1) Prices are expressed in 1996 US dollar term. Annual inflation rate from 1994 to 1996 is set at a present trend of 2.7 %
2) As a source of finance, a long term loan allocated for building up of a social infra-structure would suit the purpose. Its terms and conditions are reasonable. An example is a loan provided by the OECF; its annual interest rate is 2.6 %, and lending period is 30 years with 10 year grace period. We use these values in the table.
3) Annual depreciation rate is set at 3 % as the weighted average of useful lives of facilities and equipment is estimated at 33.5 years.
4) Future unit water rate in 1996 is set at US$0.111(=0.097x$1.027^3$) for domestic users, and at US$0.327 (=0.286x$1.027^3$) for industry and other users. Then the rate will be raised 15 % every five years presuming that the real income increase exceed 2.8 % per annum.
5) Financial efficiency is set at 95 %.
6) Government tax is set at 15 % when the enterprise makes a profit.

(5) Financial Statements of the USAG

An outcome of these assumptions is given the form of financial statements of the USAG in table 4.6.4.

During the first two years after the inception, the enterprise will have no income from the project, so the amount of interest to be paid will be covered by the government budget. Henceforward, though, with the proposed level of water rate the cash inflow will continuously exceed its outflow allowing the government to collect an income tax except years between 2003 and 2005.

On top of that, the enterprise will be able to afford the payment of amortization and replacement cost in the following years without government help, and the amount of reserved fund (=capital) will finally be 80 % to the amount of accumulated depreciation in 2019.

Thus, the table indicates that financial viability of the project could be achieved with the proposed level of water rate.

(6) A few recommendations

1) It is essential to raise the water rate up to the level (, i.e., a unit price equivalent to US$ 0.097/m^3) that cover the costs involved in the proposed expansion of water supply.

2) Introduction of differential water rates

To achieve both efficiency and equity in running the USAG in future, it is essential to monitor the unit production cost and to introduce differential water rates in the category of domestic users according to the volume used with introduction of individual meter to each household. The water rate applied to the inhabitants of Ger is very high if we compare it to the rate applied to piped water users.

An example of tariff rate for 1996 to 2001 is shown in the following table

(Unit : US$/m^3)

Apartment	0.105	Ger	0.21	Industry	0.358
Commerce	0.31	Social + Gov	0.138		

Table 4.6.1 Demand and Supply

	Population		lpcd*		Demand**					(I+O)/T	Production**					billed***
	Apartment	Ger	Apart.	Ger	Domestic	Industry	Others	Waste	Total	%	Central	I+M*4	Upper	New	Total	-161,100
1994	290,609	216,065	420	7.4	123,656	11,452	8,100	22,096	165,304	13%	87,488	53,676	24,140	0	165,304	-
1995	307,542	229,939	420	7.4	130,869	12,960	8,500	16,925	169,255	14%	97,000	58,000	24,000	0	179,000	-
1996	323,368	242,270	420	7.4	137,608	14,468	8,900	17,886	178,862	15%	97,000	58,000	24,000	0	179,000	-
1997	338,143	253,256	420	7.4	143,894	15,976	9,300	18,797	187,967	15%	97,000	58,000	24,000	0	179,000	-
1998	351,923	263,089	420	7.4	149,754	17,484	9,700	19,660	196,598	15%	97,000	58,000	72,000	0	227,000	15,838
1999	364,761	271,967	420	7.4	155,212	18,992	10,100	20,478	204,783	16%	97,000	58,000	72,000	0	227,000	23,204
2000	376,715	280,084	430	10	164,788	20,500	10,500	21,754	217,543	16%	97,000	58,000	72,000	0	227,000	34,688
2001	387,839	287,636	430	10	169,647	22,800	10,770	22,580	225,797	17%	97,000	58,000	72,000	0	227,000	42,117
2002	398,189	294,817	430	10	174,170	25,100	11,040	23,368	233,677	17%	114,300	58,000	72,000	0	244,300	49,210
2003	407,821	301,824	430	10	178,381	27,400	11,310	24,121	241,212	18%	114,300	58,000	72,000	0	244,300	55,991
2004	416,789	308,852	430	10	182,308	29,700	11,580	24,843	248,431	18%	114,300	58,000	72,000	41,400	285,700	62,488
2005	425,150	316,095	430	10	185,975	32,000	11,850	25,536	255,362	19%	114,300	58,000	72,000	41,400	285,700	68,725
2006	432,958	323,750	430	10	189,410	34,100	12,140	26,183	261,833	20%	114,300	58,000	72,000	41,400	285,700	74,550
2007	440,270	332,011	430	10	192,636	36,200	12,430	26,807	268,074	20%	114,300	58,000	72,000	41,400	285,700	80,166
2008	447,140	341,074	430	10	195,681	38,300	12,720	27,411	274,112	21%	114,300	58,000	72,000	41,400	285,700	85,601
2009	453,625	351,134	430	10	198,570	40,400	13,010	27,998	279,978	21%	114,300	58,000	72,000	41,400	285,700	90,880
2010	459,779	362,387	430	10	201,330	42,500	13,300	28,570	285,700	22%	114,300	58,000	72,000	41,400	285,700	96,030

