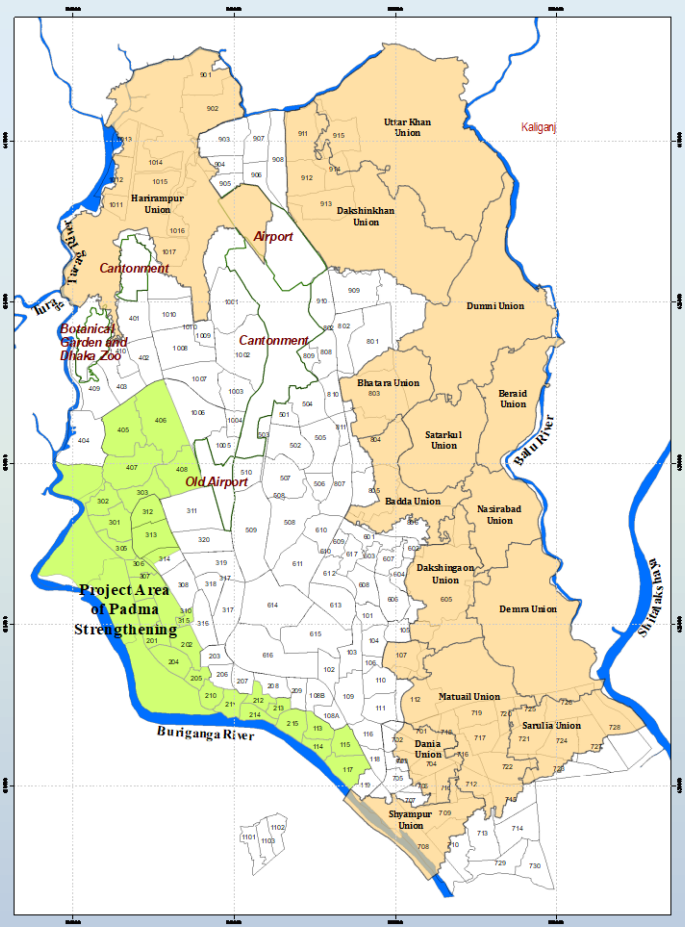




Ministry of Local Government Rural Development and Co-Operatives

Dhaka Water Supply and Sewerage Authority (DWASA)

Feasibility Study for the Expanded Dhaka City Water Supply Resilient Project



December 2022



Institute of Water Modelling

Expanded Dhaka City Water Supply Resilient Project

This project consists of two studies,

Part 1: Padma Strengthening and

Part 2: Newly included 16 Unions water supply study.

Part 1: The Padma strengthening project is necessary to construct for distributing water in the Padma North-West Sector of Dhaka city.

Part 2: The 16 Unions water supply project is mainly to construct water lines and tubewells to supply water to the newly added 16 unions areas of DWASA Jurisdiction of Dhaka city.

Both projects will ensure sustainable and reliable water supply to the existing coverage area and expanded areas of Dhaka city. Under this project, there will be 1495 km of water lines and 71 number of production tube-wells with relevant components. Total duration of the project is 4 years. The cost of both the studies have been updated and the updated combined cost is 277.37 million USD equivalent to 27,792.14 million BDT. The exchange Rate is considered as 1 USD = 100.2 BDT as per 23 Oct, 2022).

Executive Summary

Background

Dhaka Water Supply and Sewerage Authority (DWASA) is the entrusted organization with the responsibility to supply piped potable water to dwellers of Dhaka City and its adjacent areas. DWASA has the vision to adopt more surface water to meet its demand. Due to the resource's constraint, vision of DWASA has been being hampered. However, DWASA and GoB have taken a firm decision to meet major portion of city water demand from surface water source and thereby reduce the dependency on groundwater source to protect the environment as well as to reduce the risk of water supply in the capital. In 2014, Dhaka WASA has prepared a Water Supply Master Plan aiming to develop a sustainable and environment friendly water supply system in its services area.

This report comprises of two studies of expanded Dhaka city. One of the studies is the feasibility study of Padma Strengthening (Part-1) which have been done in the year 2015 and the other one is feasibility study of water supply in the newly added 16 Unions area in Dhaka city (Part-2) in 2018. This report is the combined report of both feasibility studies for the expanded Dhaka city area. The estimated cost of both studies has been updated as per present-day rates and updated accordingly. The total cost of Expanded Dhaka city Water Supply Resilient project is the combination of both studies.

Considering all relevant factors, the master plan recommended to develop sector wise water supply infrastructures depending on the sources of water. Padma North-West Sector comprising a command area of 50.9 sq.km is one the Sectors which includes significant part of old city, Dhanmondi, Mohammadpur, Bosila, Hazaribag, Dhaka Uddyan, part of Mirpur etc where the treated water to be obtained from the 1st Phase of the Padma (Jashaldia) Water Treatment Plant (WTP). The WTP will supply 450 MLD of water. It was identified in the Master Plan that the existing water distribution network in this sector was inadequate to cope 450 MLD water. The first phase of Padma (Jashaldia) is already in operation, but the distribution network is not adequate. Furthermore, existing water supply network under the commanding area of this WTP is aggravating day by day. A feasibility study was done in 2015(Part-1) in this regard. In the feasibility study several lines were proposed in addition to the primary distribution mains to ensure connectivity with surface water injection points of District Metered Areas (DMA) in the command area. The total length of the pipeline is around 40 km with diameter ranging from 400mm to 1800mm. This includes more than 12 km of pipes with diameter 1000mm or higher. This construction will ensure safe, reliable surface water supply to the Padma North-West sector of Dhaka city and reduce dependency on groundwater resources. Again, this will cover the party of MODS Zone 2, 3 and 4 (part: along the Mirpur Road) for supplying water. Therefore, this distribution network will reduce the dependency on SWTP. On the other hand, SWTP can able to supply enough water to MODS Zone 1 (including some portions of 16 Unions i.e; Demra, Matuail), 7 (including some portions of 16 Unions i.e; Dania, Sarulia).

