CAPITAL REGION INDEPENDENT
DEVELOPMENT AUTHORITY(CRIDA)

IMPLEMENTATION REVIEW STUDY REPORT ON THE PROJECT FOR IMPROVEMENT OF WATER SUPPLY FACILTIES IN DEHSABZ SOUTH AREA

NOVEMBER 2018

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

YACHIYO ENGINEERING CO., LTD.

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SUMMARY

1. Outline of the Country

The population of the Islamic Republic of Afghanistan (hereinafter referred to as "Afghanistan"), is approximately 29 million (2016, Afghanistan Statistical Yearbook), and the main industries are agriculture (wheat, barley, potatoes, rice, almonds, sugarcane, etc.). Construction and service industries have been being developed by the reconstruction demands in Kabul and other major urban centers. However, it remains one of the poorest countries in the world. It is placed at the 168th out of 189 countries by the UNDP human development index of 2017.

The GDP stands at US$20.3 billion (2016, Afghanistan Statistical Yearbook) and in terms of industry-separate breakdown, primary industry accounts for 24.3 percent, secondary industry for 20.9 percent and tertiary industry for 51.3 percent (2016, Afghanistan Statistical Yearbook). The economic growth rate is 3.6 percent (2016, Afghanistan Statistical Yearbook).

The social and economic infrastructures of Afghanistan suffered from massive damages as a result of the civil war that raged for more than 20 years. However, the following collapse of Taliban Regime, the infrastructures have been being rebuilt through the supports of international organizations. The national governance mechanism building process has been finished so far. Improvements have been appearing such as 5.7 million of repatriated refugees and increase of school children (from less than 1 million in 2001 to 8 million by 2011).

In order to ensure further reconstruction and development, many fields of social infrastructure remain missing and there are urgent needs to expand assistances not only to the metropolitan area but also to the provinces.

2. Background, History and Outline of the Project

The population of Kabul City, the capital of Afghanistan was about 2 million in 1999.It is estimated at 4 or 5 million as of 2012. Moreover, it is forecasted to reach 6.5 million in 2025. Under such circumstances, the Government of Afghanistan established Dehsabz-Barikab City Development Authority (hereinafter referred as to “DCDA”) and decided to develop a new city for the increasing population, which was located in the north east area of Kabul City for approximately 740 km^2 (74,000ha). The Master Plan for the Kabul Metropolitan Area Development in the Islamic Republic of Afghanistan (hereinafter referred to as “MP”) was formulated in 2009 and public infrastructure plans for development of initial development area (Dehsabz South area) was prepared in 2011. In 2016, Capital Region Independent Development Authority (hereinafter referred as to “CRIDA”) was established and CRIDA took over the role of DCDA and has been developed the new city.

To facilitate smooth development of the new city, the Government of Japan assisted DCDA through the Project for Promotion of Kabul Metropolitan Area Development. While DCDA promotes the development of infrastructures, it has prepared private sector utilization plans, including financial analysis and guidelines for the private sector.

In parallel to these activities, DCDA selected an area of approximately 830 ha for initial development, which is called as “Parcel-1” for the population of 42,000 as a development model and had been prompted the development of the area using the private sector.

To assist the development, the Government of Japan decided to support the construction of water facilities in Parcel-1 and agreed the Exchange of Note (E/N) and the Grant Agreement (G/A) regarding “The Project for Development of Water Supply Facilities in DEHSABZ SOUTH AREA” with the Government of Afghanistan in 2013.

Unfortunately the land issues on Parcel-1 happened and the development undertaken by the private sector at Afghanistan side were not implemented after the E/N and G/A. Under the situation, the Government of Japan decided to postpone the project until the issues are solved through the discussion with UNOPS, the implementing agency for the procurement and the supervisory service of the construction for the project.

Since there was no expectation to improve these issues, CRIDA requested the Government of Japan to change the target water service area from Parcel-1 to Parcel-2.2, where is located in the southern part of Parcel-1 in April 2016.

Parcel-2.2 is designated as initial development area by the Government of Afghanistan and most

of the land owners agree to the water supply project assisted by JICA. While CRIDA and the private developer have been promoted the housing construction in Parcel-2.2, they are highly requesting a set of water supply system in the area to be supported by the Japan's Grant Aid.

Through this study, JICA study team reviewed the original outline design on a set of water supply system consisted of two (2) production wells, a reservoir, a water transmission pumping station, a water transmission main, a water pressure regulating reservoir and principal water distribution lines, which were originally designed for parcel-1, and revised the design of some water facilities for Parcel-2.2 and estimated the project cost. Finally, JICA study team built a set of water supply system for Parcel-2.2 without changing the original design of each water facility except for a part of them (water transmission pump and water transmission and distribution pipe etc.).

3. Review on Design Condition

In this study, JICA study team reviewed the outline design on a set of water facilities which were designed at original plan for Parcel-1 in 2013 and revised the design of some water facilities for Parcel-2.2 which is necessary to change the water service area from Parcel-1 (Design service population: 42,000) to Parcel-2.2 (Design population: 54,492) as shown in Figure 1 and estimated the project cost.

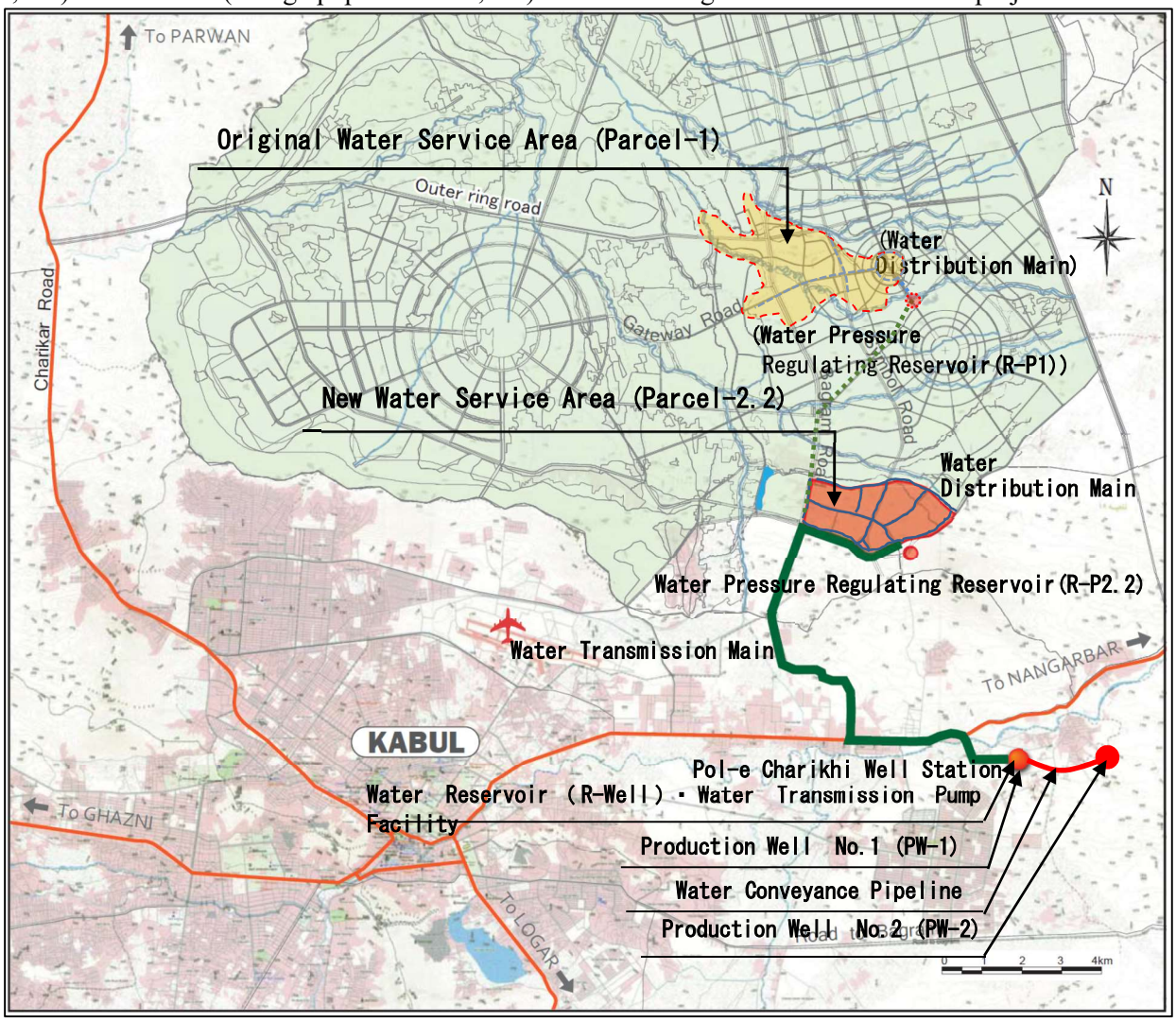

Figure-1 Outline of Japanese Assistance

As shown in Table-1, in original plan, design water supply per capita was originally set as 150LCD, which is equivalent to 8,190 m^3/day as design maximum daily water supply volume, in accordance with "The Master Plan for the Kabul Metropolitan Area Development in the Islamic Republic of Afghanistan" on the premise that water sources are newly developed by the target year. Because there

is no prospect for the development of new water source at present, design water supply per capita was revised as 92 LCD, which is equivalent to 6,517 m^3/day as design maximum daily water supply volume so that design water supply can meet design maximum daily extracting volume, 5,000 m^3/day, which can be supplied from Pol-e Charkhi wells.

Table-1 Comparison of Design Condition between Original Plan and This Plan

Parameters	Original Plan	This Plan	Unit	Applicable Facility	
Target Water Service Area	Parcel-1	Parcel-2.2			
Design Condition					
Design water supply per capita	150	92	LCD		a..
Design service population	42,000	54,492	Persons		b.
Design maximum daily extracting volume	5,000	Same as left	m^3/day	Volume of distribution reservoir	c. =d x 2
Design maximum daily extracting volume	2,500	Same as left	m^3/day	Per well	d.
Design maximum daily extracting volume	1.8	Same as left	m^3/min	Diameter of pipes and specification of pumps of production wells	e. =d
Daily variation coefficient	1.3	Same as left	-		f.
Hourly variation coefficient	1.4	Same as left	-		h.
Design maximum daily water supply volume	8,190	6,517	m^3/day	Water pressure regulating reservoir	i.=a x b x f
Design maximum hourly water transmission volume	1.7	Same as left	m^3/min	Water transmission pumps (per pump)	j. =c x h / 3
Design maximum hourly water transmission volume	5.1	Same as left	m^3/min	Diameter of transmission pipelines (during operation of 3 pumps)	k. =j x3
Design maximum hourly water distribution volume	11,466	9,124	m^3/day	Diameter of distribution pipeline	l. =i x h

4. Outline of the Plan and Contents of the Project

The contents of the project at the original plan in 2013 and ones revised at this plan are shown in Table-2.

Table-2 Comparison of Components between Original Plan and This Plan

Facility Name	Components	Specifications		Note
		Original Plan (2013)	This Plan	
1. Pol-e Charihi Well Station				
(1) Production wells	Deep well, Submersible pump, Electric power receiving equipment	Production well(PW-1, PW-2): 2 units (One (1) well is the existing test well) Pump Capacity; 2,500 m^3/day x 2 units Pumping Head: 23 m. Necessary electrical facilities.	No change	
(2) Water conveyance pipeline	Water conveyance pipeline	Pipe laying: L = 1.6 km, DN 250 mm and 180 mm, HDPE	No change	
(3) Reservoir and water transmission pump facility	Reservoir	Reservoir (R-Well): 1 location, 1,700 m^3 (850 m^3 x 2 units), Reinforced concrete	No change	
	Water transmission pump, Electric power facility	Pump capacity: 1.7 m^3/min x 3 units and 1 unit for standby, Pump head: 90 m, electric power facilities	Pump head is changed to 101m	Pump head increases due to changing location of water pressure regulating reservoir

Facility Name	Components	Specifications		Note
		Original Plan (2013)	This Plan	
	Disinfection facility	Calcium hypochlorite solution Tank, Calcium hypochlorite dosing pump: 1 unit	No change	
(4) Monitoring wells	Deep well	Monitoring wells: 4 units	No change	
(5) Maintenance facilities	Operation building etc.	Operation building, guardhouse: Flow meter, water quality analytical equipment, tools for maintenance etc.	No change	
2. Pipeline	Transmission and distribution pipe	Pipe laying: L = 36.5km, DN125 ~ 500 mm, HDPE (Pipe laying works for distribution pipe include road construction works)	Pipe laying: L = 33.1km, DN125 ~ 500 mm, HDPE (Pipe laying works for distribution pipe do not include road construction works)	Pipe diameter and length are changed due to changing target water service area (Road construction work is conducted by private developer)
3. Water pressure regulating reservoir	Elevated tank	Elevated Tank (R-P1): 1 unit, 400 m^3 (400 m^3 x 1 unit), Reinforced concrete	Elevated Tank (R-P2.2): Volume and structure are not changed	Location is changed due to changing target water service area

5. Project Implementation Schedule and Approximate Project Cost

In the case where the project is implemented under the Japan's Grant Aid scheme, it is scheduled to take approximately 9.0 months for the tender process including preparation of tender documents and approximately 27.0 months for construction works after handing the design to the procurement agent (UNOPS).

5.1 Cost to be Borne by Japanese Side

This information is closed due to the confidentiality.

5.2 Cost to be Borne by Afghanistan Side

Total estimated Cost: 268,972 thousand AFA (405 million Japanese Yen)

(Unit: thousand AFA)

Contents	Quantity	Cost (Local Currency)	Remarks
Bank Commission for opening bank account	1	2,356 (Approx. 4 million Japanese Yen)	Borne by CRIDA
Other distribution mains which are excluded from the Grant Aid project	-	- -	
Other distribution branch lines which are excluded from the Grant Aid project	Approx. 160km estimated	266,616 (Approx. 401 million Japanese Yen)	Borne by the Private Developer
Total		268,972 (Approx. 405 million Japanese Yen)	

5.3 Conditions for Cost Estimation

The conditions for cost estimation are shown below;

1. Date : June, 2018
2. Exchange Rate : US$ = 108.75 JPY
   1AFA = 1.507 JPY
3. Construction Period : 27 months
4. Tax : As of Japan's Grant Aid scheme

6. Project Evaluation

Effects of this project is as follows:

6.1 Quantitative Project Evaluation

Figure-2 Quantitative Project Evaluation

Indicator	Current Condition (2018)	Index (2025) [3 years after commission]
Water supply (m^3/day)	0	5,000
Service Population	0	54,492
Water Supply Hours (Hour / Day)	0	24

6.2 Qualitative Project Evaluation

Construction of a set of water facilities promotes the development of Parcel-2.2 area.

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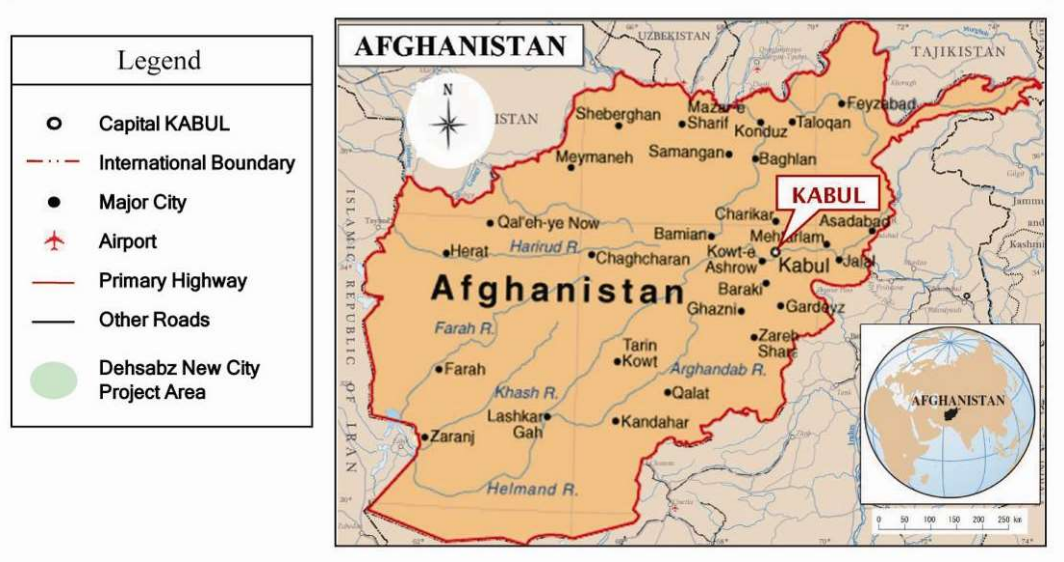
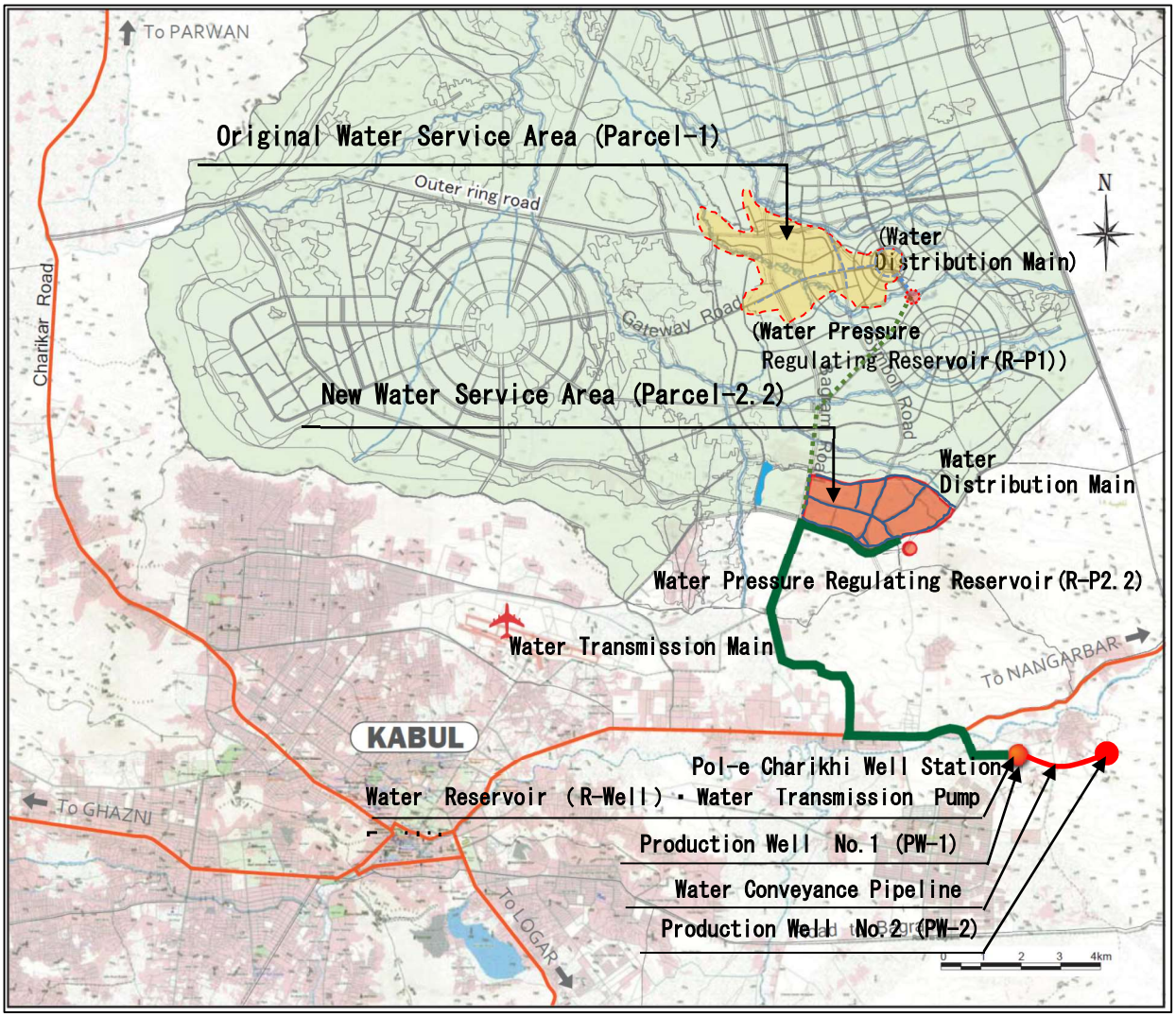
Islam Republic of Afghanistan





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Abbreviations

℃	Degree Celsius
A/A	Agent Agreement
AC	Alternating Current
AFA	Afghani
AISA	Afghanistan Investment Support Agency
ANDS	Afghanistan National Development Strategy
ANSA	Afghanistan National Standard Authority
AUWSSC	Afghan Urban Water Supply and Sewerage Corporation
BOD	Biochemical Oxygen Demand
CAD	Computer Aided Design System
CAWSS	Central Authority for Water Supply and Sewerage
CD	Capacity Development
CEO	Chief Executive Officer
CRIDA	Capital Region Independent Development Authority
DABS	Da Afghanistan Breshna Sherkat
dB	Decibel
DCDA	Dehsabz-Barikab City Development Authority
E/N	Exchange of Note
EIA	Environmental Impact Assessment
F/S	Feasible Study
FGL	Future Grand Level
G/A	Grant Agreement
GDP	Gross Domestic Product
GKD Project	The Project for Promotion of Kabul Metropolitan Area Development
GL	Grand Level
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
ha	Hectare
HDPE	High Density Polyethylene
HWL	High Water Level
Hz	Hertz
IEE	Initial Environmental Examination
JICA	Japan International Cooperation Agency
KfW	Kreditanstalt für Wiederaufbau
km	Kilometer
kN	Kilo-Newton
kV	Kilovolt
kW	Kilowatt
L, l	Liter

LCD	Liter/Capita/Day
LLWL	Lowest Low Water Level
LWL	Low Water Level
m	Meter
m^2	Square Meter
m^3	Cubic Meter
mg	Milligram
min	Minute
mm	Millimeter
MWL	Middle Water Level
N	Newton
NEPA	National Environmental Protection Agency
MP	Master Plan
MPa	Mega Pascal
No.	Number
NOx	Nitrogen Oxide
O&M	Operation and Meintenance
pH	pH Value
ppm	Parts Per Million
PQ	Prequalification
PVC	Polyvinyl Chloride
PW-1	Production Well No. 1
PW-2	Production Well No. 2
R-P1	Water Pressure Regulating Reservoir
R-Well	Reservoir for Well
RAP	Resettlement Action Plan
RC	Reinforced Concrete
SO_X	Sulfur Oxide
SP	Sub-Project
SPM	Suspended Particulate Matter
SS	Suspended Solid
TOR	Terms of Reference
UN	United Nations
UNICEF	United Nations Children's Fund
UNOPS	United Nations Office for Project Services
USAID	United States Agency for International Development
USD, US$	U.S. Dollar
V	Volt
WB	World Bank
WHO	World Health Organization

Chapter 1 Background of the Project

1.1. Background of the Requested Project

The population of Kabul City, the capital of Afghanistan was about 2 million in 1999. It is estimated at 4 or 5 million as of 2012. Moreover, it is forecasted to reach 6.5 million in 2025. Under such circumstances, the Government of Afghanistan established Dehsabz-Barikab City Development Authority (hereinafter referred as to "DCDA") and decided to develop a new city for the increasing population, which was located in the north east area of Kabul City for approximately 740 km^2 (74,000ha). The Master Plan for the Kabul Metropolitan Area Development in the Islamic Republic of Afghanistan (hereinafter referred to as "MP") was formulated in 2009 and public infrastructure plans for development of initial development area (Dehsabz South area) was prepared in 2011. In 2016, Capital Region Independent Development Authority (hereinafter referred as to "CRIDA") was established and took over the role of DCDA and has been developed the new city.

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To assist the development, the Government of Japan decided to support the construction of water facilities in Parcel-1 and agreed the Exchange of Note (E/N) and the Grant Agreement (G/A) regarding "The Project for Development of Water Supply Facilities in DEHSABZ SOUTH AREA" with the Government of Afghanistan in 2013.

Unfortunately the land issues on Parcel-1 happened and the development undertaken by the private sector at Afghanistan side were not implemented after the E/N and G/A. Under the situation, the Government of Japan decided to postpone the project until the issues are solved through the discussion with UNOPS, the implementing agency for the procurement and the supervisory service of the construction for the project.

Since there was no expectation to improve these issues, CRIDA requested the Government of Japan to change the target water service area from Parcel-1 to Parcel-2.2, where is located in the southern part of Parcel-1 in April 2016.

Parcel-2.2 is designated as initial development area by the Government of Afghanistan and most of the land owners agree to the water supply project assisted by JICA. While CRIDA and the private developer have been promoted the housing construction in Parcel-2.2, they are highly requesting a set of water supply system in the area to be supported by Japan's Grant Aid.

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1.2. Contents of the Requested Project

Contents of (1) Requested Project (2012), (2) Original Plan (Parcel-1, 2013), (3) This Plan (Parcel-2.2) are shown in Table 1.1.

Table 1.1 Components of the requirement for the Japan's Grant Aid

Facility	Component	Requested Project (2012)	Original Plan (2013, Parcel-1)	This Plan (2018, Parcel-2.2)	Note
(1) Production wells	Deep well, Submergible pump, Electric power facility	2,500m^3/day x 2 wells（including one existing monitoring well）	Production well(PW-1, PW-2): 2 units (One (1) well is the existing test well) Pump Capacity; 2,500 m^3/day x 2 units Pumping Head: 23 m. Necessary electrical facilities.	Same as left	
(2) Water conveyance pipeline	Water conveyance pipeline		Pipe laying: L = 1.6 km, DN 250 mm and 180 mm, HDPE	Same as left	
(3) Reservoir and water transmission pump facility	Reservoir	Reservoir: 1,700m^3	Reservoir (R-Well): 1 location, 1,700 m^3 (850 m^3 x 2 units), Reinforced concrete	Same as left	
	Water Transmission pump, Electric power facility	Pump facility: 5,000m^3/day (=3.5m^3/min) as daily maximum basis	Pump capacity: 1.7 m^3/min x 3 units and 1 unit for standby, Pump head: 90 m, electric power facilities	Pump head is changed to 101m	Pump head increases due to changing location of water pressure regulating reservoir
	Disinfection facility		Calcium hypochlorite solution Tank, Calcium hypochlorite dosing pump: 1 unit	Same as left	
(4) Monitoring wells	Deep well		Monitoring wells: 4 units	Same as left	
(5) Maintenance facility	Operation building etc.		Operation building, guardhouse: Flow meter, water quality analytical equipment, tools for maintenance etc.	Same as left	
2.Pipeline	Transmission and distribution pipe	Transmission pipe: 18km, DN500mm Distribution pipe: 30km, DN125～450mm	Pipe laying: L = 36.5km, DN125 ~ 500 mm, HDPE (Pipe laying works for distribution pipe include road construction works)	Pipe laying: L = 33.1km, DN125 ~ 500 mm, HDPE (Pipe laying works for distribution pipe do not include road construction works)	Pipe diameter and length are changed due to changing target water service area (Road construction works are conducted by the private developer)
3.Water pressure regulating reservoir	Elevated tank	Elevated Tank：400m^3	Elevated Tank (R-P1): 1 unit, 400 m^3 (400 m^3 x 1 unit), Reinforced concrete	Elevated Tank (R-P2.2): Volume and structure are not changed	Location is changed due to changing target water service area

1.3. Environmental and Social Consideration

1.3.1 Eniviromental Impact Assesment

(1) Outline of the Project Components

This project consists of four (4) main components as follows:

- Production wells, Pumping station
  2 production wells, water reservoir and pumping station
- Water transmission main
  Water pipes between the production wells and the water pressure regulating reservoir. Basically it is installed along the existing road.
- Water pressure regulating reservoir
  Elevated water reservoir to distribute the water to Percel-2.2
- Water distribution mains
  Water distribution mains which deriver water to city blocks in the Percel-2.2

(2) Environmental and Social Conditions

The basic environmental and social condition for each project component is shown in Table 1.2.

Table 1.2 Basic Environmental and Social Condition

Classification	Production wells, Pumping station	Water transmission main	Water pressure regulating reservoir	Major water distribution lines
Land use	Wheat field (PW-1) Open area beside the existing road (PW-2)	Existing road	Soil area located outside of Parcel-2.2	Planned road
Natural Environment	Important fauna/flora does not exit	Important fauna/flora does not exit	Important fauna/flora does not exit Dry river exists near the location	Important fauna/flora does not exit
Social environment	Private houses locate closer to the area	No facilities to be relocated in ROW	Private houses do not exist. Brick factories scatter at a distance from the location.	Resident houses and brick factories scatter in the Percel-1

* ROW: Right of Way

(3) Legal Framework for Environmental and Social Consideration in Afghanistan

NEPA (National Environmental Protection Agency) is responsible for regulating regarding conservation and restoration of environment, monitoring and compliance of environmental laws. As a procedure for environmental permit, project proponent submits the screening report to NEPA upon implementation of the project. The target project is categorized as one of following categories depending on the possible impacts[※1].

- Category A
  It is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented, and affects and area broader than the sites or facilities subject to physical works.
- Category B
  The potential adverse environmental impacts on human populations or environmentally sensitive areas (e.g. wetlands, forests, grasslands and other natural habitats) are less adverse than those of Category A projects. These impacts are site-specific. Few are irreversible.
- Category C
  It is likely to have minimal or no adverse environmental impacts.

※1 Administrative Guidelines for the Preparation of Environmental Impact Assessment, March 2007, NEPA

Based on the screening report, categorization of the project and public disclosure, NEPA certifies the environmental permit or require further EIA (Environmental Impact Assessment) study to the project proponent.

(4) Alternative Analysis

Although snow-melt-runoff water flow into the Dehsabz area temporarily throughout year, annual precipitation is 300mm and recharge capability of the area is low. Therefore, securement of steady water resource in the area is difficult. Thus water resource from other region is necessary for supply of drinking water to the area.

Water conveyance/transmission from Panjshir fan has been planned, but there is no prospect for the implementation of the plan in current. If this project is not implemented, the development of Parcel-2.2 cannot be advanced. Therefore the implementation of this project is the most appropriate.

JICA team shared with CRIDA until now that Pol-e-Charkhi is the most appropriate water source.

Because water transmission main is installed under the existing road, the works is thought to be cheap and less impact on environment.

(5) Screening Report and Project Categorization

In June 2012, DCDA submitted the IEE (Initial Environmental Examination) report for the development in Dehsabz south area to NEPA and the permission was issued and categorized as B. Moreover it is notified that the further survey is also not necessary.

CRIDA also received the permission of the development regarding water supply service from NEPA.

This project for Parcel-1 was originally categorized as “B” by JICA Guidelines for Environmental and Social Considerations (April 2004). Because this project for Parcel-2.2 is the same environmental social condition as original plan for Parcel-1 although target water service area is changed, this project is also thought to be categorized as B.

(6) Scoping and Environmental and Social Surveys

In this survey, CRIDA confirmed that there are no items that need to change the result of survey and evaluation at the time when the survey for original plan was conducted.

(7) Mitigation Measures and Cost

Environmental impact and the mitigation measures are same as the original plan.

(8) Environmental Management and Monitoring Plans

Environmental monitoring plan on the basis of the mitigation measures is same as the original plans, which are shown in Table 1.3 and Table 1.4.

Table 1.3 Environmental Monitoring Plan （Construction phase）

Impact	Monitoring item	Monitoring method	Location	Frequency	Responsible organization
Air Quality	Dust	Visual observation	Target area	Everyday	Contractor
Water Quality	Turbidity	Visual observation	Target area	Everyday	Contractor
Wastes	Material, volume	Visual observation	Target area	Everyday	Contractor
Noise and Vibration	Noise and Vibration	Measurement by equipment	Boundary of the area, road side	2 times/month	Contractor
Hydrology	Turbid water, change of water flow	Visual observation	Target area	Everyday	Contractor
River	Turbidity	Visual observation	Target area	Everyday	Contractor
Ground water	Water level, pH, Conductivity, Turbidity, color Odor, Coliform	Measurement by equipment and visual observation	Existing wells around the water resource	1 time/month	Contractor
Traffic, living facility	Traffic congestion, utilization of well	Interview, visual observation	Target area	1time/month	Contractor DCDA
Water rights	Water rights	Interview	Target area	Occasionally	DCDA

Impact	Monitoring item	Monitoring method	Location	Frequency	Responsible organization
Public health	pH, Conductivity, Turbidity, color Odor, Coliform	Measurement by equipment and visual observation (can be combined with the monitoring for the 'Ground water')	Existing wells around the water resource	1 time/month	Contractor
Working environment	Safety and health management	Confirmation by monthly progress report	Target area	1 time/month	Contractor
Accident	Safety and health management	Confirmation by monthly progress report	Target area	1 time/month	Contractor

Table 1.4 Environmental Monitoring Plan (Operation phase)

Impact	Monitoring item	Monitoring method	Location	Frequency	Responsible organization
Noise and Vibration	Noise and Vibration	Measurement Interview to residents	Surrounded area of water resource	4 times/year	AUWSSC
Ground water	Water level, pH, Conductivity, Turbidity, color Odor, Coliform	Measurement by equipment and visual observation	Existing wells around the water resource	4 times/year	AUWSSC
Ground subsidence	Ground level	Measurement	Surrounded area of water resource	4 times/year	AUWSSC

1.3.2 Land Acquisition and Resettlement

(1) Necessity of Land Acquisition and Resettlement

Status of land acquisition on each component is as follows. Table 1.5 summarizes the status of land acquisition and necessary of permits. CRIDA has completed to secure necessary land for the project and obtain permits for occupation/construction upon implementation of the project.

Table 1.5 Status of Land Acquisition and Necessary Permits

Project Component	Wells			Water Conveyance & Transmission							
	Production Well No.1	Production Well No.2	Monitoring Wells	Existing Road in the North of Radio Station	Existing Road in District 12	Kabul River	Jalalabad Road	Bypass Road between Jalalabad Road and Bagram Road	Bagram Road	MA-1 Road (Under Construction)	Water Pressure Regulating Reservoir
Land Owner	Private	Radio Station	M-1 & M-2: Private M-3 & M-4: Radio Station	District	District	Minisry of Energy and Water (MoEW)	Ministry of Public Works (MoPW)			CRIDA	The private developer
Ownership Evidence	Official evidence of land owners is required					Approval of MoEW	Approval of MoPW			Unnecessary	Unnecessary
Agreement Concurrence	Lease agreement conducted	Lease agreement unnecessary	Lease agreement conducted (Private)	Lease agreement unnecessary		Approved by MoEW	Lease agreement unnecessary			Unnecessary	Unnecessary
		Approved by Ministry of Mines	Approved by Ministry of Mines (Radio Station)				Approved by MoPW				

(2) Legal Framework on Land Acquisition and Resettlement

There had been no specific resettlement policy in Afghanistan till the recent year, but a comprehensive land policy was approved in 2007 by the cabinet. The Constitution of Afghanistan, which was ratified in early 2004, has three articles that closely relate to compensation and resettlement. For public interest purposes, such as the establishment/construction of public infrastructure or for acquisition of land with cultural or scientific values, land of higher agricultural productivity, large gardens, the Land Acquisition Law (LAL) enacted in 2009 regulates procedures of lands acquisition of private lands.

