No.

BASIC DESIGN STUDY REPORT

ON

THE PROJECT FOR WATER SUPPLY IN GUNUNGKIDUL REGENCY OF YOGYAKARTA SPECIAL TERRITORY

IN

THE REPUBLIC OF INDONESIA

MARCH 2005

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
GRANT AID MANAGEMENT DEPARTMENT

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PREFACE

In response to a request from the Government of the Republic of Indonesia, the Government of Japan decided to conduct a basic design study on Water Supply in Gunungkidul Regency of Yogyakarta Special Territory and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Indonesia a study team from September 29 to November 11, 2004 and from March 8 to 15, 2005.

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

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

I wish to express my sincere appreciation to the officials concerned of the Government of the Republic of Indonesia for their close cooperation extended to the teams.

March, 2005

Seiji Kojima

Vice-President
Japan International Cooperation Agency

March, 2005

Letter of Transmittal

We are pleased to submit to you the basic design study report on Water Supply in Gunungkidul Regency of Yogyakarta Special Territory in the Republic of Indonesia.

This study was conducted by Nippon Koei Co., Ltd., under a contract to JICA, during the period from September, 2004 to March, 2005. In conducting the study, we have examined the feasibility and rationale of the project with due consideration to the present situation of Indonesia and formulated the most appropriate basic design for the project under Japan's grant aid scheme.

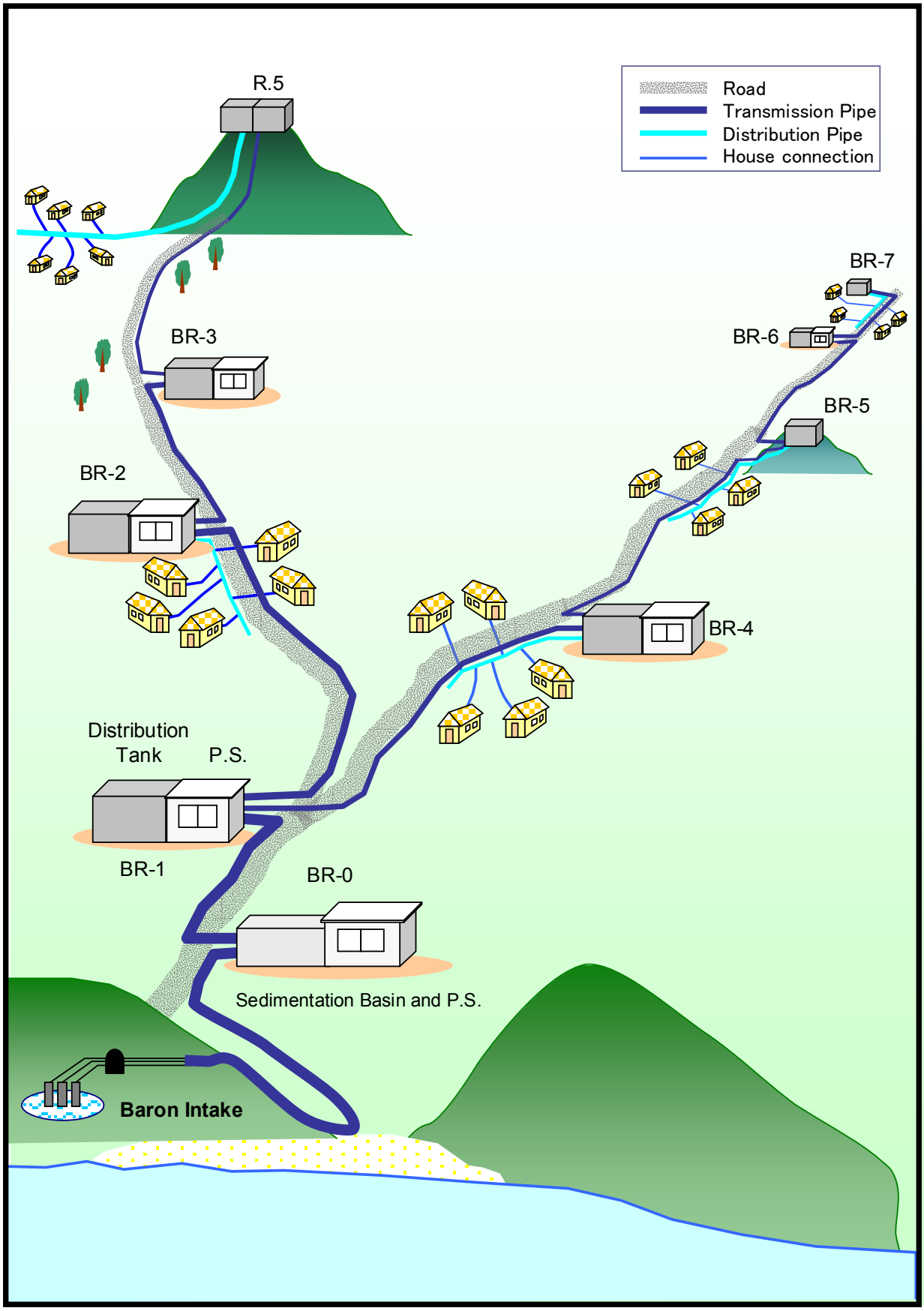
Finally, we hope that this report will contribute to further promotion of the project.

Very truly yours,

Keisuke Okazaki

Project Manager
Basic design study team on
Water Supply in Gunungkidul Regency of
Yogyakarta Special Territory
Nippon Koei Co., Ltd.

LOCATION MAP OF THE PROJECT AREA



Perspective of Proposed Water Supply Facilities

ABBREVIATIONS

	Indonesian	English
ATP	-	Affordablity to Pay
AusAID	-	Australia's Overseas Aid Program
BAPEDA	*Badan Perencanaan Pembangunan Daerah*	Regional Development Planning Agency
BAPPEDA	*Badan Perencanaan Pembangunan Daerah*	Regional Development Planning Agency
BAPENAS	*Badan Perencanaan Pembangunan Nasional*	National Development Planning Agency
BPKD	*Badan Pengelolaan Kelayaan Daerah*	Regional Asset Management Agency
CVM	-	Contingent Valuation Method
Dinas KIMPRASWIL DIY	*Dinas Permukiman dan Prasarana Wilayah Daerah Istimewa Yogyakarta*	Settlement and Regional Infrastructure Agency in Yogyakarta Special Territory
DPUP-DIY	*Daerah Istimewa Yogyakarta*	The Provincial Department of Public Works in Yogyakarta Special Territory
Ecobang	*Bagian Perekonomian dan Pembangunan*	Economic and Development Department
E/N	-	Exchange of Note
GTZ	-	German Technical Corporation
JBIC	-	Japan Bank for International Cooperation
JICA	-	Japan International Cooperation Agency
KKN	*Kuliah Kerja Nyata*	Practical College Work
M/D	-	Minutes of Discussion
NGO	-	Non-Governmental Organization
O&M	-	Operation and Maintenance
PDAM	*Perusahaan Daerah Air Minum*	Regional Water Supply Enterprise
PLN	*PT. Perusahaan Listrik Negara*	State electricity company
PPAB	*Proyek Pengadaan Air Bersih*	The project for Water Supply
PROPENAS	*Program Pembangunan Nasional*	National Development Program
PVC	-	Polyvinyl Chloride
ROA	-	Return of Asset
SCADA	-	Supervisory Control and Data Acquisition
TDS	-	Total Dissolved Solid
UNICEF	-	The United Nations Children's Fund
WTP	-	Willingness to Pay