On the other hand, in May 2016, the government decided to incorporate 16 more unions into the two city corporations of Dhaka. The decision was taken at the meeting of the National Implementation Committee for Administrative Reforms (NICAR) held at the Secretariat with Prime Minister Sheikh Hasina in the Chair. The LGRD ministry placed the proposal. Following the NICAR's approval of inclusion of the new union, an

area of 178.75 sq. km has been added to the two city corporations; where 114.58 sq. km has been added into DNCC and 64.17 sq. km has been added into DSCC. DWASA is presently providing water supply to a limited area of these union. As per government decision, DWASA has decided to extend its services to the entire area by implementing District Metered Area (DMA) for improved piped water supply. The project aims to ensure safe, reliable piped water supply to the dwellers of expanded Dhaka city area by ensuring surface water supply to the project areas.

For this reason, DWASA conducted a separate feasibility study (Part -2) in this regard in 2018. From the feasibility study, construction of 71 new production tubewells have been proposed in addition to surface water supply and construction of 1455 km of pipelines using DMA concept to distribute the water conforming with the Water Supply Master Plan and other ADP funded similar projects such as Dhaka Water Supply Sector Development Project (WSSDP), Dhaka Environmentally Sustainable Water Supply Project (DESWSP) and Dhaka Water Supply Network Improvement Project (DWSNIP).

Assessment of Supply Area

The demand and supply In **Part-1** for the Sector estimated in the Water Supply Master Plan study was reassessed. It can be seen that the total demand for the Sector will be in excess of 500 MLD by the year 2020 and will become 697 MLD by 2035. Demand for areas under DMA distribution was reassessed as demand assessment in the Master Plan did not focus on smaller areas. The demand in areas under DMA distribution is estimated to be 479 MLD by 2035. Some areas are located outside the embankment and currently are not within DWASA service. The demand in these areas is expected to become 218 MLD by 2035. In DMA areas 391 MLD will come from Padma SWTP whereas in areas outside embankment 59 MLD will come from Padma SWTP. The additional demand in these areas will be met from ground water.

In continuation with the above Part -1, knowing the existing water supply system is the first requirement to develop sustainable water supply system in newly included 16 unions and other areas of expanded Dhaka City. It will be a baseline for further study about water source selection especially about selection of ground water source. Existing water supply situation in the study area has been observed by conducting a reconnaissance survey. The survey team found that, DWASA has existing water supply coverage in some areas under 16 unions of study. Households which are not connected to DWASA water supply network are depending on private pumps installed in individual houses. People in some areas also have community water supply system. In that case, households get water supply from PTWs installed by local people or NGOs. However, the present water supply system in these areas is not sustainable. As the population in those areas is expected to increase rapidly in future, such individual or community water supply system will not work well. So, development of sustainable water supply system in those areas should be considered with priority.

Water demand in the project area has been calculated keeping compliant with Water Supply Master Plan. Projected population for 2040 has been estimated based on current population and future development plan in respective areas. Per capita water consumption in the study area was found from social survey. However, water demand has been calculated considering per capita domestic demand as 130 lpcd which is same as considered in moderate growth scenario of WSMP for the year 2035.

Around 50% of the study area is considered for District Metering Area (DMA) development for providing water supply. Total 51 nos. DMA have been demarcated considering standard criteria. Out of 51 DMAs, 42 will be full scale DMAs and remaining 9 have been considered as Small-scale DMAs. These 51 DMAs has been considered under the current study and included in 'Short-term plan' which are expected to be implemented by 2025. The areas having moderate to low population settlements with undeveloped road networks are not recommended for DMA implementation at present situation. These areas are termed as 'Medium-term plan'. To ensure proper operation and maintenance of these newly included DMAs, three (3) O&M offices have been proposed in this study.

ANNEX-1

Feasibility Study for Strengthening of the Existing Water Supply Distribution System of Dhaka to Cope with the Production of Padma Water Treatment Plant Project (Phase-1) at Jashaldia

DHAKA WATER SUPPLY AND SEWERAGE AUTHORITY



November 2015



Feasibility and ESIA Study for Strengthening of the Existing Water
Supply Distribution System of Dhaka to Cope with the Production of
Padma Water Treatment Plant Project (Phase-1) at Jashaldia

Final Report



Institute of Water Modelling (IWM)
Mohakhali, Dhaka

Executive Summary

Background

Dhaka WASA has prepared a Water Supply Master Plan for Dhaka City recently to develop a sustainable and environment friendly water supply system in its services area. A major recommendation of the study is to reduce dependency on ground water and shift to surface water sources. Considering all relevant factors, the master planning consultant, IWM also recommended to develop sector wise water supply infrastructures depending on the sources of water. Padma North-West Sector is one the Sectors which includes significant part of old city, Dhanmondi, Mohamdpur etc where the treated water to be obtained from the 1stPhase of the Padma (Jashaldia) Water Treatment Plant (WTP) which is 450 MLD will be supplied. It was also identified by the Master Plan study that the existing water distribution network in this sector is inadequate to cope with 450 MLD water. The construction of Padma WTP (Phase-1) has already been started on EPC/Turnkey basis. It is expected that the project will be completed by mid of 2018. So the importance and urgency for strengthening of the existing water supply network under the command area of this WTP is aggravating day by day. On the other hand, an order has been issued by the government to conduct feasibility study before proposing any development project. So a detail feasibility with a full scale ESIA study is essential to prepare a project for strengthening the existing water supply system of the command area of Padma (Jashaldia) WTP (Phase-1), Padma North-West Sector Distribution System.