* l/capita/day

** Unit = m^3/day

*** Demand(D+I+O) - 161,100

*4: I+M = Industrial + Meat

Table 4.6.2 EIRR

Year	Pr. Y.	billed water:m³/year Domestic	I+O	Benefit:D 0.097	Benefit:I+O 0.286	Benefit Total	Construction Replacement	O&M Cost	Total Cost	B-C US$:1994	Construction Replacement Residue Central	Upper	New	O & M Central	Upper	New
1996	1	0	0	0	0	0	342,448		342,448	-342,448		342,448				
1997	2	0	0	0	0	0	1,447,997		1,447,997	-1,447,997		1,447,997				
1998	3	4892830	888166	474,604	254,015	728,620	0	317,422	317,422	411,198					317,422	
1999	4	7132665	1336901	691,869	382,354	1,074,222	0	330,636	330,636	743,586					330,636	
2000	5	10656520	2004706	1,033,682	573,346	1,607,028	516,142	351,238	867,380	739,648	516,142				351,238	
2001	6	12833312	2539472	1,244,831	726,289	1,971,120	11,069,329	364,566	11,433,895	-9,462,774	9,751,329		1,318,000		364,566	
2002	7	14874964	3086539	1,442,872	882,750	2,325,622	26,976,770	448,845	27,425,615	-25,099,993			26,976,770	82,337	366,508	
2003	8	16792670	3644129	1,628,889	1,042,221	2,671,110	26,982,694	541,759	27,524,453	-24,853,343			26,982,694	175,251	366,508	
2004	9	18597137	4210952	1,803,922	1,204,332	3,008,255	0	648,258	648,258	2,359,997				213,323	366,508	68,427
2005	10	20298687	4786102	1,968,973	1,368,825	3,337,798	0	763,057	763,057	2,574,741				213,323	366,508	183,226
2006	11	21871254	5339363	2,121,512	1,527,058	3,648,569	0	870,249	870,249	2,778,320				213,323	366,508	290,418
2007	12	23362858	5897829	2,266,197	1,686,779	3,952,976	0	973,621	973,621	2,979,355				213,323	366,508	393,790
2008	13	24782793	6461625	2,403,931	1,848,025	4,251,956	0	1,073,648	1,073,648	3,178,308				213,323	366,508	493,817
2009	14	26140213	7031013	2,535,601	2,010,870	4,546,470	0	1,170,805	1,170,805	3,375,666				213,323	366,508	590,974
2010	15	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2011	16	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2012	17	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2013	18	27444491	7606433	2,662,116	2,175,440	4,837,555	386,640	1,265,587	1,652,227	3,185,328		386,640		213,323	366,508	685,756
2014	19	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2015	20	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2016	21	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2017	22	27444491	7606433	2,662,116	2,175,440	4,837,555	1,628,000	1,265,587	2,893,587	1,943,968	1,628,000			213,323	366,508	685,756
2018	23	27444491	7606433	2,662,116	2,175,440	4,837,555	761,630	1,265,587	2,027,217	2,810,338		761,630		213,323	366,508	685,756
2019	24	27444491	7606433	2,662,116	2,175,440	4,837,555	4,039,460	1,265,587	5,305,047	-467,492			4,039,460	213,323	366,508	685,756
2020	25	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2021	26	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2022	27	27444491	7606433	2,662,116	2,175,440	4,837,555	2,550,090	1,265,587	3,815,677	1,021,878	2,550,090			213,323	366,508	685,756
2023	28	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2024	29	27444491	7606433	2,662,116	2,175,440	4,837,555	7,826,970	1,265,587	9,092,557	-4,255,002			7,826,970	213,323	366,508	685,756
2025	30	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2026	31	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2027	32	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2028	33	27444491	7606433	2,662,116	2,175,440	4,837,555	386,640	1,265,587	1,652,227	3,185,328		386,640		213,323	366,508	685,756
2029	34	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2030	35	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2031	36	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2032	37	27444491	7606433	2,662,116	2,175,440	4,837,555	1,628,000	1,265,587	2,893,587	1,943,968	1,628,000			213,323	366,508	685,756
2033	38	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2034	39	27444491	7606433	2,662,116	2,175,440	4,837,555	4,039,460	1,265,587	5,305,047	-467,492			4,039,460	213,323	366,508	685,756
2035	40	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2036	41	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213323	366508	685756
2037	42	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2038	43	27444491	7606433	2,662,116	2,175,440	4,837,555	761,630	1,265,587	2,027,217	2,810,338		761,630		213,323	366,508	685,756
2039	44	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2040	45	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2041	46	27444491	7606433	2,662,116	2,175,440	4,837,555	0	1,265,587	1,265,587	3,571,968				213,323	366,508	685,756
2042	47	27444491	7606433	2,662,116	2,175,440	4,837,555	6,743,390	1,265,587	8,008,977	-3,171,422	6,743,390			213,323	366,508	685,756
2043	48	27444490.6	7606432.9	2,662,116	2,175,440	4,837,555	-8,458,168	1,265,587	-7,192,581	12,030,136	-6,604,316	-507,365	-1,346,487	213,323	366,508	685,756
									EIRR=	3.52%						