UNITS

Length

mm	=	millimeter
cm	=	centimeter
m	=	meter
km	=	kilometer
ft	=	feet

Area

cm^2	=	square centimeter
m^2	=	square meter
km^2	=	square kilometer

Volume

cm^3	=	cubic centimeter
m^3	=	cubic meter
l or lit	=	liter

Weight

mg	=	milligram
g	=	gram
kg	=	kilogram

Denominator

/s	=	per second
/min	=	per minute
/hr.	=	per hour
/d	=	per day
/c	=	per capita

Derived Measures

mg/L	=	milligram per liter

Money

Rp	=	Rupiah

Others

%	=	percent
Ph	=	potential of hydrogen
°C	=	degrees Celsius
ppm	=	parts per million
micro S/cm	=	micro siemens per centimeter
kV	=	kilo volt

Summary

This Project involves the construction of additional water supply facilities in the existing Ngobaran and Baron water supply systems in the Gunungkidul Regency. These two systems suffer from a constant water deficit. The facilities to be constructed under Grant Aid by the Japanese Government are the water intake, transmission pipes, pumps and a portion of the primary distribution pipe network as well as implementation of a soft component program by Japanese experts. This Grant Aid Project was originally requested in May, 2003.

In compliance with the request, a preliminary investigation was carried out in June 2004 with the aim of confirming the national plan, necessity for the Project, conditions of the existing facilities, and the current status of water resources. Based on the results of the investigation, it was confirmed that the Project is included in the "Regional Water Supply Development Program" of Indonesia stipulated in the National Five Year Plan (2000-2004) and the facilities requested are concerned with the utilization of the facilities, including connection pipes and public hydrant system, as well as identification of the requested Project costs and relevant organizations concerned.

The basic design study was carried out aiming at 1) to acquire the firm water sources and subsequently construct water supply facilities enabling a safe and stable amount of water throughout the year, 2) to educate, train and guide the staff of relevant organizations to enhance their technical skills in conducting ledgers and accounting and financial handling capabilities.

The Project will be implemented by the Project Implementation Unit together with the core organization of the Regional Development Planning Agency (BAPEDA). The major activities are the design and construction supervision to be carried out by Indonesian side, procurement of the budget, and coordination with the Japanese implementation group. The responsible provincial organization for the Project is the Dinas Kimpraswil in Jogjakarta Special Territory, which will execute the necessary procedures for the Project incorporating with the provincial management unit. The Project Management Unit is the managing organization which inspects and monitors the proceed of the whole works, including budget procurement on the Indonesian side.

After the completion of the work, the operation and maintenance work will be transferred to the O&M implementation agency, PDAM.

The outline of the Project is summarized as follow.

	Main Items of Facilities	Location of the Facilities	Name and Type of Facilities	Specification
1	Intake	Baron Cave	Submersible Pump	Q=50l/s, H=46 m, Unit=2+1(stand-by)
2	Distribution Tank, Transmission Pump	BR-0 Baron Atas	Distribution Tank	V=1,858.5 m^3 with sedimentation
			Volute Pump	Q=50 l/s, H=93 m, Unit=2+1
		BR-1 Congo	Distribution Tank	V=253 m^3
			Volute Pump (to BR-2 Buru)	Q=36.5 l/s, H=111 m, Unit=2+1
			Volute Pump (to BR-4 Kemadang Baru)	Q=27 l/s, H=95 m, Unit=1+1
		BR-2 Bulu	Distribution Tank	V=196 m^3
			Volute Pump	Q=35 l/s, H=92 m, Unit=2+1
		BR-3 Baros	Distribution Tank	V=169 m^3
			Volute Pump	Q=35 l/s, H=92 m, Unit=2+1
		BR-4 Kemadang Baru	Distribution Tank	V=144 m^3
			Volute Pump	Q=20 l/s, H=101 m, Unit=1+1
		BR-5 Gebang Baru	Distribution Tank	V=92 m^3
		BR-6 Tanjunsari	Distribution Tank	V=53 m^3
			Volute Pump	Q=15 l/s, H=60 m, Unit=2+1
		BR-7 Mendang Baru	Distribution Tank	V=169 m^3
3	Transmission Pipe	Intake ～ BR-0	Galvanized Iron Pipe (GIP)	D=300 mm, L=1030 m, Q=100 l/s
		BR-0 ～ BR-1	GIP	D=300 mm, L=2,459 m, Q=100 l/s
		BR-1 ～ BR-2	GIP	D=300 mm, L=3,654 m, Q=73 l/s
		BR-2 ～ BR-3	GIP	D=300 mm, L=4,512 m, Q=70 l/s
		BR-3 ～ B-5	GIP	D=300 mm, L=5,436 m, Q=70 l/s
		BR-1 ～ BR-4	GIP	D=200 mm, L=2,318 m, Q=27 l/s
		BR-4 ～ BR-5	GIP	D=200 mm, L=2,868 m, Q=20 l/s
		Connection to the existing Bribin system	GIP	D=150 mm, L=656 m, Q=9.3 l/s
		BR-6 ～ BR-7	GIP	D=150 mm, L=3,033 m, Q=15 l/s
4	Distribution Pipe	From BR-2	GIP	D=50 mm, L=32 m, Q=185 m^3/day
		From BR-4	GIP	D=50 mm, L=53 m, Q=417 m^3/day
		From BR-5	GIP	D=50 mm, L=1,155 m, Q=266 m3/day
		From BR-7	GIP	D=50 mm, L=53 m, Q=804 m3/day
		Distribution Main from R5	GIP	D=50 mm, L=3,340 m D=100 mm, L=880 m D=200 mm, L=3,445 m Q=418 m^3/day
		7 Sub villages	GIP	D=50 mm, L=2,000 m
		Connection to exist. pipe	GIP	D=50 mm, L=11 m

The basic design policies are as follow.

1) Planning Year: The planning year is set at 2007 taking into account the Indonesian governmental policy, topographic configuration of the planning area, surrounding socio-economic conditions, magnitude of the Project, and the preliminary Project cost.

2) Extension of Water Supply Area: The supply area was established as area within a certain area to which water can be distributed from Ngobaran and Baron underground streams. The east end is set at the border with Bribin system, the west end is set at Pangang, the south end is set at the coast facing the Indian Ocean and the north end is set at the southern part of Wonosari.

3) Planning Service Population: On the basis of the current population of 132,342 as of October 2004, the planning population for the target year 2007 was projected at 134,000. The service ratio is basically requested at 80% according to the regional water supply policy established by the government, although it is envisaged that this is high compared with current water supply conditions. After discussion with PDAM, it was agreed to adopt 70%, so the service population was calculated at 93,800.

4) Unit Water Demand: The unit water demand per capita per day was divided into "domestic water demand" and "other water demand" such as livestock. The unit water demand for the case of house connections, 80% of the service population, was set at 60 l/c/d, and for the case of public hydrants, 20% of the service population, was set at 30 l/c/d. The other water demand was calculated assuming 10% of the domestic water demand equivalent. As a conclusion, the comprehensive water demand per capita per day for individual house connections was calculated at 94.3 l/c/d and 47.2 l/c/d for public hydrants.

5) Planning Water Supply Amount: The average water supply amount in 2007 was estimated at 8,000 m^3/d based on the unit water demand and service ratio of 70%. The existing Ngobaran water supply system is affordable to supply about 3,200 m^3/d on average and the supply amount for the new Baron system was therefore, estimated at 4,800 m^3/d on average.