The RAP (Resettlement Action Plan) annexed by the EIA for Percel-1 development refers to JICA guideline and World Bank OP4.12 to prepare the RAP for land acquisition and resettlement.

During the field reconnaissance in the project site including the planned route for the water transmission main, there is no existing facilities including shops. Therefore, there is no possibility of resettlement.

(3) Stakeholders' Meeting

Although resettlement is not foreseen in this Project, explanation of the project such as project period and contents to stakeholders is necessary.

The outline of the project was explained on the stakeholder meeting described above and the project was basically agreed. Additionally, at the pumping test for production well No.1 in November 2017, CRIDA has explained again the outline of the project to the stakeholders.

1.3.3 Others

(1) Monitoring Form

Monitoring forms for environmental impacts on this project are shown in Table 1.14 and Table 1.15.

Table 1.6 MONITORING FORM (Construction Phase)

-If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent should refer to the following monitoring form for submitting reports.

-When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle (such as construction phase and operation phase) should be considered.

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Answer to the requirements by residents in Pol-e-Charehki on the 1st stakeholder meeting (road improvement, usage of water well)	
Number and contents of comments from the public	

2. Mitigation Measures

- Noise / Vibration

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards (Ministry of Environment, Japan)	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level	dB				60 (6AM-10PM) 50 (10PM-6AM)	Water resource area
	dB				70 (6AM-10PM) 65 (10PM-6AM)	Road side
Vibration level	dB				65 (6AM-10PM) 60 (10PM-6AM)	Water resource area
	dB				70 (6AM-10PM) 65 (10PM-6AM)	Road side

Note : Vibration level is referred to the levels for construction for water resource area and road traffic for road side in Tokyo.

- Water Quality (Existing wells)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards (WHO)	Remarks (Measurement Point, Frequency, Method, etc.)
pH	-				6.5-8.5	Existing wells
Conductivity	mS/cm				-	ditto
Turbidity	NTU				5	ditto
Color, Odor					-	ditto, Visual observation
Coliform bacteria	MPN/100mL				Not detected	ditto

Source: Guidelines for Drinking-water Quality, Fourth Edition, WHO

- **Hydrology (Water Level: River/Wells)**

Item	Unit	Measure 1	Measure 2	Measure 3	Measure 4	Annual Average
River	cm					
Well 1	cm					
Well 2	cm					
Well 3	cm					
Well 4	cm					
Well 5	cm					
Well 6	cm					
Well 7	cm					
Well 8	cm					

Note: Water level shall be measured above the same bench mark.

- **Ground subsidence (Ground level)**

Item	Unit	Measure 1	Measure 2	Measure 3	Measure 4	Annual Average
Ground 1	cm					
Ground 2	cm					
Ground 3	cm					
Ground 4	cm					
Ground 5	cm					

Note: Ground level shall be measured above the same bench mark.

- **Waste**

Day	Content	Volume	Way of disposal
day 1			
day 2			
day 3			

3. Social Environment

- **Living / Livelihood**

Monitoring Item	Monitoring Results during Report Period
Water usage (well)	
Hygiene	
Working environment	
Accident	

Table 1.7 MONITORING FORM (Operation Phase)

-If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent should refer to the following monitoring form for submitting reports.
-When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle (such as construction phase and operation phase) should be considered.

1. Responses/Actions to Comments and Guidance from Government Authorities and the Public

Monitoring Item	Monitoring Results during Report Period
Number and contents of comments from the public	

2. Mitigation Measures

- Noise / Vibration

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards (Ministry of Environment, Japan)	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level	dB				60 (6AM-10PM) 50 (10PM-6AM)	Water resource area
Vibration level	dB				60 (8AM-7PM) 55 (7PM-8AM)	Water resource area

Source: Vibration level is referred to the levels for residential area in Tokyo.

- Water Quality (Existing wells)

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards (WHO)	Remarks (Measurement Point, Frequency, Method, etc.)
pH	-				6.5-8.5	Existing wells
Conductivity	mS/cm				-	ditto
Turbidity	NTU				5	ditto
Color, Odor					-	ditto, Visual observation
Coliform bacteria	MPN/100mL				Not detected	ditto

Source: Guidelines for Drinking-water Quality, Fourth Edition, WHO

- **Hydrology (Water Level: River/Wells)**

Item	Unit	Measure 1	Measure 2	Measure 3	Measure 4	Annual Average
River	cm					
Well 1	cm					
Well 2	cm					
Well 3	cm					
Well 4	cm					
Well 5	cm					
Well 6	cm					
Well 7	cm					
Well 8	cm					

Note: Water level shall be measured above the same bench mark.

- **Ground subsidence (Ground level)**

Item	Unit	Measure 1	Measure 2	Measure 3	Measure 4	Annual Average
Ground 1	cm					
Ground 2	cm					
Ground 3	cm					
Ground 4	cm					
Ground 5	cm					

Note: Ground level shall be measured above the same bench mark.

3. Social Environment

- **Living / Livelihood**

Monitoring Item	Monitoring Results during Report Period
Water usage（Testing well）	
Public health	

(2) Environmental Check List

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a)Y (b)Y (c)Y (d)N	(a)IEE report has been prepared and submitted by DCDA. (b)NEPA's approval was confirmed. (c)ditto, condition will not be imposed. (d)N/A
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a)Y (b) N	(a)Project has been explained and accepted by the stakeholders. (b)CRIDA and the private developer has attained concurrence from the stakeholders and land owners.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a)Y	(a)Alternatives of water resources have been studied.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that chlorine from chlorine storage facilities and chlorine injection facilities will cause air pollution? Are any mitigating measures taken? (b) Do chlorine concentrations within the working environments comply with the country's occupational health and safety standards? (c) Is there a possibility that air pollutants emitted from the project related sources, such as vehicles traffic will affect ambient air quality? Does ambient air quality comply with the country's air quality standards? Are any mitigating measures taken? (d) Where industrial areas already exist near the route, is there a possibility that the project will make air pollution worse?	(a)N (b)Y (c)Y (d)N	(a)The facility will be covered. No consideration is necessary as low concentration of chlorine is used. (b)It will be confirmed and managed by AUWSSC (c)Emission of air pollutants from construction machineries/vehicles may temporarily increase during construction phase. Mitigation measures to reduce emission will be taken. (d)The impact is limited in the construction phase and it is temporal.
	(2) Water Quality	(a) Do pollutants, such as SS, BOD, COD contained in effluents discharged by the facility operations comply with the country's effluent standards? (b) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? (c) Is there a possibility that surface runoff from roads will contaminate water sources, such as groundwater?	(a)N (b)N (c)N	(a)No facility to discharge such effluent is planned. (b)It is hardly considered as river flow is spatially and temporally limited. (c)ditto
	(3) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed in accordance with the country's regulations? (b) Are wastes generated from the project facilities, such as parking	(a)N (b)Y	(a)No facility for discharge such effluent is planned. (b)Surplus soil by construction will be brought to the designated dumping site.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		areas/service areas, properly treated and disposed of in accordance with the country's regulations?		
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as pumping stations comply with the country's standards? (b) Do noise and vibrations from the vehicle and train traffic comply with the country's standards?	(a)Y (b)Y	(a)It will be confirmed and managed by AUWSSC. (b)It will be monitored during construction phase.
	(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a)N	(a)According to the previous study, there is no possibility of ground subsidence. However it will be monitored.
3 Natural Environment	(1) Protected Areas	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a)N	(a)There is no protected area surround the project area.
3 Natural Environment	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site or discharge area encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by project will adversely affect aquatic	(a)N (b)N (c)N (d)N (e)N	(a)There is no habitat mentioned. (b)ditto (c)Significant ecological impact is not foreseen. (d)According to the previous study, it is not considered. However it will be monitored. (e)Small area is planned to be newly developed, However the location is arid land and no important natural environment is recognized.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms? (e) In cases the project site is located at undeveloped areas, is there a possibility that the new development will result in extensive loss of natural environments?		
	(3) Hydrology	(a) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect surface water and groundwater flows?	(a)N	(a)According to the previous study, it is not considered. However it will be monitored.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement?	(a)N (b)Y (c)N (d)N (e)N (f)N (g)Y (h)Y (i)Y (j)Y	(a)No existing facilities necessary for resettlement in the project site. (b~f)Resettlement and compensation is not foreseen. (g)It is planned, if necessary. (h)Certain department will be responsible. (i)ditto (j)ditto

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?		
4 Social Environment	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect the existing water uses and water area uses?	(a)N (b)N	(a)Major negative impact cannot be foreseen. Water level of the existing wells will be monitored. With the construction, existing road will be improved. So that positive impact is considered. (b)According to the previous study, it is not considered. However it will be monitored, especially the water level of existing wells.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are	(a)N	(a)No local archeological, historical, cultural, and religious heritage exists around the project area.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		adequate measures considered to protect these sites in accordance with the country's laws?		
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a)Y	(a)Elevated water pressure regulating reservoir is planned, considering the harmonization with the tower and surrounded landscape.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a)Y (b)Y	(a)It is considered that the affected ethnic minorities and indigenous people do not exist. (b)ditto
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a)Y (b)Y (c)Y (d)Y	(a)This will be considered in the Environmental Management Plan. (b)ditto (c)ditto (d)ditto

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a)Y (b)Y (c)Y (d)Y	(a)This will be considered in the Environmental Management Plan. (b)ditto (c)ditto (d)ditto
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a)Y (b)Y (c)Y (d)Y	(a)This will be considered in the Environmental Management Plan.(b)ditto(c)ditto(d)ditto
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Dam and River Projects checklist should also be checked.	(a)Y	(a)Checklist for 'Roads' is also considered and merged in this checklist.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
6 Note	Note on Using Environmental Checklist	(a) If necessary, the impacts to trans-boundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as trans-boundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a)N	(a)No such impact is foreseen.

1) Regarding the term “Country’s Standards” mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made.

In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).

2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.

Chapter 2 Concepts of the Project

2.1. Basic Concept of the Project

2.1.1 Overall Goal and Project Purpose

The Government of Afghanistan plans to develop the New City, which locates in the north east area of Kabul City, in order to settle the exponential growth of population and the deficiency of residential property for the Kabul metropolitan area. Because there are neither the existing water supply facilities nor sufficient water resources which sustain the Parcel-1 area, the Government of Afghanistan planned to construct a set of water facilities in the area by 2015.

To support the development, the Government of Japan made the agreement with the Government of Afghanistan regarding the Japan's Grant Aid project "The Project for Development of Water Supply Facilities in Dehsabz South Area" in 2013.

Unfortunately the land issues on Parcel-1 happened and the development undertaken by the private sector at Afghanistan side were not implemented after the E/N and G/A. Under the situation, the Government of Japan decided to postpone the project until the issues are solved through the discussion with UNOPS, the implementing agency for the procurement and the supervisory service of the construction for the project.

Since there was no expectation to improve these issues, CRIDA requested the Government of Japan to change the target water service area from Parcel-1 to Parcel-2.2, where is located in the southern part of Parcel-1 in April 2016.

Parcel-2.2 is designated as initial development area by the Government of Afghanistan and most of the land owners agree to the water supply project assisted by JICA. While CRIDA and the private contractor have been promoted the housing construction in Parcel-2.2, they are highly requesting a set of water supply system in the area to be supported by Japan's Grant Aid.

Under such circumstances, the project objectives are to develop water resource, to construct water conveyance and water transmission facilities and water distribution mains, and to secure the required water in the Parcel-2.2.

2.1.2 Basic Concept of the Project

Through this study, JICA study team reviewed the original outline design on a set of water supply system consisted of two (2) production wells, a reservoir, a water transmission pumping station, a water transmission main, a water pressure regulating reservoir and water distribution mains, which were originally designed for parcel-1, and revised the design of some water facilities for Parcel-2.2 and estimated the project cost. Finally, JICA study team built a set of water supply system for Parcel-2.2 without changing the original design of each water facility except for a part of them (water transmission pump and water transmission and distribution pipes etc.).

In addition, JICA study team changed design water supply per capita (daily maximum water supply per capita) in 2025 from 150LCD (Liter/capita/day) at original plan to 92 LCD in this survey considering no expectation at present for the development of new water source.

2.2. Outline Design of the Japanese Assistance

2.2.1 Design Policy

2.2.1.1 Basic Concept

The scope of Japanese assistance aims to transmit the required water to Parcel-2.2. Moreover, the water sources of 5,000m^3/day as the daily maximum pump discharge is secured in Pol-e Charkhi area. According to these conditions, the basic concept of the Project is as follows:

(1) Target Area of the Japanese Assistance

The target area of the Japanese assistance is Parcel-2.2. The project sites include Pol-e Charkhi area (the production wells, the reservoir for wells and the water transmission pumping station), water transmission lines, and the area adjacent to Parcel-2.2 for the water pressure regulating reservoir, the existing road where water conveyance pipe and water transmission pipe are located and the construction

site of Parcel-2.2.

(2) Design Service Population for Water Supply

The design service population for water supply is 54,492 in the target year of 2025 in accordance with the development plan of CRIDA.

(3) Design Water Supply

In original plan, design water supply per capita was set as 150LCD, which is equivalent to 8,190 m^3/day as design maximum daily water supply volume, in accordance with "The Master Plan for the Kabul Metropolitan Area Development in the Islamic Republic of Afghanistan" on the premise that water sources are newly developed by the target year. Since there is no expectation for the development of new water source at present, design water supply per capita was revised as 92 LCD so as to meet design maximum daily extracting volume, 5,000 m^3/day, which can be supplied from Pol-e Charkhi wells, which is equivalent to 6,517 m^3/day as design maximum daily water supply volume.

(4) Component of the Japanese Assistance

The component of Japanese assistance covers intake facility, reservoir, water transmission pump facilities, water transmission mains, water pressure regulating reservoir and water distribution mains. Any other necessary water distribution mains after the water pressure regulating reservoir shall be constructed by CRIDA so that they can be aligned with each urban development plan including ones made by the private contractor. Water distribution branches laying in the town and housing areas will be constructed with the budget of private developers.

2.2.1.2 Concept Regarding Natural Conditions

Frequent earthquakes hit Afghanistan and earthquake resistant structure should be applied in the design. Moreover, it snows and becomes freezing temperature in winter. Snow loads and cryogenic temperatures shall be taken account in the design.

2.2.1.3 Concept Regarding Social and Economic Conditions

Anti-governmental activities have been still active in Afghanistan. Therefore, the exposed pipes, which may become potential target of attacks, should be refrained as much as possible or paved with concreted if exposure on the ground is unavoidable. Moreover, the properties such as a pumping station and reservoirs should be surrounded with concrete structures. Therefore, Japan's assistance will include construction of these facilities.

Those areas, where pressure regulating reservoir will be constructed, have not been electrified. Therefore, use of electricity in the structures and facility operation should be prevented. Yet, the design of these facilities shall allow installing electrical equipment and instruments in the future.

2.2.1.4 Concept Regarding Construction and Procurement Conditions

A number of construction and development projects have been undertaken by assistance of donors such as the United Nations. Capacity of construction companies has been improved and the markets for construction materials have been matured. Therefore, it can be concluded that no special consideration is required for procurement of general construction materials and contractors for construction of facilities.

Among the required construction materials in this Project, pipes and concrete materials can be procured in the local markets. On the other hand, majority of electrical and mechanical facilities including pumping devices should be imported or procured among imported items. Therefore, both local and international markets should be considered for the construction and procurement plans.

There are several metal and steel processing factories. Therefore, procurement of processed steel is available. On the other hand, there is no factory available which markets secondary products such as steel tanks based on sufficient experience and sales record. Therefore, the structure of water tanks shall be limited to the reinforced concrete types.

2.2.1.5 Concept Regarding Utilization of Local Contractors

Local construction companies and vendors are available in local markets. Therefore, capacity and capability of local contractors should be taken account in design and specification.

2.2.1.6 Concept Regarding Operation and Maintenance

CRIDA and AUWSSC have agreed that AUWSSC will be responsible for operation and maintenance of water supply and sewerage services of the New City. CRIDA will lead facility construction. The facilities will be transferred to AUWSSC and AUWSSC will conduct operation of water supply and sewerage services.

AUWSSC has faced severe conditions in the aspects of operation, maintenance and finance. Additionally, securing appropriate engineers and skilled labors is one of the issues due to high rate of leaving their jobs. Therefore, simple structure of facilities in terms of operation and maintenance should be adopted. Especially it is important to minimize the electrical and electrical signal type operation systems in consideration of troubles.

2.2.1.7 Concept Regarding Grade of Facility and Materials

The facilities in this Project consist of ordinal structures such as concrete structures, pipelines for water supply, pump facilities including wells and transmission of water. Therefore, special attention on selection of grade of facilities and materials is not required.

2.2.1.8 Concept regarding Construction and Procurement Plans, and Schedule

It is assumed the United Nations Office for Project Services (hereinafter referred to as “UNOPS”) will stand as a procurement agency on behalf of the Government of Afghanistan. Therefore, procurement plans shall take account of the procurement scheme of the UNOPS.

A part of main pipelines will be developed under the pilot project of the Infrastructure SP. It is important the construction schedule should be harmonized with the pilot project.

2.2.2 Basic Plan (Construction Plan / Equipment Plan)

2.2.2.1 Overall Plan

This Project covers production wells, a reservoir, a water transmission pump facility, a water transmission main, a water pressure regulating reservoir and water distribution mains. For the purpose to secure necessary water head for water supply, elevated tank is applied as water pressure regulating reservoir. It is difficult to construct large scale elevated tanks due to structure and issues relating to land acquisition. Water reservoir and water transmission pump facility shall be constructed near production wells in respect to cost reduction. Therefore, the water reservoir can be utilized for distribution to Kabul city in the future. Figure 2-1 and Table 2.1 show the outlines of each facility.

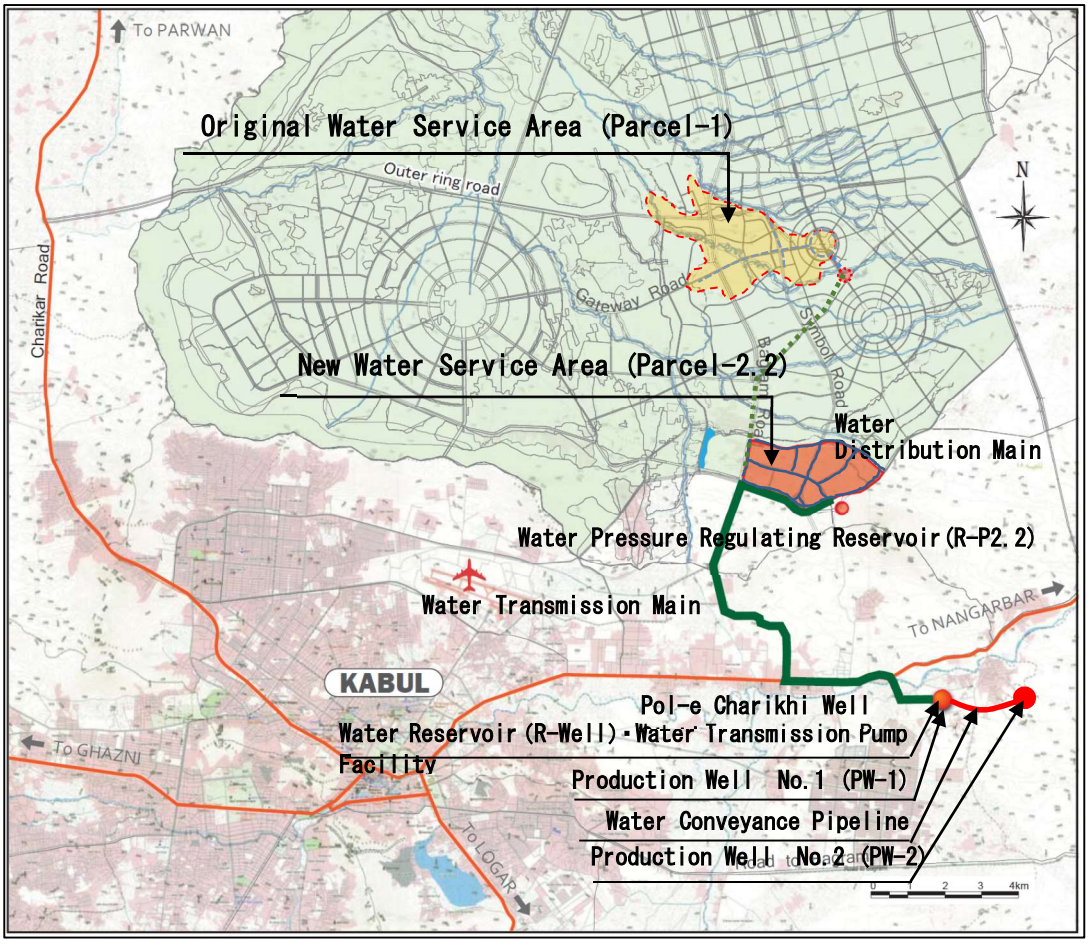


Figure 2-1 Outline of the Project

Table 2.1 Scope of Japanese Assistance

Facility Name	Components	Specifications
1. Pol-e Charihi Well Station		
① Production well (PW-1, PW-2)	Deep well, Submersible pump, Power receiving equipment	Production well: 2 units (One (1) well is the existing test well) Pump Capacity; 2,500 m^3/day x 2 units Pumping Head: 23 m. Necessary electrical facilities.
② Water Conveyance Pipeline	Water conveyance facility	L = 1.6 km, Outer Diameter: 250 mm and 180 mm, HDPE
③ Reservoir and Water Transmission Pimp Facility	Reservoir (R-Well)	1 location, 1,700 m^3 (850 m^3 x 2 units), Reinforced concrete
	Water transmission pump, Power receiving equipment	Pump capacity: 1.7 m^3/min x 3 units and 1 unit for standby, Pump head: 101 m, necessary electrical facilities.
	Disinfection facility	Calcium Hypochlorite Solution Tank, Calcium Hypochlorite Dosing Pump: 1 unit
④ Monitoring Wells	Deep well	Monitoring wells: 4 units
⑤ Maintenance facilities	Operation building at Pol-e Charihi Well Station	Operation building (Chemical room, electric room, pump room and administration room): 1 unit, Reinforced concrete, Guardhouse: 1 unit Flow meter, water quality analytical equipment:1 unit Tools for maintenance: 1unit
2. Pipeline	Transmission and distribution lines	L = 33.1km, Outer diameter: 125 ~ 500 mm, HDPE (Pipe laying works for distribution pipe do not include road construction works)
3. Water pressure regulating reservoir	Elevated tank (R-P2.2)	1 location, 400 m^3 (400 m^3 x 1 unit), Reinforced concrete

2.2.2.2 Design Conditions

(1) Design Water Quality

There is no specific drinking water quality standard in Afghanistan and the standard of World Health Organization (WHO) is commonly applied. This Project also adopts the WHO's drinking water standard in design. A water quality examination for the test wells was conducted under the Sub-Project for Groundwater Survey for Dehsabz South Development Area (hereinafter referred to as Groundwater SP). The result of the test concluded the groundwater is suitable as water resources of drinking water (results of the test are shown in Table 2.2 and Table 2.3)

Table 2.2 Result of Water Quality Analysis

Parameter	Unit	TW-1	TW-2	WHO's Guidelines (4th edition)
Water Temperature	℃	25.0	20.8	-
pH	-	7.7	7.6	6.5-8.5
Electrical Conductivity (EC)	μS/cm at 25℃	800	950	-
DO	mg/l	6.2	4.8	-
COD	mg/l	2	2	-
BOD	mg/l	2	2	-
Anionic Surfactant	mg/l	0.05	0.10	< 0.2 mg/l（Drinking water quality standard）
Coliforms	CFU/ml	15	0	Not detected（Drinking water quality standard）by EC-plate
	CFU/ml	26	0	Not detected（Drinking water quality standard）by Coliform detection paper
Fecal Coliform (E. Coli)	CFU/ml	0	0	Not detected（Drinking water quality standard）
Standard Plate Count Bacteria	CFU/ml	14	120	-
Turbidity	NTU	0.5	0.5	< 5 NTU
Alkalinity	mg/l as $CaCO_3$	210	320	-
Bicarbonate (HCO_3^-)	mg/l	256	390	-
Ammonia (NH_3)	mg/l as NH_3-N	0.05	0.03	-
Nitrite (NO_2^-)	mg/l as NO_2-N	0.003	0.004	< 3mg/l（short‐term exposure）
Nitrate (NO_3^-)	mg/l as NO_3-N	7.0	8.1	< 50 mg/l（short‐term exposure）
Hardness	mg/l as $CaCO_3$	450	480	-
Sodium (Na^+)	mg/l	75	62	< 50 mg/l
Potassium (K^+)	mg/l	3.5	1.5	-
Magnesium (Mn^{2+})	mg/l as $CaCO_3$	285	295	-
Calcium (Ca^{2+})	mg/l as $CaCO_3$	165	185	-
Iron, Total (T-Fe)	mg/l	0.02	0.02	< 0.3 mg/l
Manganese (Mn^{2+})	mg/l	0.2	1.1	< 0.4 mg/l
Chloride (Cl^-)	mg/l	87.5	62.5	< 250 mg/l
Sulfate (SO_4^{2-})	mg/l	140	160	< 500 mg/l
Fluoride (F^-)	mg/l	0.34	0.40	< 1.5 mg/l
Arsenic (As)	mg/l	0.000	0.000	< 0.01 mg/l

Source: Water quality examination in the Groundwater SP

Table 2.3 Result of Heavy Metal Analysis

Parameter	Unit	TW-1	TW-2	WHO's guidelines (4th edition)
Cadmium	mg/l	<0.001	<0.001	< 0.003 mg/l
Cyan, Total	mg/l	Not detected		< 0.0006 mg/l
Lead	mg/l	<0.005	<0.005	< 0.01 mg/l
Chromium (VI)	mg/l	<0.01	<0.01	< 0.05 mg/l
Arsenic	mg/l	<0.005	<0.005	< 0.01 mg/l
Mercury, Total	mg/l	<0.0005	<0.0005	< 0.006 mg/l
Selenium	mg/l	<0.002	<0.002	< 0.04 mg/l
Fluoride	mg/l	0.40	0.38	< 1.5 mg/l
Boron	mg/l	0.15	0.15	< 2.4 mg/l

Source: Water quality examination in the Groundwater SP

(2) Design Condition

Design conditions to be applied are defined in Table 2.4.

Table 2.4 Design Condition

Parameters	Value	Unit	Applicable Facility	
Design water supply per capita	92	LCD		a.
Design service population	54,492	Persons		b.
Design maximum daily extracting volume	5,000	m^3/day	Volume of distribution reservoir	c. =d x 2
Design maximum daily extracting volume	2,500	m^3/day	Per well	d.
Design maximum daily extracting volume	1.8	m^3/min	Diameter of pipes and specification of pumps of production wells	e. =d
Daily variation coefficient *1	1.3	-		f.
Design load *1	0.769			g = 1/f
Hourly variation coefficient *2	1.4	-		H
Design maximum daily water supply volume	6,517	m^3/day	Water pressure regulating reservoir	i.=a x b x f
Design maximum hourly water transmission volume	1.7	m^3/min	Water transmission pumps (per pump)	j. =c x h / 3
Design maximum hourly water transmission volume	5.1	m^3/min	Diameter of transmission pipelines (during operation of 3 pumps)	k. =j x3
Design maximum hourly water distribution volume	9,124	m^3/day	Diameter of distribution pipeline	l. =i x h

*1 Based on the master plan.

*2 Hourly variation coefficient was calculated based on Japan's design criteria for waterworks facilities.

Hourly variation coefficient (K) = $2.7445 \times (Q/24)^{-0.0726}$

where;

Q: Daily maximum water supply (m^3/day)

The expected design population in 2025 is 1.5 million based on the master plan.

$Q = 150LCD \times 1.3 \times 1.5 \times 10^6 = 292{,}500\ m^3/day$

Therefore, 1.4 was adopted as hourly variation coefficient

$K=2.7445 \times (292{,}500/24)^{-0.0726}=1.386 \fallingdotseq 1.4$

(3) Seismic Load

No clear standard for seismic load has been established in Afghanistan. Yet, design horizontal seismic coefficient of Kh = 0.3 or equivalent is commonly applied for important structures. In this Project, Kh = 0.3 is applicable for design since the value is equivalent to Japanese architectural standard.

$C \geqq 0.3\ Zs\ I$

where,

Zs : 1.0 is applied as regional seismic coefficient

I : 1.0 is applied as usage coefficient. Since water tanks and control building are integrated as one function, 1.0 is applied for the whole system.

(Source: Design recommendation for storage tanks and their supports, Architectural Institute of Japan)

(4) Wind Load

Wind load is considered for those structures which are potentially influenced by wind such as the water pressure regulating reservoir. No clear standard on wind load has been established in Afghanistan, but the load can be calculated based on the Japanese relevant criteria.

P＝Q･C･A

where;

P : Wind Load (kN)
Q : Wind Pressure KN/m^2
C : Wind Coefficient 0.7
A : Effective projection area (m^2)

(5) Snow Load

No clear criteria on snow load are established in Afghanistan. However, snowfall is foreseen during winter period and load of snow shall be included in the design.

S＝Ws×Zs×μb

where;

S: Snow Load (kN) = 1 KN/ m^2
Ws : Average unit weight of snow (at heavy snow region) 20 N/m^2/cm
Zs : Design snow depth 50cm
μb : Roof shape coefficient due to slope 1.0 (no slope)

2.2.2.3 Facility Layout Plan

(1) Pol-e Charikhi Well Station

As the result of reviewing the original plan, JICA study team confirmed that water facilities except for water transmission pump which was designed at original plan can be applied to this plan without any design change.

(a) Layout of Pol-e Charikhi Well Station

CRIDA prepare the plan of layout of Pol-e Charikhi Well Station as Figure 2-2. The existing test wells will be used as production wells and water transmission facilities will be constructed adjacent to the production wells.

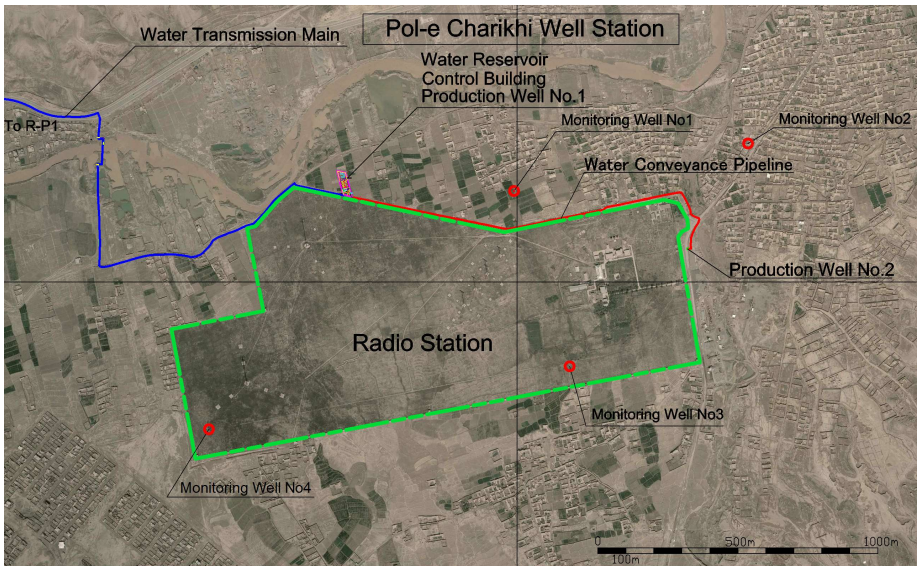


Figure 2-2 Layout of Pol-e Charikhi Well Station

(b) Structure of Pol-e Charikhi Well Station

The main structures of the Pol-e Charikhi Well Station are shown below and Figure 2-3 shows the

overall system of the station.

- Production Wells (+ Well Pumps): 2 Wells (PW-1, PW-2)
- Water Distribution Conveyance lines：PW-1 ~ R-Well, PW-2 ~ R-Well
- Water Reservoir（R-Well）
- Water Transmission Pump Facility
- Control Building
- Monitoring Wells：4 Wells

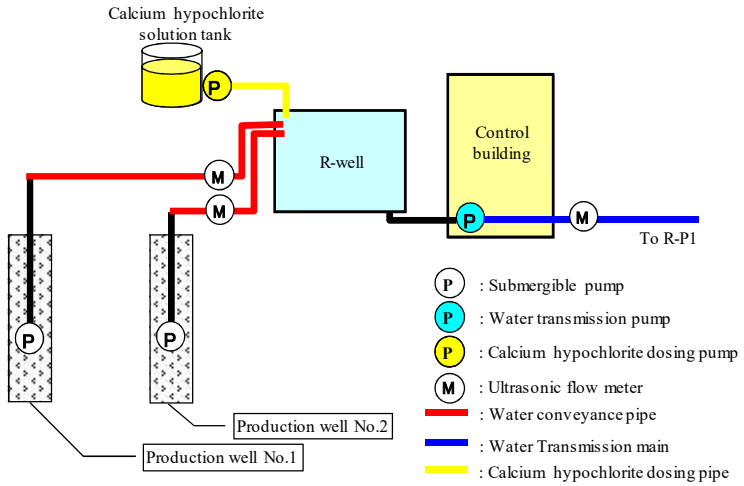


Figure 2-3 Pol-e Charikhi Well Station System

(c) Production Wells

The design maximum extracting volume is 2,500 m3/day/well based on the survey conducted under the JICA's Groundwater SP. The test well will be used as the production well No. 1 (PW-1). By considering the interference of extracting, the production well No. 2 (PW-2) shall be constructed in the eastern side of the radio station which is approximately one (1) km away from PW-1. Table 2.5 shows the outline of the production wells.

In addition, because many years have passed at present since 2013, when "Outline Design Survey for the Project for Development of Water Supply Facilities in Dehsabz South Area, JICA" was conducted, CRIDA conducted the pumping test for production well No.1 in November, 2017 (refer to APPENDIX-3 (2)) and confirmed that the design yield is secured.