Table 4.6.3 FIRR

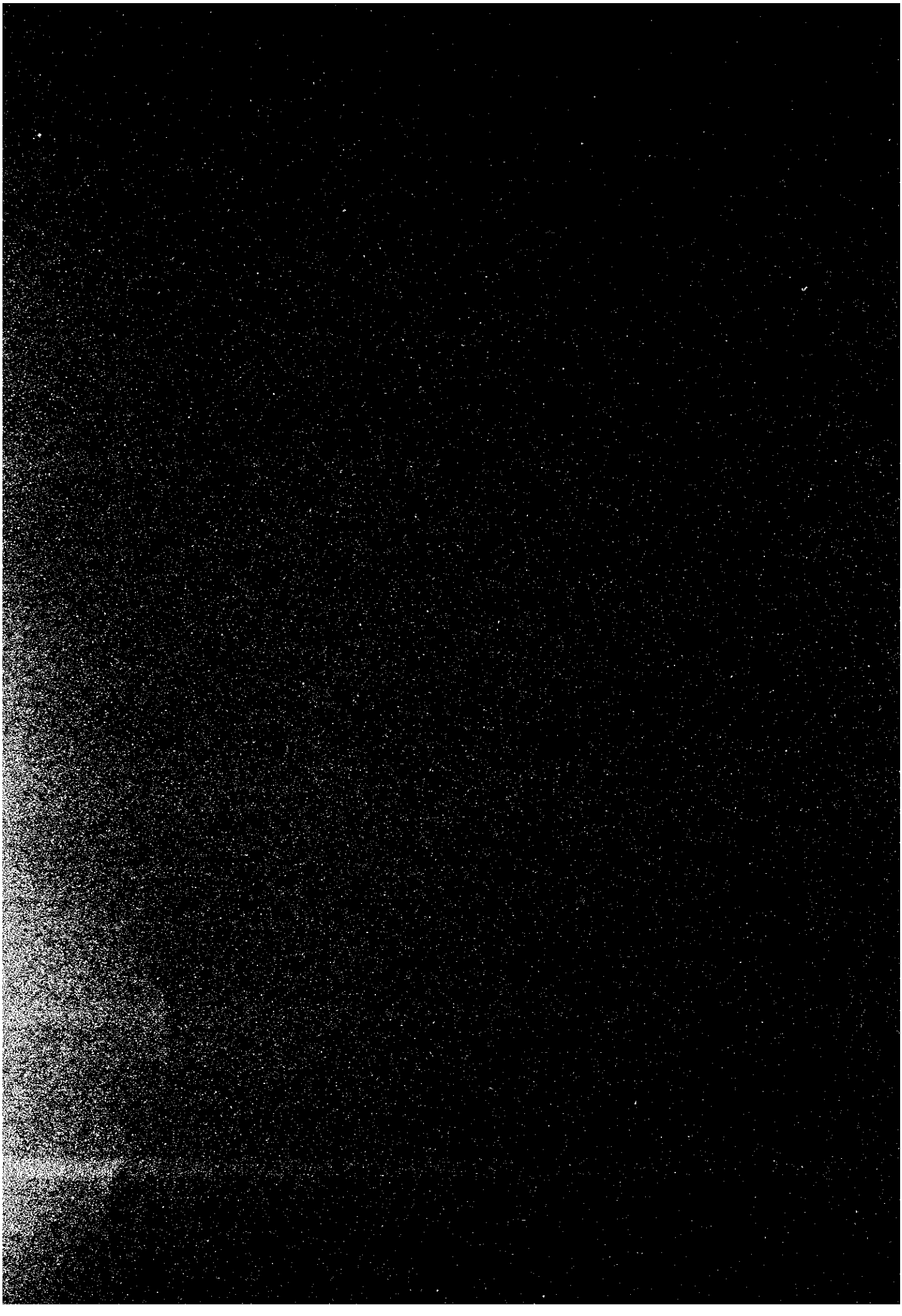
Year	Pr. Y.	billed water:m³/year Domestic	I+O	Income:D 0.09	Income:I+O 0.27	Income Total	Construction Replacement	O&M Cost	Gov.Tax 0.04	Total Cost	I - C US$;1994	Construction Replacement Residue Central	Upper	New	O & M Central	Upper	New
1996	1	0	0	0	0	0	342,448			342,448	-342,448		342,448				
1997	2	0	0	0	0	0	1,447,997			1,447,997	-1,447,997		1,447,997				
1998	3	4892830	888166	450,874	241,315	692,189	0	317,422	27,688	345,110	347,079					317,422	
1999	4	7132665	1336901	657,275	363,236	1,020,511	0	330,636	40,820	371,457	649,054					330,636	
2000	5	10656520	2004706	981,998	544,679	1,526,677	516,142	351,238	61,067	928,447	598,230	516,142				351,238	
2001	6	12833312	2539472	1,182,590	689,974	1,872,564	11,069,329	364,566	74,903	11,508,797	-9,636,233	9,751,329		1,318,000		364,566	
2002	7	14874964	3086539	1,370,728	838,613	2,209,341	26,976,770	448,845	88,374	27,513,989	-25,304,648			26,976,770	82,337	366,508	
2003	8	16792670	3644129	1,547,445	990,110	2,537,554	26,982,694	541,759	101,502	27,625,956	-25,088,401			26,982,694	175,251	366,508	
2004	9	18597137	4210952	1,713,726	1,144,116	2,857,842	0	648,258	114,314	762,571	2,095,270				213,323	366,508	68,427
2005	10	20298687	4786102	1,870,524	1,300,384	3,170,908	0	763,057	126,836	889,894	2,281,014				213,323	366,508	183,226
2006	11	21871254	5339363	2,015,436	1,450,705	3,466,141	0	870,249	138,646	1,008,895	2,457,246				213,323	366,508	290,418
2007	12	23362858	5897829	2,152,887	1,602,440	3,755,328	0	973,621	150,213	1,123,834	2,631,493				213,323	366,508	393,790
2008	13	24782793	6461625	2,283,734	1,755,623	4,039,358	0	1,073,648	161,574	1,235,222	2,804,136				213,323	366,508	493,817
2009	14	26140213	7031013	2,408,821	1,910,326	4,319,147	0	1,170,805	172,766	1,343,570	2,975,576				213,323	366,508	590,974
2010	15	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2011	16	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2012	17	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2013	18	27444491	7606433	2,529,010	2,066,668	4,595,678	386,640	1,265,587	183,827	1,836,054	2,759,624		386,640		213,323	366,508	685,756
2014	19	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2015	20	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2016	21	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2017	22	27444491	7606433	2,529,010	2,066,668	4,595,678	1,628,000	1,265,587	183,827	3,077,414	1,518,264	1,628,000			213,323	366,508	685,756