Study area

The water from Padma/Jashaldia Phase-1 SWTP will be distributed to the Padma North West Sector according to the Water Supply Master Plan of DWASA. The Sector comprises of 50.9 sq.km area covering most of the area of Hazaribagh, Kamrangir Char and Mohammadpur Thana; parts of Kafrul, Keranigan, Kotwali, Lalbagh, Sutrapur, Dhanmondi, Shyampur and Cantonment Thana areas. For easy understanding, Padma North-West Sector has been subdivided into four subsectors named Subsector-North, Subsector-Old Dhaka, Subsector-Kamrangir Char and Subsector-Keraniganj. Primary Distribution network of water supply of Padma North-west pass through eight different Detail Planning Zones of DMDP (2010). The average land level of this sector is around 6.5 mPWD. The river Buriganga flows through the west side of this sector. The present (2011) average density of population of Padma North-West sector is about 44,000/sq.km which will rise to around 76,000/sq.km in 2035. Total length of road and water supply pipe network is 722 km and 364 km respectively.

General Approach

A technical feasibility study for Padma SWTP Ph-I water distribution system has been done under the Water Supply Master Plan of DWASA. During the technical feasibility several aspects were identified for full scale feasibility study. This included consideration of any new information between project planning and implementation period, environmental and social impact assessment studies, primary data collection in areas where the pipeline will cross major infrastructures etc. Some stakeholder meetings are also held in order get their feedback and to collect relevant information available from them. In general the following tasks have been carried out for the feasibility study

- Data collection and stakeholder consultation
- ESIA and identification of alignment
- Pipe line modeling and design
- Costing and financial viability
- Recommendation – economic, social and environmental

Demand and Supply Assessment of Study Area

The demand and supply for the Sector estimated in the Water Supply Master Plan study was reassessed. It was observed that the total demand for the Sector will be in excess of 500 MLD by the year 2020 and will become 697 MLD by 2035. Demand for areas under DMA distribution was reassessed as demand assessment in the Master Plan was done on a larger scale. Under the current feasibility study demand specific to local areas were also assessed. The demand in areas under DMA distribution is estimated to be 479 MLD by 2035. Some areas are located outside the embankment and DWASA provides very limited service. The demand in these areas is expected to become 218 MLD by 2035. In DMA areas 391 MLD will come from Padma SWTP where as in areas outside embankment 59 MLD will come from Padma SWTP. The additional demand in these areas will be met from ground water.

Alignment of pipeline

A major part of the primary distribution will have to be laid along the embankment located west side of the City. There are several canal outlets located on this embankment. The feasibility study investigated canal crossings along the embankment. After survey it was found out that significant land fill occurred along the embankment and it now functions more as a road instead of an embankment. The routes proposed in the Master Plan in Mirpur, Mohammadpur and Old Dhaka area were reevaluated under the current study. After further investigation new routes were proposed in these areas. An important part of this feasibility study is validating the proposed water distribution system of Padma Phase-I with ongoing and proposed DMA projects and future plan of Dhaka City. To ensure connectivity with surface water injection points of DMA two options were proposed, one of which recommends constructing lines in addition to the primary distribution mains. Connection was also ensured with primary distribution of other Sectors. **The total length of the pipeline came out to be about 40 km with diameters ranging from 400mm to 1800mm.**

Stakeholder Consultation

The proposed alignment passes through some critical areas of the City. One of them is through Pilkhana Area where the head quarter of Bangladesh Border Guard (BGB) is located. Another important consideration is constructing the transmission along Dhaka Western Embankment. The roads where the pipe lines will be constructed are maintained by the City Corporations. RHD is considering widening the embankment road. The agencies those were consulted are BWDB, BGB, DSCC and RHD. Some of the feedbacks from them are as follows:

- BWDB suggested to ensure protection of the embankment, specially flood control structures and regulators
- BGB informed construction could be done during night time
- RHD mentioned the proposed road along embankment would be 30m wide
- All agencies welcomed the project and requested detail proposal about the project

The findings and suggestions were considered and recommendations of the feasibility study were prepared based on them.

Environmental and Social Impact Assessment

The proposed project fall under “Red Category” according to ECR 1997 of the Department of Environment (DoE) of Bangladesh Government (GoB); hence, require carrying out a full scale Environmental Impact Assessment (EIA). During construction phase, mitigation measures for the specific adverse impacts of the proposed construction of primary distribution water pipeline network could be minimized or even removed if appropriate mitigation measures are taken. During operational phase, no specific adverse impacts are anticipated; however, regular and routine O & M of the developed facilities should be carried out diligently.

During construction phase, the environmental management should focus on addressing the possible negative impacts arising from: (a) Traffic / communication problems; (b) Air pollution; (c) Noise pollution; (d) Drainage congestion; (e) Water and Soil pollution; (f) Cutting / clearing of vegetation along RoW of water distribution lines; (g) Employment of labor force giving priority to local people with required skills; and (i) Safety and accidents. It must be ensured that these measures are implemented in the field under the supervision of the PD of the proposed project. The environmental management during the operation phase should primarily be focused on regular/ routine operation and maintenance of the installed pipelines.