Table 2.5 Outline of Production Wells

Item	Outlines
Number of Wells	2 wells (PW-1, PW-2)
Daily maximum yield capacity	2,500m^3/day/well
Diameter of casing and material	10 inches and SUS304
Depth of wells	40 m

(d) Water Conveyance Line and Intake Pump

i) Water Conveyance Line

Various materials have been utilized as water supply pipelines in Kabul City. Yet, High Density Polyethylene (HDPE) pipeline has become the most popular material in recent years in terms of easiness in construction and maintenance, economic aspects, and availability in markets. Based on the discussion among AUWSSC, CRIDA and the study team, HDPE pipeline will be applied for the pipelines. Table 2.6 shows the main feature of the conveyance pipeline.

The minimum earth coverage is determined as 1 m by accounting of the freezing depth of 80 cm. Based on the result of geological survey, excavation of rocks is not foreseen. Standard cross section for conveyance pipeline is shown in Figure 2-4.

Table 2.6 Main feature of the conveyance pipeline

Facility	Type	Diameter(mm)	Length (m)
Production well No. 1 (PW-1) ~ Water Reservation(R-Well)	HDPE	153 (Outer Diameter 180)	90
Production well No. 2 (PW-2) ~ Water Reservation(R-Well)	HDPE	213 (Outer Diameter 250)	1,545

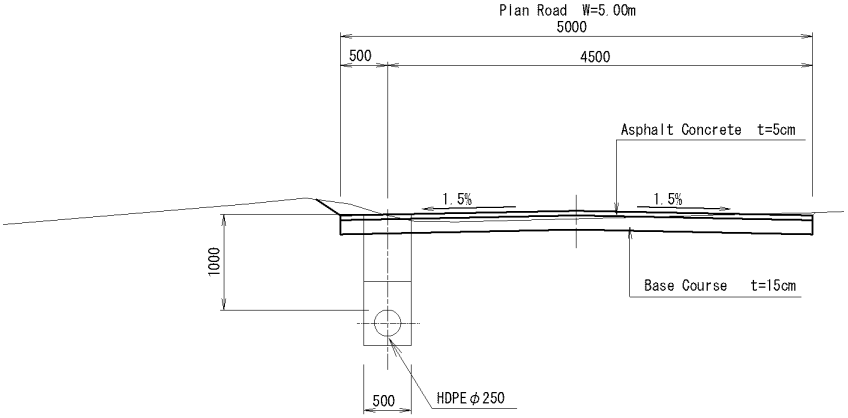


Figure 2-4 Standard Cross Section of Water Conveyance Line

ii) Production Well No. 1 (PW-1)

Actual head, which is the level difference between dynamic water level of PW-1 and R-well, is 11.8m. By considering friction loss, pumping head and diameter of water conveyance line were calculated by Hezan Williams Formula. Additionally seven (7) m of safety factor is considered for aging and drought. By simulating the friction loss as well as necessary pumping head, pipelines of outer diameter 180 mm are recommended with submersible pumps having 23 m of pumping head.

iii) Production Well No. 2 (PW-2)

Actual head, which is the level difference between dynamic water level of Well-2 and R-well is 5.1m. By simulating the friction loss as well as necessary pumping head, pipelines of outer diameter 250 mm are recommended with submersible pumps having 23m of pumping head.

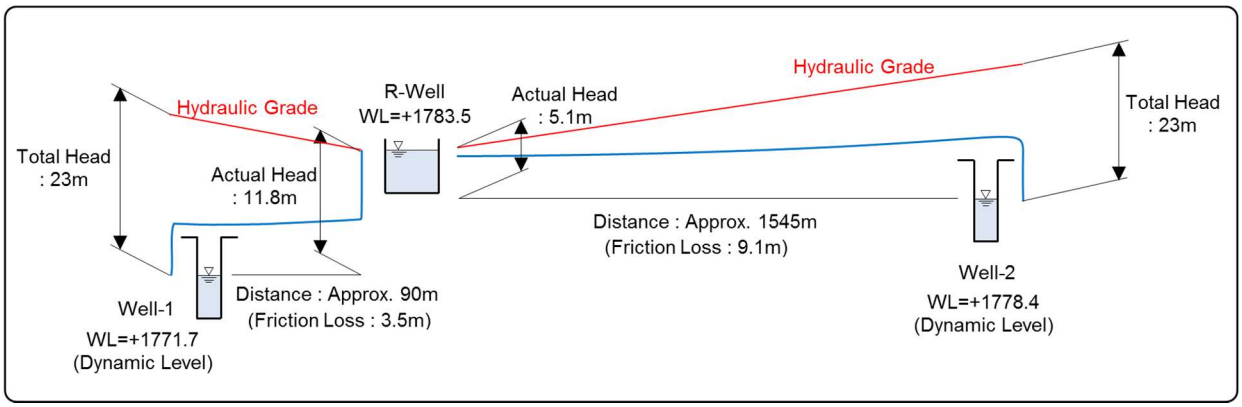


Figure 2-5 Calculation of Friction Loss of Well Pumps and Water Conveyance Lines

Table 2.7 Calculation of Friction Loss

Item	Yield Capacity (m^3/min)	No. Pump	Diameter (mm)	Length (m)	Actual Pumping Head (m)	Friction Pile (m)	Total Dynamic Head (m)
Water Intake Pump (Well-1)	1.8	1	153 (Outer Diameter: 180)	90	11.8	3.5	15.3
Water Intake Pump (Well-2)	1.8	1	213 (Outer Diameter: 250)	1,545	5.1	9.1	14.2

[Hazen Williams Formula]

$$H = 10.666 \times C^{-1.85} \times D^{-4.87} \times Q^{1.85} \times L$$

where

H: Friction Head (m)
C: Flow velocity coefficient (110 : HDPE pipeline)
D: Inner Diameter (m)
Q: Flow volume (m^3/sec)
L: Length (m)

(e) Basic Specification of Intake Pumps

Basic specification of water intake pumps is described below;

i) Production Pump No. 1 (Well-1)

- Type : Deep well submergible pump
- Quantity : 1 unit
- Unit capacity : 1.8 m^3/sec
- Total dynamic head : 23 m
- Motor : Submergible motor
  Electricity : 400V x 50 Hz
  Motor Output : Approximately 15 kW

ii) Production Pump No. 2 (Well-2)

- Type : Deep well submergible pump
- Quantity : 1 unit
- Unit capacity : 1.8 m^3/sec
- Total dynamic head : 23 m
- Motor : Submergible motor
  Electricity : 400V x 50 Hz
  Motor Output : Approximately 15 kW

(f) Water Reservoir: R-well

i) Capacity

The capacity is to be 8 hours capacity of the daily maximum yield volume of 5,000 m^3/day. Therefore, it was calculated at 1,700 m^3.

Volume V (m^3) = 5,000m^3/day / 24hour x 8hour
= 1,666 m^3 (≒1,700m^3)

ii) Number of Tanks

By considering maintenance aspects, two (2) units shall be designed. Therefore, the unit capacity of the reservoir is 850 m^3.

iii) Structure

Reinforced concrete structure will be adopted.

(g) Structure of Operation Building

The operation building consists of chemical room, electric room, pump room and administration room. Reinforced concrete structure is adopted. As an anti frost measure, thermal insulating material is used in walls for chemical room, pump room and administration room (except electricity room).

(h) Transmission Pump Facility

i) Hydrologic Accounting

Actual head, which is the level difference between R-well and R-P2.2, is 77.6m. Considering friction loss, pumping head and diameter of water distribution line were calculated by Hezan

Williams Formula. By simulating the friction loss as well as necessary pumping head, pipeline of outer diameter 500 mm is recommended with pumps having 101 m of pumping head. Simulation results are shown in Figure 2-6 and Table 2.8.

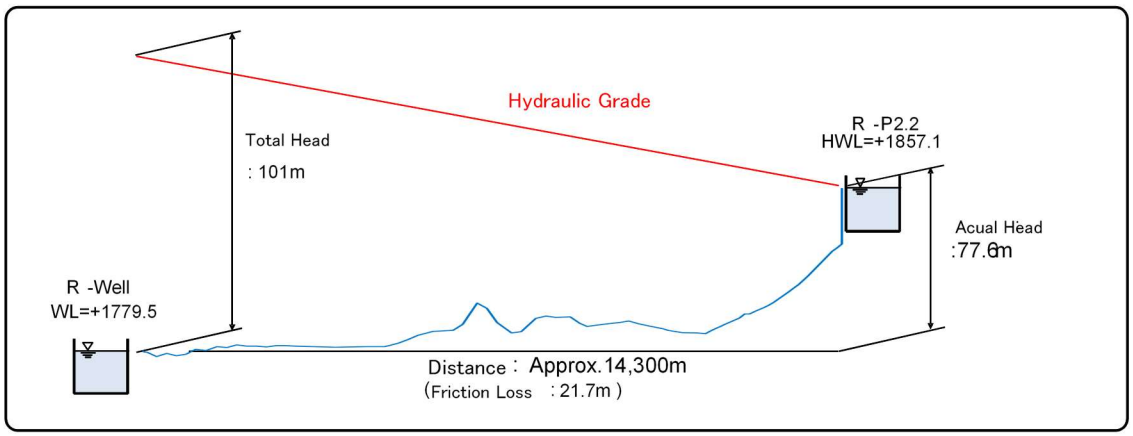


Figure 2-6 Longitudinal Profile of Transmission Pumps and Water Transmission Main

Table 2.8 Result of Simulation for Pumping Head and Pipe Diameter: Transmission Pump

Water Capacity (m^3/min)	Operation Nos. of Pump (-)	Pipe Diameter (mm)	Distance (km)	Actual Head (m)	Friction Loss (m)	Total Head (m)
5.1	3	426 (Outer Diameter 500)	14.3	77.6	21.7	101

ii) Study for Water Hammer

The watering route from water transmission pumps to R-P2.2 is long in distance of approximately 14 km with continuous undulating hills. Therefore, the water hammer, which is caused by water column separation in distribution pipeline due to the distance and topographical feature, shall be examined. In order to prevent the water hammer, it is important to reduce negative pressure at less than 7m in water head.

Figure 2-7 shows the result of calculation of water hammer for the case of flywheel that inertia effect (GD^2) is 44 kg/cm^2. The result shows that the negative pressure will be less than 7 m. Therefore, flywheel shall be adopted in the design.

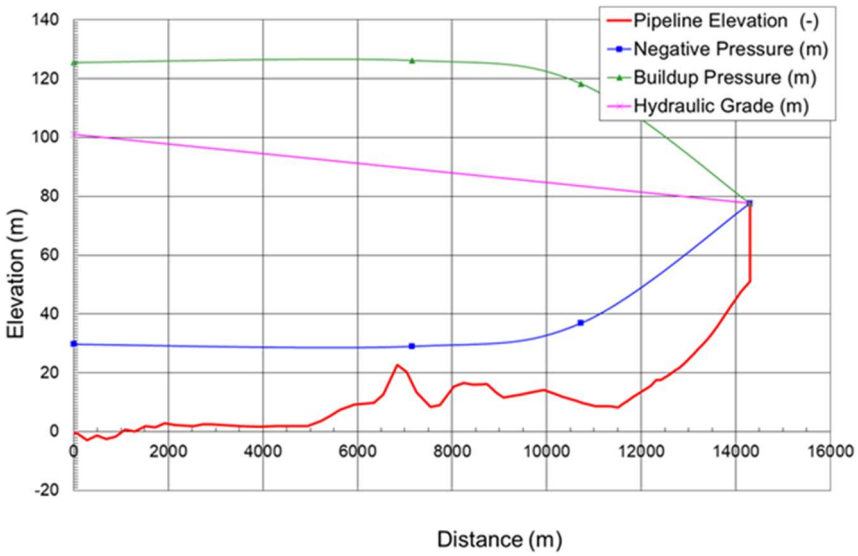


Figure 2-7 Negative Pressure on Water Transmission Main

(i) Basic Specification of Water Transmission Pump

Basic specification of water transmission pump and motor unit is as follows;

i) Water Transmission Pump
- Type : horizontal shaft, multistage centrifugal pump
- Quantity : 4 units (1 unit is for standby)
- Unit capacity : 1.7 m^3/sec
- Total dynamic head : 101 m
- Pump rated efficiency : Not less than 65.0%

ii) Motor for Water Transmission Pump
- Type : Squirrel cage induction motor
- Quantity : 4 units
- Motor output : Approx. 55kW
- Maximum ambient temperature : 50 degree C
- Electrical supply : AC 400V x 50 Hz

(j) Disinfection Facility

According to confirmation with AUWSSC, 30% concentration of calcium hypochlorite (bleaching powder) is usually utilized by AUWSSC. It is difficult in Afghanistan to procure high concentration hypochlorite or sodium hypochlorite solution. Therefore, solid status calcium hypochlorite (30% of concentration) will be dissolved into water and injected at the entrance of the reservoir.

Assuming the dosing rate at minimum 0.5mg/l and maximum 3mg/l, the following equipment is recommended:

i) Calcium Hypochlorite Solution Tank
- Type : Cylindrical tank, open top type
- Quantity : 2 units
- Capacity : 1,000 L

ii) Calcium Hypochlorite Dosing Pump
- Type : Metering Pump
- Quantity : 2 units
- Unit capacity : 360 mL/min
- Discharge Pressure : Approx. 1 MPa
- Electricity : 230V x 50 Hz
- Output : Approx. 30 W

(k) Flow Meter

Two (2) units of ultrasonic flow meters will be installed to manage the extracted volume from each production wells. In the similar manner, one (1) unit of ultrasonic flow meter will be installed at the transmission pump facility.

(l) Monitoring Wells

Four (4) monitoring wells will be provided nearby the production wells for monitoring the groundwater level and water quality. Table 2.9 shows the outline of the monitoring wells.

Table 2.9 Outline of Monitoring Wells

Item	Outlines
Number of Wells	4 wells
Diameter of casing and material	4 inches and PVC
Depth of wells	40 m

(2) Power Receiving and Control System

The condition of electricity power supply is in general recognized as poor. Variation in frequency and voltage in the supplied electricity is considerably large and blackout frequently occurs in

Afghanistan. The electricity power supply source for this Project is from the Pol-e Charikhi substation with a dedicated line. Hence, stabilized power supply is expected and emergency generators are not required for the Project.

(a) Required Electrical Energy

Required electrical power for the pump operation at each well is summarized in Table 2.10.

Table 2.10 Necessary Electric Power for Pump

No.	Facility	Necessary Power (kW)
1	No.1 Production Well (Well-1)	220
2	No.2 Production Well (Well-2)	20

(b) Middle Voltage Power Receiving Facility

Power supply and receiving facilities at Pol-e Charikhi Well Station are designed based on the design criteria of DABS (Da Afghanistan Breshna Sherkat). The applicable middle voltage power at the well stations provided by DABS is 10 kV. The electricity is supplied from the existing electrical poles. It is separately provided to the production well No. 1 and No. 2. This 10 kV electricity is reduced to 400 V low voltage by transformers set at each production well. It is supplied to each equipment through low voltage switchgear.

10kV power supply route is shown in Figure 2-8 and power receiving equipment installed in this project is shown in Table 2.11.

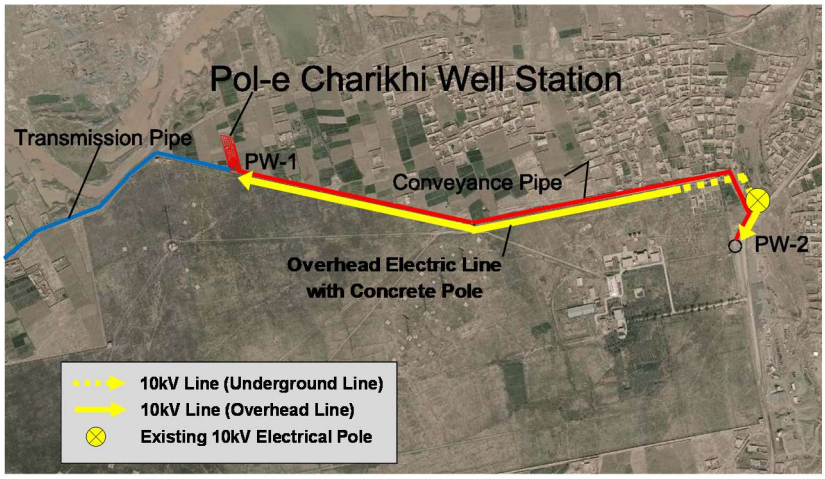


Figure 2-8 10 kV Power Supply Route

Table 2.11 Power Receiving Equipment

No.	Area	Control Panel	Usage
1	Production Well No.1	10kV Receiving Panel	The panel is for receiving 10 kV middle voltage provided from the existing power system. It has a function to protect from accidents occurring in power supply system.
		Transformer (10kV/400V reduction)	Transformer reduces 10 kV power supply into 400 V.
		400V Switchgear	This equipment provides power supply to each load after converted by the transformer.
2	Production Well No.2	Pole Mounted Transformer (10kV/400V reduction)	Transformer reduces 10 kV power supply into 400 V.
		400V Switchgear	This equipment provides power supply to each load after converted by the transformer.

(c) Low Voltage Control System

Pump system, instrumentation control and lightning are operated by 400V of low voltage power. Main control panels of low voltage for the pump operation are as shown in Table 2.12.

Table 2.12 Main Control Panels in Pump House

No.	Item	Description
1	Power Distribution Panel	Power distribution panel is a device to distribute 400 V of low voltage electrical power to major electrical equipment, such as pump, motorized valve, etc, on pump operation.
2	Well Pump Local Control Panel	Well pump local control panel is a device to conduct field control of well pump system. This panel is installed beside each well.
3	Chemical Panel	Chemical panel is a device to operate the calcium hypochlorite dosing system.
4	Monitoring and Control Panel	Monitoring & control panel is a device to operate pump system and to monitor the operation condition. In case trouble is detected, alarm will beep to notify the mal condition.
5	Aux. Relay Panel	Aux. relay panel is a device to interface a signal on controlling the pump system.
6	Lightning Panel	Lightning panel is a device to supply the electrical power for the lightning and other general services.

(d) Operation of Well Pump System

Operation of well pumps can be conducted by two (2) modes, "Auto" and "Manual". By connecting the control cable between wells and water reservoir (R-Well), automatic operation system will be introduced by reflecting water level at the water reservoir (R-Well). Manual operation mode is also available for inspection, repair and emergency cases. Interlock condition on automatic and manual operations and operational concept are as illustrated in Figure 2-9.

i) Interlock Condition at Automatic Operation Mode

a) In case that a well water level becomes low by aging or drought, well pump stops automatically to prevent dry operation.
b) In case that a water level becomes middle water level in R-well, well pump operates automatically.
c) In case that a water level reaches high water level in R-well, pump stops automatically.

ii) Interlock Condition at Manual Operation Mode

For case of emergency or any trouble of automatic system, the well pump is controllable to switch on / off in manual.

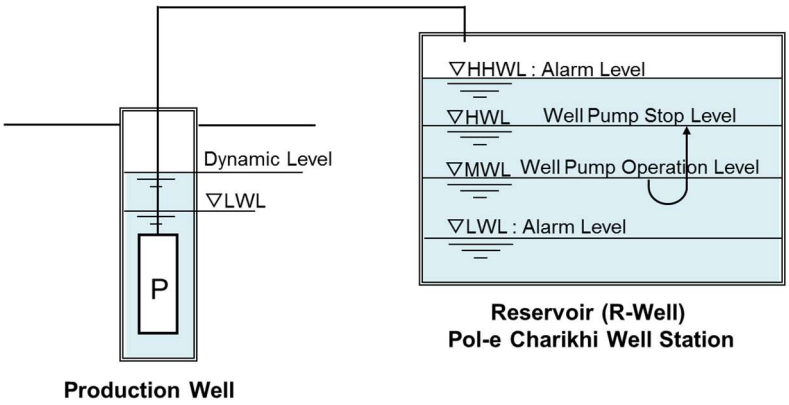


Figure 2-9 Operation Concept on Well Pump Control

(3) Operation of Water Transmission Pump System

Electricity power supply has not been served in the area where water pressure regulating reservoir is constructed. Therefore, On/Off control of water transmission pump is done manually. However, in order

to prevent the overflow from R-P1 by the human error, float valve is installed at inlet pipe of R-P1 for compulsive shut down of the water transmission if water level raises at a certain height. In case that an inner pressure of pipeline rises by closing action of float valve, pressure switch detect the high pressure and triggers emergency stop of pump operation. Interlock condition in the operation is as follows, and operational concept is as shown in Table 2.10

(a) Basic Operation Procedure

- Water level will be observed by visual inspection at the water pressure regulating reservoir (R-P2.2) and the information of the water level (low / middle / high) will be transmitted to the operator by telephone.
- Operator controls the transmission pump based on the water level information at the water pressure regulating reservoir (R-P2.2).
- The best suitable operation mode will be prepared during the trial operation and efficient and systematic operation mode will be established.

(b) Interlock Condition for Manual Operation

- In case that a water level in R-well is under the low level, pump does not start the operation even the start button is pressed in manual.
- In case that a water level becomes lower alarm level (LWL) in R-well, pump stops immediately to prevent dry operation.
- The air would be mixed into the pump due to lower level of R-well, which is lower than the lower low level. It may be caused by malfunctions of water level meter in R-well. In this case, water transmission pressure will decrease in the transmission main due to the mixed air. For such case, the pressure switch assembled in transmission pipe detects the low pressure, and then the pumps stop immediately to prevent dry operation.
- In case that the pressure switch detects high pressure in the water transmission main, pumps stop automatically.

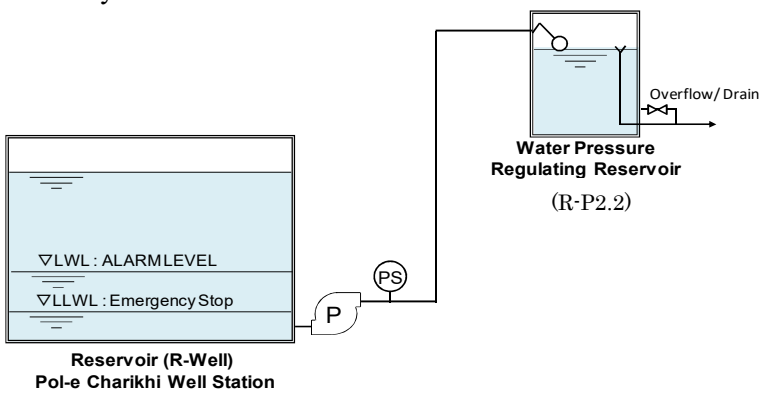


Figure 2-10 Operation Concept on Water Transmission Pump Control

(4) Water Transmission Main

(a) Water Transmission Main

A part of the pipeline route of water transmission main was changed due to the change of target water service area and the total length was changed to 14.3km.

In the similar manner as water conveyance pipeline, HDPE pipeline will be adopted and the main feature is shown in Table 2.13.

Table 2.13 Water Transmission Main

Item	Type	Diameter(mm)	Length(km)
Transmission Pump Facility ~ Water Pressure Regulating Reservoir (R-P1)	HDPE	426 (Outer Diameter 500)	14.3

The minimum earth coverage for pipe laying woks is 1 m by considering the expected freezing depth of 80 cm. The pipeline will pass Kabul River and 27 water channels by inverted siphon. Excavation of rock is not foreseen based on the result of geological survey. Standard sectional drawing for laying of water transmission pipe is show in Figure 2-11.

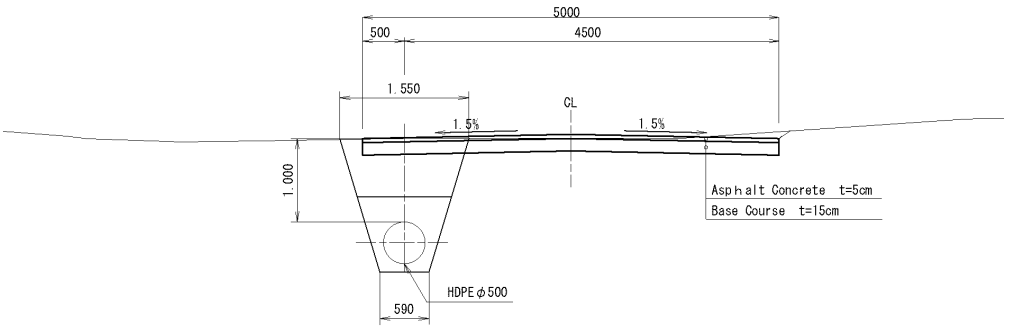


Figure 2-11 Standard Sectional Drawing for Laying of Water Transmission Pipe

(b) Pipeline Route

The pipeline route and the total length are shown in Table 2.14.

Table 2.14 Pipeline Route and Location

Route	Location	Length (km)
Transmission Pump Facility ~ Access Road to District 12	A pipe is laid under the existing main road on the north of radio station. After the installation of pipe, the access road (5m length) is paved.	1.0
Access Road to District 12 ~ Siphon at Kabul River	A pipe is laid under the shoulder on the east side of the existing main road	0.4
Siphon at Kabul River	A pipe is laid under Kabul River	0.1
Jalalbad Road ~ Bagram Road	A pipe is laid under the shoulder next to the paved road	10.0
Bagram Road ~ MA-1 Road / Water Pressure Regulating Reservoir	A pipe is laid under the sidewalk on the south side of the road.	2.8

(5) Water Pressure Regulating Reservoir (R-P2.2)

A water pressure regulating reservoir will be installed for stabilization of water pressure and temporary storage of water for emergency case.

(c) Capacity of the Reservoir

Water is supplied to the water pressure regulating reservoir from the pump facility of Pol-e Charikhi Well Station depending on the demands. Because sufficient water storage capacity is secured at water reservoir (R-Well), the capacity shall be equivalent to 1.5 hour volume of the design daily maximum water supply volume, 6,517 m^3/day. Therefore, the capacity is 400 m^3 as shown below calculation.

Although the capacity was set as 1 hour volume of the design daily maximum water supply volume in original plan, it was set as 1.5 hour volume of the design daily maximum water supply volume in this plan considering the request of CRIDA. As reference, it is described that standard design capacity for elevated water reservoir is 1-3 hour volume of the design daily maximum water supply volume in design manual for drinking water facility in Japan.

Capacity V (m^3) = 6,517 m^3/day / 24 hours x 1.5 hours
= 407 m^3 (≒400m^3)

(d) Number of Tanks

For the purpose to avoid additional construction of elevated tanks by considering its construction cost, the number of the reservoir is determined as one (1) unit. However, the water transmission pipeline will be directly connected to water transmission pipelines for continuing water transmission during maintenance works.

(e) Height of the Reservoir

As described in 2-2-3-6, water distribution network analysis for the water distribution mains has been conducted. Based on the result of the analysis, the Low Water Level (LWL) of the elevated tank is set at 1,852.5m. The effective water depth is set at 4.6 m and the high water level (HWL) is 1,857.1 m.

(f) Structure

Figure 2-12 shows the design of reinforced concrete type elevated tank based on the discussion with CRIDA. Table 2.15 shows the outline of the tank.

Based on the result of the geological survey, the expected N value is more than 20 (clay). The results of stability calculation (fall, slip and subgrade reaction) and examination of vertical bearing capacity, direct foundation can be applicable for the structure.

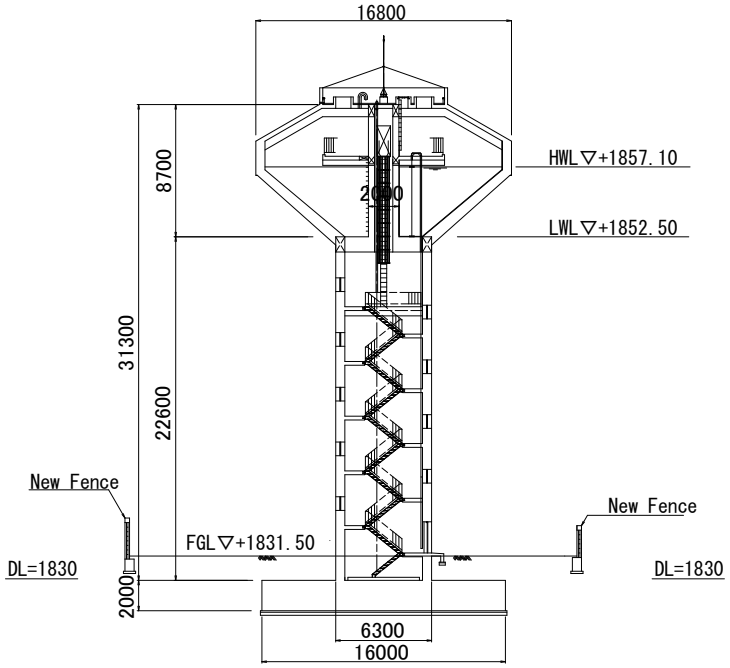


Figure 2-12 Cross Section of the Water Pressure Regulating Reservoir

Table 2.15 Outline of the Water Pressure Regulating Reservoir

Item	Outline
Ground Level G.L	1,831.5m
Low Water Level (LWL)	1,852.5 m
High Water Level (HWL)	1,857.1 m
Capacity	400m^3
Height of the Tank	31.3m

(6) Water Distribution Mains

Water distribution mains are newly planned and designed from original plan on the basis of water demand of each area and geography in Parcel-2.2 due to the change of water service area from Pacel-1 to Parcel-2.2.

(a) Overall Plan

i) Plan of Water Distribution Main

Plan of water distribution main is shown in Figure 2-13.

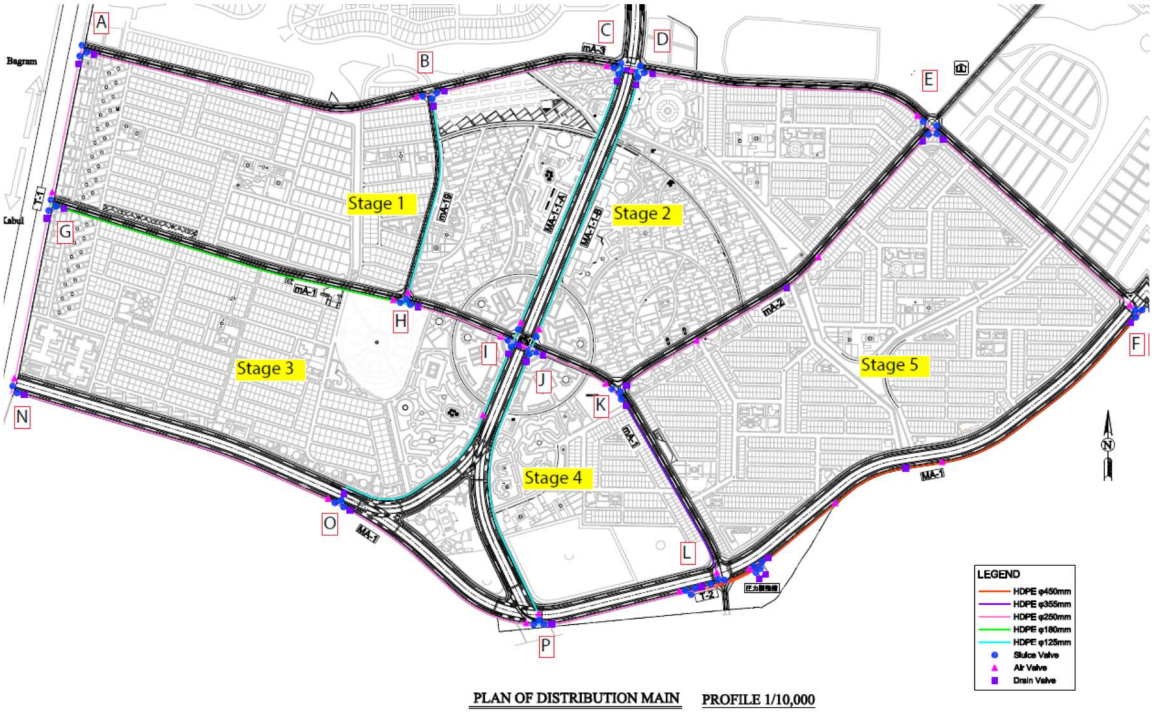


Figure 2-13 Plan of Water Distribution Main

ii) Material, Diameter and Length of Each Water Distribution Main

Material, diameter and length of each water distribution main are shown in Table 2.16.

Table 2.16 Material, Diameter and Length of Each Water Distribution Main

Route	Material	Diameter(mm)	Length (km)
MA-1	HDPE	250	2.60
	HDPE	450	1.75
mA-1	HDPE	180	1.25
	HDPE	250	0.80
	HDPE	355	0.75
mA-3	HDPE	250	3.96
mA-19	HDPE	125	0.74
MA-1-1-A	HDPE	125	2.00
MA-1-1-B	HDPE	125	2.06
mA-2	HDPE	250	1.42
T-1	HDPE	250	1.21
T-2	HDPE	450	0.25
Total			18.79

(b) Design Condition

i) Basic Condition

① Water Service Area

Water service area is 5 areas consisted of from Stage 1 to Stage 5, which is shown in Figure 2-13.

② Design Water Distribution Volume

Pre-condition of water demand for water distribution network calculation applies the design maximum hourly water distribution volume which is shown in the following equation:

Design maximum hourly water distribution volume (m^3/day)
= Design water supply per capita (LCD) × Daily variation coefficient (-)
× Hourly variation coefficient (-)

Design water supply per capita (LCD) :92
Daily variation coefficient (-) :1.3
Hourly variation coefficient (-) :1.4

③ Design Service Population and Design Water Distribution Volume on Each Area

Design service population and design water distribution volume on each area are shown in Table 2.17

Table 2.17 Design Service Population and Design Water Distribution Volume on Each Area

Service Area	Design Service Population※1	Design Water Distribution Volume※2	
	(Pop.)	(m^3/day)	(m^3/sec)
ACIG(Stage 1)	16,458	2,756	0.032
CEKI(Stage 2)	16,524	2,767	0.032
GION(Stage 3)	6,204	1,039	0.012
IKLPO(Stage 4)	2,268	380	0.004
EFLK(Stage 5)	13,038	2,183	0.025
Total	54,492	9,124	0.106

※1 Design service population is based on the master plan which is made by CRIDA

※2 Design water distribution volume is calculated on the basis of design maximum hourly water distribution volume which is defined in ②.

④ Maximum Hydrostatic Pressure and Minimum Hydrodynamic Pressure

Maximum Hydrostatic Pressure 100mH
Minimum Hydrodynamic Pressure※3 20mH

※3 Or water pipe is designed so that minimum hydrodynamic pressure can secure 15mH or more at the branch line of water distribution.

ii) Specification and Installation Condition of Water Distribution Main Pipe

① Installation Condition of Water Distribution Pipe

Water distribution main pipes at the location except for crossing the main road are installed under the sidewalk next to the main road which is shown in the road plan submitted by CRIDA. Design thickness of earth covering is set as 1.0m.

② Material of Water Distribution Main Pipe

As original outline design, high density polyethylene (HDPE) pipe is applied

③ Installation Condition of Valves etc.