2018	23	27444491	7606433	2,529,010	2,066,668	4,595,678	761,630	1,265,587	183,827	2,211,044	2,384,634		761,630		213,323	366,508	685,756
2019	24	27444491	7606433	2,529,010	2,066,668	4,595,678	4,039,460	1,265,587	183,827	5,488,874	-893,196			4,039,460	213,323	366,508	685,756
2020	25	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2021	26	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2022	27	27444491	7606433	2,529,010	2,066,668	4,595,678	2,550,090	1,265,587	183,827	3,999,504	596,174	2,550,090			213,323	366,508	685,756
2023	28	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2024	29	27444491	7606433	2,529,010	2,066,668	4,595,678	7,826,970	1,265,587	183,827	9,276,384	-4,680,706			7,826,970	213,323	366,508	685,756
2025	30	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2026	31	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2027	32	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2028	33	27444491	7606433	2,529,010	2,066,668	4,595,678	386,640	1,265,587	183,827	1,836,054	2,759,624		386,640		213,323	366,508	685,756
2029	34	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2030	35	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2031	36	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2032	37	27444491	7606433	2,529,010	2,066,668	4,595,678	1,628,000	1,265,587	183,827	3,077,414	1,518,264	1,628,000			213,323	366,508	685,756
2033	38	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2034	39	27444491	7606433	2,529,010	2,066,668	4,595,678	4,039,460	1,265,587	183,827	5,488,874	-893,196			4,039,460	213,323	366,508	685,756
2035	40	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2036	41	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213323	366508	685756
2037	42	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2038	43	27444491	7606433	2,529,010	2,066,668	4,595,678	761,630	1,265,587	183,827	2,211,044	2,384,634		761,630		213,323	366,508	685,756
2039	44	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2040	45	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2041	46	27444491	7606433	2,529,010	2,066,668	4,595,678	0	1,265,587	183,827	1,449,414	3,146,264				213,323	366,508	685,756
2042	47	27444491	7606433	2,529,010	2,066,668	4,595,678	6,743,390	1,265,587	183,827	8,192,804	-3,597,126	6,743,390			213,323	366,508	685,756
2043	48	27444490.6	7606432.9	2,529,010	2,066,668	4,595,678	-8,458,168	1,265,587	183,827	-7,008,754	11,604,431	-6,604,316	-507,365	-1,346,487	213,323	366,508	685,756
											FIRR=	2.55%					