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Acronyms and Abbreviations

BBS	Bangladesh Bureau of Statistics
BDT	Bangladeshi Taka
BGB	Border Guard Bangladesh
BM	Bench Mark
BTM	Bangladesh Transverse Mercator
BWDB	Bangladesh Water Development Board
DAP	Detailed Area Plan
DEM	Digital Elevation Model
DI	Ductile Iron
DLRS	Land Record and Survey Department
DMA	District Metered Area
DMC	Design Management Consultant
DMDP	Dhaka Metropolitan Development Plan
DN	Nominal Diameter
DND	Dhaka-Narayanganj-Demra
DOE	Department of Environment
DPHE	Department of Public Health Engineering
DPZ	Detail Planning Zone
DWASA	Dhaka Water Supply and Sewerage Authority
DWSSDP	Dhaka Water Supply Sector Development Project
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
FGD	Focus Group Discussion
FIRR	Financial Internal Rate of Return
FS	Feasibility Study
GIS	Geographic Information System
GNSS	Global Navigation Satellite System
GOB	Government of Bangladesh
GPS	Global Positioning System
ICB	International Competitive Bidding
IECs	Important Environment Components
IWM	Institute of Water Modelling
KII	Key Informants Interview
LPCD	Litres per Capita per Day
MLD	Million Liter per Day
MODS	Maintenance and Operation of Distribution System
mPWD	Meter Public Works Department
NDCC	North Dhaka City Corporation
NPV	Net Present Value
NRW	Non-Revenue Water
PRV	Pressure Reducing Valve
RHD	Roads and Highways Department
ROI	Return On Investment

ROW	Right of Way
RTK	Real Time Kinematic
SDCC	South Dhaka City Corporation
SEIA	Social & Environmental Impact Assessment
SIA	Social Impact Assessment
SWTP	Surface Water Treatment Plant
TBM	Temporary Bench Mark
TOC	Table of Contents
TOR	Terms of Reference
WRP	Water Resources Planning
WSMP	Water Supply Master Plan
WTP	Water Treatment Plant

1 Introduction

1.1 Background

Dhaka Water Supply and Sewerage Authority (DWASA) is entrusted with the responsibility to supply piped potable water to dwellers of Dhaka City and its adjacent area. It may be mentioned here, DWASA since its inception has a vision to adopt more surface water treatment plant to meet its demand. Due to the constraint of the resources, vision of DWASA has been being hampered. As a result, DWASA is in true sense compelled to extract water from groundwater sources to meet the day to day demand of the mega city. So as mentioned above, DWASA and GoB have taken a firm decision to produce major portion of city water demand from surface water source and thereby reduce the dependency on groundwater source to protect the environment as well as to reduce the risk of water supply in the capital.

Currently DWASA is extracting about 1900MLD water from Ground Water Sources (GWS) within its service area encircled by about 500sqkm through about 650 nos. Deep Tube Wells which is neither environment friendly nor techno-economical. This excessive GW extraction is imparting a tremendous pressure to the GWS in all respects resulting GW mining i.e. depletion of the ground water table.

Recently Dhaka WASA has prepared a Water Supply Master Plan aiming to develop a sustainable and environment friendly water supply system in its services area. Assessment of demand shows that by the year 2035 the total demand is expected to be 5,268 MLD in the 617 sq. km of Dhaka WASA jurisdiction area. Considering all relevant factors, the master planning consultant, IWM recommended to develop water supply infrastructures sector wise depending on the sources of water. Padma North-West Sector is one the Sectors which includes significant part of old city, Dhanmondi, Mohamdpur etc where the treated water to be obtained from the 1stPhase of the Padma (Jashaldia) Water Treatment Plant (WTP) which is 450 MLD will be supplied. It was also identified by IWM that the existing water distribution network in this sector is inadequate to cope 450 MLD water.

The construction of Padma WTP (Phase-1) has already been started on EPC/Turnkey basis with the financial assistance of China Exim Bank. The scope of work under this ongoing project includes construction of WTP and ancillary structures and treated water transmission line up to Mitford of Dhaka city. It is expected that the project will be completed by mid of 2018. So the importance and urgency for strengthening of the existing water supply network under the command area of this WTP is aggravating day by day. On the other hand, an order has been issued by the government to conduct feasibility study before proposing any development project. So a detail feasibility with a full scale ESIA study is now required to prepare a project for strengthening the existing water supply system of the command area of Padma (Jashaldia) WTP (Phase-1), Padma North-West Sector Distribution System.

1.2 Objective

The main objective of this assignment is to conduct feasibility study of “Padma North-West Sector Distribution System” project including a full scale ESIA study to finalize the most sustainable cost effective primary and secondary distribution network to distribute the Water of Padma (Jashladia) WTP (Phase 1) considering all relevant technical, social, economic & institutional aspects.

The specific objectives are as follows:

- a) To develop a sustainable distribution network for Padma North-West Sector of the Water Supply Master Plan.
- b) To validate the ongoing DMA work with Padma North-West Sector network to be constructed.
- c) To further detailing of the outline design delineated in WSMP for the relevant Sector
- d) To prepare an analytical cost estimates.
- e) To evaluate financial viability of the proposed improvements.
- f) To conduct detail ESIA following acceptable international format.
- g) To check requirement of land acquisition along primary and secondary distribution mains.