Installation condition of each valves is as follows:

- 3 sets of gate valve are installed at the branch part (T-joint part) so that change of the flow direction and water stop for the pipe maintenance can be conducted at the parts.
- Drain valve and air valve are installed at the downstream and the upstream of each section between 2 branches of each water distribution main pipe, respectively so that the sludge accumulated in each section of the pipe can be drained
- Air valve is installed at the convex part so that air cannot be stuck and drain valve is installed at the concave part so that the sludge accumulated in the pipe can be discharged.

(c) Pipe Network Calculation

The calculation for the basic pipe network which is shown in Figure 2-13 is conducted so that design water distribution volume can be supplied to all the water service area while securing design minimum hydrodynamic water pressure at all the water service area and the appropriate diameter of each water distribution main pipe is estimated.

Details of pipe network calculation is referred to APPENDIX -2 Pipe Network Calculation of Water Distribution Main.

2.2.3 Auxiliary Facility and Equipment

Table 2.18 shows the auxiliary facility and equipment concerning to the Project.

Table 2.18 Auxiliary Facility and Equipment

Priority	Facility and Equipment	Location	Qty.	Application
1	Operators Station Building	Water Pressure Regulating Reservoir	1	Prefabricated house (3 x 2 m) for 2 or 3 persons
2	Maintenance tool	Pol-e Charikhi Well Station and Water Pressure Regulating Reservoir	1	General workshop tools (wrenches and drivers), specific tools (testers, cramp meters), power generators, welding machine etc.
3	Office furniture	Pol-e Charikhi Well Station and Water Pressure Regulating Reservoir	1	Desk, chair, PC, etc.
4	Spare pump for wells	Pol-e Charikhi Well Station	2 units	Similar as PW-2
5	Security Room	Pol-e Charikhi Well Station	1	Prefabricated house (3 x 3 m)
6	Spare parts for pumps	Pol-e Charikhi Well Station	1	Spare parts for pumps such as gaskets, packing, and bearings
7	Spare valves	Water Conveyance Pipeline and Transmission Main	1	Spare valves for water conveyance pipelines and transmission mains (sluice valves and air valves)
8	Water Quality Analysis Equipment	Pol-e Charikhi Well Station	3 sets	For field analysis of water quality
9	Flow meter and chamber	Water Pressure Regulating Reservoir	1	For recording distribution flow
10	Solar Panel and battery	Water Pressure Regulating Reservoir	1	Electricity support for water pressure regulating reservoir
11	Automatic Water Level Detector	Monitoring Wells	4	For monitoring wells

Priority	Facility and Equipment	Location	Qty.	Application
12	Motor Cycle	Pol-e Charikhi Well Station and Water Pressure Regulating Reservoir	3	For route inspection of transmission main (14 km) and communication with Water Pressure Regulating Reservoir
13	Hypochlorite	Pol-e Charikhi Well Station	1	Equivalent amount to 1 year consumption

2.2.4 Priority in Project Components

Considering the impact of the Project and urgency, the priority in the Project components is ranked as Table 2.19.

Table 2.19 Priority in Project Components

Priority	Facility / Equipment	Location
1	Production well, Water conveyance pipe, Monitoring wells, Water Reservoir, Water transmission pumping station, Administrative building, Disinfection facility, Water Transmission Main, Water pressure regulating reservoir	Pol-e Charikhi, Parcel-1, Water pressure regulating reservoir and road between the facilities
2	Auxiliary Facility and Equipment	Pol-e Charikhi, Parcel-1 and Water pressure regulating reservoir
3	Water Distribution Mains (MA-1, mA-1, mA-3, mA-19, MA-1-1-A, MA-1-1-B, mA-2, T-1, T-2)	Parcel-2.2

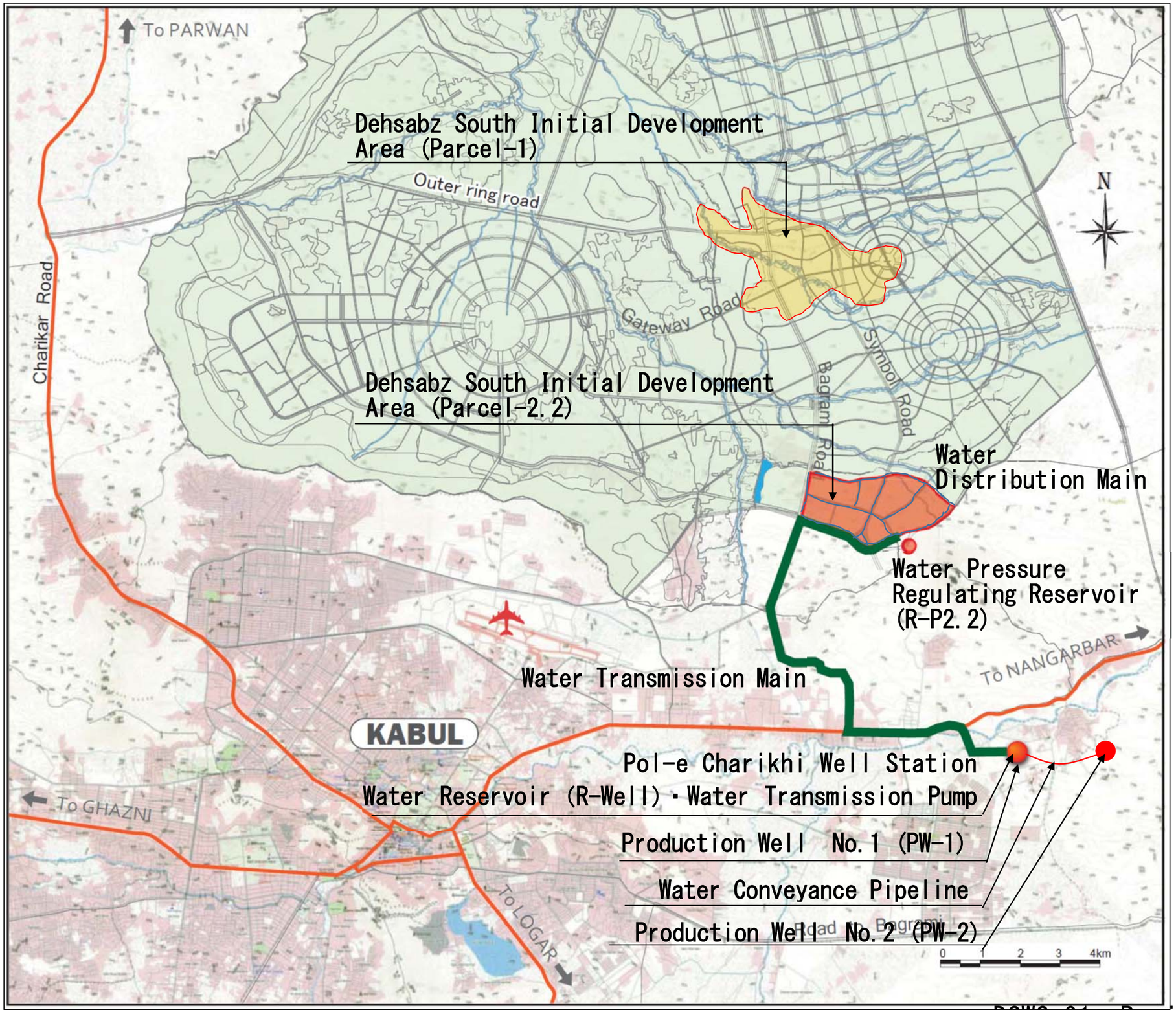
2.2.5 Outline Design Drawing

The basic design drawings of the Project are shown from the next page.

[List of Drawing]

Drawing No.	Drawing Title
DSWS-01	Project Location Map
DSWS-02	System Flow
DSWS-03	General Layout of Pol-e Charikhi Well Station
DSWS-04	Plain of Pol-e Charikhi Well Station
DSWS-05	Structural Drawing of Wells
DSWS-06	Plan of Water Pressure Regulating Reservoir (R-P2.2)
DSWS-07	Structural Drawing of Water Pressure Regulating Reservoir (R-P2.2)
DSWS-08	Plan of Water Distribution Mains

Project Location Map



DSWS-01: Project Location Map

SYSTEM FLOW DIAGRAM

LEGEND

SYMBOL	NAME
	Manual sluice valve
	Check valve
	Butterfly valve
	Manual ball valve
	Flexible joint
M	Motor Control Valve
	High speed air vent valve
	Air Valve
	Back Pressure Valve
	Safety Valve
A	Air Chamber
	Strainer
	Ultrasonic Flow Meter
	Electrode
LI	Level Indicator
CI	Compound Indicator
LS	Level switch
PI	Pressure Indicator
PS	Pressure Switch
P	Utility Water Unit
	Water Faucet

Water Pressure Regulating Reservoir
(R-P2.2)

HWL=1857.1

400m3

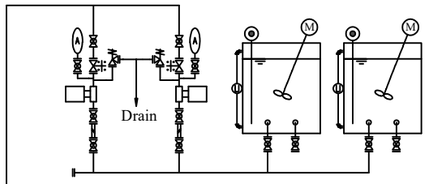
LWL=1852.5

Drain

Parcel-2.2

Water Distribution Lines (HDPE)

Water Transmission Main
HDPE 500mm (Outer Diameter)



Calcium Hypochlorite Dosing System

Pump Station

GL+1779.7

Water Transmission Main
HDPE 500mm(Outer Diameter)

Water Transmission Pump

Drain

Water Reservoir (R-Well)
850m3 x 2 Basins

HWL=1783.5

LWL=1779.5

HWL=1783.5

LWL=1779.5

Drain

Installation level shoud be less than LWL

WL=1783.5

Water Conveyance Pipe
HDPE 250mm (Outer Diameter)

Water Conveyance Pipe
HDPE 180mm
(Outer Diameter)

125A
150A
SS304

GL+1779.7

125A SS304

SWL : GL+1773.93

DWL : GL+1771.7

GL+1767.7

1.8m3/min

PW-1

125A
200A
SS304

GL+1786.4

125A SS304

SWL : GL+1780.63

DWL : GL+1778.4

GL+1774.4

1.8m3/min

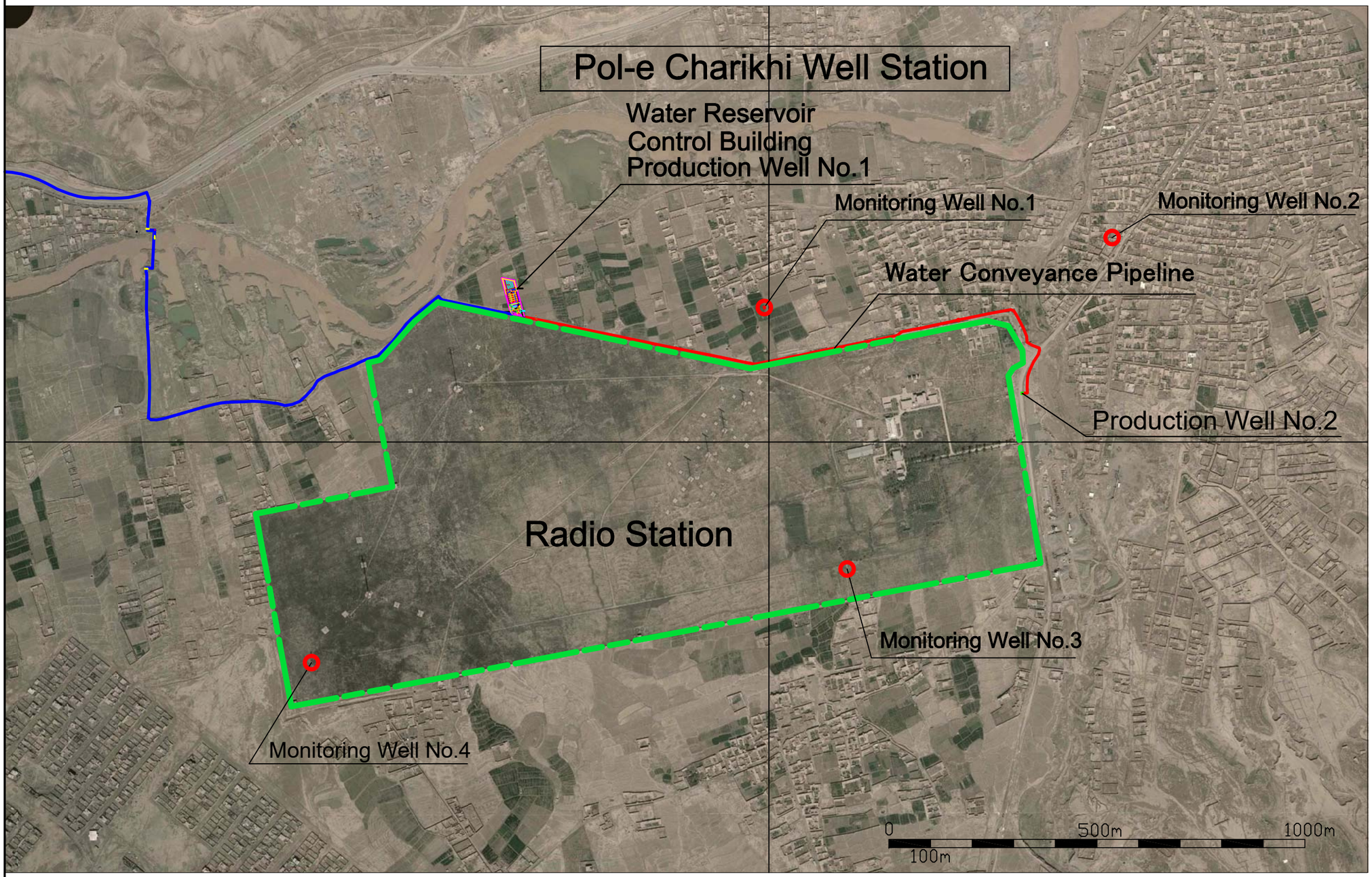
PW-2

WATER TRANSMISSION DISTANCE

PIPING ROUTE	DISTANCE
PRODUCTION WELL-1 TO R-WELL	APPROX. 90m
PRODUCTION WELL-2 TO R-WELL	APPROX. 1545m
R-WELL TO R-P2.2	APPROX. 14300m

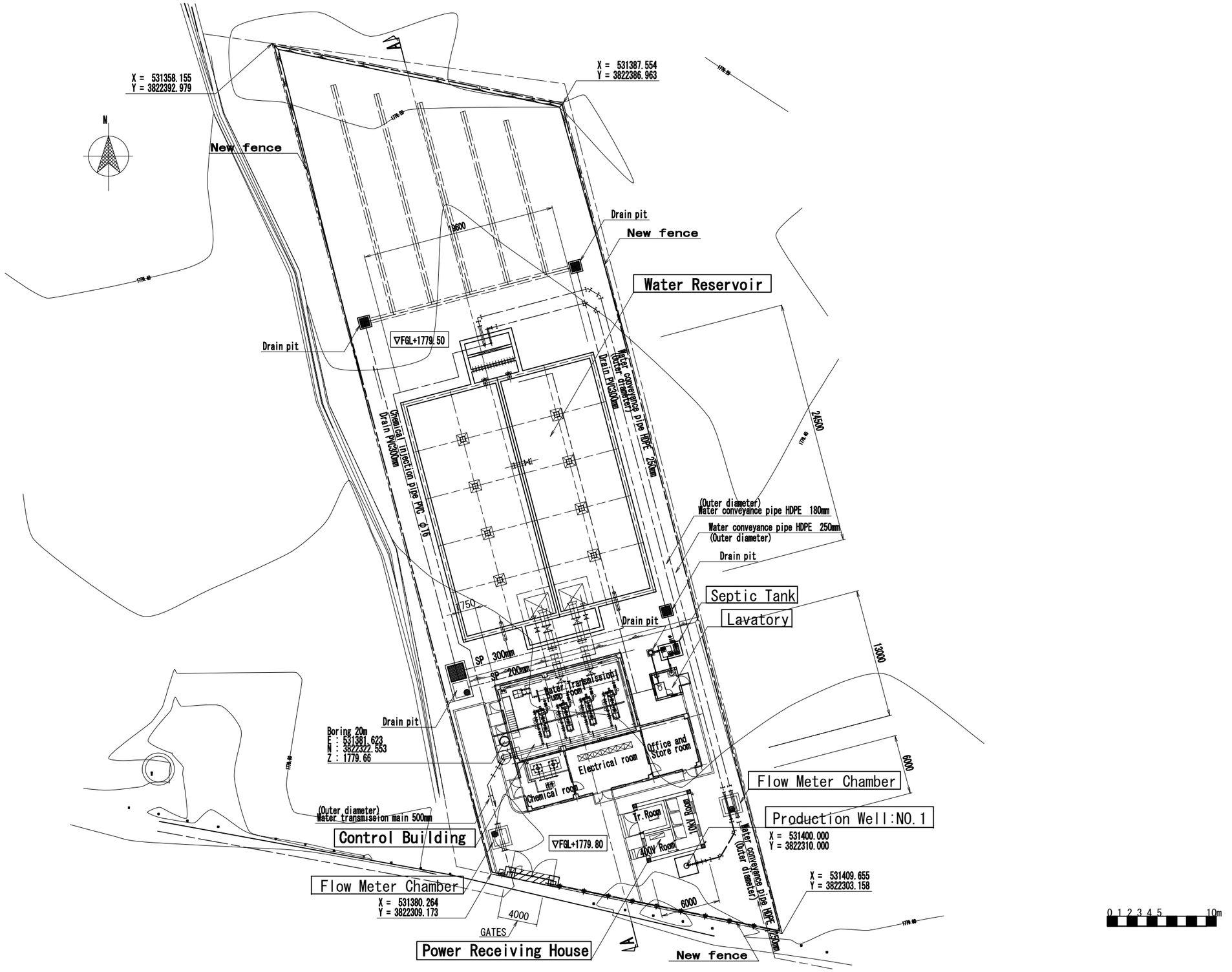
DSWS-02: System Flow

GENERAL LAYOUT OF POL-E CHARIKHI WELL STATION S=1:10000



DSWS-03: General Layout of Pol-e Charikhi Well Station

PLAN OF POL-E CHARIKHI WELL STATION S=1:400

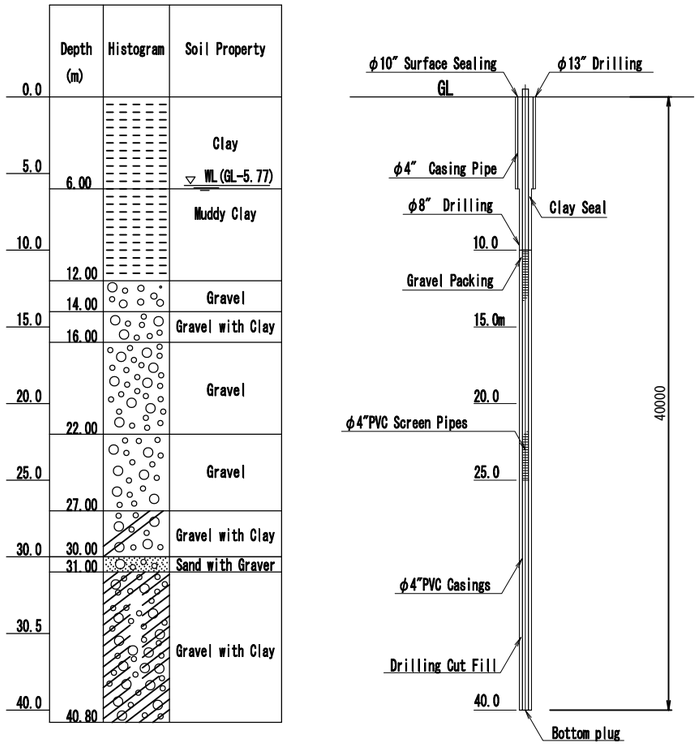


DSWS-04: Plan of Pol-e Charikhi Well Station

WELL STRUCTURE DRAWING

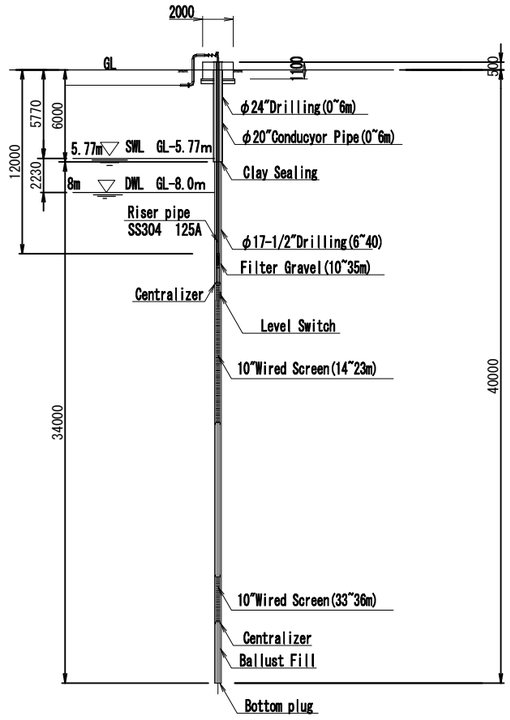
MONITORING WELL V=1:400 H=1:100

(X=532, 609 Y=3822, 310)

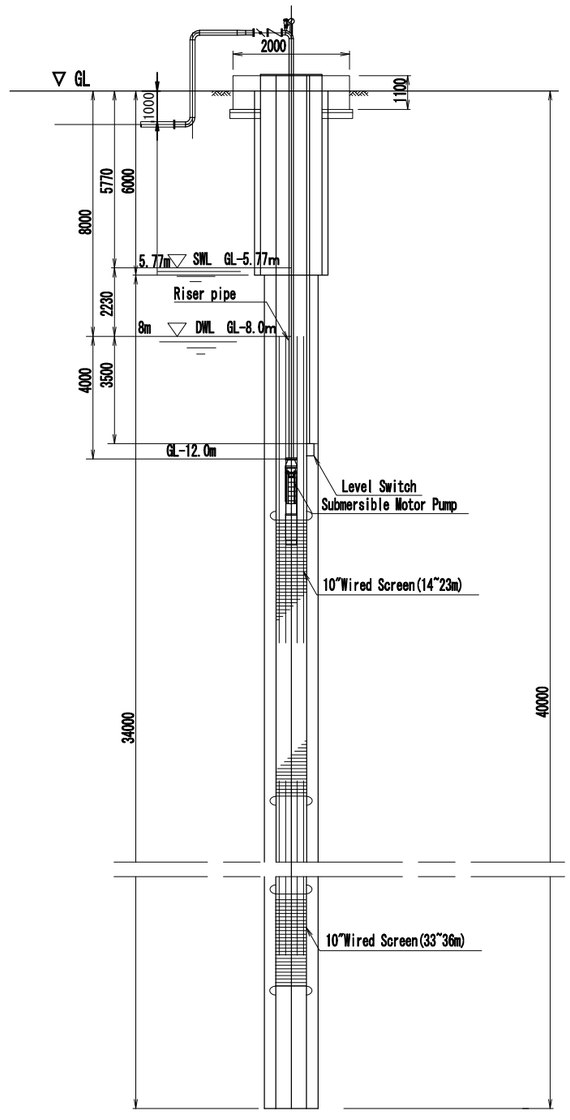


	Ground Level	Static Water Level	Dynamic Water Level	Pump installation Level
Well No.1	GL+1779.7	GL+1773.93	GL+1771.7	GL+1767.7
Well No.2	GL+1786.4	GL+1780.63	GL+1778.4	GL+1774.4

PRODUCTION WELL S=1:400

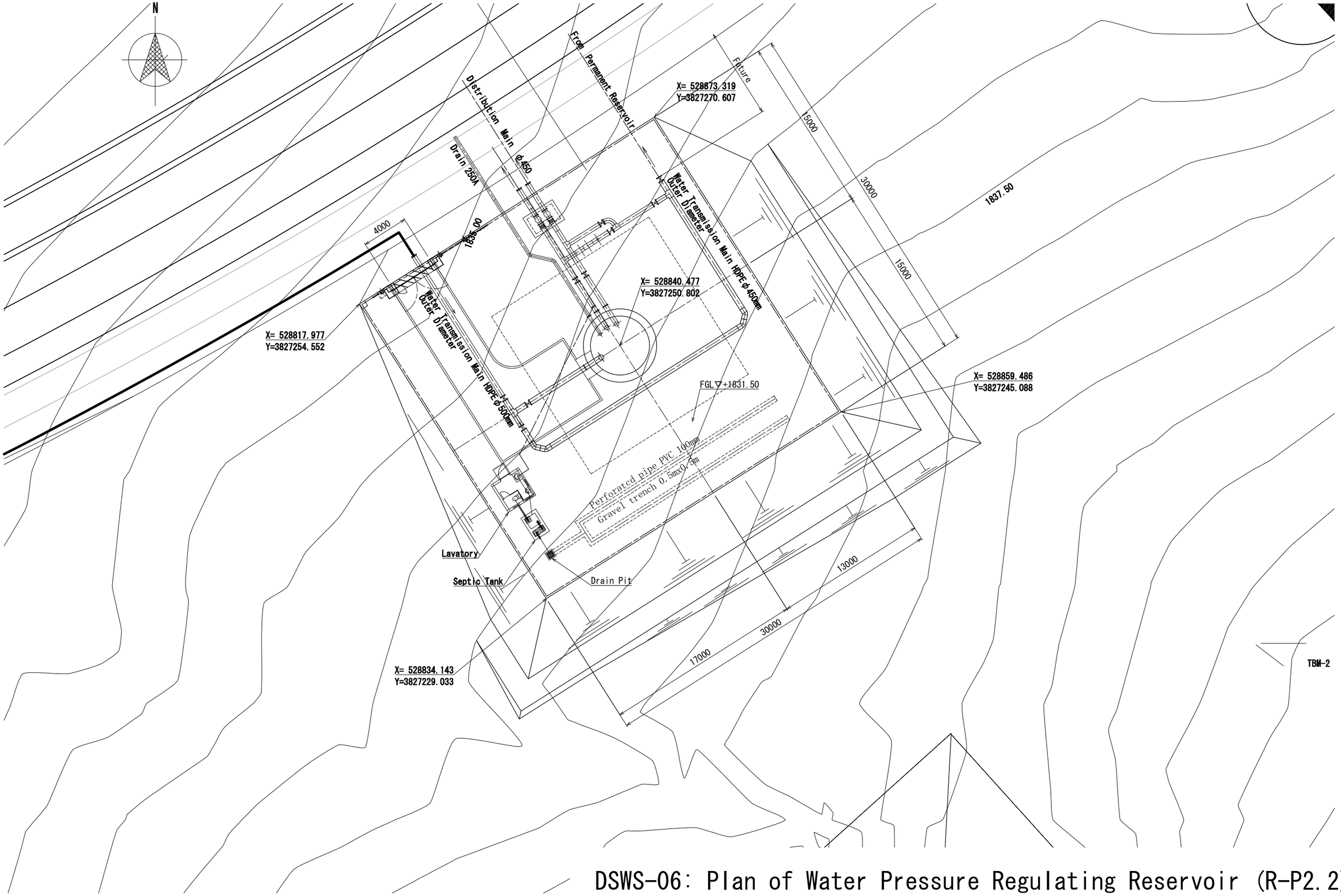


INSTALLATION OF SUBMERSIBLE MOTOR PUMP



DSWS-05: Structural Drawing of Wells

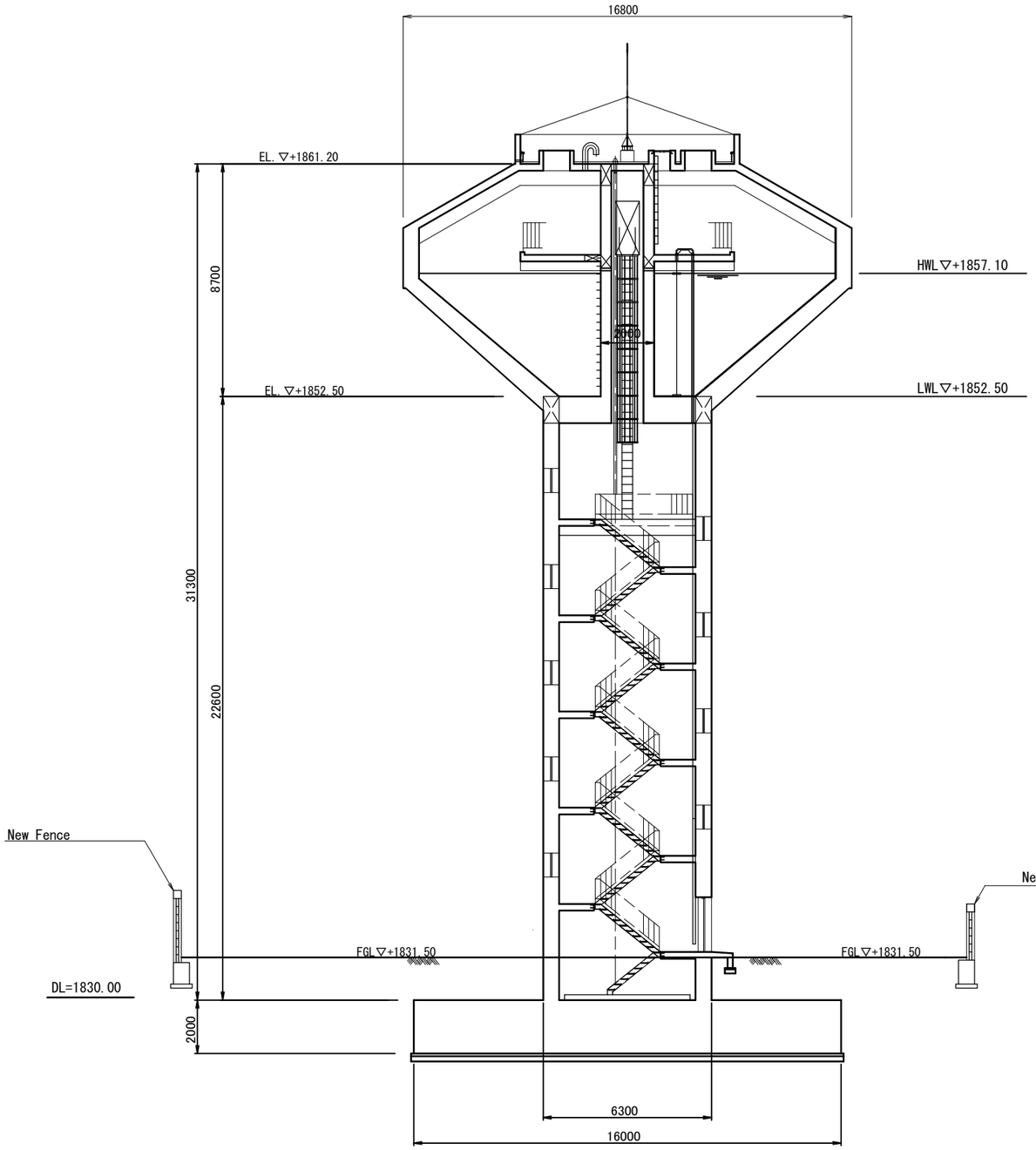
PLAN OF WATER PRESSURE REGULATING RESERVOIR (R-P2.2) S=1:300

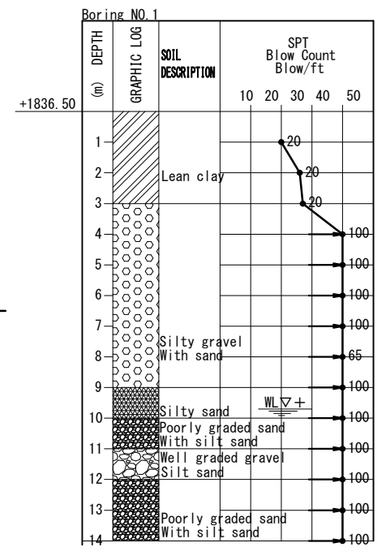


DSWS-06: Plan of Water Pressure Regulating Reservoir (R-P2.2)

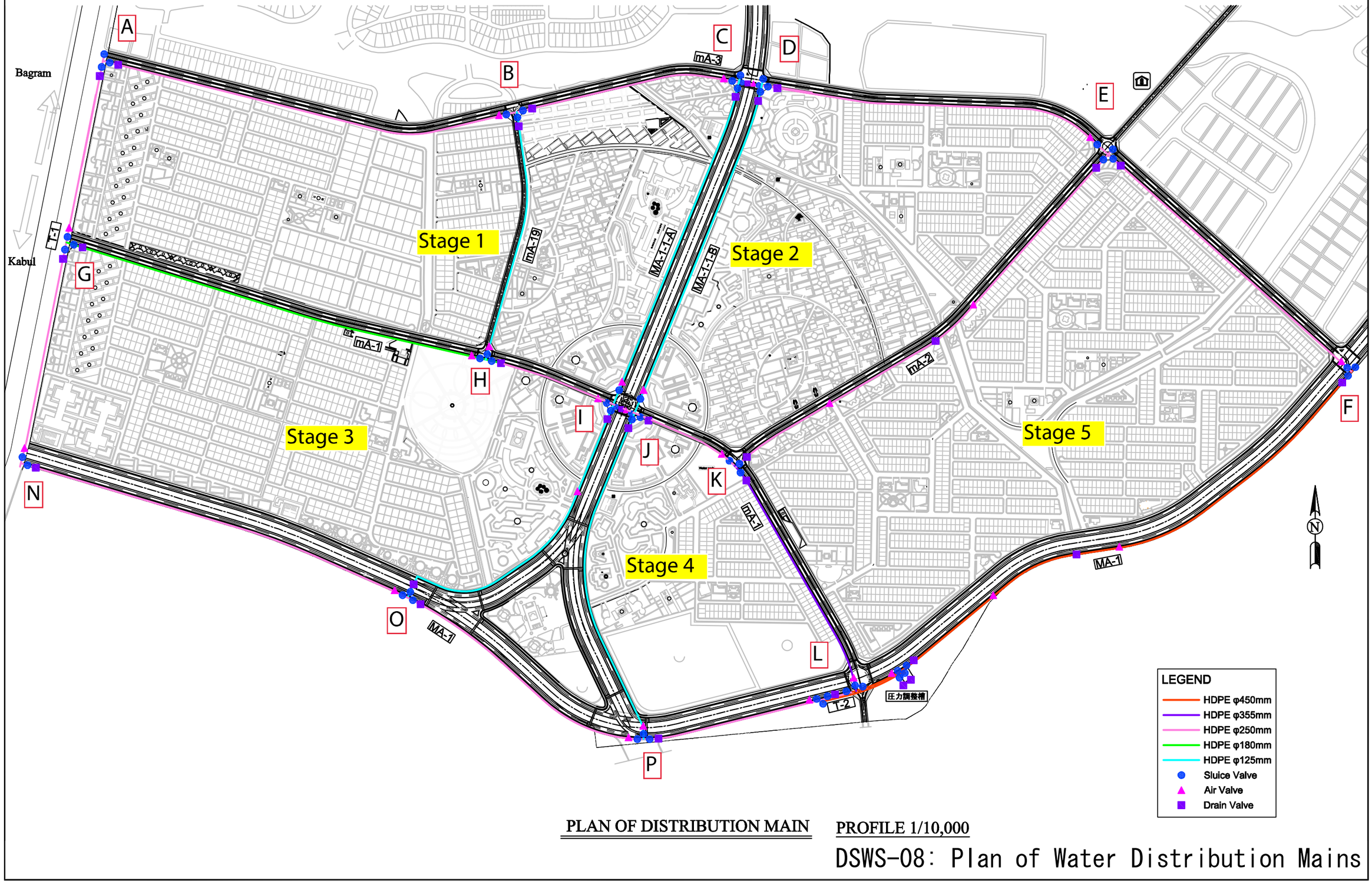
STRUCTURAL DRAWING OF WATER PRESSURE REGULATING RESERVOIR

SECTION S=1:200





DSWS-07: Structural Drawing of Water Pressure Regulating Reservoir (R-P2.2)



PLAN OF DISTRIBUTION MAIN PROFILE 1/10,000

DSWS-08: Plan of Water Distribution Mains

2.2.6 Implementation Plan

2.2.6.1 Implementation Policy

The Project will be implemented according to the scheme of Japan's Grant Aid for conflict prevention and peace building. Accordingly, unlike ordinary Grant Aid projects, execution of the works will be conducted by local contractors.