Table 4.6.4 Financial Statements of USAG

BALANCE SHEET (SIMPLIFIED) unit:1996 US$ mil. (inflation rate 2.7% pa up to 1996)

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
YEAR	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Assets	0.36	1.89	1.89	1.89	2.43	14.11	42.56	71.02	71.02	71.02	71.02	71.02	71.02	71.02	71.02	71.02	71.02	71.02	71.02	71.02	71.02	71.02	71.02	71.02
Depreciation: 3%	0.01	0.06	0.06	0.06	0.07	0.42	1.28	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13
(-)Accum.Depreciation	0.01	0.07	0.12	0.18	0.25	0.68	1.95	4.08	6.22	8.35	10.48	12.61	14.74	16.87	19.00	21.13	23.26	24.98	27.11	29.24	31.37	31.79	33.12	30.99
Assets: net	0.35	1.82	1.76	1.71	2.18	13.43	40.61	66.94	64.81	62.67	60.54	58.41	56.28	54.15	52.02	49.89	47.76	46.04	43.91	41.78	39.65	39.23	37.91	40.03
Current Assets	0.00	0.00	0.35	1.03	2.19	3.74	5.11	6.09	7.40	9.00	11.50	14.22	17.22	20.14	22.95	25.99	27.65	27.56	27.96	28.43	29.90	29.73	30.55	27.99
TOTAL ASSETS	0.35	1.82	2.12	2.74	4.37	17.17	45.72	73.03	72.20	71.68	72.05	72.63	73.51	74.30	74.97	75.88	75.41	73.60	71.86	70.21	69.54	68.96	68.46	68.03
Long Term Loan	0.36	1.53	0.00	0.00	0.54	11.68	28.45	28.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Loan:Cumulative	0.36	1.89	1.89	1.89	2.43	14.11	42.56	71.02	71.02	71.02	71.00	70.91	70.81	70.72	70.60	69.89	67.76	64.21	60.66	57.11	53.56	50.01	46.46	42.91
[(-)Amortization:5%]	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.09	0.09	0.09	0.12	0.71	2.13	3.55	3.55	3.55	3.55	3.55	3.55	3.55
Reserved Fund	-0.01	-0.07	0.23	0.85	1.93	3.07	3.16	2.01	1.18	0.66	1.05	1.73	2.69	3.58	4.38	5.99	7.65	9.39	11.20	13.10	15.98	18.95	22.00	25.12
TOTAL LIABIL.&CAPITAL	0.35	1.82	2.12	2.74	4.37	17.17	45.72	73.03	72.20	71.68	72.05	72.63	73.51	74.30	74.97	75.88	75.41	73.60	71.86	70.21	69.54	68.96	68.46	68.03
INCOME AND EXPENDITURE STATEMENT																								
Income: Domestic	0.00	0.00	0.52	0.75	1.12	1.55	1.80	2.03	2.25	2.46	3.05	3.25	3.45	3.45	3.45	3.97	3.97	3.97	3.97	3.97	4.56	4.56	4.56	4.56
Income: I+O	0.00	0.00	0.28	0.44	0.66	0.95	1.16	1.37	1.58	1.80	2.31	2.55	2.79	2.79	2.79	3.21	3.21	3.21	3.21	3.21	3.69	3.69	3.69	3.69
Gov.Contribution	0.01	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Income	0.01	0.05	0.79	1.19	1.78	2.51	2.96	3.40	3.83	4.26	5.35	5.80	6.24	6.24	6.24	7.18	7.18	7.18	7.18	7.18	8.26	8.26	8.26	8.26
O/M Costs	0.00	0.00	0.33	0.35	0.37	0.38	0.47	0.57	0.68	0.80	0.92	1.03	1.13	1.23	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33
Depreciation	0.01	0.06	0.06	0.06	0.07	0.42	1.28	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13	2.13
Interest Payment:2.6%	0.01	0.05	0.05	0.05	0.06	0.37	1.11	1.85	1.85	1.85	1.85	1.84	1.84	1.84	1.84	1.82	1.76	1.67	1.58	1.48	1.39	1.30	1.21	1.12
Expenditure	0.02	0.11	0.44	0.45	0.51	1.17	2.86	4.55	4.66	4.78	4.89	5.00	5.10	5.20	5.30	5.28	5.23	5.14	5.04	4.95	4.86	4.77	4.67	4.58
Government Tax	0.00	0.00	0.05	0.11	0.19	0.20	0.02	0.00	0.00	0.00	0.07	0.12	0.17	0.16	0.14	0.28	0.29	0.31	0.32	0.33	0.51	0.52	0.54	0.55
BALANCE: after tax	-0.01	-0.06	0.30	0.62	1.08	1.13	0.09	-1.15	-0.83	-0.53	0.39	0.68	0.97	0.88	0.80	1.61	1.66	1.74	1.82	1.89	2.89	2.97	3.05	3.12
CASH FLOW																								
Loan	0.36	1.53	0.00	0.00	0.54	11.68	28.45	28.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Income: D+I+O	0.00	0.00	0.79	1.19	1.78	2.51	2.96	3.40	3.83	4.26	5.35	5.80	6.24	6.24	6.24	7.18	7.18	7.18	7.18	7.18	8.26	8.26	8.26	8.26
Gov.Contribution	0.01	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Inflow	0.37	1.58	0.79	1.19	2.32	14.18	31.41	31.86	3.83	4.26	5.35	5.80	6.24	6.24	6.24	7.18	7.18	7.18	7.18	7.18	8.26	8.26	8.26	8.26
Investment	0.36	1.53	0.00	0.00	0.54	11.68	28.45	28.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
O/M Costs	0.00	0.00	0.33	0.35	0.37	0.38	0.47	0.57	0.68	0.80	0.92	1.03	1.13	1.23	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33	1.33
Amortization: 5%	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.09	0.09	0.09	0.12	0.71	2.13	3.55	3.55	3.55	3.55	3.55	3.55	3.55
Interest Payment:2.6%	0.01	0.05	0.05	0.05	0.06	0.37	1.11	1.85	1.85	1.85	1.85	1.84	1.84	1.84	1.84	1.82	1.76	1.67	1.58	1.48	1.39	1.30	1.21	1.12
Government Tax	0.00	0.00	0.05	0.11	0.19	0.20	0.02	0.00	0.00	0.00	0.07	0.12	0.17	0.16	0.14	0.28	0.29	0.31	0.32	0.33	0.51	0.52	0.54	0.55
Total Outflow	0.37	1.58	0.44	0.51	1.17	12.63	30.05	30.88	2.53	2.65	2.85	3.08	3.24	3.32	3.43	4.14	5.52	6.86	6.78	6.71	6.79	6.71	6.63	6.55
Net Cash Inflow	0.00	0.00	0.35	0.68	1.15	1.56	1.37	0.98	1.30	1.60	2.50	2.72	3.00	2.92	2.81	3.04	1.66	0.32	0.40	0.47	1.47	1.55	1.62	1.70
Cash Balance	0.00	0.00	0.35	1.03	2.19	3.74	5.11	6.09	7.40	9.00	11.50	14.22	17.22	20.14	22.95	25.99	27.65	27.56	27.96	28.43	29.90	29.73	30.55	27.99
paid water (D): m³/year/mil		0	4.89	7.13	10.66	12.83	14.87	16.79	18.60	20.30	21.87	23.36	24.78	24.78	24.78	24.78	24.78	24.78	24.78	24.78	24.78	24.78	24.78	24.78
paid water:I+O: m³/year/mil		0	0.89	1.34	2.00	2.54	3.09	3.64	4.21	4.79	5.34	5.90	6.46	6.46	6.46	6.46	6.46	6.46	6.46	6.46	6.46	6.46	6.46	6.46
water rate:D:US$./m³	0.10507	0.10507	0.105071	0.105071	0.10507	0.12	0.12	0.12	0.12	0.12	0.14	0.14	0.14	0.14	0.14	0.16	0.16	0.16	0.16	0.16	0.18	0.18	0.18	0.18
water rate:I+O:US$./m³	0.3098	0.3098	0.309797	0.309797	0.3098	0.36	0.36	0.36	0.36	0.36	0.41	0.41	0.41	0.41	0.41	0.47	0.47	0.47	0.47	0.47	0.54	0.54	0.54	0.54
depreciation rate	0.03														Replacement (mil.US$)=			0.4078				1.7171	0.80331	4.26054
interest rate	0.026																							
inflation rate:2.7%pa	1.05473 (1994-1996)																							
water rate increase	1.08321 /3 years after 1993					1.15 /5 years after 1996					1.15 /5 years after 2001					1.15 /5 years after 2006						1.15 /5 years after 2011		
financial efficiency	0.95		real income increase pa =		1.02835																			
gov. profit tax rate	0.15																							

CHAPTER 5. RECOMMENDATION



CHAPTER 5. RECOMMENDATION

(1) Early Implementation of Proposed Project

An early implementation of the project after the Emergency Rehabilitation Program as described below, is necessary to meet the increasing water demand of Ulaanbaatar City.