6) The Water Quality: For treatment of the source water, sedimentation basin was adopted after comparison study between this method and sand filter; the decision was from the economic viewpoint of not only initial investment cost, but also operation and maintenance cost. Chlorine injection was selected as treatment for fecal coliform, which was detected at levels of 50 - 100 MPN/100 ml.

The individual work items to be implemented by each of the Japanese and Indonesian sides are shown as follows.

(1) Japanese responsibilities for construction

1) Detail design
2) Preparation of tender documents, evaluation and assistance of contracting
3) Construction works

(2) Indonesian responsibilities for construction

1) Land acquisition for building the facilities (sedimentation and distribution tanks, pumps and pipes)
2) Clearance and compensation within the private land along the road
3) Fences and parking lots around the sedimentation and distribution tanks, pumping units and transmission and distribution pipes.
4) Installation of individual connection pipes
5) Construction of access road
6) Customs duty, internal taxes and other taxes to be implied for payment
7) Approval of construction and building and payment of the necessary charges
8) Provision of necessary counterpart personnel

In the soft component program, the following targets were established to be achieved.

1) PDAM staff will become capable of managing the facilities to be constructed in this Project as well as the existing facilities by doing the training of maintaining works, repair and water quality controls.
2) Staff of PDAM and the relevant organizations will gain an understanding and skills for water charge collection, accounting procedures and for financial management.

Contents of the major activities for the soft component program are as follow.

1) Technical activities

i) Preparation stages

- Preparation works (explanation of the program technical aspects)

ii) Implementation stages

- Planning and designing guidance and education
- Training for inspection and operation for pumps, transmission and distribution pipes and guidance for control of facilities ledger
- Technical training for automatic operation devices

- Technical guidance for water quality control

iii) Monitoring stages
- Confirmation and verification of the above implementation items

2) Financial Activities

i) Preparation stages
- Preparation works (explanation of soft component program financial aspects and request for cooperation)

ii) Implementation stages
- Financial management guidance
- Implementing accounting programs and guidance
- Establishment of water charge collection systems
- Advancing of customer services

iii) Monitoring stages
- Confirmation and verification of above implementation items

The staff necessary for implementation of the soft component program is as follow.

1) Japanese consultant : 1 expert (O&M)
2) Japanese consultant : 1 expert (accounting and financial management)
3) Local consultant : 2 experts (O&M and accounting and financial management)

The implementation schedule for this Project is divided into two stages because the Baron and Ngobaran systems are closely connected to each other and so work will be congested. Also, various tests need to be carried out to ensure appropriate and effective works for works such as concreting and installation of pipes.

<u>Stage 1 work period</u>

1) Detail design : 3.5 months
2) Tender bidding : 3.5 months
3) Construction works : 13 months
4) Soft component : 4.5 months

<u>Stage 2 work period 2</u>

1) Detail design : 3.5 months
2) Tender bidding : 3.5 months
3) Construction works : 13 months

4) Soft component : 4.2 months

The necessary Project cost under the Japanese Grant Aid and the cost for the Indonesian financed portion are as follows. The Project cost shown here is still preliminary and does not imply a commitment to that amount for the Grant Aid at the time Exchange of Notes.

(1) The Project cost to be financed by the Japanese side 1,031 Mil. Yen
(2) The cost to be financed by the Indonesian side 4,376 Mil Rp.（53,392,000 Yen）

The points to be considered for the implementation of this Project are as follow.

(1) In coordination with the construction schedules, timely procedures for approval and land acquisition should be completed beforehand.
(2) Clearance, removal of plants and construction of access roads should be completed prior to the commencement of the construction of facilities.
(3) Provision of necessary cables and transformers for electricity supply should be completed prior to the commencement of the works.

At the same time, the following points should also be considered for operation and maintenance.

(1) As the existing distribution pipes have mostly not been identified in regards to their installation location, diameters, and lengths, the inventory surveys should be completed prior to the preparation of the facilities ledgers necessary for the soft component programs. The survey areas should cover the whole service areas.
(2) After the implementation of the soft component, the activities implemented should be summarized and compiled for checking at the time of defect inspection after one year.

The impact of the Project implementation is as follows.

The Effect and Improvement by the Project Implementation

Present Conditions and Problems	Measures to be taken in the Grant Aid Project	Effect and Improvement by the Project Implementation
The Project area in the Gunungkidul Regency is laid within severe topographic constraints and the average income of the residents is comparatively low. In addition, the area is underprivileged for water resources due to extremely low rainfall, particularly in the dry season. Therefore, the bare essential of water for maintaining safe and sanitary life is not obtainable unless the public water supply system is drastically improved or developed.	In order to provide a sufficient amount of water for 24 hours per day, the intake, transmission, distribution and connection pipe facilities shall be provided. In addition, turbidity management and disinfection facilities to obtain safe water shall be provided.	Out of the population of 134,000 in the Project area, 70% of the service population (93,800) will be able to obtain safe and sufficient water.
The water supply facilities development plan has been executed in Jogyakarta Province and Gunungkidul Regency up to this date, the magnitude and the extent of project implementation are extremely limited. Therefore, an appropriate operation and maintenance organization has not yet been built. In order to meet this requirement, the capacity building for "hardware side" such as facilities improvement and "software side" such as water charge collection and financial management have become indispensable.	Supporting the soft component. • For the operation and maintenance of the facilities, water supply ledger, strengthening of technical capabilities, training, preparation of manual and guidelines and conduct of monitoring system shall be performed. • For the operation and maintenance aspects, the financial guidance, conduct of programs, and monitoring system in parallel with the utilization of computer shall be executed to establish water charge collection system.	• With training and guidance, the staff of the public works of the regency and PDAM will be strengthened in their capability for operation and maintenance. • After the completion of the facilities, appropriate operation and maintenance activities will be established.

In the course of project implementation, the following aspects should be taken into account for the smooth and effective operation of the water supply facilities.

- In the course of the construction, land acquisition, construction of access roads, acquisition of various approvals for the procedures, and provision of electric supply facilities should be completed prior to the commencement of the Project.
- After the completion of the facilities, the water intake, transmission and distribution facilities will be increased considerably. This increase will create new water leakage problems, which have not been evident for a long time when the water supply amount was extremely small. Therefore, prior to the commencement of the Project, the inventory surveys

should be carried out without question to grasp the existing condition of distribution pipes under the finance of the Indonesian side. The results of the inventory survey can be utilized for the preparation of the facilities ledger and will be also utilized for the training and acquisition of technical skills for the O&M works.

- Utilizing the technical skills obtained by the implementation of the soft component programs, effective operation and maintenance works will be expected in the future. At the same time, enlightenment of the residents on the province of a new system should be indispensable. Particularly, public hearings will contribute significantly to the disclosure of information to the consumers.

For the following reasons, the implementation of the Grant Aid Project based on this Basic Design Study is verified as worth doing.

- The objective of the Project is to bring the residents safe, steady, and sufficient amount of potable water. This is a major contribution from the view point of basic human needs.
- The implementation of the Project, including the technical assistance for the soft component program, will enable the organization to perform appropriate operation and maintenance under the domestic budget and technology in the future.
- The Project corresponds to the National Plan of 2000-2004 (PROPENAS), which is the basic policy of the Indonesian Government.
- The impact on the environmental is envisaged to be negligible.
- In the light of the Japanese regulations for implementing Grant Aid Projects, no obvious difficulties are envisaged.

The Project can supply safe and steady potable water to the residents, minimizing water related diseases and bringing comfortable life and good sanitary conditions as well as contributing to relief from poverty. Thus the implementation of the Grant Aid Project is verified.