The United Nations Office for Project Services (UNOPS) is assumed as the procurement agent in the Project implementation stage.

(1) Implementation setup

Following the Exchange of Notes (E/N) and signing on the Grant Agreement (G/A), the Government of Afghanistan will consign the procurement agent to select and bind a contracts with the contractors. Consultant in charge of construction supervision and contractor(s) will enter their contracts with the procurement agent for their implementation of works.

(a) Implementing Agency

The responsible implementing agency for the Project will be CRIDA.

The Project will be implemented based on the Agent Agreement (A/A) that is signed between CRIDA and the procurement agent. In this scheme, CRIDA will have overall control over the Grant Aid project for conflict prevention and peace building and will be responsible for facilitating smooth project implementation as the contract partner of the procurement agent. Moreover, the JICA Office in Afghanistan and procurement agent will establish a working group in Afghanistan to check the progress and hold discussions on technical confirmation items. The implementation scheme is indicated in Figure 2-14.

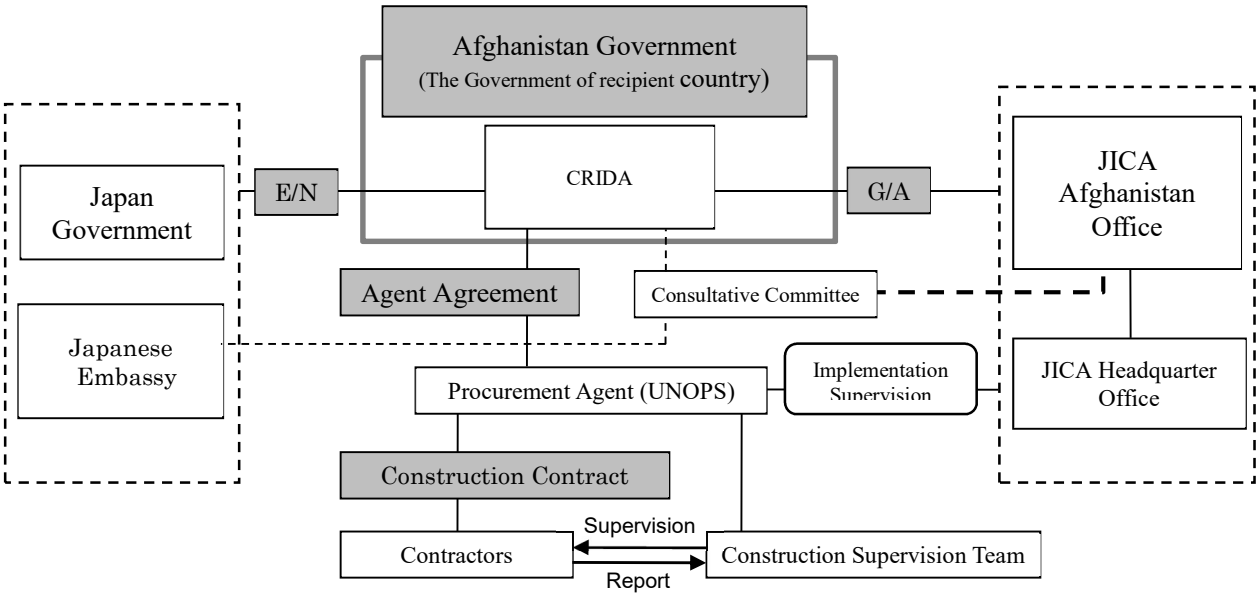


Figure 2-14 Implementation Scheme

(b) Procurement Agent

UNOPS will manage the tender and conduct works supervision in its capacity as the procurement agent. UNOPS has a local office in Kabul.

When conducting works supervision, in other projects in Afghanistan, UNOPS directly recruits works supervision engineers from third countries and Afghanistan, and a team organized within UNOPS conducts the actual supervision work.

(2) Tender System

Since the Project works will basically be conducted using methods, specifications and materials, etc. that are commonly used in Afghanistan, local construction companies will be able to comfortably implement them.

UNOPS will implement the bidding. The works are implemented by a local construction company selected in general competitive bidding or limited competitive bidding.

There is a number of water relating facility construction project in Afghanistan under assistance of international donors such as USAID, WB, UN, KfW, etc. Under these projects pipelines, RC structure reservoirs and pump facilities are constructed. Although the project cost of the majority of the projects are less than US$ 10 million, there are some large scale projects with the scale of US$ 30 million or US$ 40 million.

(3) Contract Method

In similar projects implemented by UNOPS in Afghanistan, Lump Sum contract is widely employed. Because this Project includes a number of uncertain factors on a part of the location of roads, several variation orders in quantities of works may be supposed. Therefore, introduction of quantitative method such as BQ contract will be discussed with UNOPS.

The contract currency will be United States dollars (USD).

2.2.6.2 Implementation Conditions

(1) Construction Supervision

Since it is assumed local contractors will execute the works, it is necessary to strengthen the capacity for supervision particularly on quality control, construction management and safety control.

The cost for construction supervision is, therefore, accounted in the Project cost.

(2) Site Adapt Method

Site adapt method is commonly employed in Afghanistan in order to correspond to variation order depending on the site conditions. There are some facilities designed under uncertain condition in this Project. Particularly the line shape and earth cover of transmission mains shall be flexibly adjusted to the site condition. Therefore, application of site adapt method is recommended.

2.2.6.3 Scope of Works

Table 2.20 shows the scope of works to be undertaken by the Japanese side and the Afghan implementing agency for construction of the facilities.

Table 2.20 Scope of works

No.	Work Item	Japanese Side	Afghan Side	Remarks
1.	Wells, Water Transmission and Distribution Facilities			
(1)	Securing site and discussion on use of the land		●	Before Exchange of Note (E/N)
(2)	Survey and removal of mines and unexploded bombs		●	Before commencement of work by the Grant Aid
(3)	Removal and relocation of the existing facilities		●	Before commencement of work by the Grant Aid
(4)	Construction of the facilities - Production Wells - Transmission Main - Monitoring Wells - Reservoir - Transmission Pump Facility - Control Building - Disinfection Facility - Conveyance Pipeline - Water Pressure Control Reservoir - Water Distribution Mains	●		Including civil and architectural works, procurement of equipment and trial operation
(5)	Electricity cabling to the middle voltage switchgear (approx. 150 m from the production well (PW-2))		●	DABS
(6)	Pavement of internal road at the site	●		
(7)	Security lighting (Pol-e Charikhi Station)	●		
(8)	Security lighting (Water pressure Regulating Reservoir)	●		
(9)	Drainage facility for general effluent	●		
(10)	Planting in the site		●	After the works by the Grant Aid
(11)	Construction of fences and gates	●		
(12)	Construction of security guard building	●		
(13)	Installation of fire extinguisher	●		
(14)	Procurement of office furniture	●		
(15)	Provision of electricity power and water required for trial operation		●	
2.	Import and Transportation of Materials and Equipment for Facility Construction			
(1)	Procurement of Materials and Equipment	●		
(2)	Sea Transportation	●		
(3)	Custom Clearance, Tax Exemption and customs bond for storage		●	According to E/N
(4)	Inland transportation in Afghanistan	●		

● : locus of responsibility

2.2.6.4 Construction Supervision

(1) Local Consultant

There are few consulting firms in Afghanistan and it is difficult to secure appropriate engineers required for supervision of the construction. There has been no quality control standard established, sufficient experience in construction supervision and advanced engineering skills are required for this Project. Therefore, it is highly recommended to employ international consultant for supervision works

including quality control, schedule and progress management and safety control. Under the supervision by the international consultants, local consultants will supervise the works at the site.

(2) Implementation Setup

(a) Implementation design period (tender period)

Tender process will be conducted by UNOPS. However, consultants employed by UNOPS shall assist answering to the technical question from bidders, evaluation of technical proposal, and other technical aspects.

(b) Works supervision period

During the construction phase, the consultant will conduct the necessary onsite guidance and technical guidance centering on the quality supervision, progress supervision and safety supervision required for Project implementation. It will provide reports on the works progress and work contents to the procurement agent and CRIDA, and propose discussions, investigations and solutions in cases where technical problems arise.

(c) Works supervision setup

A supervision office will be established in Kabul city or Dehsabz area. Throughout the construction period, a Project Manager will be assigned and supervise the construction works together with construction supervision team consisting of engineers specialized in pipelines, networks, structures, etc.

2.2.6.5 Quality Control Plan

The works supervision team organized by UNOPS will implement quality control assuming the following major quality control items as of Table 2.21.

Table 2.21 Main Quality Control Plan

Construction name	QC items	Inspection Method	Frequency
Earth work	Degree of compaction	visual inspection	each after compaction
Backfilling work	Carried soil test	grain size test	1 item / borrow pit
Formwork	Finishing work	visual, dimension inspection and photo	all member
Reinforcement works	Material	mill certification report	every after carrying in
	Assembly test	visual inspection (pitch and cover thickness)	all member
Concrete work	Material	cement : intensity test aggregate : grain size test water : quality test of water	each parts (if any)
	Trial batch concrete	temperature, slump and air content	before placing concrete laboratory sample (1sample/day)
	or Plant data	compressive strength test	laboratory sample (1sample/day) site sealed box cure 7 and 28 days later
Asphalt pavement work	Material	aggregate density test	before construction work
Base course work	Material	grain size test	before construction work
Pipeline Works	Material	factory test	before delivery of goods
	Finished work	laying location / water pressure test	per certain construction quantity

2.2.6.6 Procurement Plan

Procurement of materials for construction works is included in the contract of construction with the contractors, procurement will be conducted based on the contract between the procurement agency and contractor. The suppliers of construction materials and equipment are assumed as shown in the table below.

Table 2.22 Suppliers of construction materials and equipment

Name of materials and equipment	Source of Procurement			Remarks
	Local	Japan	Third country	
[Materials]				
Reinforcement bars	●			Import from Russia, etc.
Cement	●			Import from Pakistan, etc.
Concrete aggregates	●			
Asphalt	●		●	Iran, Pakistan, Uzbekistan, etc.
Road marking	●			Pakistan, India, etc.
HDPE Pipeline	●		●	Saudi Arabia, etc.
PVC Pipeline	●			
Valves			●	Imported from Germany, etc.
Pumps		●	●	Imported from Japan, Italy, Germany, Sweden
Circuit Breaker	●		●	Imported from Germany, France, etc.
Transformer			●	Imported from Germany, U.S.A, etc.
Instruments			●	Imported from Germany
Main Control Panel			●	Imported from U.S.A, etc.
Generator			●	Imported from U.S.A, U.K, etc.
Chlorine injection system			●	Imported from Italy, Sweden, etc.
Well Casing	●		●	Import from the U.S.A., etc. PVC can be procured in local market
Precast Manhole	●			
Ratio	90.1%	5.6%	4.3%	

Note: Ratio is expressed by cost

Transportation route

The transportation route differs based on the availability in market and importers. The Grant Aid will cover transportation cost.

○ Route from Iran

i) Inside Iran to Dogarun (at border)
ii) Transfer of goods from Iranian trucks to Afghan Trucks at Afghanistan Islam Qala (at border) 6 days
iii) Islam Qala to Herat 3 days
iv) Herat to Kandahar 3 days
v) Kandahar to Kabul 3 days

○Route from Karachi

i) Country of origin to Karachi
ii) Procedures taken in Karachi 10 days
iii) Karachi to Peshawar 5 days (including 2 days in Peshawar)
iv) Peshawar to Torkham (national border) 4 days
v) Torkham to Kabul 2 days

vi) Customs clearance in Kabul 2 - 3 days
vii) Transport inside Kabul 1 day

○Route from Uzbekistan

i) Country of origin to Hairatan 3 days
ii) Procedures in Hairatan 1 day
iii) Hairatan to Kabul 2 days
Additional one (1) week is necessary for the procedure for tax benefit.

2.2.6.7 Operational Guidance Plan

AUWSSC has supplied water toward approximately 140,000 customers. Therefore, it is understood that AUWSSC has acquired basic skills on operation and maintenance of water supply facilities and enables to conduct daily operation and maintenance works. However, the items to be procured under this Project require special operation and maintenance procedures. Therefore, initial operation training by the contractor(s) is essential for smooth and efficient operation after hand over.

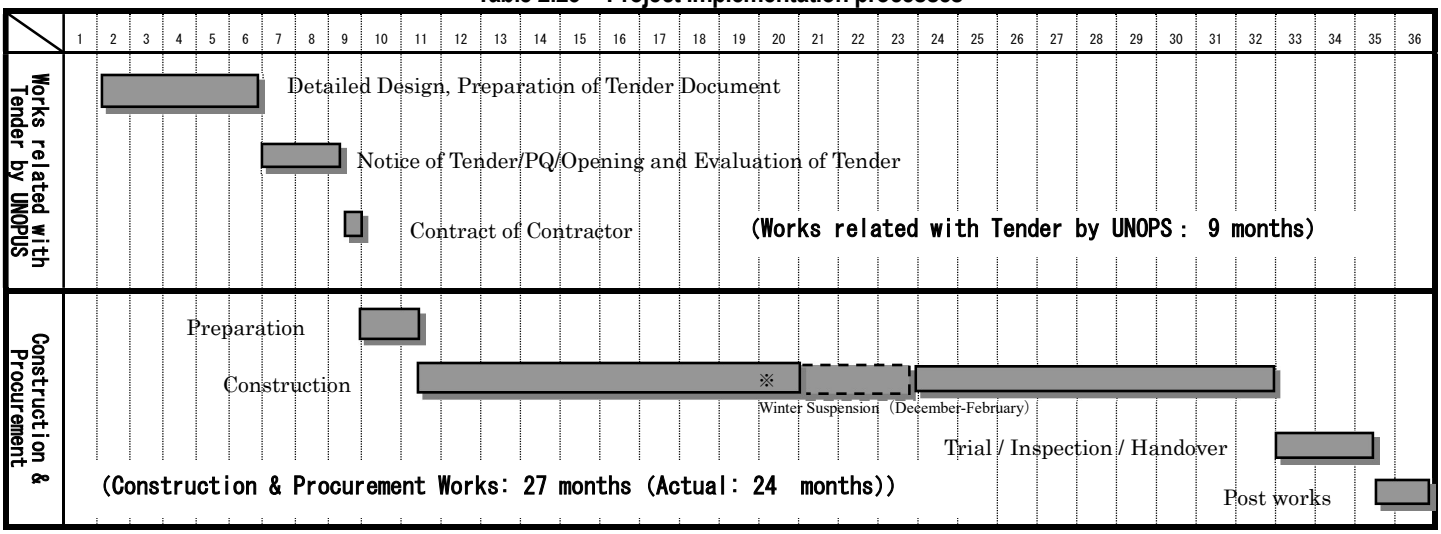
2.2.6.8 Soft Component (Technical Assistance) Plan

There will be no soft component plan in the Project. However, a technical cooperation project for strengthening the operation and maintenance capacity of AUWSSC as a part of Greater Kabul Development Project is expected to be commenced from 2014.

2.2.6.9 Implementation Schedule

As shown in Table 2.23, tender process requires approximately 9 months and construction works require approximately 27 months after handing the detailed design to the procurement agent (UNOPS). However, suspension of construction works during winter season should be taken account.

Table 2.23 Project implementation processes



2.3 Obligations of Recipient Country

Following the E/N, the Afghanistan side will undertake the following items in cooperation between the responsible agency and implementing agencies.

2.3.1 General Items

- Ensure the necessary conveniences for Project officials (Japanese and third country nationals) regarding their entry to, stay and safety in Afghanistan.
- Exempt/Bear any tariffs or domestic taxes that may otherwise be levied on services, materials and Japanese nationals concerned with the Project.
- Properly operate the facilities that are constructed under the Japan's Grant Aid, and make sure that appropriate maintenance is continued.
- Bear all the costs that are required under the Project but are not covered by the Japan's Grant Aid.
- Ensure relocation of facilities, etc. located in the Project area under the implementing agency's own responsibility and authority

2.3.2 Special Items

- The obligation and responsibility of DABS covers securing the sites of the middle voltage switchgear which is approximately 150 m away as well as cabling to the switchgear. The Project shall execute cabling works from the switchgear in 10 kV. The power feeding facilities, which will be constructed by the Project, shall be constructed as a property of CRIDA and transferred to AUWSSC together with the pump facilities. AUWSSC will be responsible for operation and maintenance of the water supply facilities.
- CRIDA will be responsible for giving advance explanations to roadside residents and seeking their cooperation (prior to construction).
- In cases where it is necessary to obtain authorization from government agencies and so on, the necessary applications will be made by CRIDA.
- Removal of mines and unexploded bombs

2.4 Project Operation Plan

2.4.1 Responsible Setup in Afghanistan

AUWSSC is responsible for operation and maintenance of this Project including distribution networks. Since the target area is relatively small and Pol-e Charikhi is close to Kabul, Kabul branch office of AUWSSC will be in charge of operation and maintenance of the facilities to be constructed in the Project.

The Kabul branch office has currently planned to establish a new sub-section for the new city in charge of water supply of Pol-e Charikhi system. This new organization is expected to be a model case of operation and maintenance of water supply and sewerage works in the future new city. Table 2.24 and Table 2.25 show the required personnel in the department of sales & customers relations and the department of O&M, respectively.

Table 2.24 Required Personnel in department of sales & customers relations

Position	Number	Remarks
Section Manager	1	BA. in Business Administration
Meter reader / cash tariff collector	6	14.3 collectors per 100,000 population
Total	7	

Table 2.25 Required Personnel in department of O&M

Position	Number	Remarks
Department Director (in charge for the New City)	1	B.Eng. in Engineering
Pre-Charikhi Well Station Section		Wells, Reservoirs, Pumps and Transmission Mains
Section Manager	1	B.Eng. in Engineering
Technician	5	1 person x 3 shifts
Clerk	2	
Miscellaneous worker	9	2 persons x 3 shifts
Security	13	3 persons x 3 shifts 2 for PW1 and 1 for PW2
Network & Pipeline Section		Water Pressure Regulating Reservoir and Distribution Networks
Section Manager	1	B.Eng. in Engineering
Technician	5	1 person x 3 shifts
Miscellaneous worker	9	2 persons x 3 shifts
Water Quality Management Section		
Section Manager (Chief Analyst)	1	B.Eng. in Engineering or BSc in Chemistry
Total	47	

2.4.2 Basic Policy

For long-term effective use of the facilities constructed under the Project and stably and continuous water supply with reflecting the change in daily demand, operation, management and protection of facility environment are indispensable. The Afghan side should carry on appropriate protection and maintenance of the facilities and the equipment derived from increase in reliability, safety and effectiveness for preserving the ability and the function of the facilities and the equipment, and constant water supply. Figure 2-15 shows the basic policy of maintenance of the facility in the Project.

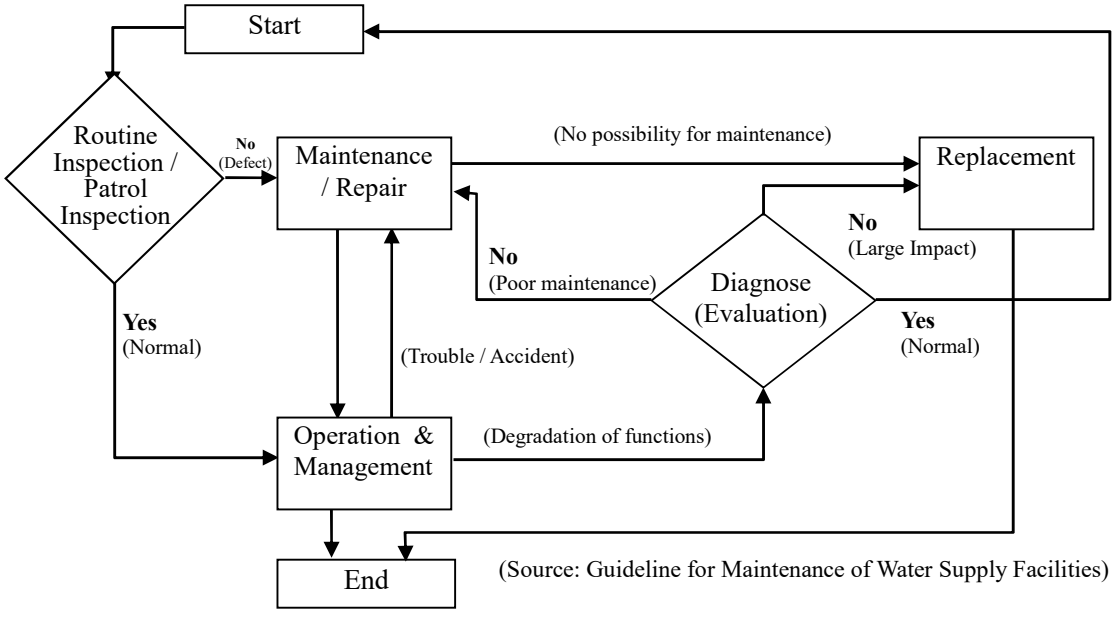


Figure 2-15 Maintenance Flow of Water Supply Facilities

2.4.3 Items for Regular Check

Based on the policy mentioned above, the following points are the basic items that AUWSSC shall conduct operational and maintenance management of the water supply facilities. Figure 2-15 shows the main items for O&M of the new water supply facilities.

Operation Management: Carrying on operation and control under normal circumstances
Maintenance Management: Carrying on maintenance, repair and prepare so that the facility, equipment and device can show full ability for operation.

Table 2.26 Main Items for Operation and Maintenance (O&M)

Classification	Main Management Item
Operation Management	1) Water volume control: Controlling equipment and devices conforming to the design water volume 2) Water quality control: Measuring raw water and check whether treated water meets the design water quality standard (pH, Electrical conductivity, Turbidity, Color and Odor: daily). Measuring residual chlorine after disinfection and confirming whether it becomes lower than the value at the reservoir, water pressure regulating reservoir and hydrant. After the measurement, resetting injection rate of disinfection reagent, if required.
Maintenance	1) Inspection Item: Inspecting and checking facilities, equipment and devices with meters and naked eyes and repairing and maintaining faults or breakdowns. Additionally securing and protecting safety of chemicals (chlorine) needed for disinfection. 2) Prevention: Renewing facilities, equipment and devices periodically depending on the importance and characteristics even without any breakdowns. This leads to safe and secure operation since ensuring reliability and safety over facilities, equipment and devices may increase.

AUWSSC is required to carry on appropriate operation and maintenance of equipment according to O&M manuals of equipment supplied by production makers. Table 2.27 indicates the standard checking items of pumps and power receiving equipment as the main equipment for water supply facilities, respectively.

Table 2.27 Standard Check List for Pump Equipment

Pump	Daily (during operation)	Record in operation diary (distribution volume, check with naked eyes, abnormal noise, shaft temperature, leakage, pressure of inflow and outflow)
	Monthly	Check of shaft oil and grease Check of gland packing
	Every 6 months	Replacement or refilling of shaft oil and grease Precision of the shaft center Measurement of vibration and noise Tightening each part of the equipment
	Every year	Dismantling check (vibration of rotating parts, aperture of gliding parts, corrosion of inside, choking with substances, paint) Check of accessories and spares
Motor	Daily (during operation)	Record in operation diary (electrical currency, check with naked eyes, abnormal noise, shaft temperature, leakage)
	Every 6 months	Refilling of shaft grease Measurement of vibration and noise Check of temperature of shaft
	Every year	Check of shaft holder Measurement of non-conductance resistance value

Table 2.28 Standard Check List for Power Receiving Equipment

Item	Content (Method)	Regular Inspection	Normal Inspection	Precise Inspection
Appearance	Open/Close display device, Display Condition	○	○	
	Abnormal Noise and odor	○	○	
	Hot Coloring at end points	○	○	
	Cracks, faults and stains of bushing and pipes	○	○	
	Rust on found case, hang base, etc.	○	○	
	Abnormal Temperature	○	○	
	Tightness of bushing end (mechanical check)	○	○	
Operation and control devices	Display condition of each equipment	○	○	○
	Rotation order		○	○
	Rust and stains of controlling box and its inside		○	○
	Oil change and cleanness		○	○
	Tightness of electricity wiring connection	○	○	○
	Open/close display condition		○	○
	Air and oil leakage (with air pressure, etc.)		○	○
	Pressure before and after operation (with air pressure, etc.)		○	○
	Operation meter condition		○	○
	Rust, deformation, damage on spring (repair)	○	○	○
	Abnormal pins for connection		○	○
	Spare electricity circuited breaker and relay		○	○
Measure-ment and test	Non conductance resistance		○	○
	Contact resistance			○
	Heater snapper line		○	○
	Movement test for the relay		○	○

2.4.4 Spare Parts Purchase Plan

Spare parts required for this Project are divided into (a) consumable parts which may be replaced periodically and (b) replacement parts or emergent spare parts, which are necessary for accidents, etc., for replacement. Thus, it is necessary that the Afghan side shall purchase those main goods in accordance with the periodical inspection cycle as described before.

2.5 Project Cost

2.5.1 Cost to be Borne by Japanese Side

This information is closed due to the confidentiality.

2.5.2 Cost to be Borne by Afghanistan Side

Total estimated Cost: 268,972 thousand AFA (405 million Japanese Yen)

(Unit: thousand AFA)

Contents	Quantity	Cost (Local Currency)	Remarks
Bank Commission for opening bank account	1	2,356 (Approx. 4 million Japanese Yen)	Borne by CRIDA
Other distribution mains which are excluded from the Grant Aid project	-	-	
Other distribution branch lines which are excluded from the Grant Aid project	Approx. 160km estimated	266,616 (Approx. 401 million Japanese Yen)	Borne by the Private Developer
Total		268,972 (Approx. 405 million Japanese Yen)	

2.5.3 Conditions for Cost Estimation

The conditions for cost estimation are shown below;

5. Date : June, 2018
6. Exchange Rate : US$ = 108.75 JPY
   1AFA = 1.507 JPY
7. Construction Period : Construction period is shown as Table 2.23
8. Tax : As of Japan's Grant Aid scheme

2.5.4 Operation and Maintenance Cost

2.5.4.1 Operation and Maintenance Cost

Table 2.26 shows the operation and maintenance costs for the well pumps, transmission pump facility and reservoirs consisting of labor cost, electricity cost, cost for chemicals (chlorine) and contingency for procurement of spare parts.

Labor and energy cost are tentatively estimated on the basis of the quotation acquired at Afghanistan in 2012 considering the price escalation until June 2018, the date when cost estimation was implemented. O&M cost and depreciation cost greatly increase against ones of original plan due to the fluctuation of currency exchange rate.

Table 2.29 Operation and Maintenance Cost

Item	Cost (thousand AFA/y)	Remarks
Labor Cost	17,196	Only direct operators
Energy	19,222	
O&M Cost	2,225	2% of construction cost of electro-mechanical facilities
Miscellaneous Cost	8,598	50% of Labor cost (overhead including transport and office consumables)
Chemicals for Disinfection	257	
Depreciation Cost	23,751	
Emergency Generation	1,922	
Total	73,172	

Note: Operation cost of the facility for 5,000 m^3/day

2.5.4.2 Renewal Plan for Mechanical and Electrical Equipment

In this Project, main equipment such as borehole pumps, water transmission pumps and electrical equipment related to power receiving will be installed in the related facilities. These mechanical and electrical equipment are expected to be replaced in the period defined in Table 2.30.

Table 2.30 Renewal Plan for Mechanical and Electrical Equipment

Equipment Name	Category	Expected Service Life
Borehole Pump	Submersible pump	10 years
Water Transmission Pump	Surface pump	15 years
Electrical Equipment		15 years

2.5.4.3 Budget Security

The operation and maintenance cost per unit water supply is equivalent to approximately 40 AFA/m^3. Since the national water tariff for water service is 25.00 AFA/m^3, required cost for operation and maintenance can be secured by the tariff.

It is estimated that the operation and maintenance Cost per unit water supply is equivalent to approximately 40 AFA/m^3 although it is tentatively estimated on the basis of the price at original plan considering price escalation until June 2018 as described previously.

Since the national water tariff for water service is 25.00 AFA/m^3, AUWSSC needs to estimate the operation and maintenance cost using the prices at Afghanistan in current and study the appropriate organization again so that the O&M cost can be covered by water tariff at the implementation stage of the project

Chapter 3 Project Evaluation

3.1 Preconditions

The critical path of the Project includes land acquisition for the construction site and discussion with road management authority on road occupation for laying pipelines by CRIDA as the executing agency.

3.2 Necessary Inputs by Recipient Country

The Afghan side is responsible for land acquisition for the construction site and discussion with road management authority on road occupation for pipelines.

3.3 Important Assumptions

Anti-governmental activities have frequently occurred in Afghanistan. Therefore, the important assumption is securing the facilities during construction works and post-construction works. Abduction targeting foreign engineers has also frequently occurred and there is possibility that foreign engineer's travel to Afghanistan may become difficult. Such background reveals the Project accomplishment largely depends on security conditions.

3.4 Project Evaluation

3.4.1 Relevance

This Project is relevant to the needs of Afghanistan and development policy as well as Japan's assistance policy. This Project will contribute to secure required water for the Parcel-2.2 and will be a model case for development of the new city. Therefore, the relevance is evaluated as high.

3.4.2 Effectiveness

3.4.2.1 Quantitative Project Evaluation

Table 3.1 Quantitative Project Evaluation

Indicator	Current Condition (2018)	Index (2025) [3 years after commission]
Water supply (m^3/day)	0	5,000
Service Population	0	54,492
Water Supply Hours (Hour / Day)	0	24

3.4.2.2 Qualitative Project Evaluation

Construction of water supply and transmission facility promote the development of Parcel-2.2 area.

[APPENDICES]

APPENDIX-1

Member List of the Study Team

Member List of the Study Team

No.	Name	Role	Organization
1	Mr.IGARASHI Hideyuki	Leader/Water Transmission and Distribution Plan	Yachiyo Engineering Co.Ltd.
2	Mr.ONOZATO Tsuyoshi	Water Distribution Facility Plan/Pipe Network/Environmental Social Considerations	Yachiyo Engineering Co.Ltd.
3	Mr.FUJII Katsumi	Civil Engineering Facility Plan	Yachiyo Engineering Co.Ltd.
4	Mr.KASUYA Toshinobu	Electrical and Mechanical Facility Plan	Yachiyo Engineering Co.Ltd.
5	Mr.SHINDO Oki/ Mr.KONNO Hideki	Construction Plan/Cost Estimation	Yachiyo Engineering Co.Ltd.

APPENDIX-2

Pipe Network Calculation of Water Distribution Main

Pipe Network Calculation of Water Distribution Main

1. Introduction

There are mainly 2 typed water distribution systems, dendritic type and mesh type. Because of the disadvantages of dendritic typed water distribution system that water supply is stopped at a large area when a part of pipe is burst and water is stagnated at the end point of pipe etc., the system is not applied to city water supply in general. Instead, because of the advantages of mesh typed water distribution system that water pressure can be stable not only at the normal condition but also at the emergency condition when a pipe burst is arisen, the system is applied in many cities.

Therefore we are going to apply mesh typed water distribution system for this project.

For the study of mesh typed water distribution, we need network calculation for solving simultaneous equations consisted of "equation of continuity at each connection point" and "equation of pressure drop around each pipe loop".

Now we explain about the details of water distribution design for this project using distribution network calculation below.

2. Basic Plan

(1) Water Supply Condition

Target Area	Parcel 2.2
Number of water service area	5
Service Population	Total 54,492 pop.

(Stage 1: 16,458 pop. Stage 2: 16,524 pop. Stage 3: 6,204 pop. Stage 4: 2,268 pop. Stage 5: 13,038 pop.)

Daily water supply per capita	92LCD
Daily variation coefficient	1.3
Hourly variation coefficient	1.4

Design water distribution volume (= Hourly maximum water supply volume)

= 92 (L/person ・day) × 54,492 pop.× 0.001 ×1.3×1.4

= 9,124 (m^3/day)

3. Pre-Condition and Details for Pipe Network Calculation

Pre-condition and details for pipe network calculation are referred to Attachment 1.

we studied the appropriate diameter of each pipe in the basic pipe network to secure the following pressure condition at all the points of water distribution main pipe even at the emergency condition that one pipeline is closed for the maintenance or fire-fighting water is used at each connection point;

Maximum Hydrostatic Pressure 100mH
Minimum Hydrodynamic Pressure 20mH

4. Examples of Water Distribution Network Calculation on Each Option

Draft plan of water distribution network to be applied in this project is referred to Attachment 2.

We conducted the calculation at the following options to verify the draft plan.

(1) Option Studied

Option	Option 1	Option 2	Option 3
Normal or Emergency Condition	Normal	Emergency	
Detailed Condition	-	Close each section of pipe	Use fire-fighting water at each connection point
Design Water Distribution Volume	Design maximum hourly water distribution volume = 92 LCD×1.3×1.4 × 54,492 pop. =167 LCD × 54,492 pop.		
Result of Calculation	Attachment 3	Attachment 4, Attachment 5	Attachment 6, Attachment 7
Note	-	Study at the time of pipe maintenance	Study at the time of fire

(2) Explanation of Calculation Result for Each Option

1) Calculation for Option 1 ※Attachment 3

The result of calculation at normal condition using draft plan of water distribution network to be applied in this project (Attachment 2) is shown in Attachment 3.

We found that hydrodynamic pressure at all the connection points secures 20mH or more.