- Expansion of water supply facilities for Upper Water Source
- Expansion of water supply facilities for Central Water Source
- Development of new water source of Lower Part of Nalaih.

Hence, it is recommended to commence the necessary financial procurement.

(2) Groundwater potential

Groundwater source, namely Upper Water Source, Central Water Source, and Lower Part of Nalaih can satisfy the water demand in 2010.

After 2010, groundwater resources of downstream of Tuul River are available to supply the large volume of water to the City, but these water resources are located far from the City and then the development cost of these water resources are estimated high. Consequently, the development of these water resources shall be examined on its economical merits comparing with the development of surface water.

(3) Surface Water

Surface water has the large potential, but development cost is estimated to be very high. It is unsuitable for the independent project of the water supply. The development of surface water shall be considered in connection with the development of flood mitigation, hydroelectric power generation, irrigation water , and industrial water from the economical point of view.

(4) Improvement of Water Tariff System

It is recommended that the Water Tariff System applied to the Apartment dwellers should be changed from the present uniform tariff system (Tg. 8/m^3 x 150 l/person/day) to the water tariff system based on the consumption capacity by using the water meters.

If the tariff is to be charged according to the consumption capacity, water saving of the dwellers and decrease of water leakage from the taps is expected which will lead to the stability of water supply. In the Emergency Rehabilitation Program, installation of water meters at the Central Heating Centers (CTP) is proposed.

As the first stage of the improvement of tariff system, USAG should collect the tariff from CTP based on the consumption capacity by using the water meters.

Installation of water meters to each apartment is recommended finally. More over, the improvement of water tariff collection ratio by strengthening the organization of USAG is also recommended

(5) Measuring System of Supply Water

(i) At present, water meters are not used for CTP, large consumers, and Pumping Stations.
Installing and utilizing the water meters, the actual capacity will be recognized, which will be the basis of daily operation and maintenance and tariff collection. It will also improve the people's consciousness of saving water.

(ii) The employment of economical lever for the economical use of the City Water Supply should consider the items below.

- USAG and CTP will be established measuring and monitoring system of water supply.
- Individual consumers have to uplift the saved water. It well be possible to achieve by changing from the present uniform tariff system to the water tariff system based on the actual consumption capacity by use of water meters.

(6) Measures against contamination of Water Sources

(i) It is very important to prevent the water sources from the contamination by industrial wastes, effluent from industries and sewage. The measures against these contamination of Water Sources, especially in the Industrial Water Source and Meat Complex Water Source, should be taken urgently. Waste water and industrial wastes, both treated and untreated, from the industrial factories located near the Industrial Water Source and Meat Complex Water Source should be surveyed detail and the possibility to contaminate these water sources should be studied first of all.
After that, the measures to prevent the water sources from contamination should be studied.

(ii) From the results of this study, it is found that the water qualities of all existing water sources (Upper, Central, Industrial, Meat Complex) and of the proposed new water source (Lower Part of Nalaih) are suitable for drinking water in Mongolia.
The sanitary protection zones like enclosure by fence to prevent the water quality of new water source as well as the above existing water sources are also necessary.
From the above mentioned, pollution of above water sources due to the wastewater from the Nalaih District will be not caused.
However, as the development of new water source is started, the effects of wastewater from Nalaih District shall be studied.

(7) Restriction for the groundwater development

Groundwater is the limited natural resources that shall be endeavored to be sustainable development. It shall be utilized under the management.

Fissure aquifer is the limited water resources. Especially, fissure aquifers in North of Ulaanbaatar are the precious water source which are located near by Ulaanbaatar City and its water quality is good. The development of fissure aquifer in North of Ulaanbaatar shall be restricted without the permission of USAG and Mongolian government.

Alluvial aquifer of Upper Water Source and Central Water Source in connection with Industrial and Meat Complex Water sources shall be also controlled by USAG and Mongolian government.

(8) Preservation of the existing water source

All production well in the Central Water Source shall be kept at the pumping rate of less than 1500m^3/day to protect the damage of wells and to preserve the groundwater resource.

(9) Improvement and Expansion of the Sewerage System

According to the expansion of water service area, the improvement and expansion of the existing sewerage system will be required.

This is very important for the prevention of contamination to the Industrial Water Source and Meat Complex Water Source, and also the improvement of sanitation.

(10) Improvement of Water Supply System for Ger Area

In Ger Area, the dwellers get the water from kiosks by themselves using the transporting vessels. For improving the system, the following steps are proposed.