Basic Design Study Report
on
The Project for Water Supply in Gunungkidul Regency of
Yogyakarta Special Territory
in
The Republic of Indonesia

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Chapter 1 BACKGROUND OF THE PROJECT

This Project involves the construction of additional water supply facilities in the existing Ngobaran and Baron water supply systems in the Gunungkidul Regency. These systems suffer from constant water deficit. The facilities to be constructed under the Grant Aid by the Japanese Government are the water intake, transmission pipes, pumps and some of the primary distribution pipe network as well as implementation of a soft component program by Japanese experts. This Grant Aid Project was originally requested in May, 2003.

In compliance with the request, the preliminary investigation was carried out in June 2004 with the aim of confirming the national plan, necessity for the Project, conditions of the existing facilities, and the current status of the water resources. Based on the results of the investigation, it was confirmed that the Project is allocated in the "Regional Water Supply Development Program" of Indonesia stipulated in the National Five Year Plan (2000-2004) and the facilities requested are concerned with the utilization of the facilities, including connection pipes and public hydrant system, as well as identification of the requested Project costs and relevant organizations concerned.

The outline of the Project is as follows:

1) Facilities Construction:

   i) A new water intake 2 locations（Submersible pumps 75 l/s x 6 units）

   ii) New distribution tanks and pumping facilities 7 locations

   - 3000 m^3 x 1 location (Horizontal volute pump 55 l/s x 3 unit,20 l/s x 3 units）
   - 500 m^3 x 1 location
   - 300 m^3 x 3 locations (Submersible pumps 55 l/s x 3 unit x 3 locations）
   - 300 m^3 x 2 locations (Submersible pumps 20 l/s x 3 unit x 2 locations）

   iii) Installation of Transmission Pipe (Total length: 26,600 m)

   - Diameter 12 inch : 17,400 m
   - Diameter 8inch : 9,200 m

   iv) Installation of Distribution Pipe (Total length: 13,600 m)

   - Diameter 8~3 inch : 8,900 m
   - Diameter 6inch : 4,700 m

2) Technical Assistance：

Operation and management, automatic pump control system, operation and maintenance equipment, computer for financial management and technical guidance for O&M works.

Chapter 2 CONTENTS OF THE PROJECT

2.1 Basic Concept of the Project

Gunungkidul Regency, which includes the Project area, is one of the five regencies in the Jogjakarta Special Province in Java, and it currently has a population of 750,000. The residents in the regency are served with water from the public water supply system from the sources of wells, groundwater streams and springs, and some residents get water individually from such resources. The Project area has abundant rainfall with an amount varying from 1,700 mm to 3,600 mm per annum depending on the location. However, the difference in rainfall between the rainy season (October to April) and the dry season (May to September) is considerable. The driest period, such as in July and August, has a rainfall of only around ten to twenty millimeters per month on average.

The Project area comprises karstic topography, which mainly consists of a limestone layer with a thickness from 150 m to 200 m, and the configuration makes it difficult to conserve underground water in the layer. Due to this topographic and geologic condition, the residents in the area can only rely on limited water supply from the water cooperation (PDAM) or private water sellers using water tankers during the dry season. Consequently, only around 30% of the residents are served with water by PDAM, although substantial distribution pipe facilities are provided to supply water for more than 50% of the residents.

The Project is defined as one of the significant Regional Water Supply Development Programs in compliance with the National development plan (2000 – 2004) aiming at raising the living standard and sanitary circumstances of the people with provision of safe and sufficient water and by raising the water supply ratio. For this purpose, it has been requested that the intake capability be increased and transmission and distribution facilities provided to serve water to the residents who suffer from permanent water deficit. At the same time, it has also been requested that the operation and maintenance capability be raised and the capacity building of PDAM and relevant organizations be enhanced through implementation of the “soft component program”.

The water supply system in this Project was established from two systems: the existing Ngobaran system and a new Baron system. The proposed Ngobaran system for the future was planned with the maximum use of the existing facilities by increasing the intake capacity up to 3,200 m3/day. Meanwhile, the Baron system was planned providing new intake facilities with a maximum capacity of 5,280 m3/day followed by new transmission facilities with pumps and new distribution tanks and pipes.

The project design matrix (PDM) and the outline of the proposed Project is summarized in Table 2.1.1., Table 2.1.2.

Table 2.1.1 Project Design Matrix (PDM)

Outline of the Project	Index	Method for Data Acquisition	Outer Condition
Main Target Living environment of the residents in the Gunungkidul south Project Area will be improved.	a. Water related disease in the Project Area will be minimized. b. Stable amount of water will be available all through the year.	a. Monitoring survey after implementation of the Project. b. Operation and maintenance records prepared by provincial, Regency and PDAM.	There should be no change to the regional water supply policy by the Indonesian Government.
Project Target To construct new intake facilities and provide safe and stable amount of water to the residents of the Project Areas.	a. Supply population of the Project Area shall be set at 93,800 (70% out of total population of 134,000). b. Operation and maintenance works shall be carried out making use of computers.	a. Monitoring survey after implementation of the Project. b. Operation and maintenance records by province, regency and PDAM.	Operation and maintenance system by the province, regency and PDAM will be carried out appropriately and continuously.
Performance a. Water supply facilities will be provided in the Project Area. b. Capability for operation and maintenance of the relevant organizations will be strengthened.	a. New water supply facilities will be provided. b. The staff of the relevant organizations will be strengthened in their managing capabilities. c. Operation and maintenance works will be carried out appropriately by using facilities ledgers.	a. As-built drawings after construction. b. Operation and maintenance records by the ledgers. c. Manuals, guidelines and monitoring reports.	• Potential flow rate of the groundwater streams will not be changed by climate alteration. • Operation and maintenance system will be maintained.
Activities A.Japanese Side 1. Construction of water supply facilities • Intake, conveyance, distribution, and individual house connections. 2. Implementation of the soft component program for the relevant organization. • Education and training for the relevant staff • Preparation of manual and guideline. • Implementation of monitoring. B.Indonesian Side 1. Construction of water supply facilities • Connection pipe works • Access road, clearing, parking and electric supply facilities. 2. Procedures for Construction • Tax exemption, procedures and relevant expenses. 3. Inventory survey and preparation of facilities ledger • Implementation of inventory surveys for the facilities. • Implementation of monitoring	**Input** A.Japanese Side manpower（support for the soft component） a. Japanese O&M expert 1.7 man/month b. Japanese management and financial expert 3.5 man/month c. Indonesian management and financial expert 9.2 man/month **Facility construction** a. Intake, transmission and distribution b. Material provision before individual water meter and construction of public hydrant. **Project Cost** 1.031 billion yen	B.Indonesian Side **Facility construction** a. Land acquisition b. Clearance and reclamation c. Access road d. Fence and gate e. Electric supply facilities f. Procedures and expense **Project Cost** 53 million yen	**Prerequisite** • Support and implementation by Province, regency and PDAM will be surely implemented. • Operation and maintenance works supported by the soft component program will be steadily and surely implemented.