2) Example Calculation for Option 2 ※Attachment 4 and Attachment 5

As one example for option 2, we conducted the calculation to confirm that all the connection points in the draft plan of water distribution network can secure 20mH or more as hydrodynamic pressure even when pipe L2-L1 is closed for the maintenance as emergency condition while opening pipe M2-L3. The result of calculation is shown in Attachment 4. On the condition, we found that pressure at all the connection points can secure 20mH or more as hydrodynamic pressure.

Moreover for reference, we conducted the calculation on the condition that pipe L2-L1 is closed for the maintenance as emergency condition in case the connection between pressure regulating tank (PRT) and water distribution main is connected only with one pipe (That is, the case that it is connected only with pipe M1-L2 and without pipe M2 to L3.) The result of calculation is shown in Attachment 5. On the condition, we found that pressure at a lot of connection point becomes 20mH or less as hydrodynamic pressure.

As the result of a set of calculation, to secure the designated pressure at all the connection point even when pipe L2-L1 is closed, we found that we need the connection with 2 pipes between PRT and water distribution main pipe so as to put pipe L1-K between the 2 pipes (pipe M1-L2 and M2-L3).

3) Example Calculation for Option 3 ※Attachment 6 and Attachment 7

As one example of option 3, we conducted the calculation to confirm that the connection point H where fire-fighting water is taken can secure 20mH or more and the other connection points also can secure positive pressure as hydrodynamic pressure even when $0.1m^3$/sec is taken at connection point H as fire-fighting water. The result of calculation is shown in Attachment 6. On the condition, we found that pressure at connection point H secures 20mH or more and the other connection points also secure positive pressure.

Moreover for reference, we conducted the calculation on the same condition as the previous one except that the diameter of pipe I-H is replaced from DN 250mm to DN180mm. The result of calculation is shown in Attachment 7. On the condition, we found that pressure at connection point H becomes 20mH or less as hydrodynamic pressure.

As the result of a set of calculation, to secure the designated pressure at all the connection point even when fire-fighting water is taken at conception point H, we found that we need to select DN 250mm for pipe I-H instead of DN 180mm.

5. Conclusion

As the result of a set of pipe network calculation, we found that draft plan of water distribution network to be applied in this project (Attachment 2) can secure design pressure not only at the normal condition but also at the emergency condition that one pipeline is closed for the maintenance or fire-fighting water is taken at each connection point .

End

Attachment:

1. Detailed explanation of water distribution network calculation
2. Draft plan of water distribution network (To be applied to this project)
3. Calculation result at normal condition
4. Calculation result in case one pipeline is closed (L2-L1) (The case connected with two pipes from PRT to distribution main pipe)
5. Calculation result in case one pipeline is closed (L2-L1) (The case connected with one pipes from PRT to distribution main pipe)
6. Calculation result in case fire-fighting water is used (Diameter of pipe IH is DN250mm)
7. Calculation result in case fire-fighting water is used (Diameter of pipe IH is DN180mm)

Attachment 1

Detailed Explanation of Water Distribution Network Calculation

1. Basic Pipe Network Studied

Basic pipe network studied is referred to Annex 1.

Based on the basic water distribution main layout, which is previously designed by CRIDA, we modified it into the basic flame consisted of total 19 connection points (From A to P) and total 26 pipes so that we can do hydraulic calculation using the computer.

Especially we studied the appropriate diameter of each pipe in the basic pipe network (Annex 1) to secure the following pressure condition at all the connection points even at the time of emergency condition that one pipeline is closed for the maintenance or fire-fighting water is used at each connection point:

Maximum Hydrostatic Pressure 100mH

Minimum Hydrodynamic Pressure 20mH

2. Pre-Condition

(1) Elevation of Each Connection Points

Elevation of each connection points is as follows;

No. of Connection		Elevation	Difference between the bottom of Pressure Regulating Tank (PRT) and Elevation (⊿EL)
		m	m
1	A	1,783	-48.5
2	B	1,794	-37.5
3	C	1,799	-32.5
4	D	1,799	-32.5
5	E	1,809	-22.5
6	F	1,824	-7.5
7	G	1,786	-45.5
8	H	1,798	-33.5
9	I	1,803	-28.5
10	J	1,804	-27.5
11	K	1,810	-21.5
12	L1	1,829	-2.5
13	L2	1,831	-0.5
14	L3	1,828	-3.5
15※1	M1	1,831.5	0
16※1	M2	1,831.5	0
17	N	1,789	-42.5
18	O	1,801	-30.5
19	P	1,814	-17.5

※1 Connection point where pressure regulating tank (PRT) is located.

(2) Water Level of Pressure Regulating Tank (PRT)

Water level of PRT= 21m (Hydrostatic and hydro dynamic pressure of M1 and M2)

(3) Length of Pipeline

Length of each pipeline is as follows:

No. of Pipe		Length
		m
1	AB	1,230
2	BC	670
3	CD	60
4	DE	1,050
5	EF	940
6	GH	1,250
7	HI	400
8	IJ	60
9	JK	340
10	KL1	750
11	L2M1	10
12	L3M2	250
13	NO	1,180
14	OP	790
15	PL3	530
16	AG	540
17	GN	660
18	BH	740
19	CI	1,030
20	IO	970
21	DJ	1,030
22	JP	970
23	EK	1,420
24	FL2	1,590
25	L2L1	150
26	L1L3	100

(4) Water Distribution Volume at Each Connection Point

To study the appropriate pipe diameter so that design pressure can be secured not only at the normal condition but also at the emergency condition that fire is occurred, we set the following 2 conditions for water supply volume at the normal condition and at the emergency condition (in case of using fire-fighting water).

1) Normal Condition

① Distribution main pipe is designed so that designed water distribution volume

can be supplied to 5 water service areas at design pressure or more. Designed water distribution volume on each area is as follows;

Area	Population	※1Design Water Distribution volume (At Normal Condition)		Water Service Points
	(Pop.)	(m^3/day)	(m^3/sec)	(Points)
ACIG (Stage 1)	16,458	2,756	0.032	4
CEKI (Stage 2)	16,524	2,767	0.032	8
GION (Stage 3)	6,204	1,039	0.012	4
IKLPO (Stage 4)	2,268	380	0.004	7
EFLK (Stage 5)	13,038	2,183	0.025	4
Total	54,492	9,124	0.106	

※1 Design water distribution volume (m^3/day)

= Maximum hourly water supply volume (m^3/day)

= Pop.×Daily water supply per capita (=92 LCD)

×Daily variation coefficient(=1.3) ×Hourly variation coefficient(=1.4)

② It is assumed that designed water distribution volume on each water service area is distributed equally to each water connection point. Therefore water distribution volume on each connection point is as follows;

No. of Connection		Water Supply Volume (m^3/sec)
W1	A	0.0040
W2	B	0.0080
W3	C	0.0040
W4	D	0.0080
W5	E	0.0143
W6	F	0.0063
W7	G	0.0070
W8	H	0.0080
W9	I	0.0070
W10	J	0.0089
W11	K	0.0152
W12	L1	0.0072
W13	L2	-
W14	L3	-
W15※1	M1	-
W16※1	M2	-
W17	N	0.0030
W18	O	0.0030
W19	P	0.0018
Total		0.106 (= 9,124m^3/day)

※1 Connection point where pressure regulating tank (PRT) is located.

2) Emergency Condition (In case of using fire-fighting water)

① Supposing that fire occurs at each connection point from A to P, diameter of each pipe is selected so that hydrodynamic pressure on the connection point where fire is occurring can secure 20 mH or more and that of the other connection points can secure above the positive pressure even when 0.1 m^3/sec is taken at each connection point for firefighting water in addition to designed water distribution volume.

② However, design water distribution volume is set as 50% of that at normal condition

For example when fire is occurring at point H, water distribution volume on each connection points is as follows;

No. of Connection		Water Distribution Volume (m^3/sec)
W1	A	0.0020
W2	B	0.0040
W3	C	0.0020
W4	D	0.0040
W5	E	0.0072
W6	F	0.0032
W7	G	0.0035
W8	H	0.1040
W9	I	0.0035
W10	J	0.0044
W11	K	0.0076
W12	L1	0.0036
W13	L2	-
W14	L3	-
W15※1	M1	-
W16※1	M2	-
W17	N	0.0015
W18	O	0.0015
W19	P	0.0009
Total		0.153 (= 13,202m^3/day)

※1 Connection point where pressure regulating tank (PRT) is located

(5) Apprized Formula for Water Hydraulic Calculation

Hazen Williams formula

$H=10.666\times C^{-1.85}\times D^{-4.87}\times Q^{1.85}\times L$

H: Head Loss (m)

Q: Flow Rate (m^3/sec)

C: Flow Velocity Coefficient 110 (including bending loss)

D: Pipe Diameter (m)

L: Length (m)

3. Equation Applied

(1) Equation of continuity

Water balance at each connection point is as follows:

Qi: Flow rate (m3/sec) of pipe i

Wk: Water supply (m3/sec) of connection point k

Q1+Q16-W1=0

-Q1+Q2+Q18-W2=0

-Q2+Q3+Q19-W3=0

-Q3+Q4+Q21-W4=0

-Q4+Q5+Q23-W5=0

-Q5+Q24-W6=0

Q6-Q16+Q17-W7=0

-Q6+Q7-Q18-W8=0

-Q7+Q8-Q19+Q20-W9=0

-Q8+Q9-Q21+Q22-W10=0

-Q9+Q10-Q23-W11=0

-Q10+Q25-Q26-W12=0

Q11-Q24-Q25=0

Q12-Q15+Q26=0

Q13-Q17-W17=0

-Q13+Q14-Q20-W18=0

-Q14+Q15-Q22-W19=0

(2) Equation of pressure drop around each pipe loop

Pressure drop at each pipe loop is as follows:

Hi: Pressure drop (mH) of pipe i

-H1-H18+H6+H16=0

-H2-H19+H7+H18=0

-H3-H21+H8+H19=0

-H4-H23+H9+H21=0

-H5-H24+H25+H10+H23=0

-H6-H7-H2+H13+H17=0

-H8-H22+H14+H2=0

-H9-H10+H26+H15+H22=0

(3) Other Equation related with Pressure at each connection point

Hydrodynamic pressure at each connection point considering the height difference between the elevation of BRT and that of the connection point is as follows;

P'i: Hydrodynamic pressure (mH) at connection point i considering the height difference between the elevation of BRT and that of the connection point i

Pi: Hydrodynamic pressure (mH) at connection point i (in case connection point i is located at the same elevation as BRT)

⊿ELi Height difference (mH) between the elevation of BRT and that of the connection point i

P'i=Pi-⊿ELi

Relation between pressures at BRT (Constant value) and hydrodynamic pressure at connection point of water distribution main pipe is as follows:

P'11=P'15-H11 = 21mH-H11

P'14=P'15-H12= 21mH-H12

4. Calculation Method

We calculated the hydrodynamic pressure at each point and flow rate at each pipe by solving the simulations equation described above.

For the calculation we refer to the program in the following book:

Reference:

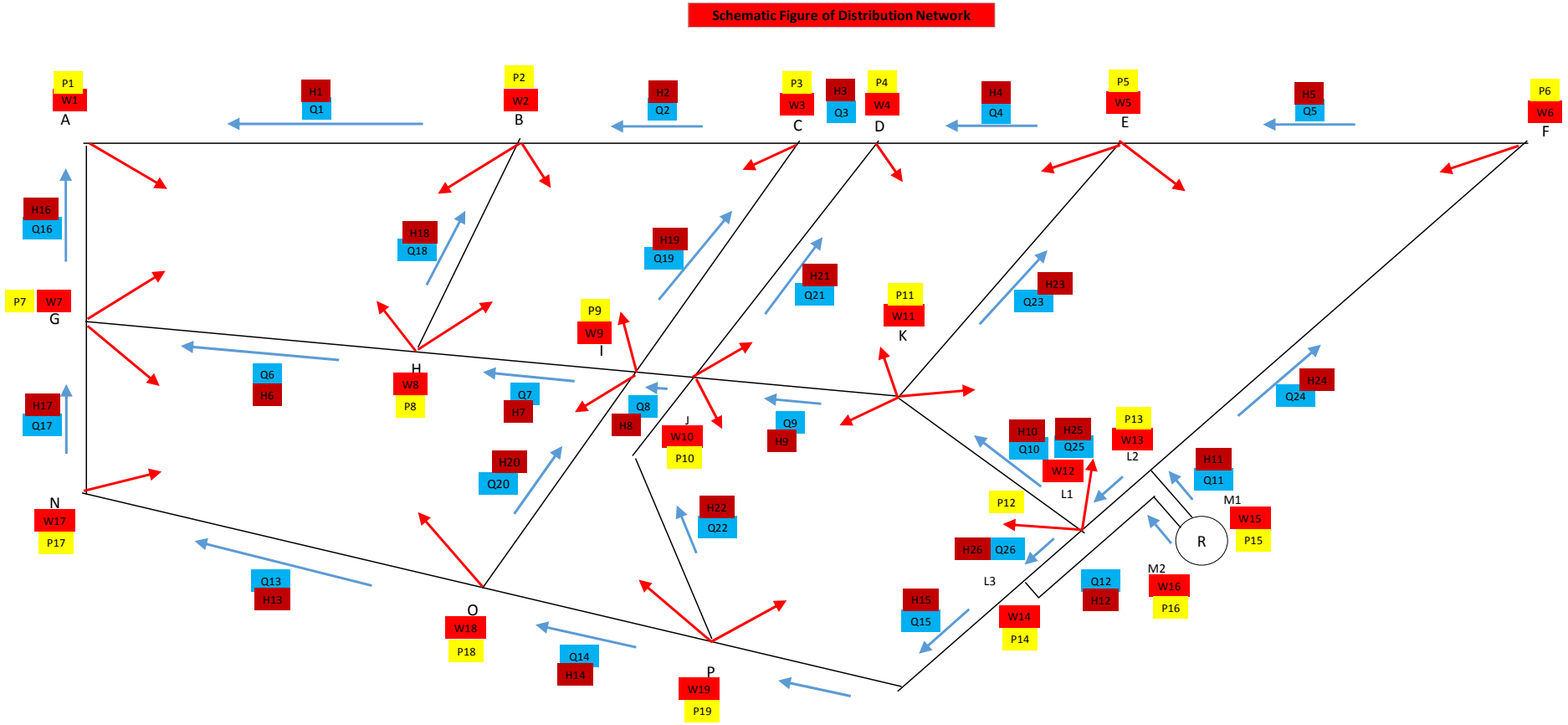
Base and Application of Water Distribution Pipe Network Analysis, Tetsuo TAKAKUWA (Japan Water Pipe Systems Research Center)

End

Annex:

1. Basic Pipe Network Studied

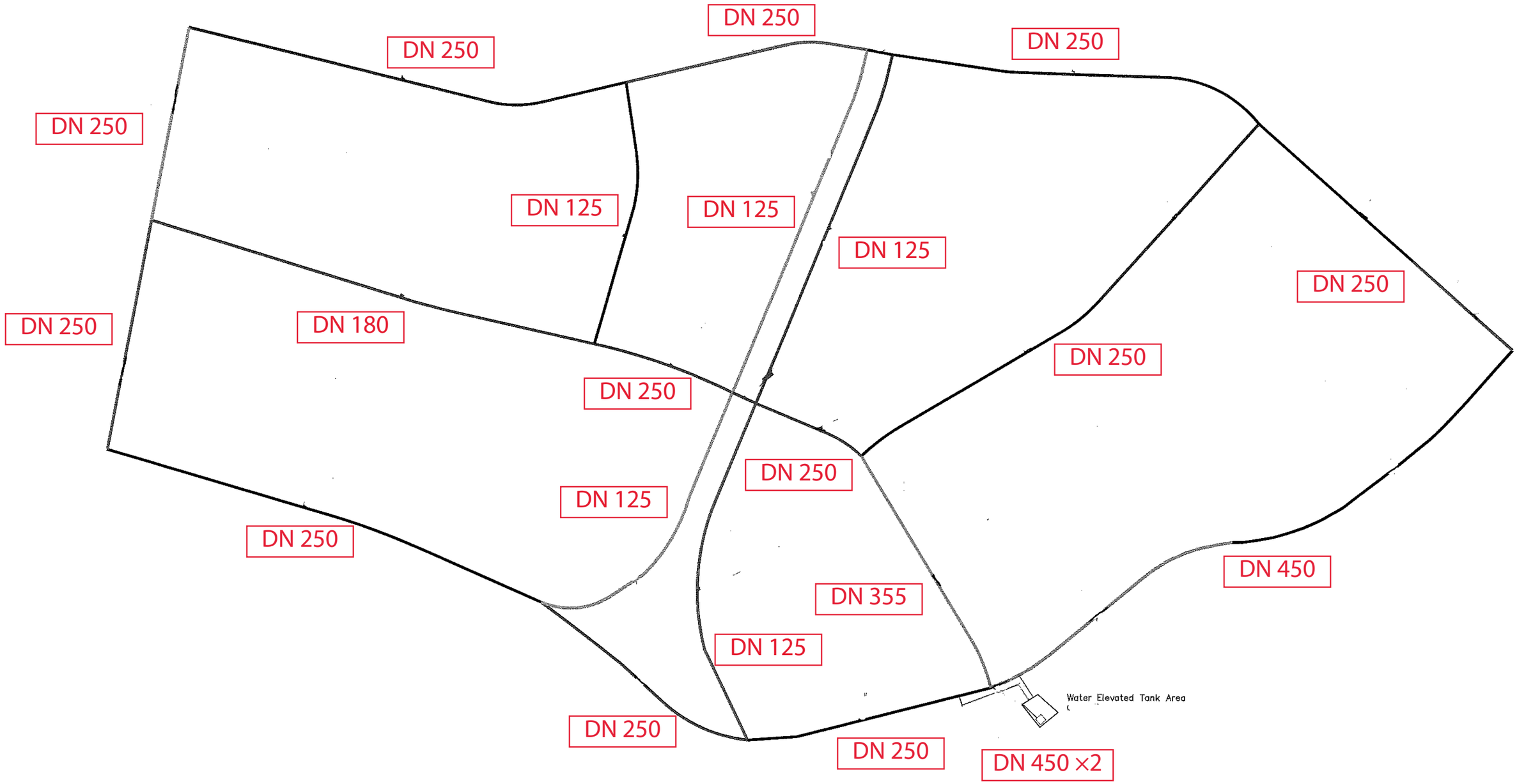
Annex 1 Basic Pipe Network Studied



Draft Plan of Water Distribution Network

Attachment 2

※ To be applied in this project



PROJECT CODE	LOCATION	PHASE / PROGRAM / PARCEL / DIVISION / DEPT / SUB DEPT / PROJECT CODE	DOCUMENT / SUB DOCUMENT / REFERENCE / REVISION
AFG/KBL/KNC	D	Ph 1 / Pg-3 / P2.2 /IS/WS/ WATER SUPPLY / (CRIDA / IS / 2016 / / 00)	PP/ / (CRIDA / IS / 2016 / / 00)

ISLAMIC REPUBLIC OF AFGHANISTAN CRIDA (CAPITAL REGION INDEPENDENT DEVELOPMENT AUTHORITY)	INFRASTRUCTURE PLANNING AND DESIGN DIVISION WATER RESOURCE & SUPPLY DEPARTMENT	DISTRIBUTION PIPES LAYOUT	SHEET CONTENTS	NAMES	SIGNATURE	DATE	SHEET NO.	REVISION	DATE
			ANNEX 03 GENERAL LAYOUT OF PIPES	DESIGNED BY: Moh. Rahim Rahimi				DD	Aug 201
				DRAWN BY: Noorullah Maroof					
				CHECKED BY: Fazal Rahim Shinwari			SCALE:		
				APPROVED BY: Alham Omar Hotaki			AS SHOWN		

Verification of Draft Pipe Network (No. 1)

Attachment 3

Distribution Network Calculation

Pre-Condition

(Including fine prevension water)

No. of Connection	Runoff at Connection	Initial Value of Energy	Elevation	Difference from BPT
	(m3/s)	m	m	m
A	0.0040	25	1783	-48.5
B	0.0080	25	1794	-37.5
C	0.0040	25	1799	-32.5
D	0.0080	25	1799	-32.5
E	0.0143	25	1809	-22.5
F	0.0063	25	1824	-7.5
G	0.0070	25	1786	-45.5
H	0.0080	25	1798	-33.5
I	0.0070	25	1803	-28.5
J	0.0089	25	1804	-27.5
K	0.0152	25	1810	-21.5
L1	0.0072	25	1829	-2.5
L2	0.0000	25	1831	-0.5
L3	0.0000	25	1828	-3.5
M1	0.0000	25	1831.5	0
M2	0.0000	25	1831.5	0
N	0.0030	25	1789	-42.5
O	0.0030	25	1801	-30.5
P	0.0018	25	1814	-17.5

At Fire

No. for Firewater	Flowrate (m3/s)	Decrease ratio(%)
#N/A	0.1	0

Basic Plan

Unit Water Consumption	92	LCD
Daily variation coefficient	1.3	–
Hourly variation coefficient	1.4	–
Allowance(incl.firefighting use)	1	–

Water Consumption at Connection Point (Except for Water of Fire Fighting)

	Water Demand		Number of Water Point	Flowrate at 1 point
Area	m3/day	m3/s	点	m3/s
ACIG	2,756	0.032	8	0.0040
CEKI	2,767	0.032	4	0.0080
GION	1,039	0.012	4	0.0030
IKLPO	380	0.004	5	0.0009
EFLK	2,183	0.025	4	0.0063
Total	9,124	0.106		

At Fire

Total	9,124	0.106

No .of Pipe		Diameter	No. of Pipe	Length	Valve
		m	Pipes	m	
1	AB	0.2132	1	1,230	Open
2	BC	0.2132	1	670	Open
3	CD	0.2132	1	60	Open
4	DE	0.2132	1	1,060	Open
5	EF	0.2132	1	940	Open
6	GH	0.1534	1	1,250	Open
7	HI	0.2132	1	400	Open
8	IJ	0.2132	1	60	Open
9	JK	0.2132	1	340	Open
10	KL1	0.3028	1	750	Open
11	L2M1	0.3838	1	10	Open
12	L3M2	0.3838	1	250	Open
13	NO	0.2132	1	1,180	Open
14	OP	0.2132	1	790	Open
15	PL3	0.2132	1	530	Open
16	AG	0.2132	1	540	Open
17	GN	0.2132	1	660	Open
18	BH	0.1066	1	740	Open
19	CI	0.1066	1	1,030	Open
20	IO	0.1066	1	970	Open
21	DJ	0.1066	1	1,030	Open
22	JP	0.1066	1	970	Open
23	EK	0.2132	1	1,420	Open
24	FL2	0.3838	1	1,590	Open
25	L2L1	0.3838	1	150	Open
26	L1L3	0.2132	1	100	Open

Result of Calculation

1.Energy, Water Pressure

No. of Connection	Energy Level	Hydrodynamic Pressure	Hydrostatic Pressure
	m	m	m
A	16.78	65.28	69.50
B	16.78	54.28	58.50
C	16.95	49.45	53.50
D	16.97	49.47	53.50
E	18.37	40.87	43.50
F	20.62	28.12	28.50
G	16.86	62.36	66.50
H	17.22	50.72	54.50
I	17.59	46.09	49.50
J	17.72	45.22	48.50
K	19.09	40.59	42.50
L1	20.88	23.38	23.50
L2	20.98	21.48	21.50
L3	20.93	24.43	24.50
M1	21.00	21.00	21.00
M2	21.00	21.00	21.00
N	17.21	59.71	63.50
O	18.25	48.75	51.50
P	19.55	37.05	38.50

2.Flowrate

No .of Pipe		Flowrate	
		m3/s	m/s
1	AB	-0.0005	-0.0146
2	BC	0.0059	0.1662
3	CD	0.0083	0.2338
4	DE	0.0146	0.4105
5	EF	0.0202	0.5670
6	GH	0.0027	0.1447
7	HI	0.0122	0.3411
8	IJ	0.0191	0.5349
9	JK	0.0268	0.7512
10	KL1	0.0507	0.7050
11	L2M1	0.0757	0.6545
12	L3M2	0.0299	0.2588
13	NO	0.0118	0.3318
14	OP	0.0165	0.4624
15	PL3	0.0211	0.5921
16	AG	0.0045	0.1264
17	GN	0.0088	0.2475
18	BH	0.0015	0.1713
19	CI	0.0016	0.1770
20	IO	0.0017	0.1861
21	DJ	0.0017	0.1916
22	JP	0.0029	0.3221
23	EK	0.0087	0.2450
24	FL2	0.0265	0.2296
25	L2L1	0.0491	0.4250
26	L1L3	-0.0088	-0.2465

Reference: Pipe Daimeter

DN	I.D.
mm	mm
125	106.6
180	153.4
250	213.2
355	302.8
450	383.8

<Condition Studied >

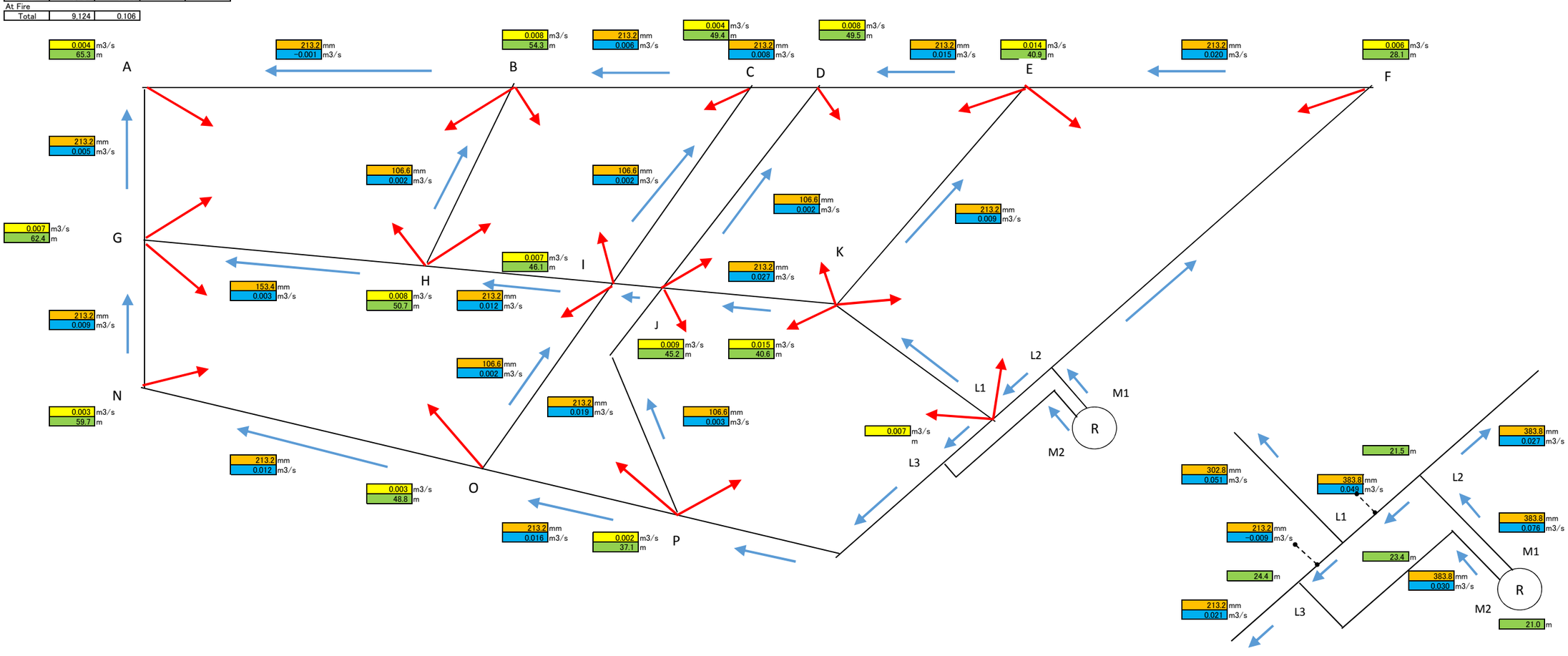
※Normal Condition

<Calculation Result>

Pressure at all the connection points is

20mH or more

Schematic Figure of Distribution Network



Verification of Draft Pipe Network (No. 2)

Attachment 4

Distribution Network Calculation

Pre-Condition

(Including fine prevension water)

No. of Connection	Runoff at Connection	Initial Value of Energy	Elevation	Difference from BPT
	(m3/s)	m	m	m
A	0.0040	25	1783	−48.5
B	0.0080	25	1794	−37.5
C	0.0040	25	1799	−32.5
D	0.0080	25	1799	−32.5
E	0.0143	25	1809	−22.5
F	0.0063	25	1824	−7.5
G	0.0070	25	1786	−45.5
H	0.0080	25	1798	−33.5
I	0.0070	25	1803	−28.5
J	0.0089	25	1804	−27.5
K	0.0152	25	1810	−21.5
L1	0.0072	25	1829	−2.5
L2	0.0000	25	1831	−0.5
L3	0.0000	25	1828	−3.5
M1	0.0000	25	1831.5	0
M2	0.0000	25	1831.5	0
N	0.0030	25	1789	−42.5
O	0.0030	25	1801	−30.5
P	0.0018	25	1814	−17.5

At Fire

No. for Firewater	Flowrate (m3/s)	Decrease ratio(%)
#N/A	0.1	0

Basic Plan

Unit Water Consumption	92	LCD
Daily variation coefficient	1.3	–
Hourly variation coefficient	1.4	–
Allowance(incl.firefighting use)	1	–

Water Consumption at Connection Point (Except for Water of Fire Fighting)

	Water Demand		Number of Water Point	Flowrate at 1 point
Area	m3/day	m3/s	点	m3/s
ACIG	2,756	0.032	8	0.0040
CEKI	2,767	0.032	4	0.0080
GION	1,039	0.012	4	0.0030
IKLPO	380	0.004	5	0.0009
EFLK	2,183	0.025	4	0.0063
Total	9,124	0.106		

At Fire

Total	9,124	0.106

No .of Pipe		Diameter	No. of Pipe	Length	Valve
		m	Pipes	m	
1	AB	0.2132	1	1,230	Open
2	BC	0.2132	1	670	Open
3	CD	0.2132	1	60	Open
4	DE	0.2132	1	1,060	Open
5	EF	0.2132	1	940	Open
6	GH	0.1534	1	1,250	Open
7	HI	0.2132	1	400	Open
8	IJ	0.2132	1	60	Open
9	JK	0.2132	1	340	Open
10	KL1	0.3028	1	750	Open
11	L2M1	0.3838	1	10	Open
12	L3M2	0.3838	1	250	Open
13	NO	0.2132	1	1,180	Open
14	OP	0.2132	1	790	Open
15	PL3	0.2132	1	530	Open
16	AG	0.2132	1	540	Open
17	GN	0.2132	1	660	Open
18	BH	0.1066	1	740	Open
19	CI	0.1066	1	1,030	Open
20	IO	0.1066	1	970	Open
21	DJ	0.1066	1	1,030	Open
22	JP	0.1066	1	970	Open
23	EK	0.2132	1	1,420	Open
24	FL2	0.3838	1	1,590	Open
25	L2L1	0.3838	1	150	Close
26	L1L3	0.2132	1	100	Open

Result of Calculation

1.Energy, Water Pressure

No. of Connection	Energy Level	Hydrodynamic Pressure	Hydrostatic Pressure
	m	m	m
A	15.83	64.33	69.50
B	15.82	53.32	58.50
C	15.98	48.48	53.50
D	16.01	48.51	53.50
E	17.47	39.97	43.50
F	20.54	28.04	28.50
G	15.92	61.42	66.50
H	16.14	49.64	54.50
I	16.48	44.98	49.50
J	16.59	44.09	48.50
K	17.76	39.26	42.50
L1	19.21	21.71	23.50
L2	21.00	21.50	21.50
L3	20.61	24.11	24.50
M1	21.00	21.00	21.00
M2	21.00	21.00	21.00
N	16.32	58.82	63.50
O	17.51	48.01	51.50
P	19.01	36.51	38.50

2.Flowrate

No .of Pipe		Flowrate	
		m3/s	m/s
1	AB	−0.0008	−0.0229
2	BC	0.0059	0.1642
3	CD	0.0085	0.2376
4	DE	0.0150	0.4203
5	EF	0.0239	0.6701
6	GH	0.0021	0.1145
7	HI	0.0114	0.3193
8	IJ	0.0176	0.4944
9	JK	0.0247	0.6916
10	KL1	0.0453	0.6292
11	L2M1	0.0303	0.2619
12	L3M2	0.0753	0.6513
13	NO	0.0127	0.3557
14	OP	0.0178	0.4992
15	PL3	0.0229	0.6420
16	AG	0.0048	0.1347
17	GN	0.0097	0.2715
18	BH	0.0013	0.1466
19	CI	0.0014	0.1537
20	IO	0.0021	0.2370
21	DJ	0.0015	0.1671
22	JP	0.0033	0.3745
23	EK	0.0054	0.1516
24	FL2	0.0302	0.2614
25	L2L1	0.0001	0.0006
26	L1L3	−0.0524	−1.4690

Reference: Pipe Daimeter

DN	I.D.
mm	mm
125	106.6
180	153.4
250	213.2
355	302.8
450	383.8

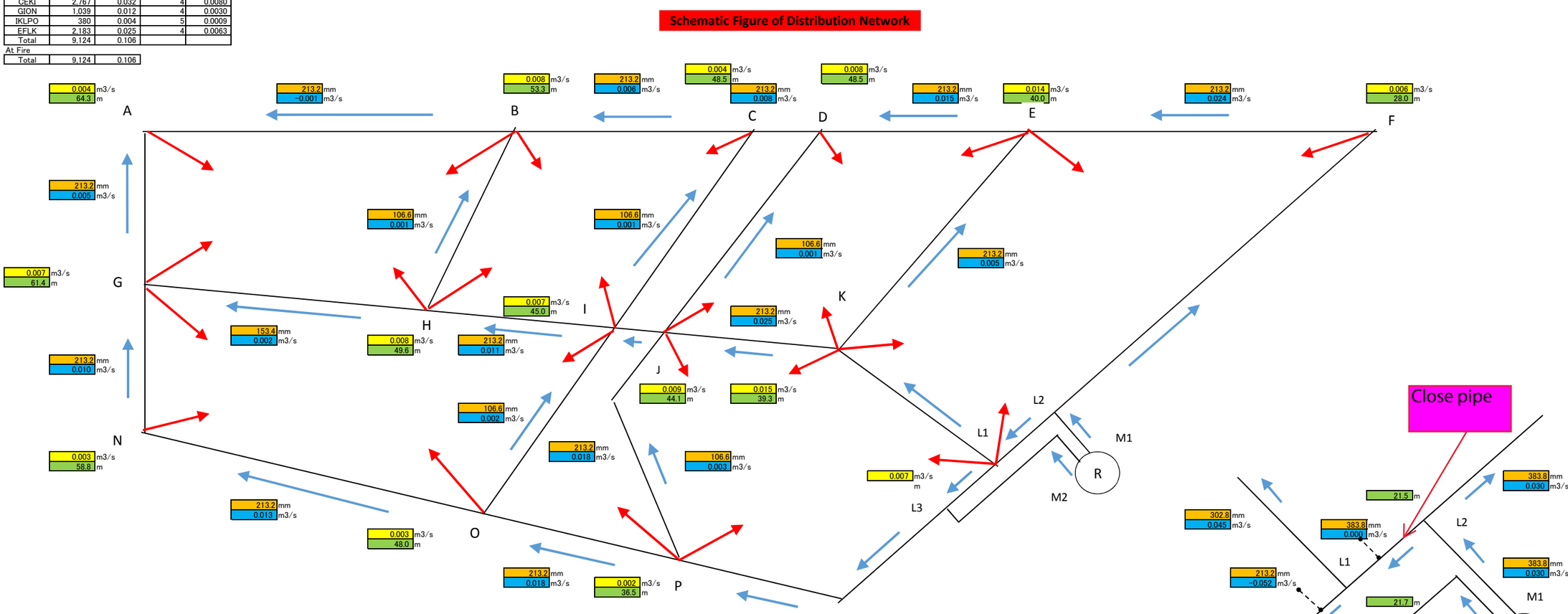
<Condition Studied>

L2-L1 Close、 (M2-L3 Open)

<Calculation Result>

(With M2-L3 opened) pressure at all the connection points is 20mH or more.