1.3 Scope of Work

1. Collection of all secondary data and reports which include
 - a. DWASA sewer, drainage, water supply Master Plan
 - b. Population census data 2011
 - c. Topographic and GIS data from DMC of DWSSDP and SDCC
2. Primary data acquisition
 - a. Conduct topographic survey for the alignments of the different size water supply pipelines delineated in WSMP and canals to be crossed by the proposed water pipeline where required.
 - b. Socio-economic survey
3. Update alignment of the primary and secondary distribution pipeline and their ROW based on survey information
4. Review the outline design of the distribution system delineated in WSMP and provide necessary updating details including the tertiary water supply pipe network.
5. Validate the proposed water distribution system with ongoing and proposed DMA
6. Investigate canal crossings along the embankment and outline design of structures
7. Assessment of connectivity with other Sectors
8. Update the mathematical model of the primary and secondary distribution system for any changes due to survey
9. Update cost estimate and financial analysis made in the Master Plan based on analysis and design under the current study

10. Identify any land acquisition requirements along the alignment of the primary and secondary distribution mains

11. Conduct ESIA study

a. *Environmental Reconnaissance of the Project Site*

Environmental reconnaissance of the project area, including alignment of the primary and secondary distribution network, canal crossings, injection points to observe the overall setting of the pre-project condition.

b. *Environmental Baseline Study*

A detailed environmental baseline study of the entire project area. The main objective of the baseline study is to assess the pre-project socio-economic and environmental conditions of project area, against which possible impacts of the proposed project will be analyzed.

c. *Identification and Analysis of Possible Impacts*

The potential impacts on various socio-economic & environmental parameters with respect to project activities. Both qualitative and quantitative impact assessments will be made. Identification of impacts based on the following:

- Location of Project Components:
- Construction Phase:
- Operational Phase:
- Design inadequacy and /or failure due to natural disaster or non-acceptance by the citizens, etc.

d. *Design of Mitigatory Measures*

To offset adverse impacts on the socio-economic and environmental condition due to the project, mitigation measures would be suggested depending on impact characteristics. Methods of rectifying the impact by repairing, rehabilitating, resettling or restoring the affected socio-economic & environmental settlements will also be included here.

e. *Preparation of Environmental Management Plan (EMP)*

f. *Environmental Monitoring*

An environmental monitoring program will be developed which will include:

- Monitoring location
- Parameters to be monitored
- Frequency of monitoring
- Resources required.

2 Profile of Study Area

The major water supply sources (SWTP plants and well fields) are located in consideration of proximity to available sources, availability of land, etc. As a result, they happen to be located in different parts in and around the city. The Transmission Mains originating from these sources will enter the city from different locations. Each source will operate in a region of the city on the basis of the following criteria:

- The maximum contiguous area where the incident demand can be adequately served by production capacity of the source.
- The area up to which the transmission main can provide water to the distribution systems at a minimum 1 bar pressure (based on preliminary hydraulic modelling).
- Existing and proposed DMA boundaries.

Delineation of such areas is referred to as sectorization. The areas that will be covered by each of these major sources are named as 'Sector'. Considering the population density, strategy of city development, nearby available sources of ground and surface water, socioeconomic condition of the locality and the corresponding water demand, the service area has been divided into eight Sectors (**Figure 2-1**). Projected populations and water requirement for each sector have been calculated up to the year 2035. The source of water for each sector has been established. The sectors are:

- Saidabad West-East Sector
- Padma North-West Sector
- Padma South Sector
- Singair Sector
- Khilkheth Sector
- Tongi & Gachcha Sector
- Bandar Sector
- Rupganj Sector