Table 2.1.2 Outline of the Project Concept

	Main Items of Facilities	Location of the Facilities	Name and Type of Facilities	Specification
1	Intake	Baron Cave	Submersible Pump	Q=50l/s, H=46 m, Unit=2+1(stand-by)
2	Distribution Tank, Transmission Pump	BR-0 Baron Atas	Distribution Tank	V=1,858.5 m^3 with sedimentation
			Volute Pump	Q=50 l/s, H=93 m, Unit=2+1
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		BR-7 Mendang Baru	Distribution Tank	V=169 m^3
3	Transmission Pipe	Intake ～ BR-0	Galvanized Iron Pipe (GIP)	D=300 mm, L=1030 m, Q=100 l/s
		BR-0 ～ BR-1	GIP	D=300 mm, L=2,459 m, Q=100 l/s
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		BR-4 ～ BR-5	GIP	D=200 mm, L=2,868 m, Q=20 l/s
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4	Distribution Pipe	From BR-2	GIP	D=50 mm, L=32 m, Q=185 m^3/day
		From BR-4	GIP	D=50 mm, L=53 m, Q=417 m^3/day
		From BR-5	GIP	D=50 mm, L=1,155 m, Q=266 m3/day
		From BR-7	GIP	D=50 mm, L=53 m, Q=804 m3/day
		Distribution Main from R5	GIP	D=50 mm, L=3,340 m D=100 mm, L=880 m D=200 mm, L=3,445 m Q=418 m^3/day
		7 Sub villages	GIP	D=50 mm, L=2,000 m
		Connection to exist. pipe	GIP	D=50 mm, L=11 m

2.2 Basic Design of the Requested Japanese Assistance

2.2.1 Design Policy

(1) Basic Policy for Selection of the Project Area

The Project area is located, as shown in the Location Map of the Project on the first page of this report, at the southwest of the Gunungkidul Regency and extends east to west for 34 km and south to north for 15 km. For implementation of the Project, the following basic policy was established to verify the adequacy of the Project and set up an appropriate Project area.

i) The Project area shall be the area most severely suffering from water deficit in the dry season, and subsequently urgent water resources development and water supply facilities improvement plans will be requested.
ii) All the population in the Project area concerned shall be served by the water sources that are situated in the Project area and it must be possible to implement economical development of water resources and water supply facilities plans.
iii) Although initial pumping of water from the water sources to the distribution tanks is indispensable, the water distribution service thereafter, from the tanks, shall be performed by gravity to all the supply area effectively and economically.

(2) Basic Policy for Natural Condition

Out of the natural conditions of the Project area, specific items which impact on the project implementation are: i) difference in rainfall amount between rainy and dry seasons, ii) topographic configuration that reveals a karstic hilly area with poor water conservation having an influence on surface water pollution to the groundwater streams, and iii) necessity of pumping water from the Baron groundwater stream to the distribution tanks due to extensive hilly topographic conditions. These conditions were fully taken into account in the Basic Design Study.

As the rainfall concentrates in the rainy season from November to April, attention was fully paid to the procurement of construction materials during the period and the preparation of supervising and implementation schedules. During the rainy season, surface water frequently infiltrates into underground streams through the gap in the rocks below the ground surface making the underground streams turbid and contaminated by coliform. Therefore, provision of facilities to reduce turbidity and remove coliform was considered.

(3) Policy for the Socio-economic Conditions

As the Project area has very little rainfall during the dry season and the water tank resource accumulated during the rainy season depletes in the dry season, the residents are only able to acquire expensive, privately sold water, or bring water themselves from the springs several kilometers away, if the public water supply is not functioning satisfactorily.

Under such conditions, it has been strongly requested that a steady and safe water supply be provided for the residents under the management of PDAM. However, the Project site is located in the mountainous and economically poor area in the south west of the Gunungkidul Regency. Therefore, provision of an appropriate and feasible water supply system considering residents' "affordability to pay" and "willingness to pay" the water charge, as well as economical operation and maintenance activities, are taken into account.

Meanwhile, 15.7% of the patients who visit hospitals, according to the report by the Gunungkidul Health Center, are suffering from water related diseases. In particular, reserve tanks in each house that contain rain water as a part of the main water source of the residents, as well as reserves of purchased water, are not in a good sanitary condition. Therefore, the sanitary environment shall be enhanced by providing safe water and monitoring the water quality constantly.

(4) Water Supply Development/Improvement Policy

1) Policy on Water Supply Planning

The water supply service ratio with respect to the provision of distribution facilities as of October, 2004 is approximately 50%. However, the practical service ratio under the condition of constant water supply including the dry season covers only around 30% due to reduction of the water intake amount, transmission capacity and deterioration of pipe facilities. In order to cope with the constraints, development of intake, transmission and distribution facilities to provide water supply up to 150 l/s at a maximum as well as installation of 40 km of pipes and eight new reservation tanks was initially planned and requested from the Japanese Government in 2002.

In compliance with the request, implementation of an inventory survey of existing facilities, review of details of the requested contents, comparative study of alternative water resources, and a social survey that was carried out in this Basic Design Study, were implemented in the field survey from October to November in 2004. Thereafter, preliminary design and quantitative analysis of the proposed facilities were carried out in the home work. For the implementation of the field survey and subsequent home work analysis, the following basic policy for the water supply development plans was established.

i) In compliance with the strategic plan defined by the Indonesian Government, a water supply

development plan shall be carried out to increase the service ratio as high as possible. In this context, existing supply facilities shall be utilized to the maximum extent in consideration of economic planning by reducing construction cost.

ii) The basic conditions for planning, such as the target year, planning population, unit water demand and design criteria, shall be reviewed and subsequently appropriate design parameters shall be established.

iii) Based on these planning conditions and the existing capacity of the facilities, the intake amount, size of facilities and their allocation shall be determined appropriately. The facility planning shall be followed by comparative analysis in order to achieve economic construction works.

iv) As for the facility planning, the rationality of the operation and maintenance and effectiveness after the completion of the construction together with economic aspects shall be considered.

2) Water Resource Development Policy

A water resources comparative study was carried out during the field work concerning the existing Ngobaran and Baron underground streams in the Project area, the Toto underground streams in the Bribin district, the tube wells in the Wonosari and Prayan districts, Bekah underground streams in the far western area, and the Oyo river as a representative surface water source.

With respect to alternative water sources other than the Baron and Ngobaran underground streams it was clarified that: i) these are located very far from the proposed service area requiring a lot of transmission pipes and pumps, and thus are not economical, ii) the tube wells in the Wonosari and Prayan districts have little potential of yielding groundwater and would incur a large construction cost, iii) surface water runoff discharge in the dry season is extremely small and water conservation is difficult, even after construction of dams, since the geology of the site comprises mainly limestone which easily allows infiltration of water into the ground.

Taking these into account, water source development analysis was carried out with the condition of having enough potential in flow rate and least initial investment and operation and maintenance cost. As a result, Ngobaran and Baron underground streams were selected as the main water sources. The Ngobaran groundwater stream was identified to have an average flow rate of 80 l/s and able to be utilized continuously in the future, while the Baron water source has more than 5,000 l/s on average, even in the dry season, and was identified as sufficient for the future.

3) Establishment Policy for the Water Supply System

The Project area shall be served with water from the Ngobaran and Baron systems as mentioned

above. Both Ngobaran and Baron sources transmit water to the Kemadang distribution reservoir (R-5) situated at the highest altitude in the Project area and then the water is distributed by gravity. As for the water distribution, existing distribution pipes shall be utilized to a maximum extent in the future. Therefore, an analysis of the flow rate capacity is required and deterioration of pipes and frequency and magnitude of leakage are to be surveyed by PDAM as a prerequisite for proceeding with this Project successfully.

The target service ratio for the area has been established at 70%. Of this ratio, 80% is planned for direct connection from the distribution pipes and the remaining 20% is planned for use with public hydrants.

The water supply to the Project area shall be planned for continuous, 24 hour supply. In order to meet this requirement, provision of water level indicators and automatic pump switch operation are planned.