- Installation of Public Hydrants
- Connecting the existing distribution pipeline to the kiosks

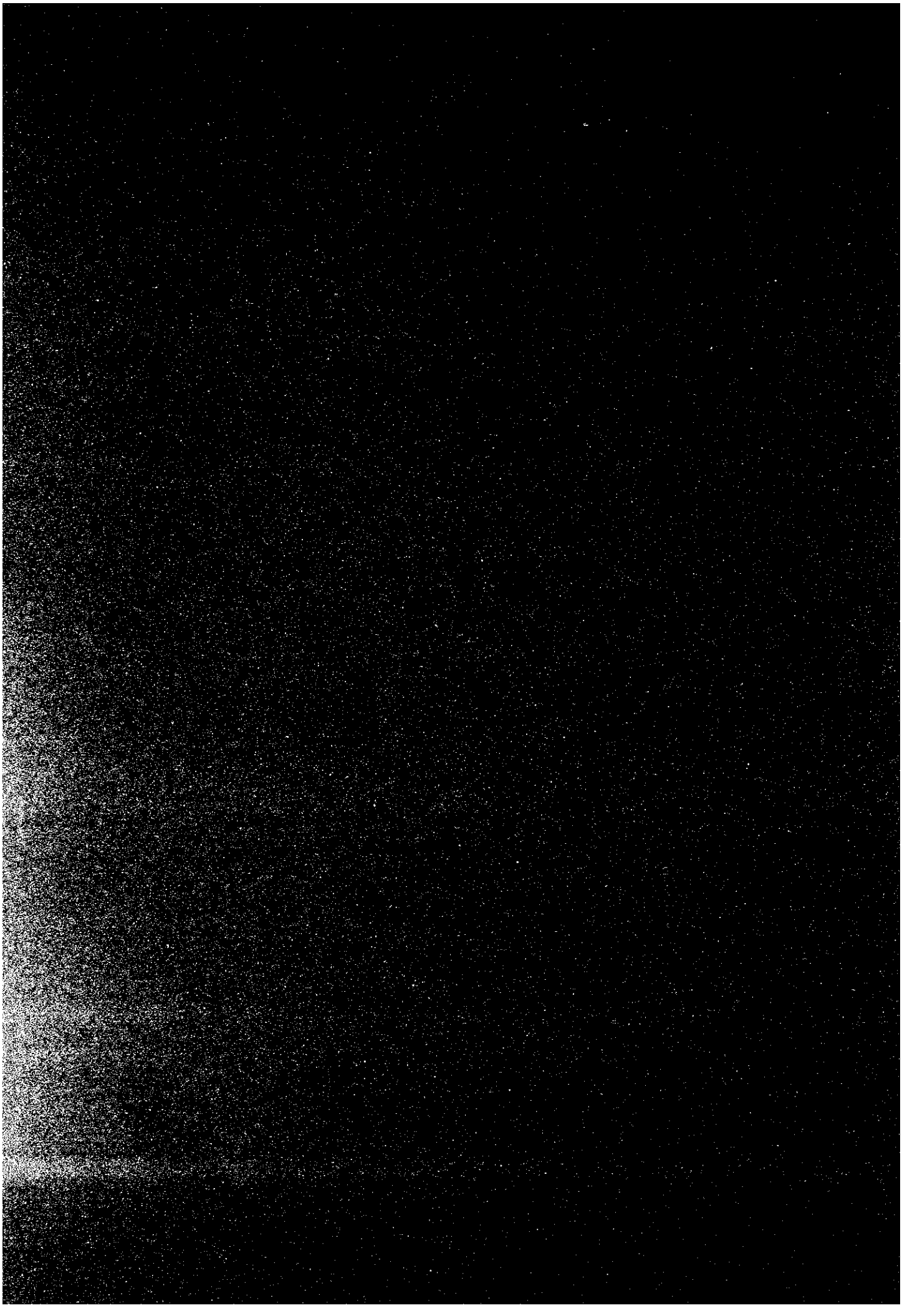
(11) Others

(i) Test well shall be used for the measurement of groundwater table to manage the groundwater resources. A-1 to A-4 test wells except A-2, which have the sufficient groundwater for local use, shall be considered to supply the water to Ger dwellers. The water of A-2, B-1 and B-2 test wells will be able to use for drinking water if Mn and Fe are removed.
Water quality of test wells shall be studied based on the periodical analysis of the groundwater before utilization

Intake facilities and pipeline, including the water hydrants or kiosks, from these wells to the adjacent Ger areas shall be studied.

(ii) If factories and other consumers require a new water source in future, a utilization of surface water, Lower Part of Power Plant and The Down Stream shall be studied to meet the purpose of the usage of the water.

APPENDIX



APPENDIX

EMERGENCY REHABILITATION PROGRAM

1. PLANNING OF THE EMERGENCY REHABILITATION PROGRAM

As the results of this surveys, several technical problems were confirmed in the present water supply system. The problems are categorized into two types; namely, (1) problems to be urgently taken care, and (2) problems to be solved in the long term plan.

The category (1) problems are proposed to be solved by implementation of the Emergency Rehabilitation Program. These problems are as follows.

1) Damage or deterioration of the existing intake pumps.
2) Breakage (out of service) of the existing remote operation system for intake pumps.
3) Damage of the existing distribution pumps.
4) Shortage in number of water tank lorries.
5) Deterioration of the existing intake tube wells.
6) Lack/damage of water flow-rate measuring devices at CTP

These are mainly mechanical troubles: damage or deterioration of pumps and machinery. Therefore, these are expected to be solved or improved with replacement of the existing pumps/machinery, very effectively within comparatively short time. Unless the damaged equipment had been replaced or repaired, the water supply system would not work properly; thus people would not be supplied with domestic water for their daily life. By the implementation of the Program, the water supply system of Ulaanbaatar City will resume its proper function.

In order to solve the above problems, the following items are proposed for the Emergency Rehabilitation Program.

(Item-1) : Replacement of the existing intake pumps.
(Item-2) : Remote operation system for the above pumps.
(Item-3) : Replacement of the existing distribution pumps.
(Item-4) : Procurement of water tank lorries.
(Item-5) : Procurement of materials for well construction.
(Item-6) : Remote operation system for existing intake pumps.
(Item-7) : Replacement of water meters at Central Heating Centers (CTP).