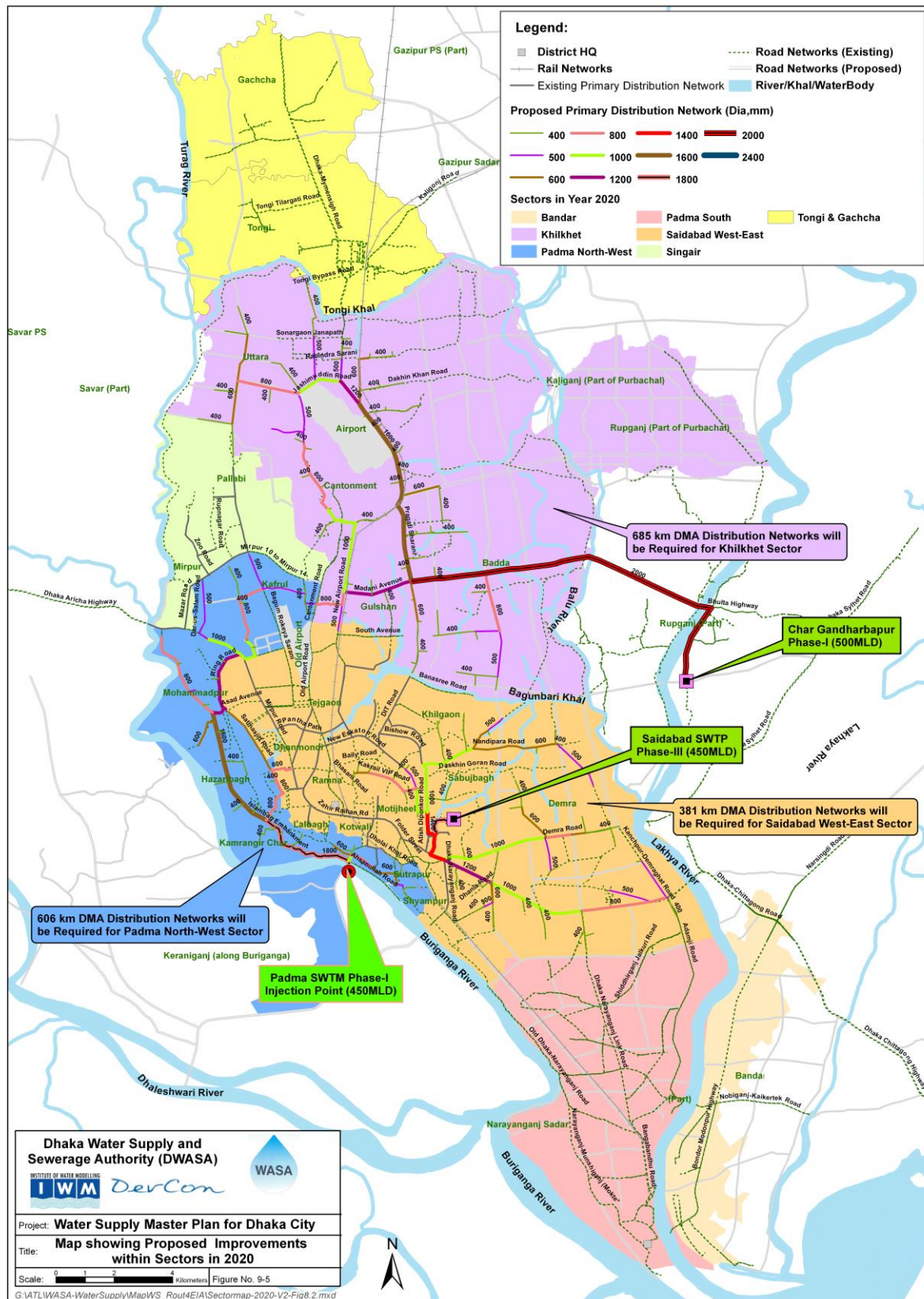


Figure 2-1: Different Sectors of Water supply master plan of Dhaka city

The water from Padma/Jashaldia Phase-1 SWTP will be distributed to the Padma North West Sector according to the Water Supply Master Plan of DWASA. The Sector comprises of 50.9 sq.km area covering most of the area of Hazaribagh, Kamrangir Char and Mohammadpur Thana; parts of Kafrul, Keranigan, Kotwali, Lalbagh, Sutrapur, Dhanmondi, Shyampur and Cantonment Thana areas. For easy understanding, Padma North-West Sector has been subdivided into four subsectors named Subsector-North, Subsector-Old Dhaka, Subsector-Kamrangir Char and Subsector-Keraniganj.

Primary Distribution network of water supply of Padma North-west pass through eight different Detail Planning Zones (Table 2.1) of DMDP (2010). The average land level of this sector is around 6.5 mPWD. The river Buriganga flows through the west side of this sector. The present (2011) average density of population of Padma North-West sector is about 44,000/sq.km which will rise to around 76,000/sq.km in 2035 (Table 2.2). Total length of road and water supply pipe network is 722 km and 364 km respectively (Table 2.3).

Table 2.1: Detail Planning Zone (DPZ) of RAJUK in of Padma North-West Sector

Sector Name	DPZ Name	DPZ No	Group
Padma North-West	DPZ-01: Old Dhaka-West	DPZ 1	DPZ C
	DPZ-02: Old Dhaka-East	DPZ 2	DPZ C
	DPZ-07: CBD North-West	DPZ 7	DPZ C
	DPZ-08: East-Westsub	DPZ 8	DPZ C
	DPZ-09: Mid-Westsub	DPZ 9	DPZ C
	DPZ-10: North-Westsub	DPZ 10	DPZ C
	DPZ-11: Cantonment-Banani	DPZ 11	DPZ C
		DPZ 11	DPZ E