4) Policy for Facility Design

For designing the facilities, construction conditions in Indonesia as well as the Project area have been taken into consideration. At the same time, Japanese design standards and criteria have been used for design purposes for details of facilities. The policies applied for designing major facilities are shown as follows.

i) Selection of pipes: Under the conditions that inner water pressure is being placed on the pipes to 1.18 MPa（12 kgf/cm2）at a maximum and impact will be applied to the outer pipes at the time of transportation and installation, and for ease of local procurement of pipes, galvanized iron pipe was selected for transmission and distribution pipes.

ii) Distribution tank: Taking into account the magnitude and economy of the structure of tanks, a concrete type with water proofing was selected. As for the foundation, a simple structure like a “mat foundation” was selected.

iii) Pump facilities: A submersible pump was selected for the intake taking into accounts the site conditions, workability, and ease of operation and maintenance. Other pumps were selected from the horizontal type volute pumps.

(5) Policy for the Site Condition and Local Contractor

The Baron intake is located near a beach, which is famous for its recreational area for the neighboring cities. As the site is not designated as a national park, the construction in this area does not require any particular concurrence. However, environmental conservation should be carefully considered including being free from noise, vibration and discharging of wastewater.

The construction of water supply facilities in this area has been carried out by the contractors in Jog Jakarta or neighboring cities under the control of PDAM. It is envisaged that this project will be also implemented by the contractors in those areas as sub-contractors. The local contractors are not familiar with high level constructions, but they have sufficient capability to easily manage the work, such as distribution pipes, tanks and pump facilities. Therefore, utilizing the local contractors will be useful and economical.

(6) Policy for the Activities of Operation and Maintenance Organizations

Operation and maintenance works are supposed to be implemented by PDAM. The problems which PDAM has are: 1) ledgers for pump facilities and transmission and distribution pipes have not been provided yet, and subsequent periodical operation and maintenance works are not being implemented, 2) know how for operation and maintenance works for automatic pump control facilities has not been acquired, 3) knowledge for water quality control and monitoring is required, 4) water charges have not been constantly and appropriately collected, 5) accounting and financial management capability is not adequate, and 6) claims from the residents have not been replied to appropriately.

In order to solve these problems, efforts by the implementation organizations themselves should be indispensable. However, as far as the current operation and maintenance capability and financial management of PDAM are concerned, this self effort will be not be sufficient to continuously and appropriately manage the water business. Therefore, a "soft component program" should be implemented in parallel with this Project to strengthen the operation and maintenance capability together with financial management skill.

(7) Policy for Construction Works

For execution of the construction, the climate conditions of rainy and dry seasons, the hilly topographic configurations around the project site, and conditions of material procurement from Jogjakarta and Wonosari cities shall be taken into account to perform effective construction works.

Transmission and distribution pipes shall be basically installed under the road shoulder to avoid disturbance to traffic and to achieve workability. At the same time, procurement of pipes for the work sites shall be effectively managed since the transmission pipes extend for more than 30 km

and a lot of pipes should be provided at one time. In addition, an appropriate work schedule should be prepared to complete the work in a timely manner.

For the construction of pump stations and distribution tanks, access roads and parking lots shall be appropriately and suitably arranged for easy operation of the work as well as O&M works in the future.

(8) Policy on Procurement of O&M Machinery and Material

The major items to be maintained are transmission and distribution facilities, including pipes, valves, pumps, meters and electric devices. PDAM as an operation and maintenance organization requested that the Japanese Government provide a grant for O&M machinery and repair tools as a part of "machinery and material grant aid". These machinery items and repair tools are available to be procured domestically, and PDAM staff are familiar with the method of handling them. In addition, the water level gauges in the distribution tanks, cables between the tanks and control panels for automatic pump control devices are also available to be obtained in the local markets.

2.2.2 Basic Plan

(1) Plan of Water Supply Facilities

1) Target Year

The target year of the Project was set at 2007, in which the Project will terminate, taking into account the conditions of high order plans prepared by Indonesian Governmental organizations, topographic configurations of the Project site, socio-economic conditions, magnitude of the Project, and the preliminary construction cost.

2) Water Supply Area

The water supply area is set as shown on the Location Map of the Project on top of this report. The source of water was determined as two underground steams at Ngobaran and Baron caves, and the supply area was established as that within which the available system could distribute water. The east end was set as the border line of the Bribin system, the west end on the edge of the Pangang district, the south end on the seashore of the Indian Ocean and the north end is set at the south of Wonosari.

3) Service Population

On the basis of the current population of 132,342 as of October 2004, the planning population for the target year 2007 was projected at 134,000. The service ratio is basically requested at 80% according to the regional water supply policy established by the government, although it is envisaged to be high to achieve as far as the current water supply condition is concerned. In compliance with the discussion with PDAM, it was agreed to adopt 70% and subsequent service

population was calculated at 93,800.

4) Unit Water Demand

Unit water demand was estimated by dividing probable water demand into domestic water demand and other water demand, such as for livestock. Out of the domestic water demand, 60 l/c/d for the case of connection by pipe was applied to 80% of the service population and 30 l/c/d for the public hydrants was applied to 20% of the service population. UFW at the target year was estimated to be settled at 30% and this amount was included in the unit water demand. The other water demand for livestock was counted as equivalent to 10% of the domestic water demand. Consequently, the substantial water demand per capita was set at 94.3 l/c/d for "connection pipe" and 47.2 l/c/d for "public hydrant", respectively.

5) Planning Water Supply Amount

The average daily water supply requirement as of 2007 was counted at 8,000 m^3/d multiplying unit water demand per capita by a service ratio of 70% and allowing for the type of unit water demand.

As the existing Baron intake, transmission and distribution facilities have deteriorated and are not suitable for future use, these facilities are to be abandoned after completion of the Project.

The Ngobaran system has a capability of average daily water production at 3,200 m3/d under the pumping operation rate at 60 l/s for 15 hours. Therefore, the additional water production to be supplied in this project is 4,800 m3/d.

6) Water Quality Control

The source water is dependent upon the groundwater streams at Baron and Ngobaran and is good quality. However, the geological condition in the Project area is dominated by limestone, and the surface water easily infiltrates into the underground streams through the porous limestone. Due to such conditions, it has been reported that high turbidity and coliform concentration are observed in the rainy season. However, water quality data is lacking in quantity, particularly as the data on turbidity is very limited, being only a low number of samples.

Some settled sand was observed in the bottom of tanks during the inventory survey, and it was reported that the operator of PDAM occasionally stops the pumps and settles the sand down in the distribution tanks during the times of high turbidity. Accordingly, it was anticipated that some remedy of removing sand was needed by using sedimentation tanks for sand filtering.

After a comparison analysis between sedimentation and a sand filter concerning initial construction cost, O&M cost and ease of maintenance works, a sedimentation tank was selected due to predominance in this Basic Design Study. In addition, chlorine injection facilities were also determined to be provided in accordance with the quick water quality test results that revealed coliform concentration of 50～100 MPN/100 m.

(2) Facility Design

1) Intake

For water sources, the existing Ngobaran and Baron cave groundwater streams shall be used. The intake volume from the Baron source shall be 60 l/s for 15 hours and 3,200 m^3/d on average.