2. PRELIMINARY DESIGN FOR THE EMERGENCY REHABILITATION PROGRAM

2.1 Preliminary Planning

The Emergency Rehabilitation Program aims to rehabilitate the present water supply facilities which have been deteriorated/damaged and become out of service, by replacing the damaged/deteriorated equipment such as intake pumps, distribution pumps, water tank lorries and so on with new equipment. Accordingly, technical specification of new equipment is in principle proposed to be the same as or similar to the existing one.

The Program is preliminarily planned with the following component and conception.

(Item-1) : Replacement of the Existing Intake Pumps.

- Number of pump to be replaced with new submersible pump = 35 units (procurement and installation)
- Number of extra new submersible pump = 11 units (procurement only)

Note: - The above both items will include the following:
Major pipes in the pump house, flow-rate measurement device, electric-motor valve and non-return valve in the delivery pipe, electric control panel, room heater, lamps, manual hoist.
- The number of extra new pumps is proposed to be about 30% of the number of new pumps.
- Intake pumps in Upper Water Source were installed in 1991, comparatively new; and these are not required to be urgently replaced.

List of Intake Pumps to be Replaced

Water Source	Number's	Specification of the New Intake Pumps (Submersible Type)
	Actual + Extra	
1) Central	23 units + 7 units	$63m^3$/hour x 60m x30 units
2) Industrial	7 units + 2 units	120 " x 60m x 9 "
3) Meat	5 units + 2 units	120 " x 60m x 7 "
4) Upper	- -	-
Total	35 units + 11 units = 46 units	

(Item-2) : Remote Operation System for the above Pumps.

This remote operation system aims to enable operators to operate from the control room in the pumping stations where the above new pumps are located.

(Item-3) : Replacement of the Existing Distribution Pumps.

List of Distribution Pumps to be Replaced

Pumping Stations	Number's	Specification of the New Pumps
1) Central (Old)	4 units (Nos.1,2,3&4)	$630m^3$/hour x 90m x 4 units
2) " (New)	1 unit (No.6)	1,800 " x 90m x 1 unit
3) Tasgan	1 " (No.1)	630 " x 90m x 1
4) Industrial	2 units (Nos.2 & 4)	900 " x 60m x 2 units
5) Meat Complex	-	-
6) Upper	2 units (Nos.2 & 3)	1,000 " x 180m x 2 units
Total	10 units	10 units

(Item-4) : Procurement of Water Tank Lorries.

- Number of water tank lorry to be procured : Seven (7) units
- Tank volume : more than 5 m^3 (with measures against freeze)
- Truck chassis : more than 6 ton

(Item-5) : Procurement of Materials for Well Construction.

Some of the existing intake wells are almost out of service, or will be out of use in the very near future. For the purpose of reconstruction of these wells, procurement of materials for wells and a drilling machine are proposed in the program.

(1) Materials for well construction
- Number of well = 20 wells
- Depth of well = 33m
- Diameter = 300mm
- Screen : round-wire type; 300mm diameter, 11 meters long each
- Casing pipe : Steel pipe or equivalent made; 300mm diameter, 22 meters long each

(2) Drilling machine
- Type : Percussion type, truck-mounted
- Diameter : Max. ϕ 500mm
- Drilling depth : Max. D = 100m

(Item-6) : Remote Operation System for Existing Intake Pumps.

This remote operation system aims to enable operators to operate existing intake pumps from the control room located in the distribution pumping stations. The system had been once operated and have been presently out of service due to the mechanical damages.

(Item-7) : Replacement of Water Meters at Central Heating Centers (CTP).

Water meters had been installed in the Central Heating Centers; however, none of them are working presently because of the mechanical troubles. Replacement of water meters at CTP is proposed in the Program.

- Number of water meters to be replaced = 44
- Diameter = 150mm

2.2 Preliminary Design Drawings

Among the above items, preliminary design drawings for Items-1, 2, 3, 4 and 6 are shown in Fig. (1) - (20).

3. COST ESTIMATE

Cost for implementing of the Emergency Rehabilitation Program was estimated.

3.1 Basis of Cost Estimation

(1) Equipment Cost

(i) Equipment for rehabilitation listed up in 2.1 (Item-1 ~ Item 7) will be procured in Japan and transported by ocean freight and inland transportation.

(ii) Equipment cost was estimated on the current price in December, 1993.

(2) Installation Cost

Installation cost was estimated based on the unit cost of labor and material in November, 1993, issued by Department of Economy & Building Policy, Ministry of Construction & Urban Development, Mongolia.

(3) Indirect Cost

The following indirect costs are included.

(i) Consultants fee for detailed design and construction supervision:

The percentage of consultant fee are as follows

Item No.	Component	Percentage of Consultant Fee
Item-1:	Replacement of Intake Pumps	8%
Item-2:	Remote Operation System for New 35 Intake Pumps	8%
Item-3:	Replacement of Distribution Pumps	8%
Item-4:	Procurement of Water Tank Lorries	3%
Item-5:	Procurement of Materials for Wells	3%
Item-6:	Remote Operation System for Existing 98 Intake Pumps	8%
Item-7:	Water Meters at 44 central Heating Centers (CTP)	8%

Note : Consultant fee is percentage of amount for equipment and installation cost.

(ii) Physical contingency : 10% of equipment cost and installation cost

The following costs are not included in the indirect cost.

(i) Price escalation
(ii) Land acquisition
(iii) Training

3.2 Result of Cost Estimate

The summary of the cost estimate is shown below.