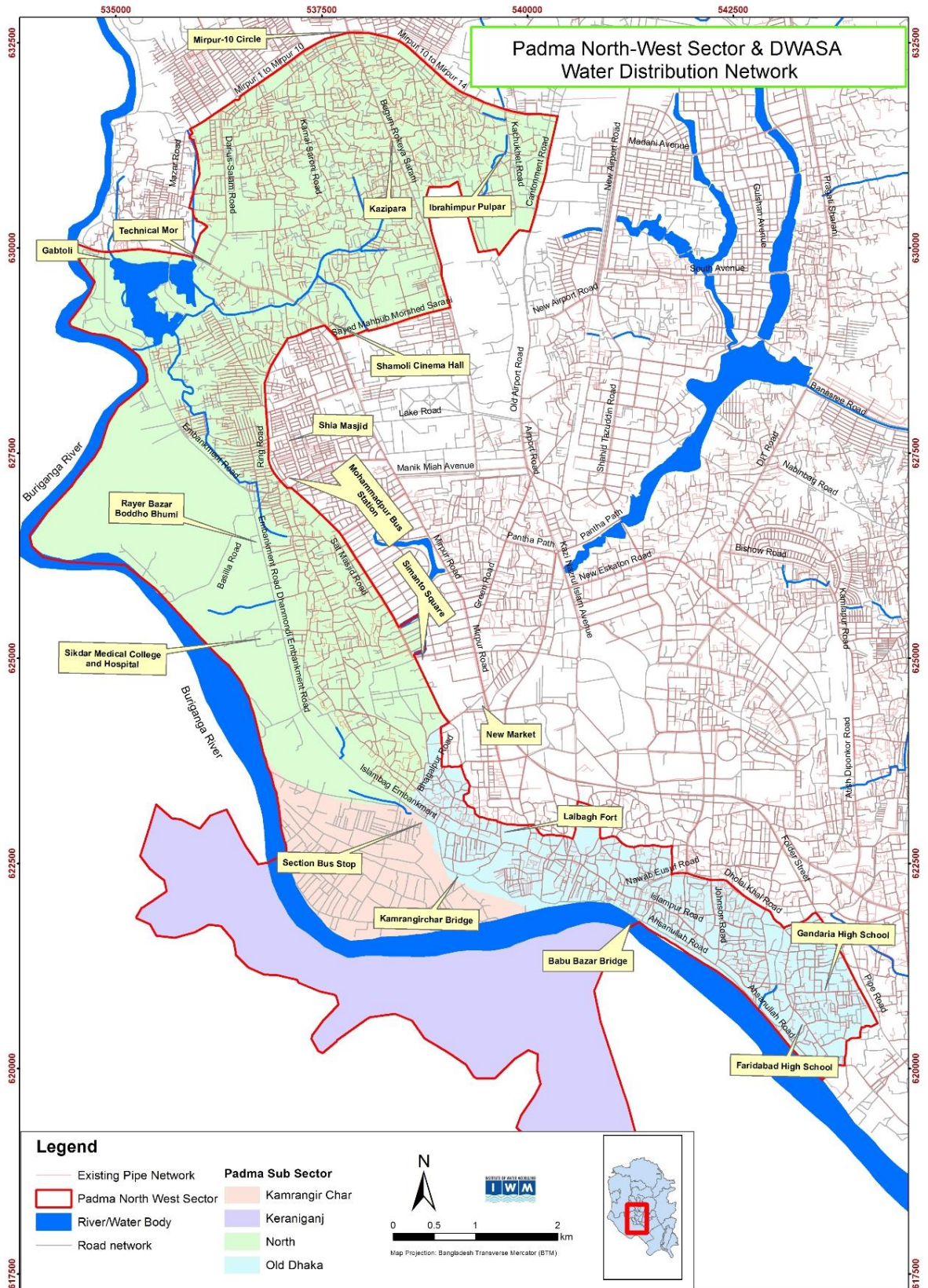


Figure 2-2: Water supply distribution area of Padma Phase-1

Table 2.2: Administration Boundary and Population Density of Padma North-West Sector

Sector Name	Subsector	Thana Name	Thana Area (sqkm) within Service Area	% of Thana Area within Sector	Population Density (Person per sqkm)					
					2011	2015	2020	2025	2030	2035
Padma North-West	Subsector-North	Cantonment	10.6	6%	13,075	14,573	16,489	18,294	20,099	21,867
		Dhanmondi	6.3	31%	51,900	58,983	67,716	76,242	84,177	92,484
		Hazaribagh	5.5	100%	34,801	37,670	41,084	42,753	43,789	44,450
		Kafrul	7.7	55%	55,581	61,352	68,069	75,154	82,166	88,953
		Mirpur	14.1	41%	53,606	59,402	67,208	75,117	82,935	89,786
		Mohammadpur	12.0	79%	57,785	64,408	73,050	82,407	91,431	99,962
	Subsector-Kamrangir Char	Kamrangir Char	3.2	100%	30,066	35,580	43,497	52,921	63,463	75,375
	Subsector-Keraniganj	Keraniganj (along Buriganga)	34.2	40%	4,941	6,949	10,643	15,639	22,556	32,232
	Subsector-Old Dhaka	Kotwali	2.0	54%	131,961	137,319	142,901	147,240	150,958	153,235
		Lalbagh	4.1	63%	133,587	139,011	144,661	149,796	154,344	158,241
		Shyampur	10.3	11%	56,232	67,058	82,176	98,879	111,328	123,519
		Sutrapur	3.8	40%	94,619	98,890	102,655	105,509	107,636	109,806

Table 2.3: Existing Road and Water Supply Network of Padma North West Sector

Sector Name	Subsector	Thana Name	Thana Area (sqkm) within Service Area	% of Thana Area within Sector	Road Length (m)	Pipe Length (m)	
Padma North-West	Subsector-North	Cantonment	10.6	6%	11,410	3,228	
		Dhanmondi	6.3	31%	36,634	25,584	
		Hazaribagh	5.5	100%	47,006	26,141	
		Kafrul	7.7	55%	106,839	67,138	
		Mirpur	14.1	41%	122,523	66,758	
		Mohammadpur	12.0	79%	110,497	58,404	
	Subsector-Kamrangir Char	Kamrangir Char	3.2	100%	43,175	0	
	Subsector-Keraniganj	Keraniganj (along Buriganga)	34.2	40%	87,126	0	
	Subsector-Old Dhaka	Kotwali	2.0	54%	24,386	20,773	
		Lalbagh	4.1	63%	60,822	50,456	
		Shyampur	10.3	11%	28,846	14,519	
		Sutrapur	3.8	40%	42,738	30,818	
	Total					722,002	363,819

2.1 Subsector-North

This part of sector comprise with part of Mirpur (41%), Kafrul (55%), Cantonment (6%), Mohammadpur (79%), Dhanmondi (31%) and Hazaribagh (100%) Thana. A brief description of housing pattern, utilities and others of this part of sector is given below-

Settlement Pattern & Housing

The government housing estates consisting of one/two units' family quarter are observed at Mohammadpur, Dhanmondi, Zigatola areas. There are dwellings which are many in number and vary in size from bricks built (semi pucca) with corrugated iron roofed to big modern buildings. There are also new houses of two or more storey. Besides, there are also few spacious buildings of elaborated structure and design, and there are some schools of international standard, churches, mosques and municipal halls.

Recently, the area witnessed the growth by innumerable private housing societies which through purchase of low-lying lands in western part of Royerbazar, Mohammadpur areas, allocated plots to people in accordance with demands and deposits.

Under this area a number of slums are established. These slums are scattered all over Mohammadpur/Hazaribagh. They vary in size, forms a small cluster of just a few dwellings to massive areas with thousands of dwellings such as Agargoan, Katashor embankment, Johuri Mohalla, Bijli Mohalla, Tikkapara, and Aziz Mohalla.

Agargoan and Beriband or Katasur embankment are the biggest and the second largest slums in Dhaka respectively. The slums of Johuri mohalla, Bijli Mohalla, Tikkapara and Aziz mohalla constitute one single slum, land being owned by the housing and settlement Directorate. Another slum lies near Mohammadpur's ring road.