Because the existing facilities of the Baron water supply system are small in capacity and deteriorated due to age, new intake and transmission facilities were proposed. The average daily intake amount shall be 4,800 m^3/d.

i) Intake Pump

Flow rate of pump:	Q = 50 l/s, Unit: 3 (1 standby),
Total pump head:	H = 48.5 m
Type of pump:	Submersible pump (detaching type)

ii) Plan of Intake Facilities

There is a narrow path from the entrance along the slope with a gradient approximately 30-35 degrees to the groundwater stream side down the cave. The height of the path is about 2 m and it is not easy to transport pumps, pipes, scaffold materials and excavated soil to and from the bottom of the cave. In order to improve the workability, the provision of a small trolley with steel rails was planned. At the water's edge down in the cave, a steel deck was provided to install 3 submersible pumps and to make for easy setting and detaching of pump units.

Out of the cave, a temporary asphalt concrete road with a width of 3 m was planned between the entrance of the cave and the beach to carry the excavated soil using a small truck.

2) Transmission Pipe

For the transmission pipe, galvanized iron pipe was selected based on the experience of use by the O&M organization, the topographic configurations of the site where it is to be installed, ease of procurement locally, and economic aspects. The route of the transmission was divided into two sections; one from the intake site to BR-7 of the Baron system and the other one diverted from mid-way to BR-5 of the Ngobaran system. A velocity coefficient of 110 was adopted as the uniform parameter. The length, diameter, flow rate and head loss calculation results are summarized in Table 2.2.1.

3) Pump Facilities

Pump facilities were provided for each distribution tank to transmit water to the downstream distribution tank located up on a hill. The type of pump selected was the economical horizontal volute pump considering the conditions of easy handling and economic O&M works.

Table 2.2.1 Result of Flow Rate Calculation

	Extension	Length (m)	Diameter (mm)	Flow (m^3/s)	Difference of Elevation (m)	Calculated Total Head Loss (m)
1.	Intake ～ Baron Atas	1,030	300	0.100	35.8	48.93
2.	Baron Atas ～ BR-1	2,459	300	0.100	69.5	95.31
3.	BR-1 ～ BR-2	3,654	300	0.073	95.5	117.60
4.	BR-2 ～ BR-3	4,512	300	0.070	66.6	91.28
5.	BR-3 ～ R-5	5,436	300	0.070	56.6	85.52
6.	BR-1 ～ BR-4	2,318	200	0.027	81.0	98.14
7.	BR-4 ～ BR-5	2,869	200	0.020	89.5	102.83
8.	BR-6 ～ BR-7	3,033	150	0.015	35.0	62.52
	Total	25,311				

4) Water Tank

The plan of each distribution tank was made depending upon the categories divided into two functions. One function is only to transmit water to the next tank, which is called a head tank, and the other function is to distribute water to the neighboring residents at the same time as transmitting water, which is called a distribution tank. The structure of the tank is concrete which is economical in construction and is water-tight. The foundation of the tank was planned as a mat foundation. At each water tank, water level indicators were provided, connected by cables to pumps that have automatic control devices.

5) Sedimentation Tank

It was reported that the water quality at the Baron intake rises in turbidity during rainy seasons. In order to deal with the high turbidity issue, it is necessary to provide either a sedimentation pond or sand filters. Although, the water quality tests carried out in the past by PDAM, as well as by the basic design study team in October 2004, gave only a low level record of turbidity, some sand in the bottom of the distribution tanks was obviously occasionally found during the rainy season. Therefore, sedimentation tanks were selected in view of the necessity of removal of turbidity and from the economic viewpoint for construction, operation and maintenance.

In addition to the issue of high turbidity, the coliform number is much higher in the rainy season compared to the dry season, so it was determined that chlorine injection facilities were to be provided.

6) Distribution Pipes

A type of galvanized iron pipe was selected as the distribution pipe material based on topographic and geological conditions as well as the experience of use at the proposed site by PDAM and ease of procurement locally.

7) Temporary Works

A temporary road was planned from the entrance of the intake cave to the beach where a stockyard for building materials and machines is provided. The temporary road is to be 3 m wide with an asphalt pavement for easy transportation by small pickup truck.

2.2.3 Basic Design Drawing

The design drawings prepared in the study are listed as follows.

Table 2.2.2 List of Basic Design Drawings

No. of Figure	Title of Drawings
BD-01	Location Map of the Project
BD-02	Intake Facility
BD-03	BR-0: Plan of Distribution Tank
BD-04	BR-1: Plan of Distribution Tank
BD-05	BR-2: Plan of Distribution Tank
BD-06	BR-3: Plan of Distribution Tank
BD-07	BR-4: Plan of Distribution Tank
BD-08	BR-5: Plan of Distribution Tank
BD-09	BR-6: Plan of Distribution Tank
BD-10	BR-7: Plan of Distribution Tank
BD-11	Plan of Distribution Pipe
BD-12	Installation of Pipe and Typical Cross Section
BD-13	Public Hydrant

440000 445000 450000 455000

9110000 9110000

L=8,031m,D=50-200mm
L=2,000m,D=25mm

DISTRIBUTION PIPELINE

L=5,436m,D=300mm

R-5: Karang-Existing
GL=354
V=1000m3

BR-3: Baros
GL=297
V=169m3
PUMP 3 (1)

L=4,512m,D=300mm

BR-6: Tanjungsari
GL=282
V=53m3
PUMP 2 (1)

L=53m, D=150mm

L=604m,D=150mm

EXISTING PIPE

EXISTING PIPE

L=3,033m, D=150mm

BR-5: Gebang Baru
GL=306
V=92m3

BR-7: Mendang Baru
GL=317
V=169m3

NGOBARAN SYSTEM

BR-2: Bulu
GL=231
V=196m3
PUMP 3 (1)

L=2,869m, D=200mm

BARON SYSTEM

L=3,654m, D=300mm

BR-4: Kemadang Baru
GL=216
V=144m3
PUMP 2 (1)

9105000

BR-1: Congo
GL=135
V=253m3
PUMP 5 (2)

L=2,318m, D=200mm

L=2,459m, D=300mm

BR-0: BARON ATAS
GL=66
V=1859m3
PUMP 3 (1)

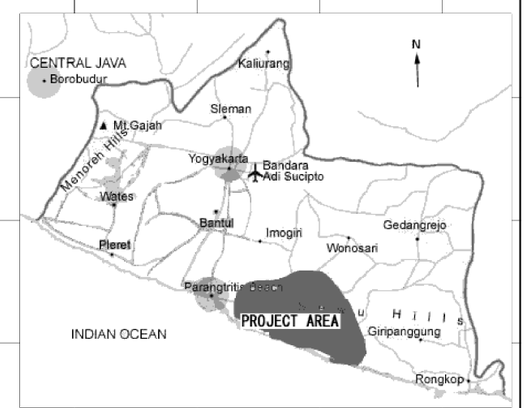
BARON INTAKE
PUMP 3 (1)