Schematic Figure of Distribution Network



Verification of Draft Pipe Network (No. 3)

Attachment 5

Distribution Network Calculation

Pre-Condition

(Including fine prevension water)

No. of Connection	Runoff at Connection	Initial Value of Energy	Elevation	Difference from BPT
	(m3/s)	m	m	m
A	0.0040	25	1783	−48.5
B	0.0080	25	1794	−37.5
C	0.0040	25	1799	−32.5
D	0.0080	25	1799	−32.5
E	0.0143	25	1809	−22.5
F	0.0063	25	1824	−7.5
G	0.0070	25	1786	−45.5
H	0.0080	25	1798	−33.5
I	0.0070	25	1803	−28.5
J	0.0089	25	1804	−27.5
K	0.0152	25	1810	−21.5
L1	0.0072	25	1829	−2.5
L2	0.0000	25	1831	−0.5
L3	0.0000	25	1828	−3.5
M1	0.0000	25	1831.5	0
M2	0.0000	25	1831.5	0
N	0.0030	25	1789	−42.5
O	0.0030	25	1801	−30.5
P	0.0018	25	1814	−17.5

At Fire

No. for Firewater	Flowrate (m3/s)	Decrease ratio(%)
#N/A	0.1	0

Basic Plan

Unit Water Consumption	92	LCD
Daily variation coefficient	1.3	–
Hourly variation coefficient	1.4	–
Allowance(incl.firefighting use)	1	–

Water Consumption at Connection Point (Except for Water of Fire Fighting)

	Water Demand		Number of Water Point	Flowrate at 1 point
Area	m3/day	m3/s	点	m3/s
ACIG	2,756	0.032	8	0.0040
CEKI	2,767	0.032	4	0.0080
GION	1,039	0.012	4	0.0030
IKLPO	380	0.004	5	0.0009
EFLK	2,183	0.025	4	0.0063
Total	9,124	0.106		
At Fire				
Total	9,124	0.106		

No .of Pipe		Diameter	No. of Pipe	Length	Valve
		m	Pipes	m	
1	AB	0.2132	1	1,230	Open
2	BC	0.2132	1	670	Open
3	CD	0.2132	1	60	Open
4	DE	0.2132	1	1,060	Open
5	EF	0.2132	1	940	Open
6	GH	0.1534	1	1,250	Open
7	HI	0.2132	1	400	Open
8	IJ	0.2132	1	80	Open
9	JK	0.2132	1	340	Open
10	KL1	0.3028	1	750	Open
11	L2M1	0.3838	1	10	Open
12	L3M2	0.3838	1	250	Close
13	NO	0.2132	1	1,180	Open
14	OP	0.2132	1	790	Open
15	PL3	0.2132	1	530	Open
16	AG	0.2132	1	540	Open
17	GN	0.2132	1	660	Open
18	BH	0.1066	1	740	Open
19	CI	0.1066	1	1,030	Open
20	IO	0.1066	1	970	Open
21	DJ	0.1066	1	1,030	Open
22	JP	0.1066	1	970	Open
23	EK	0.2132	1	1,420	Open
24	FL2	0.3838	1	1,590	Open
25	L2L1	0.3838	1	150	Close
26	L1L3	0.2132	1	100	Open

Result of Calculation

1.Energy, Water Pressure

No. of Connection	Energy Level	Hydrodynamic Pressure	Hydrostatic Pressure
	m	m	m
A	−39.23	9.27	69.50
B	−38.13	−0.63	58.50
C	−36.15	−3.65	53.50
D	−35.85	−3.35	53.50
E	−25.87	−3.37	43.50
F	16.39	23.89	28.50
G	−39.46	6.04	66.50
H	−39.46	−5.96	54.50
I	−39.38	−10.88	49.50
J	−39.34	−11.84	48.50
K	−38.96	−17.46	42.50
L1	−39.11	−36.61	23.50
L2	20.97	21.47	21.50
L3	−39.13	−35.63	24.50
M1	21.00	21.00	21.00
M2	21.00	21.00	21.00
N	−39.46	3.04	63.50
O	−39.42	−8.92	51.50
P	−39.30	−21.80	38.50

2.Flowrate

No .of Pipe		Flowrate	
		m3/s	m/s
1	AB	0.0119	0.3329
2	BC	0.0226	0.6344
3	CD	0.0304	0.8517
4	DE	0.0423	1.1863
5	EF	0.0985	2.7608
6	GH	0.0001	0.0059
7	HI	0.0053	0.1484
8	IJ	0.0089	0.2500
9	JK	0.0135	0.3782
10	KL1	−0.0132	−0.1829
11	L2M1	0.1052	0.9099
12	L3M2	0.0004	0.0034
13	NO	0.0020	0.0563
14	OP	0.0046	0.1295
15	PL3	0.0067	0.1892
16	AG	−0.0079	−0.2211
17	GN	−0.0010	−0.0282
18	BH	−0.0028	−0.3127
19	CI	−0.0038	−0.4226
20	IO	−0.0004	−0.0447
21	DJ	−0.0039	−0.4417
22	JP	0.0004	0.0423
23	EK	−0.0419	−1.1731
24	FL2	0.1048	0.9065
25	L2L1	0.0004	0.0034
26	L1L3	0.0064	0.1782

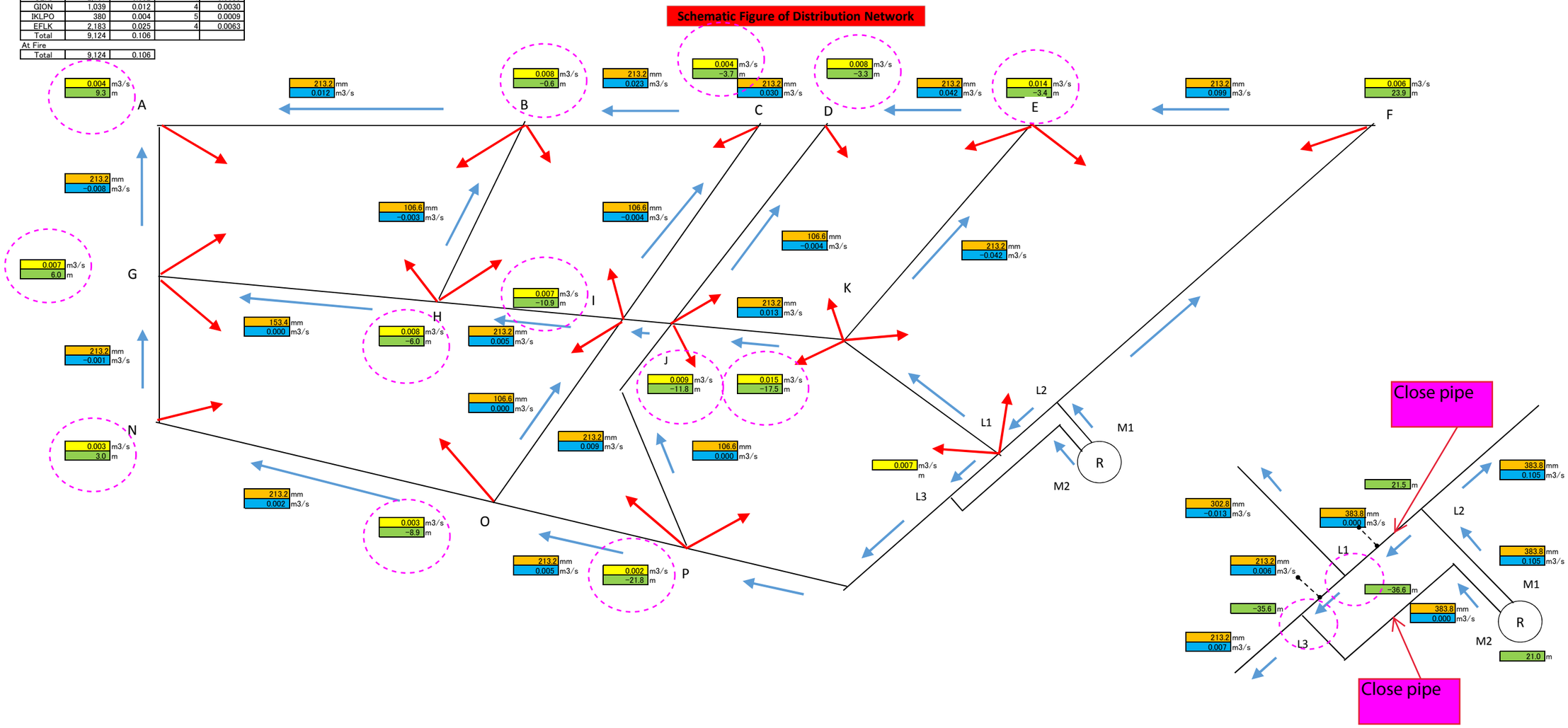
Reference: Pipe Daimeter

DN	I.D.
mm	mm
125	106.6
180	153.4
250	213.2
355	302.8
450	383.8

<Condition Studied>
M2-L3 Close, L2-L1 Close

<Calculation Result>
Pressure at a lot of connection points becomes 20mH or less

Schematic Figure of Distribution Network



Verification of Draft Pipe Network (No. 4)

Attachment 6

Distribution Network Calculation

Pre-Condition

(Including fine prevension water)

No. of Connection	Runoff at Connection	Initial Value of Energy	Elevation	Difference from BPT
	(m3/s)	m	m	m
A	0.0020	25	1783	−48.5
B	0.0040	25	1794	−37.5
C	0.0020	25	1799	−32.5
D	0.0040	25	1799	−32.5
E	0.0072	25	1809	−22.5
F	0.0032	25	1824	−7.5
G	0.0035	25	1786	−45.5
H	0.1040	25	1798	−33.5
I	0.0035	25	1803	−28.5
J	0.0044	25	1804	−27.5
K	0.0076	25	1810	−21.5
L1	0.0036	25	1829	−2.5
L2	0.0000	25	1831	−0.5
L3	0.0000	25	1828	−3.5
M1	0.0000	25	1831.5	0
M2	0.0000	25	1831.5	0
N	0.0015	25	1789	−42.5
O	0.0015	25	1801	−30.5
P	0.0009	25	1814	−17.5

At Fire

No. for Firewater	Flowrate (m3/s)	Decrease ratio(%)
H	0.1	50

Basic Plan

Unit Water Consumption	92	LCD
Daily variation coefficient	1.3	–
Hourly variation coefficient	1.4	–
Allowance(incl.fire fighting use)	1	–

Water Consumption at Connection Point (Except for Water of Fire Fighting)

	Water Demand		Number of Water Point	Flowrate at 1 point
Area	m3/day	m3/s	点	m3/s
ACIG	2,756	0.032	8	0.0040
CEKI	2,767	0.032	4	0.0080
GION	1,039	0.012	4	0.0030
IKLPO	380	0.004	5	0.0009
EFLK	2,183	0.025	4	0.0063
Total	9,124	0.106		

At Fire

Total	4,562	0.053

No .of Pipe		Diameter	No. of Pipe	Length	Valve
		m	Pipes	m	
1	AB	0.2132	1	1,230	Open
2	BC	0.2132	1	670	Open
3	CD	0.2132	1	60	Open
4	DE	0.2132	1	1,060	Open
5	EF	0.2132	1	940	Open
6	GH	0.1534	1	1,250	Open
7	HI	0.2132	1	400	Open
8	IJ	0.2132	1	60	Open
9	JK	0.2132	1	340	Open
10	KL1	0.3028	1	750	Open
11	L2M1	0.3838	1	10	Open
12	L3M2	0.3838	1	250	Open
13	NO	0.2132	1	1,180	Open
14	OP	0.2132	1	790	Open
15	PL3	0.2132	1	530	Open
16	AG	0.2132	1	540	Open
17	GN	0.2132	1	660	Open
18	BH	0.1066	1	740	Open
19	CI	0.1066	1	1,030	Open
20	IO	0.1066	1	970	Open
21	DJ	0.1066	1	1,030	Open
22	JP	0.1066	1	970	Open
23	EK	0.2132	1	1,420	Open
24	FL2	0.3838	1	1,590	Open
25	L2L1	0.3838	1	150	Open
26	L1L3	0.2132	1	100	Open

Result of Calculation

1.Energy, Water Pressure

No. of Connection	Energy Level	Hydrodynamic Pressure	Hydrostatic Pressure
	m	m	m
A	9.16	57.66	69.50
B	9.32	46.82	58.50
C	10.57	43.07	53.50
D	10.75	43.25	53.50
E	15.94	38.44	43.50
F	20.45	27.95	28.50
G	9.14	54.64	66.50
H	-3.42	30.08	54.50
I	7.73	36.23	49.50
J	9.18	36.68	48.50
K	16.48	37.98	42.50
L1	20.75	23.25	23.50
L2	20.97	21.47	21.50
L3	20.84	24.34	24.50
M1	21.00	21.00	21.00
M2	21.00	21.00	21.00
N	10.65	53.15	63.50
O	13.74	44.24	51.50
P	17.24	34.74	38.50

2.Flowrate

No .of Pipe		Flowrate	
		m3/s	m/s
1	AB	0.0042	0.1180
2	BC	0.0177	0.4951
3	CD	0.0232	0.6497
4	DE	0.0297	0.8335
5	EF	0.0294	0.8242
6	GH	−0.0184	−0.9987
7	HI	0.0761	2.1320
8	IJ	0.0706	1.9785
9	JK	0.0661	1.8523
10	KL1	0.0812	1.1280
11	L2M1	0.1057	0.9138
12	L3M2	0.0471	0.4077
13	NO	0.0212	0.5951
14	OP	0.0282	0.7902
15	PL3	0.0355	0.9939
16	AG	−0.0022	−0.0619
17	GN	0.0197	0.5530
18	BH	−0.0095	−1.0620
19	CI	−0.0035	−0.3951
20	IO	0.0055	0.6119
21	DJ	−0.0026	−0.2869
22	JP	0.0064	0.7167
23	EK	0.0075	0.2100
24	FL2	0.0326	0.2816
25	L2L1	0.0731	0.6322
26	L1L3	−0.0117	−0.3276

Reference: Pipe Daimeter

DN	I.D.
mm	mm
125	106.6
180	153.4
250	213.2
355	302.8
450	383.8

<Condition Studied>

Flowrate of connection point H:

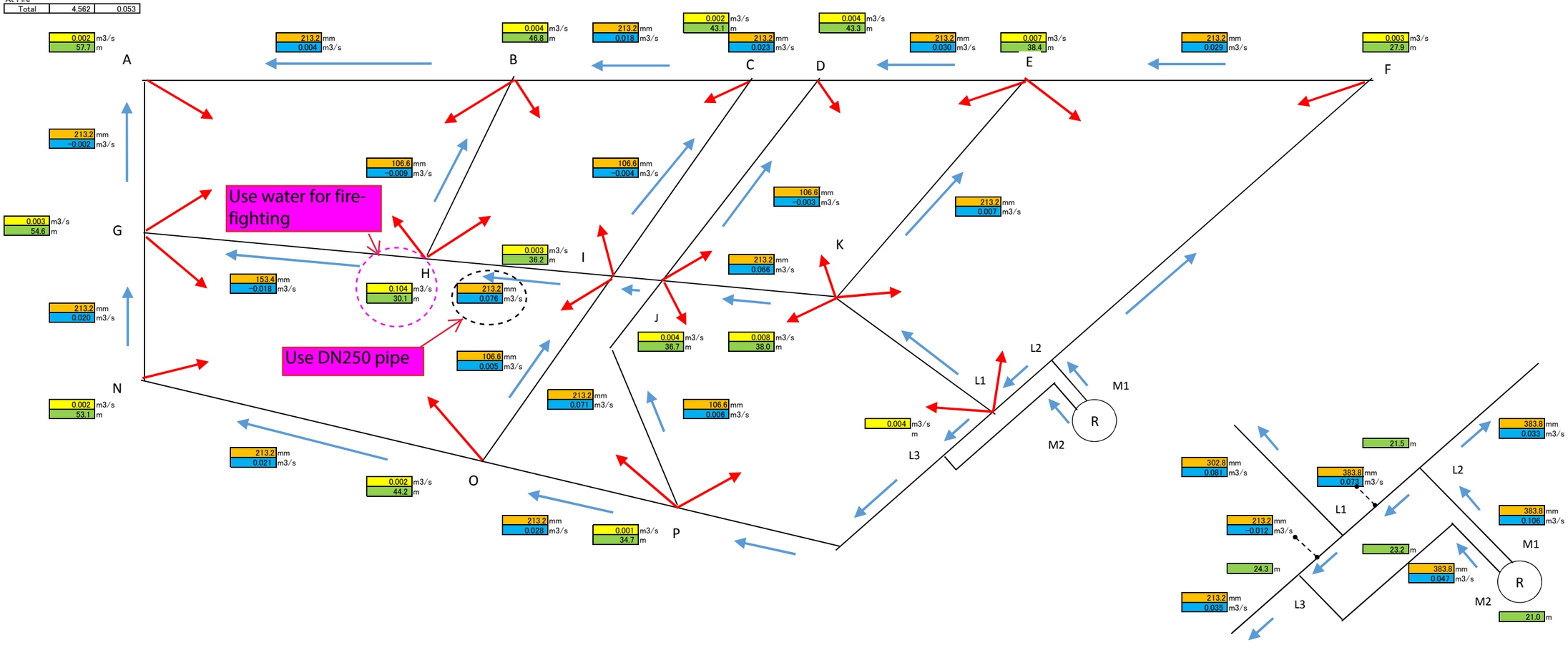
0.1m3/sec+ 50% × design water distribution volume at normal condition

Pipe diameter of H-I : DN 250

<Calculation Result >

Pressure at connection point H, where fire-fighting water is used, is 20mH or more and pressure at the other connection point is positive.

Schematic Figure of Distribution Network



Verification of Draft Pipe Network (No. 5)

Attachment 7

Distribution Network Calculation

Pre-Condition

(Including fire prevension water)

No. of Connection	Runoff at Connection	Initial Value of Energy	Elevation	Difference from BPT
	(m3/s)	m	m	m
A	0.0020	25	1783	−48.5
B	0.0040	25	1794	−37.5
C	0.0020	25	1799	−32.5
D	0.0040	25	1799	−32.5
E	0.0072	25	1809	−22.5
F	0.0032	25	1824	−7.5
G	0.0035	25	1786	−45.5
H	0.1040	25	1798	−33.5
I	0.0035	25	1803	−28.5
J	0.0044	25	1804	−27.5
K	0.0076	25	1810	−21.5
L1	0.0036	25	1829	−2.5
L2	0.0000	25	1831	−0.5
L3	0.0000	25	1828	−3.5
M1	0.0000	25	1831.5	0
M2	0.0000	25	1831.5	0
N	0.0015	25	1789	−42.5
O	0.0015	25	1801	−30.5
P	0.0009	25	1814	−17.5

At Fire

No. for Firewater	Flowrate (m3/s)	Decrease ratio(%)
H	0.1	50

Basic Plan

Unit Water Consumption	92	LCD
Daily variation coefficient	1.3	–
Hourly variation coefficient	1.4	–
Allowance(incl.firefighting use)	1	–

Water Consumption at Connection Point (Except for Water of Fire Fighting)

	Water Demand		Number of Water Point	Flowrate at 1 point
Area	m3/day	m3/s	点	m3/s
ACIG	2,756	0.032	8	0.0040
CEKI	2,767	0.032	4	0.0080
GION	1,039	0.012	4	0.0030
IKLPO	380	0.004	5	0.0009
EFLK	2,183	0.025	4	0.0063
Total	9,124	0.106		
At Fire				
Total	4,562	0.053		

No .of Pipe		Diameter	No. of Pipe	Length	Valve
		m	Pipes	m	
1	AB	0.2132	1	1,230	Open
2	BC	0.2132	1	670	Open
3	CD	0.2132	1	60	Open
4	DE	0.2132	1	1,060	Open
5	EF	0.2132	1	940	Open
6	GH	0.1534	1	1,250	Open
7	HI	0.1534	1	400	Open
8	IJ	0.2132	1	60	Open
9	JK	0.2132	1	340	Open
10	KL1	0.3028	1	750	Open
11	L2M1	0.3838	1	10	Open
12	L3M2	0.3838	1	250	Open
13	NO	0.2132	1	1,180	Open
14	OP	0.2132	1	790	Open
15	PL3	0.2132	1	530	Open
16	AG	0.2132	1	540	Open
17	GN	0.2132	1	660	Open
18	BH	0.1066	1	740	Open
19	CI	0.1066	1	1,030	Open
20	IO	0.1066	1	970	Open
21	DJ	0.1066	1	1,030	Open
22	JP	0.1066	1	970	Open
23	EK	0.2132	1	1,420	Open
24	FL2	0.3838	1	1,590	Open
25	L2L1	0.3838	1	150	Open
26	L1L3	0.2132	1	100	Open

Result of Calculation

1.Energy, Water Pressure

No. of Connection	Energy Level	Hydrodynamic Pressure	Hydrostatic Pressure
	m	m	m
A	5.41	53.91	69.50
B	6.20	43.70	58.50
C	9.38	41.88	53.50
D	9.69	42.19	53.50
E	15.85	38.35	43.50
F	20.44	27.94	28.50
G	5.19	50.69	66.50
H	−25.03	8.47	54.50
I	9.53	38.03	49.50
J	10.60	38.10	48.50
K	16.78	38.28	42.50
L1	20.76	23.26	23.50
L2	20.97	21.47	21.50
L3	20.83	24.33	24.50
M1	21.00	21.00	21.00
M2	21.00	21.00	21.00
N	7.57	50.07	63.50
O	12.31	42.81	51.50
P	16.70	34.20	38.50

2.Flowrate

No .of Pipe		Flowrate	
		m3/s	m/s
1	AB	0.0099	0.2773
2	BC	0.0293	0.8199
3	CD	0.0305	0.8556
4	DE	0.0326	0.9145
5	EF	0.0297	0.8326
6	GH	−0.0296	−1.6047
7	HI	0.0590	3.1927
8	IJ	0.0596	1.6704
9	JK	0.0604	1.6941
10	KL1	0.0781	1.0855
11	L2M1	0.1043	0.9022
12	L3M2	0.0485	0.4193
13	NO	0.0267	0.7495
14	OP	0.0318	0.8924
15	PL3	0.0382	1.0711
16	AG	−0.0079	−0.2215
17	GN	0.0252	0.7074
18	BH	−0.0154	−1.7237
19	CI	0.0007	0.0816
20	IO	0.0036	0.4033
21	DJ	0.0019	0.2135
22	JP	0.0055	0.6168
23	EK	0.0101	0.2826
24	FL2	0.0329	0.2842
25	L2L1	0.0715	0.6180
26	L1L3	−0.0103	−0.2878

Reference: Pipe Daimeter

DN	I.D.
mm	mm
125	106.6
180	153.4
250	213.2
355	302.8
450	383.8

<Condition Studied>

Flowrate of connection point H:

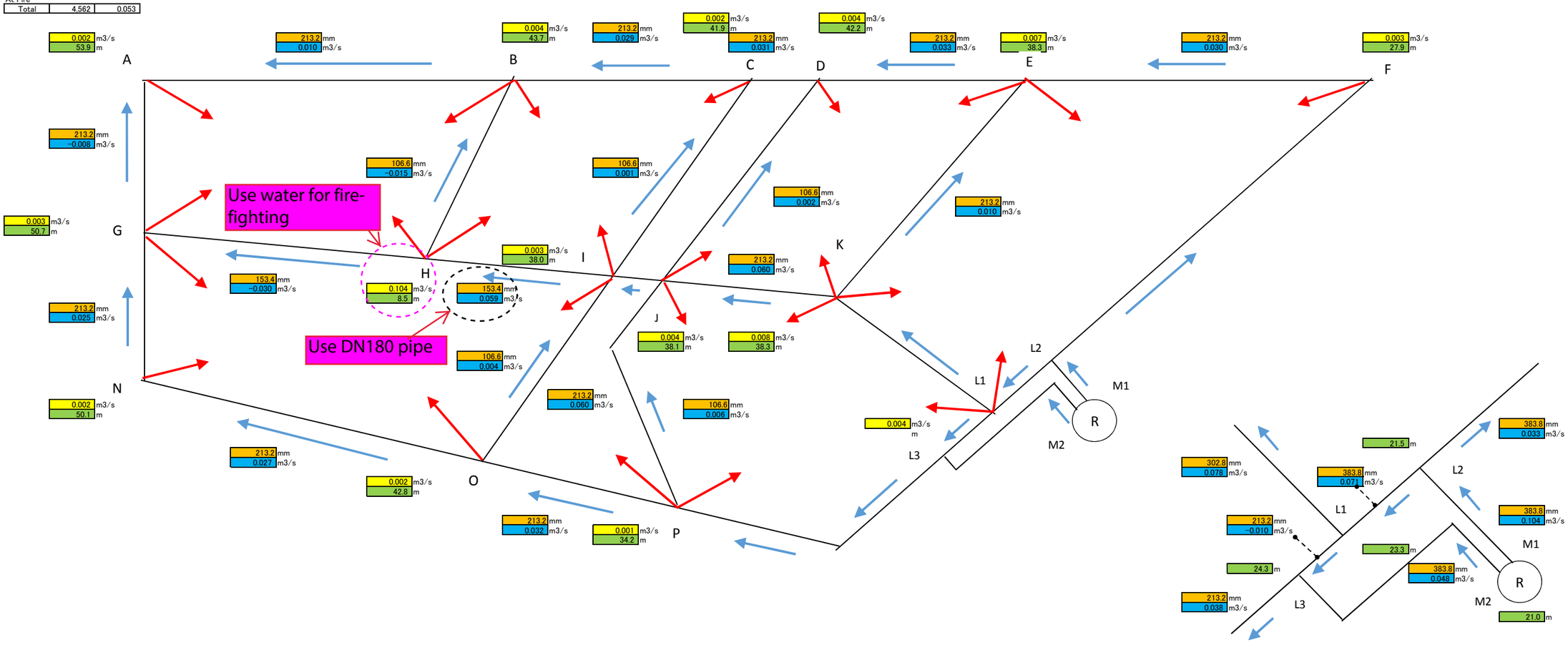
0.1m3/sec+ 50% × design water distribution volume at normal condition

Pipe diameter of H-I : DN 250→DN180

<Calculation Result >

Pressure at connection point H is 20mH or less (8.5mH)

Schematic Figure of Distribution Network



APPENDIX-3

Natural Condition Survey

(1) Result of Soil Investigation Survey

Reno Geotechnical & Construction Material Testing Company
Address: House No.14,6th Street of Khoshal Khan Road,Shama Square,Kabul
Website: www.renolab.co. Email: lab.reno@yahoo.com - info@renolab.co
Phone: 0770909020, 0788909020, 0781102009

Geotechnical Report of

Water Tower at Residential & Commercial

Shahrak Ayaran, Phase 1, Parsil 2.2

Kabul -e- Jaded, Deh Sabz, Kabul/Afghanistan.

Client:	CRIDA
Contractor:	Oxian Aryana Construction Company
Project Location:	Deh Sabz, Kabul/Afghanistan.

1. Site Description

This geotechnical report is about provides geotechnical information that was obtained and compiled from the geotechnical field exploration and laboratory tests completed for a Water Tower at Residential & Commercial Shahrak Ayaran, Phase 1, Parsil 2.2, Deh Sabz /Kabul.
The objective of the project was to characterize subsurface conditions to support the foundation design for signal poles. The geotechnical investigation was carried out in Dec 2017 to provide information on surface and subsurface conditions and to provide soil samples for laboratory tests, and engineering evaluations.
The investigation comprised the excavation of five (02) boreholes (BH#01 & BH#02) by 15m depth below ground surface. All soil samples obtained from borehole sent to RENO main laboratory in Kabul.

1.1. Site Location

The Water Tower is located at Residential & Commercial Shahrak Ayaran, Phase 1, Parsil 2.2, Deh Sabz Kabul /Afghanistan see figure 1.

Figure

Reno *Geotechnical & Construction Material Testing Company*

Address: House No.14,6th Street of Khushal Khan Road,Shama Square,Kabul
Website: www.renolab.us Email: info.reno@yahoo.com - info@renolab.us
Phone: 0 799979620, 0799999999

LOG OF Bore (1)

(ASTM D- 5434)

Client: CRIDA	Borehole No. (1)	Date: 30-11-2017
Contractor:OACC	Depth: 1m - 15 m	Weather: Sunny
Location:kabul Province, afg.	water table: (35) m	Field Engineer: Nasir Ahmad
Excavation Method:Rotary Drilling Machine		
Sampling method: SS / Field technician		
SPT Hammar: 140-lb/30In-Auto Drop		

Project Name: water Tower of Residential & Commercial Shahrak Ayaran, Phase 1, Parsil 2.2, Shahrak-e-Jadid Kabul

Depth (m)	Graphic Log	Sampling Type	Core Recovery %	Material Description	USCS Classification	Depth of SPT (m)	SPT Blows Per 15 cm			Blow Counts (N-Value)	Description
1			100	Lean Clay	CL	1	7	9	11	20	Very stiff
2			100	Lean Clay	CL	2	10	13	13	26	Very stiff
3			100	Lean Clay	CL	3	7	12	15	27	Very stiff
4			100	Silty Clayey gravel	GC-GM	4	23	Re	Re	0	Very Dense
5			100	Silty Clayey gravel with sand	GC-GM	5	Re	Re	Re	0	Very Dense
6			100	Silty gravel	GM	6	Re	Re	Re	0	Very Dense
7			100	Silty gravel with sand	GM	7	17	Re	Re	0	Very Dense
8			100	Silty gravel with sand	GM	8	18	28	37	65	Very Dense
9			100	Silty gravel with sand	GM	9	24	Re	Re	0	Very Dense
10			100	Silty Sand	SM	10	19	Re	Re	0	Very Dense
11			100	Poorly graded sand with Silt and gravel	SP-SM	11	26	Re	Re	0	Very Dense
12			100	Well graded gravel with sand	GW	12	26	33	Re	0	Very Dense
13			100	Poorly graded sand with Silt and gravel	SP-SM	13	14	Re	Re	0	Very Dense
14			100	Poorly graded sand with Silt and gravel	SP-SM	14	Re	Re	Re	0	Very Dense
15			100	Silty Sand	SM	15	25	31	37	68	Very Dense

Sampling Type: By Hand | Split Spoon (SS) | Corebit

Note:

1- PRIMARY LITHOLOGICAL LOG HAS PREPARED BY FIELD SITE ENGINEER.

2- FIELD LITHOLOGICAL LOG HAS COMPLETED AFTER LAB TEST AND CHECKED BY LAB MANAGER

3- SPT TEST PERFORMED PER ASTM D 1586 IN EVERY 1.0 m ACCORDING TO SOIL TYPES DID NOT TAKE SPLIT SPOON SAMPLES.

Water Table is at (35) meters

Remarks:

LEGENDS

SYMBOLS AND RANGE OF VALUE

Cohesive Soil

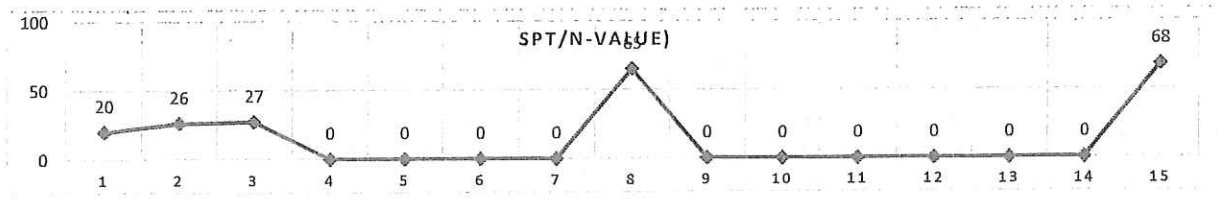
N-Value	Consistencey
0 - 1	Very Soft
2 -- 4	Soft
5 -- 8	Medium Stiff
9 -- 15	Stiff
16 -- 30	Very stiff
31 -- 50	Hard
> 50	Very Hard

Granular Soil

N-VALUE	Density
0 - 4	Very Loose
5 -- 10	Loose
11 --25	Medium Dense
26 -- 50	Dense
> 50	Very Dense

Rock Quality Designation (RQD)

RQD %	Description
< 25	Very Poor
25 - 50	Poor
51 - 75	Fair
76 - 90	Good
> 90	Excellent



Performed By:

Approved By:

Reno *Geotechnical & Construction Material Testing Company*

Address: House No.14,6th Street of Khushal Khan Road,Shams Square,Kabul
Website: www.renolab.co Email: lab.reno@yahoo.com - info@renolab.co
Phone: 0770599029 0785999029

LOG OF Bore (2)

(ASTM D- 5434)

Client: CRIDA | Borehole No. (2) | Date: 30-11-2017 | Excavation Method:Rotary Drilling Machine

Contractor:OACC | Depth: 1m - 15 m | Weather: Sunny | Sampling method: SS / Field technician

Location:kabul Province, afg. | water table: (35) m | Field Engineer: Nasir Ahmad | SPT Hammar: 140-lb/30in-Auto Drop

Project Name: water Tower of Residential & Commercial Shahrak Ayaran, Phase 1, Parsil 2.2, Shahrak-e-Jadid Kabul

Depth (m)	Graphic Log	Sampling Type	Core Recovery %	Material Description	USCS Classification	Depth of SPT (m)	SPT Blows Per 15 cm			Blow Counts (N-Value)	Description
1			100	Lean Clay	CL	1	5	8	11	19	Very stiff
2			100	Lean Clay	CL	2	5	10	11	21	Very stiff
3			100	Lean Clay with Sand	CL	3	8	17	11	28	Very stiff
4			100	Clayey gravel with sand	GC	4	14	Re	Re	0	Very Dense
5			100	Gravely Silt	ML	5	12	39	32	71	Very Dense
6			100	Silty gravel with sand	GM	6	22	Re	Re	0	Very Dense
7			100	Silty gravel with sand	GM	7	Re	Re	Re	0	Very Dense
8			100	Silyt gravel with sand	GM	8	Re	Re	Re	0	Very Dense
9			100	Silyt gravel with sand	GM	9	18	Re	Re	0	Very Dense
10			100	Silty sand with gravel	SM	10	19	27	41	68	Very Dense
11			100	Poorly graded gravel with silt and Sand	GP-GM	11	Re	Re	Re	0	Very Dense
12			100	Poorly graded Sand with silt and Gravel	SP-SM	12	20	Re	Re	0	Very Dense
13			100	Well graded gravel with silt and gravel	SW-SM	13	14	Re	Re	0	Very Dense
14			100	Poorly graded Sand with silt and gravel	SP-SM	14	12	17	Re	0	Very Dense
15			100	Silty sand with gravel	SM	15	Re	Re	Re	0	Very Dense

Sampling Type: By Hand | Split Spoon (SS) | Corebit

Note:

1- PRIMARY LITHOLOGICAL LOG HAS PREPARED BY FIELD SITE ENGINEER.