L=1,030m,D=300mm

LEGEND

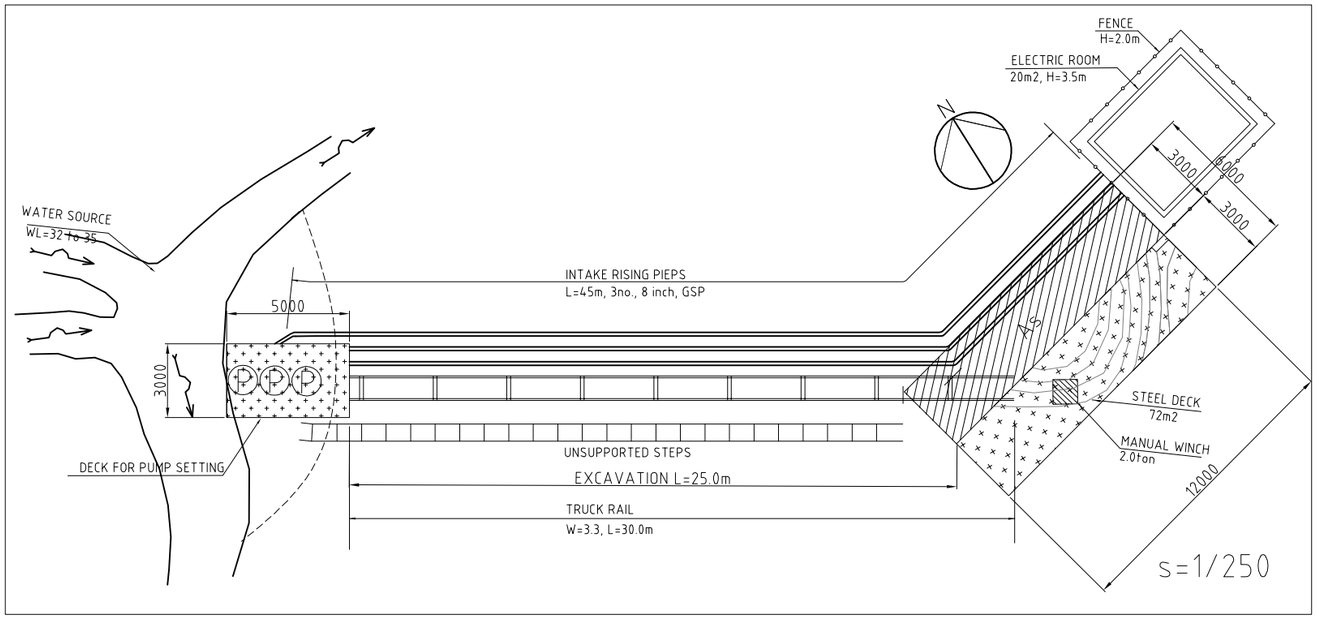
- I :INTAKE FACILITY
- P :PUMP STATION UNITS
- :PROPOSED TRANSMISSION PIPELINE
- :PROPOSED DISTRIBUTION PIPELINE
- :EXSISTING PIPELINE
- :PROPOSED HEAD TANK
- :PROPOSED HEAD TANK WITH DISTRIBUTION PIPE
- :EXSISTING HEAD TANK WITH DISTRIBUTION PIPE

s=1/10000

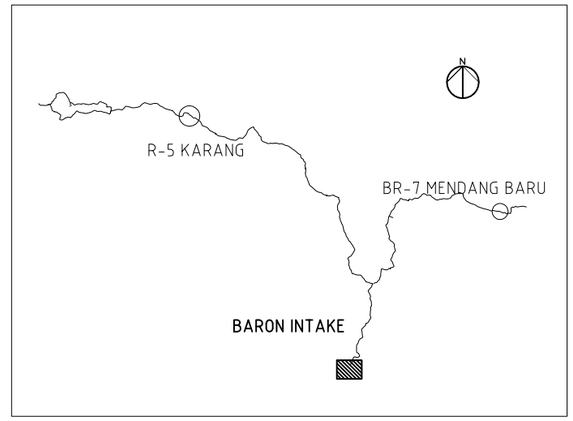


KEY MAP

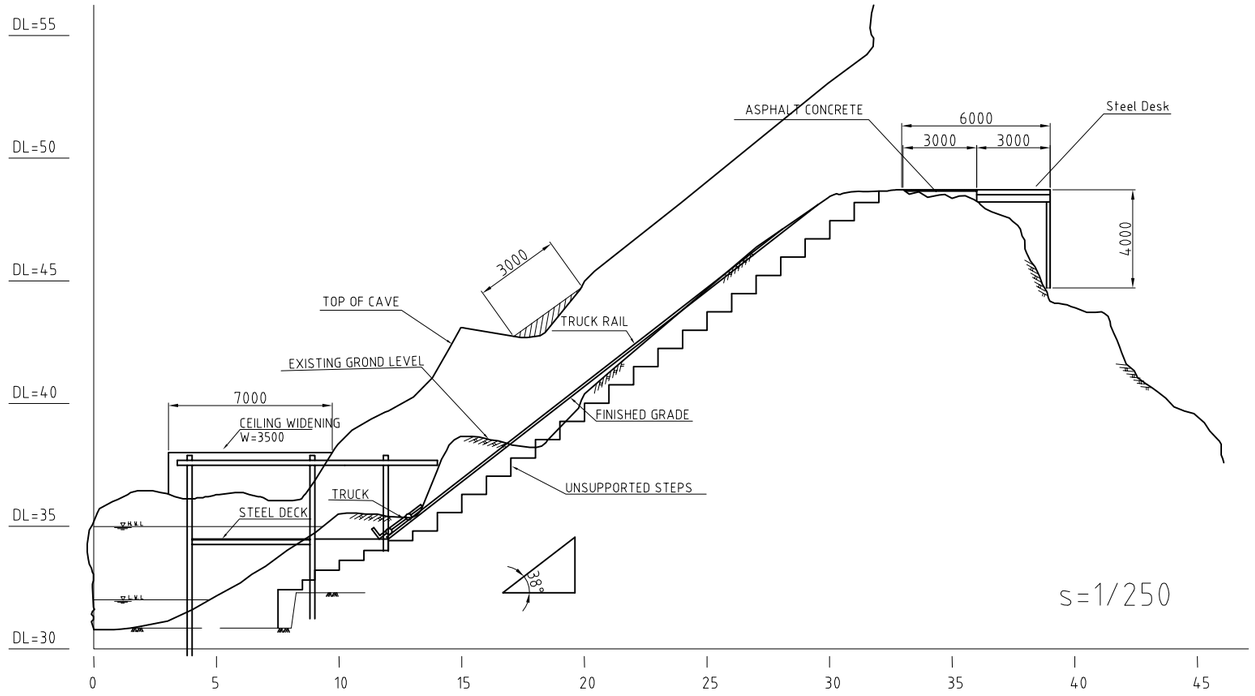
THE BASIC DESIGN STUDY ON THE PROJECT FOR WATER SUPPLY IN GUNUNKIDUL REGENCY OF YOGYAKARTA SPECIAL TERRITORY IN THE REPUBLIC OF INDONESIA	JAPAN INTERNATIONAL COOPERATION AGENCY	NIPPON KOEI CO.,LTD.	DRAWING TITLE: Location Map of the Project		
			SCALE	DATE: JAN 2005	DRAWING NO.: BD - 01



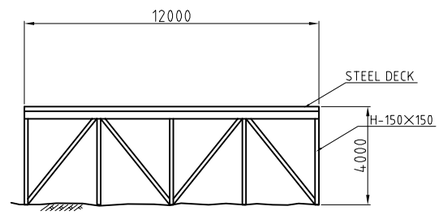
PLAN OF INTAKE FACILITIES



KEY PLAN



SECTION OF INTAKE FACILITIES



DETAIL A

S=1/200

THE BASIC DESIGN STUDY ON THE PROJECT FOR WATER SUPPLY IN GUNUNKIDUL REGENCY OF YOGYAKARTA SPECIAL TERRITORY IN THE REPUBLIC OF INDONESIA	JAPAN INTERNATIONAL COOPERATION AGENCY	NIPPON KOEI CO.,LTD.	DRAWING TITLE: Intake Facility		
			SCALE	DATE: JAN 2005	DRAWING NO.: BD - 02