2- FIELD LITHOLOGICAL LOG HAS COMPLETED AFTER LAB TEST AND CHECKED BY LAB MANAGER

3- SPT TEST PERFORMED PER ASTM D 1586 IN EVERY 1.0 m ACCORDING TO SOIL TYPES DID NOT TAKE SPLIT SPOON SAMPLES.

Water Table is at (35) meters

Remarks:

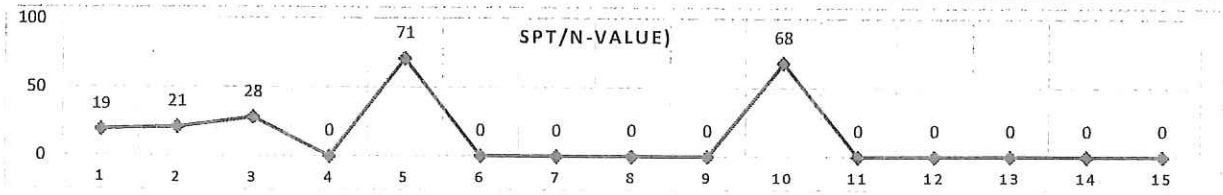
LEGENDS

SYMBOLS AND RANGE OF VALUE

Cohesive Soil	
N-Value	Consistencey
0 - 1	Very Soft
2 -- 4	Soft
5 -- 8	Medium Stiff
9 -- 15	Stiff
16 -- 30	Very stiff
31 -- 50	Hard
> 50	Very Hard

Granular Soil	
N-VALUE	Density
0 - 4	Very Loose
5 -- 10	Loose
11 --25	Medium Dense
26 -- 50	Dense
> 50	Very Dense

Rock Quality Designation (RQD)	
RQD %	Description
< 25	Very Poor
25 - 50	Poor
51 - 75	Fair
76 - 90	Good
> 90	Excellent



Performed By:

Approved By:

APPENDIX-3

Natural Condition Survey

(2) Result of Pumping Test

CRIDA
د پلازمېنې زون د پراختیا خپلواکه اداره | اداره مستقل انکشاف زون پایتخت
CAPITAL REGION INDEPENDENT DEVELOPMENT AUTHORITY

Technical Report

Kabul	12/3/2017
Place	Date

Subject/Title

Pol-e-Charkhi Well Pump Test, Results Report

ISD +93 (0) 777287534

Author(s), E-mail	Department/Division	Tel.	Signature
Sayed Waliullah Aqili	sayedwaliullah.aqili@crida.gov.af		
Fazli Rahim Shinwari	fazli.rahim@crida.gov.af		

Signature for Release by Division/Dept. Head (for Contents, Handling, Distribution)

Signature for External Release General Director

Project

Implementation Project of Capital Region

Handling Instructions

Non Confidential

Export Classification*)

Eng. Farhad Jalal Zai
Acting Director of CRIDA

President Approval (if needed)

Project Code	Location	Program/Type/Project/Division/Sub Division	Document/Sub Document/Reference/Revision
AFG/KBL/Gen	KBL	Pg-1/ST/Pr-1/ISD/Sub Div	TR/ICR /(CRIDA/ ISD / 2017 /2931)/xxx

Pages of Text: 3 Appendices: 1

Summary*)

This report contained the Pol-e-Charkhi pump test result which had been requested by JICA for reconsideration of The Project for Development of Water Supply Facilities in Dehsabz Southern Area. The pump test conducted by CRIDA through private company. The pump test performed in four consecutive days in four steps from 11th Nov 2017 to 15th Nov 2017 (Preparatory pumping test and removal of sediment, step drawdown test, constant discharge test and recover test). The result has shown, the well capacity is 32li/sec with approximately 1m drawdown which the well discharge is more than JICA water team expectation.

The details of pump test result are attached with this report.

REVIEWED
۱۳۹۶/۹/۱۲
Deputy CEO-Technical

*) In Technical Reports add key words (max. 12) at the end of the Summary and enter Export Classification

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ISP							
IS							

REVIEWED

JICA Specification for Pumping Test for Water Resources

The pumping test shall be implemented to analyze capacity of the existing one (1) test well in Pol-e Charkhi Area and hydraulic parameter of aquifer. Items of Component are as follows:

a) Preparatory pumping test and removal of sediments: Preparatory pumping test shall be implemented to know the maximum yield of the boreholes after removal of sediment and muddy groundwater from the boreholes.

b) Step drawdown test: Step draw-down test shall be implemented to analyze critical yield and safe yield of boreholes. Drawdown of groundwater level of borehole shall be measured while pumping rate is increased in 5 steps. This pumping test shall take 1 day per 1 borehole.

c) Constant discharge test: In the constant discharge test, drawdown of groundwater level of borehole shall be measured with constant pumping rate. The constant yield for the test shall be obtained from the result of step drawdown test. Hydraulic parameters of aquifer (transmissivity and coefficient of permeability) shall be analyzed based on the result of the constant discharge test. This test shall take 2 days together with recovery test.

d) Recovery test: Recovery test shall start immediately after pumping of the constant discharge test is finished. Recovery of groundwater level of the borehole shall be measured with time. Hydraulic parameters (transmissivity and coefficient of permeability) of aquifer shall be analyzed based on the result of the test.

Conducted Pump test by CRIDA

Based on JICA recommendation, CRIDA contracted pump test with private company to conduct pump test in side as JICA specification as following:

a) Preparatory pumping test and removal of sediments
To clean the well from debris, mud and unwanted materials, compressor test on targeted well was performed for 24 hours until production of clean and soft water. Actually, well discharged clean water before 24 hours however, the test was extended for more validation.

b) Step drawdown test:
The step drawdown test was performed for 24 hours and 23 minutes in four consecutive steps. The average draw down was 1.01 with maximum and minimum values of 1.13 and 0.40 respectively. Regarding water level, the static.water level was 12.97 m and average dynamic water level was 13.95 m.cm with maximum and minimum values of 14.10 m.cm and 13.37 m.cm correspondingly.
On the other hand, discharge rate was very different in each step. 15, 22.5, 30 and 32 liter/sec for each step respectively.

c) Constant discharge test:
Constant discharge test is conducted for two days with 32li/sec which the drawdown was 1.13m. The discharge of well with 32 li/sec dynamic water level was stable. There is sufficient water potential for Dehsabz south development.

d) Recovery test:
Recovery test is conducted for step drawdown test and constant discharge test. The water level after pump stopping recover about 30 minutes every stage. During recovery stage average dynamic water level was 12.98 m with 14.10 12.97 static water level. However, average recovery water level was 0.015 m with 14.10 m water level at the end of the pumping test.

شرکت ساختمانی، آبرسانی و حفر چاه های عمیق

محمد عیسی سردارزاده

تاریخ :

به اداره مستقل انکشاف زون پایتخت

محترما!

شرکت ساختمانی، آبرسانی و حفرچاه های عمیق محمدعیسی سردارزاده مطابق قرارداد شماره (NPA/PPD/PO/01 شماره خریداری 95) میان شرکت محمدعیسی سردارزاده و اداره مستقل زون پایتخت یک حلقه چاه آب آشامیدنی را که واقع پلچرخی میباشد پاک کاری و پمپ تست نموده و چاه متذکره در قدم اول به مدت 24 ساعت پاک کاری و به مدت 72 ساعت پمپ تست در مراحل مختلف اجرا نموده که قرار ذیل است:

1. **پاک کاری چاه توسط کمپریسور**
2. **به شکل استخراج مرحله یی**
   - o 15liter/sec
   - o 22.5liter/sec
   - o 30liter/sec
   - o 32liter/sec
   - o ریکوری
3. **به شکل استخراج ثابت**
   - o 32liter/sec
4. **ریکوری**

البته تاریخ شروع کار 11/11/2017 و تاریخ ختم آن 15/11/2017 که چاه متذکره به مقدار 32 لیتر در یک ثانیه آب دارا میباشد و راپور کاراجرا شده ضمیمه مکتوب هذا میباشد.

شماره وارده (2162)
مدیریت آرشیف
تاریخ 96/9/15

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شرکت محمد عیسی سردارزاده

ساختمانی، آبرسانی و حفرچاه های عمیق

Mohammad Eisa Sardar Zada Co.Ltd

Construction, water supply & well drilling

Compressor test & Pump test report

- project location: pol-e-charkhi
- constant pump test for: 32 liter/second
- well depth: 40 meter
- well casing type: Black steel
- well casing dia meter: 10 inch
- result: successfull

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MES Company

Construction, Water supply & Well drilling

Date: 11/11/2017

Compressor test report

We have developed and compressor tested the water well for preparation of pumping test to remove sediment and muddy ground water of the well. test has been used for preparation of the following step drawdown and pumping test. To remove sediment of the bottom, walls of borehole and has been washed the well for 24 hours there was no need to develop the well for the extra time as the well has been producing clear and clean water for usage.

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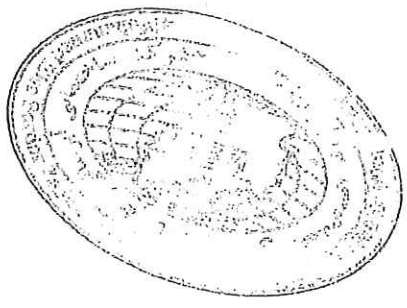
Pumping test result

- Step drawdown pump test
- Constant pump test
- Recovery report



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Step drawdown pump test Report

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MES Company

Construction, Water supply & Well drilling

Date:

Step drawdown test

Location: Pol-e-Charkhi
Well Depth: 40 meter
Casing Type: Black steel casing
Casing Diameter: 10 inch

Pump Test Hour: 24:35
Started Time: 09:00 AM – 12/11/2017
Ended Time: 09:35 AM – 13/11/2017
Result: successfully

Data	Time Observation		Water level(m)	Dynamic level (m.cm)	Draw Down	Q Lit/sec	Comment
	Hour	Min:Se	Static(m)				
	Step - 1						
	09	00:00	12.97				
	09	01:00		13.37	0.40	15	
	09	02:00		13.40	0.43	15	
	09	03:00		13.43	0.46	15	
	09	04:00		13.45	0.48	15	
	09	05:00		13.47	0.50	15	
	09	06:00		13.49	0.52	15	
	09	07:00		13.52	0.55	15	
	09	08:00		13.54	0.57	15	
	09	09:00		13.57	0.60	15	
	09	10:00		13.59	0.62	15	
	09	11:00		13.60	0.63	15	
	09	12:00		13.61	0.64	15	
	09	13:00		13.62	0.65	15	
	09	14:00		13.62	0.65	15	
	09	15:00		13.63	0.66	15	
	09	16:00		13.63	0.66	15	
	09	17:00		13.64	0.67	15	
	09	18:00		13.64	0.67	15	
	09	19:00		13.65	0.68	15	
	09	**20:00**		13.65	0.68	15	
	09	22:00		13.65	0.68	15	
	09	24:00		13.66	0.69	15	
	09	26:00		13.67	0.70	15	
	09	28:00		13.67	0.70	15	
	09	30:00		13.68	0.71	15	
	09	32:00		13.68	0.71	15	
	09	34:00		13.68	0.71	15	
	09	36:00		13.68	0.71	15	
	09	38:00		13.69	0.72	15	
	09	40:00		13.69	0.72	15	
	09	42:00		13.69	0.72	15	

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Data	Time Observation		Water level(m) Static(m)	Dynamic level (m.cm)	Draw Down	Q Lit/sec	Comment
	Hour	Min:Se					
	09	44:00		13.70	0.73	15	
	09	46:00		13.71	0.74	15	
	09	48:00		13.72	0.75	15	
	09	50:00		13.72	0.75	15	
	09	52:00		13.72	0.75	15	
	09	54:00		13.73	0.76	15	
	09	56:00		13.73	0.76	15	
	09	58:00		13.73	0.76	15	
	10	**00:00**		13.73	0.76	15	
	10	05:00		13.73	0.76	15	
	10	10:00		13.74	0.77	15	
	10	15:00		13.74	0.77	15	
	10	20:00		13.74	0.77	15	
	10	25:00		13.74	0.77	15	
	10	30:00		13.75	0.78	15	
	10	35:00		13.76	0.79	15	
	10	40:00		13.77	0.80	15	
	10	45:00		13.77	0.80	15	
	10	50:00		13.77	0.80	15	
	10	55:00		13.77	0.80	15	
	11	**00:00**		13.77	0.80	15	
	11	20:00		13.78	0.81	15	
	11	40:00		13.78	0.81	15	
	12	**00:00**		13.78	0.81	15	
	12	30:00		13.79	0.82	15	
	01	00:00		13.79	0.82	15	
	01	30:00		13.79	0.82	15	
	02	00:00		13.79	0.82	15	
	02	30:00		13.79	0.82	15	
	02	47:00		13.79	0.82	15	
	Step – 2						
	02	47:00	12.97	13.79	0.82	22.5	
	02	48:00		13.80	0.83	22.5	
	02	49:00		13.83	0.86	22.5	
	02	50:00		13.85	0.88	22.5	
	02	51:00		13.85	0.88	22.5	
	02	52:00		13.85	0.88	22.5	
	02	53:00		13.85	0.88	22.5	
	02	54:00		13.85	0.88	22.5	
	02	55:00		13.85	0.88	22.5	

Data	Time Observation		Water level(m) Static(m)	Dynamic level (m.cm)	Draw Down	Q Lit/sec	Comment
	Hour	Min:Se					
	02	56:00		13.86	0.89	22.5	
	02	57:00		13.86	0.89	22.5	
	02	58:00		13.86	0.89	22.5	
	02	59:00		13.86	0.89	22.5	
	02	00:00		13.86	0.89	22.5	
	03	01:00		13.87	0.90	22.5	
	03	02:00		13.87	0.90	22.5	
	03	03:00		13.87	0.90	22.5	
	03	04:00		13.87	0.90	22.5	
	03	05:00		13.88	0.91	22.5	
	03	06:00		13.88	0.91	22.5	
	03	07:00		13.88	0.91	22.5	
	03	08:00		13.88	0.91	22.5	
	03	09:00		13.88	0.91	22.5	
	03	**10:00**		13.88	0.91	22.5	
	03	12:00		13.88	0.91	22.5	
	03	14:00		13.88	0.91	22.5	
	03	16:00		13.89	0.92	22.5	
	03	18:00		13.89	0.92	22.5	
	03	20:00		13.89	0.92	22.5	
	03	22:00		13.89	0.92	22.5	
	03	24:00		13.89	0.92	22.5	
	03	26:00		13.90	0.93	22.5	
	03	28:00		13.90	0.93	22.5	
	03	**30:00**		13.90	0.93	22.5	
	03	35:00		13.90	0.93	22.5	
	03	40:00		13.90	0.93	22.5	
	03	45:00		13.90	0.93	22.5	
	03	50:00		13.91	0.94	22.5	
	03	55:00		13.91	0.94	22.5	
	04	**00:00**		13.91	0.94	22.5	
	04	10:00		13.92	0.95	22.5	
	04	20:00		13.93	0.96	22.5	
	04	30:00		13.94	0.97	22.5	
	04	40:00		13.94	0.97	22.5	
	04	50:00		13.94	0.97	22.5	
	05	**00:00**		13.94	0.97	22.5	
	05	20:00		13.95	0.98	22.5	
	05	40:00		13.95	0.98	22.5	
	06	**00:00**		13.96	0.99	22.5	

Data	Time Observation		Water level(m) Static(m)	Dynamic level (m.cm)	Draw Down	Q Lit/sec	Comment
	Hour	Min:Se					
	06	30:00		13.96	0.99	22.5	
	07	00:00		13.96	0.99	22.5	
	07	30:00		13.96	0.99	22.5	
	08	**00:00**		13.96	0.99	22.5	
	09	00:00		13.96	0.99	22.5	
	Step – 3						
	09	00:00	12.97	13.96	0.99	30	
	09	01:00		13.97	1.00	30	
	09	02:00		13.97	1.00	30	
	09	03:00		13.98	1.01	30	
	09	04:00		13.98	1.01	30	
	09	05:00		13.98	1.01	30	
	09	06:00		13.98	1.01	30	
	09	07:00		13.98	1.01	30	
	09	08:00		13.98	1.01	30	
	09	09:00		13.98	1.01	30	
	09	10:00		13.98	1.01	30	
	09	11:00		13.98	1.01	30	
	09	12:00		13.98	1.01	30	
	09	13:00		13.99	1.02	30	
	09	14:00		13.99	1.02	30	
	09	15:00		13.99	1.02	30	
	09	16:00		13.99	1.02	30	
	09	17:00		13.99	1.02	30	
	09	18:00		13.99	1.02	30	
	09	19:00		13.99	1.02	30	
	09	**20:00**		13.99	1.02	30	
	09	22:00		13.99	1.02	30	
	09	24:00		13.99	1.02	30	
	09	26:00		13.99	1.02	30	
	09	28:00		13.99	1.02	30	
	09	30:00		13.99	1.02	30	
	09	32:00		13.99	1.02	30	
	09	34:00		13.99	1.02	30	
	09	36:00		13.99	1.02	30	
	09	38:00		13.99	1.02	30	
	09	40:00		13.99	1.02	30	
	09	42:00		13.99	1.02	30	
	09	44:00		13.99	1.02	30	
	09	46:00		14.01	1.04	30	

Data	Time Observation		Water level(m) Static(m)	Dynamic level (m.cm)	Draw Down	Q Lit/sec	Comment
	Hour	Min:Se					
	09	48:00		14.01	1.04	30	
	09	50:00		14.01	1.04	30	
	09	52:00		14.01	1.04	30	
	09	54:00		14.01	1.04	30	
	09	56:00		14.01	1.04	30	
	09	58:00		14.01	1.04	30	
	10	**00:00**		14.01	1.04	30	
	10	05:00		14.01	1.04	30	
	10	10:00		14.01	1.04	30	
	10	15:00		14.01	1.04	30	
	10	20:00		14.01	1.04	30	
	10	25:00		14.01	1.04	30	
	10	30:00		14.01	1.04	30	
	10	35:00		14.01	1.04	30	
	10	40:00		14.01	1.04	30	
	10	45:00		14.01	1.04	30	
	10	50:00		14.01	1.04	30	
	10	55:00		14.01	1.04	30	
	11	**00:00**		14.01	1.04	30	
	11	20:00		14.01	1.04	30	
	11	40:00		14.01	1.04	30	
	12	**00:00**		14.01	1.04	30	
	12	30:00		14.02	1.05	30	
	01	00:00		14.02	1.05	30	
	01	30:00		14.02	1.05	30	
	02	00:00		14.02	1.05	30	
	02	30:00		14.02	1.05	30	
	03	**00:00**		14.02	1.05	30	
	Step – 4						
	03	00:00	12.97	14.02	1.05	32	
	03	01:00		14.05	1.08	32	
	03	02:00		14.05	1.08	32	
	03	03:00		14.05	1.08	32	
	03	04:00		14.05	1.08	32	
	03	05:00		14.05	1.08	32	
	03	06:00		14.05	1.08	32	
	03	07:00		14.05	1.08	32	
	03	08:00		14.05	1.08	32	
	03	09:00		14.05	1.08	32	
	03	10:00		14.05	1.08	32	

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Data	Time Observation		Water level(m) Static(m)	Dynamic level (m.cm)	Draw Down	Q Lit/sec	Comment
	Hour	Min:Se					
	03	11:00		14.05	1.08	32	
	03	12:00		14.05	1.08	32	
	03	13:00		14.06	1.09	32	
	03	14:00		14.06	1.09	32	
	03	15:00		14.06	1.09	32	
	03	16:00		14.06	1.09	32	
	03	17:00		14.06	1.09	32	
	03	18:00		14.06	1.09	32	
	03	19:00		14.06	1.09	32	
	03	**20:00**		14.06	1.09	32	
	03	22:00		14.06	1.09	32	
	03	24:00		14.06	1.09	32	
	03	26:00		14.06	1.09	32	
	03	28:00		14.06	1.09	32	
	03	30:00		14.06	1.09	32	
	03	32:00		14.06	1.09	32	
	03	34:00		14.06	1.09	32	
	03	36:00		14.06	1.09	32	
	03	38:00		14.06	1.09	32	
	03	40:00		14.07	1.10	32	
	03	42:00		14.07	1.10	32	
	03	44:00		14.07	1.10	32	
	03	46:00		14.07	1.10	32	
	03	48:00		14.07	1.10	32	
	03	50:00		14.07	1.10	32	
	03	52:00		14.07	1.10	32	
	03	54:00		14.07	1.10	32	
	03	56:00		14.07	1.10	32	
	03	58:00		14.07	1.10	32	
	04	**00:00**		14.07	1.10	32	
	04	05:00		14.07	1.10	32	
	04	10:00		14.07	1.10	32	
	04	15:00		14.07	1.10	32	
	04	20:00		14.08	1.11	32	
	04	25:00		14.08	1.11	32	
	04	30:00		14.08	1.11	32	
	04	35:00		14.08	1.11	32	
	04	40:00		14.08	1.11	32	
	04	45:00		14.08	1.11	32	
	04	50:00		14.09	1.12	32	

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Data	Time Observation		Water level(m) Static(m)	Dynamic level (m.cm)	Draw Down	Q Lit/sec	Comment
	Hour	Min:Se					
	04	55:00		14.09	1.12	32	
	05	**00:00**		14.09	1.12	32	
	05	20:00		14.09	1.12	32	
	05	40:00		14.09	1.12	32	
	06	**00:00**		14.09	1.12	32	
	06	30:00		14.09	1.12	32	
	07	00:00		14.09	1.12	32	
	07	30:00		14.10	1.13	32	
	08	00:00		14.10	1.13	32	
	08	30:00		14.10	1.13	32	
	09	**00:00**		14.10	1.13	32	

Recovery report

Recovery of the well

Data	Time Observation		Water level at the end of pumping test	Dynamic level (m)	Static water level of the well	Recovery of water level(m)	Comment
	Hour	Minute					
	09	00	14.10		12.97		
	09	01		12.99		0.02	
	09	02		12.99		0.02	
	09	03		12.98		0.01	
	09	04		12.98		0.01	
	09	05		12.98		0.01	
	09	06		12.98		0.01	
	09	07		12.98		0.01	
	09	08		12.98		0.01	
	09	09		12.98		0.01	
	09	10		12.98		0.01	
	09	12		12.98		0.01	
	09	14		12.98		0.01	
	09	16		12.97		0.00	
	09	18		12.97		0.00	
	09	20		12.97		0.00	
	09	25		12.97		0.00	
	09	30		12.97		0.00	
	09	35		12.97		0.00	

Constant pump test report

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Date:

Constant pump test

Location: Pol-e-Charkhi
Well Depth: 40 meter
Casing Type: Black steel casing
Casing Diameter: 10 inch

Pump Test Hour: 48:30
Started Time: 09:40 AM – 13/11/2017
Ended Time: 10:10 AM – 15/11/2017
Result: successfully

Data	Time Observation		Water level(m) Static(m)	Dynamic level (m.cm)	Draw Down	Q Lit/sec	Comment
	Hour	Min:Se					
	09	40:00	12.97				
	09	41:00		13.90	0.93	32	
	09	42:00		13.91	0.94	32	
	09	43:00		13.92	0.95	32	
	09	44:00		13.92	0.95	32	
	09	45:00		13.92	0.95	32	
	09	46:00		13.93	0.96	32	
	09	47:00		13.93	0.96	32	
	09	48:00		13.94	0.97	32	
	09	49:00		13.94	0.97	32	
	09	50:00		13.94	0.97	32	
	09	51:00		13.95	0.98	32	
	09	52:00		13.95	0.98	32	
	09	53:00		13.95	0.98	32	
	09	54:00		13.96	0.99	32	
	09	55:00		13.96	0.99	32	
	09	56:00		13.96	0.99	32	
	09	57:00		13.96	0.99	32	
	09	58:00		13.97	1.00	32	
	09	59:00		13.97	1.00	32	
	10	**00:00**		13.97	1.00	32	
	10	01:00		13.97	1.00	32	
	10	02:00		13.97	1.00	32	
	10	03:00		13.97	1.00	32	
	10	04:00		13.98	1.01	32	
	10	05:00		13.98	1.01	32	
	10	06:00		13.98	1.01	32	
	10	07:00		13.98	1.01	32	
	10	08:00		13.98	1.01	32	
	10	09:00		13.98	1.01	32	
	10	10:00		13.98	1.01	32	
	10	12:00		13.98	1.01	32	
	10	14:00		13.99	1.02	32	

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MES Company

Construction, Water supply & Well drilling

Data	Time Observation		Water level(m) Static(m)	Dynamic level (m.cm)	Draw Down	Q Lit/sec	Comment
	Hour	Min:Se					
	10	16:00		13.99	1.02	32	
	10	18:00		13.99	1.02	32	
	10	20:00		13.99	1.02	32	
	10	22:00		13.99	1.02	32	
	10	24:00		13.99	1.02	32	
	10	26:00		13.99	1.02	32	
	10	28:00		13.99	1.02	32	
	10	30:00		13.99	1.02	32	
	10	32:00		14.00	1.03	32	
	10	34:00		14.00	1.03	32	
	10	36:00		14.00	1.03	32	
	10	38:00		14.00	1.03	32	
	10	40:00		14.00	1.03	32	
	10	45:00		14.00	1.03	32	
	10	50:00		14.01	1.04	32	
	10	55:00		14.01	1.04	32	
	11	00:00		14.01	1.04	32	
	11	05:00		14.01	1.04	32	
	11	10:00		14.01	1.04	32	
	11	15:00		14.01	1.04	32	
	11	**20:00**		14.02	1.05	32	
	11	25:00		14.02	1.05	32	
	11	30:00		14.02	1.05	32	
	11	35:00		14.02	1.05	32	
	11	40:00		14.02	1.05	32	
	11	50:00		14.02	1.05	32	
	12	00:00		14.02	1.05	32	
	12	10:00		14.03	1.06	32	
	12	20:00		14.03	1.06	32	
	12	30:00		14.03	1.06	32	
	12	40:00		14.03	1.06	32	
	12	50:00		14.03	1.06	32	
	01	00:00		14.04	1.07	32	
	01	20:00		14.04	1.07	32	
	01	40:00		14.04	1.07	32	
	02	00:00		14.04	1.07	32	
	02	20:00		14.04	1.07	32	
	02	40:00		14.05	1.08	32	
	03	00:00		14.05	1.08	32	
	03	30:00		14.05	1.08	32	

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Data	Time Observation		Water level(m) Static(m)	Dynamic level (m.cm)	Draw Down	Q Lit/sec	Comment
	Hour	Min:Se					
	04	00:00		14.05	1.08	32	
	04	30:00		14.06	1.09	32	
	05	00:00		14.06	1.09	32	
	05	30:00		14.06	1.09	32	
	06	00:00		14.07	1.10	32	
	07	00:00		14.07	1.10	32	
	08	00:00		14.08	1.11	32	
	09	00:00		14.08	1.11	32	
	10	00:00		14.08	1.11	32	
	11	00:00		14.09	1.12	32	
	01	00:00		14.09	1.12	32	
	03	00:00		14.10	1.13	32	
	05	00:00		14.10	1.13	32	
	07	00:00		14.10	1.13	32	
	09	00:00		14.10	1.13	32	
	10	00:00		14.10	1.13	32	
	11	00:00		14.10	1.13	32	
	01	00:00		14.10	1.13	32	
	03	00:00		14.10	1.13	32	
	05	00:00		14.10	1.13	32	
	07	00:00		14.10	1.13	32	
	09	00:00		14.10	1.13	32	
	11	00:00		14.10	1.13	32	
	01	00:00		14.10	1.13	32	
	03	00:00		14.10	1.13	32	
	05	00:00		14.10	1.13	32	
	07	00:00		14.10	1.13	32	
	09	40:00		14.10	1.13	32	

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Recovery report

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Recovery of the well

Data	Time Observation		Water level at the end of pumping test	Dynamic level (m)	Static water level of the well	Recovery of water level(m)	Comment
	Hour	Minute					
	09	40	14.10		12.97		
	09	41		13.00		0.03	
	09	42		12.99		0.02	
	09	43		12.99		0.02	
	09	44		12.99		0.02	
	09	45		12.98		0.01	
	09	46		12.98		0.01	
	09	47		12.98		0.01	
	09	48		12.98		0.01	
	09	49		12.98		0.01	
	09	50		12.98		0.01	
	09	52		12.98		0.01	
	09	54		12.97		0.00	
	09	56		12.97		0.00	
	09	58		12.97		0.00	
	10	00		12.97		0.00	
	10	05		12.97		0.00	
	10	10		12.97		0.00	

Equipment and material list that we used

#	Item	Specification	No	Unit	Note
1	Truck	With 10 Ton crane	1	No	
2	Submersible water pump	15kw, 20 Hp	1	No	Made in Italy SAER Company
3	Riser pipe	Galvanized Pipe for submersible water pump	40	M	
4	Electrical Generator	50 KW	1	No	
5	Air compressor	14 bar	1	No	Capacity 500m^3/day
6	Water level indicator	150 meter	1	No	For measurement of static and dynamic of water
7	Guide pipe for installation water level indicator	1 inch	40	M	PVC pipe
8	Flow meter	Capacity 50 liter/sec	1	No	

DACAAR

WATER QUALITY ANALYSIS REPORT

Project	CRIDA	Source	Tube Well	Analysis n.	440 / 2017
Province	Kabul	District	12 th	Village	Poly Charkhee
Latitude		Longitude		Sample date& time	16.11.2017
				Sampled by:	Client

Physical parameters				WHO recc	ANSA recc	
EC	476	µS/cm		1500	3000	
TDS *	327	mg/l	0.688	1000	2000	* From Conductivity
ORP	180	mV				
Turbidity	2.15	NTU		5	5	< 1 for chlorination
pH	8.2			6.5 - 8	6.5 - 8.5	< 8 for chlorination
°T	18.5	°C		-	-	

Chemical determination — *Spectrophotometer Palintest 8000*

Anions		mg/l	conv	me/l	WHO recc	ANSA recc	Comments
Total Alkalinity	(as $CaCO_3$)	10			-	-	
Alkalinity P	(as $CaCO_3$)	5			-	-	
Alkalinity M	(as $CaCO_3$)	20			-	-	
Bicarbonate	HCO^{3-}	10	0.01639	0.164	-	-	
Carbonate	CO_3^{2-}	10	0.03333	0.333	-	-	
Hydroxide	OH^-	0	0.05880	0.000	-	-	
Chloride	Cl^-	51	0.02820	1.438	250	250	Taste
Sulphate	SO_4^{2-}	40	0.02082	0.833	250	250	Taste
Sulphite (sulphatest)	SO_3^{2-}	4	0.02498	0.100	-	-	
Sulphide		0.01		0.000	-	-	
Fluoride	F^-	0.58	0.05263	0.031	1.5	1.5	Fluorosis
Nitrate	NO_3^-	12.18	0.01613	0.196	50	50	Blue baby syndrom
Nitrite (nitricol)	NO_2^-	0.007	0.02174	0.000	0.2 - 3	3	long - short term exposiure
Phosphate	PO_4^{3-}	0.05	0.03159	0.002	-	-	
Boron	B	0.3	0.02335	0.007	2.4	2.4	Testicular lesions
Bromine	Br^-	0.34	0.01251	0.004	-	-	

Cations		mg/l	conv	me/l	WHO recc	ANSA recc	
Total Hardness	(as $CaCO_3$)	40			300	500	Taste and incrustation
Calcium Hardness	(as $CaCO_3$)	66			-	-	
Sodium	Na^+	15	0.04348	0.653	200	200	Taste
Potassium	K^+	3	0.02558	0.077	-	-	
Calcium	Ca^{2+}	26	0.0499	1.297	-	-	
Chromium	Cr^{6+}	0	0.05768	0.000	0.05	0.05	Cancerogenic
Magnesium	Mg^{2+}	13	0.08224	1.069	-	-	
Ammonia	NH_4^+	0	0.05543	0.000	1.5 - 35		Odour - taste treshold
Manganese	Mn^{2+}	0	0.03641	0.000	0.4		> 0.1 affects taste and stains laundary
Copper	Cu^{2+}	0.34	0.03148	0.011	2	2	Taste
Aluminum	Al^{3+}	0.01	0.1112	0.001	-	0.2	
Total iron	Fe^{2+} and Fe^{3+}	0.01	0.03581	0.000	0.3	0.3	Taste and odour
Arsenic	As^{3+} and As^{5+}	0			0.01	0.05	

Other components		mg/l	WHO recc	ANSA recc	
Silica	SiO_2	7.5	-	-	
Hydrogen Sulphurate	H_2S	0.0106	0.100	-	Taste and odour
Chlorine	CL_2	0	0.2-0.5	0.2-0.5	

Bacteriological Determination

		WHO recc	ANSA recc	
H_2S determination	Y/N	N	-	
Total Coliforms	Col/100 ml	0	-	(Incubation time: 24 hrs @ 37°)
Fecal coliforms (e-Coli)	Col/100 ml	0	0	(Incubation time: 24 hrs @ 44°)

Comments & recommendations — SAR 0.6

According to WHO recommendation and Afghanistan National Drinking Water Quality Standard, in physical parameters, and in chemical determination analysis results, the water is acceptable.

Signature _____

Date 16.11.2017