Moreover, Dhanmondi is the most planned and developed thana of this part of sector. Most of dwellers of Dhanmondi have well-structured building. Apart from these, a few multi storey buildings have been constructed introducing a new type in which the ground floor serves as shopping centre and the upper floor as residential houses and office establishments.

Water Supply

Though DWASA expand the water supply service in this area still access to potable drinking water is a problem as the total supply mainly depends on the groundwater sources in Mirpur and Kafrul Thana. In other thana of this area, the water supply problem tends to vary with the seasons. In the wet season, it is reported that water supply is less of a problem for most of the areas, whereas water supply it becomes acute in the dry season.

Socio-economic Condition

There are several variations that appear in the overall occupational situation in Mirpur. The vast majority of the inhabitants of Mirpur area are engaged in the urban & related pursuits such as mechanics in automobile workshops, machine tool factories, lathe machine and

engineering works. The remainders are involved in manufacturing of fine textured sari, hand-woven carpets, clothe, dolls, novelties etc. A few other minor pursuits provide jobs and occupational status for the poorer segments of Mirpur. A large number of middle class people derive their livelihood from small trading, shop keeping, hawkers, etc. The womenfolk of this area are predominantly found employed in garments and apparel. Large number of service holder's service professions and businessmen also reside here.

Other area is mainly inhabited by the middle class who live on standard suited to the respective offices and professions. High-class residential localities are Dhanmondi, Sanker, etc.

2.2 Subsector-Old Dhaka

The old Dhaka comprising Lalbagh (63%), Kotwali (54%), Shyampur (11%) and Sutrapur (40%) Thana with a narrow road networks and old houses of two to four stories building (presently high-rise buildings are randomly constructed) areas of established urban characterized. Description of the housing patterns, utilities and others are briefed below-

Settlement & Housing

Old Dhaka is the historic urban core of Dhaka City which runs along the north bank of the Buriganga River. This area contains a complex mixture of commercial and residential patterns. The physical infrastructure is overloaded and inadequately maintained. In addition, versification has occurred along with unplanned commercial and industrial setup within the Old City. Roads are narrow and congested, which have been flanked by old buildings viewed with two to four new floors.

The Old Dhaka City has developed freely with mixed land use showing less or no regard to any urban planning. It has typical land use pattern, a strip of land along the main roads generally used for commercial purpose and the inner areas used for manufacturing and residential purposes. Most of areas of the Old Dhaka City are densely built with low to medium rise structure of different forms and designs.

Water Supply

Though the problem of water supply becomes acute during dry season, especially for the slum dwellers in old part of Dhaka City about 100% households have access to drinking water. It was observed that due to small dia of pipe there are leaks in different parts of the area have enough wastage and seepage of water to supply the residents of this area.

Socio-economic Condition

The Old City has both commercial tradition and industrial heritage. Virtually, the Old City is the commercial nerve of the entire Bangladesh. It was found that the old buildings had been demolished to construct new shopping centres, and residential buildings had been converted into commercial establishments in Old City since there was little scope for horizontal expansion.

2.3 Subsector-Kamrangir Char

Kamrangir Char located along Buriganga River. Due to the urban overspill from the Dhaka centre, this area is expected to grow to relatively very high density in 2035 (75,375).

Settlement & Housing

The topography of this area is featured by revering, flood prone cultivable land which is mostly low and plain alluvial soil, with the increase of population, plain paddy fields have been filled up with earth and are being built and added to the existing established plots. The area has a number of mills and industries/factories. Presently both pucca and kacha house exist in this area. However, this area is highly growth area because this is only vacant land near central Dhaka. Number of multi storied building has been under construction in Kamrangir Char.

Water Supply

Despite long-felt demand for supplying pure drinking water to the inhabitants of this area through water supply works, nothing tangible has been done as yet. Meanwhile, DPHE has sunk some shallow tube wells. It may be mentioned here that low income people depend on river and pond for both bathing and washing. Most of the medium and higher income groups have their own shallow tubewells with motor to meet their water requirements.

Socio-Economic Condition

The economic condition of the inhabitants of is characterized by trade and commerce and day labour. People are generally pre-occupied with trading and other matters related to or deriving from it. Most of the inhabitants are either wholly or partly dependent upon trading in the following roles: manufacturers, factory owners, warehouse owner, business men, traders, labourer in the godowns and factories. Since it is close to the Buriganga which serves as the principal means of communication, it caters to the needs of people living around and across the river.

2.4 Subsector-Keranigonj

Keraniganj area is currently low density however the urban overspill from the Dhaka centre across the Buriganga River is expected to grow to relatively high density (32,232 in 2035).

Physical Features

The topography of this area is featured by revering, flood prone cultivable land which is mostly low and plain alluvial soil, with the increase of population, plain paddy fields have been filled up with earth and are being built and added to the existing established plots. The area has a number of mills and industries/factories, among which one Jute mill, one textile mill, number of Cottage industries like goldsmith, blacksmith, potteries, wood work, tailoring. There are also numbers of hats (bazar).

Water Supply

Despite long-felt demand for supplying pure drinking water to the inhabitants of this area through water supply works, nothing tangible has been done as yet. Meanwhile, DPHE has sunk some shallow tube wells. It may be mentioned here that low income people depend on river and pond for both bathing and washing. Most of the medium and higher income groups have their own shallow tubewells with motor to meet their water requirements.

Socio-Economic Condition

The economic condition of the inhabitants of is characterized by trade and commerce. People are generally pre-occupied with trading and other matters related to or deriving from it. Most of the inhabitants are either wholly or partly dependent upon trading in the following roles: manufacturers, factory owners, warehouse owner, business men, traders, labourer in the godowns and factories. The members of artisen, serving, labouring in trading house earn their livelihood by providing goods, merchandise & commodities to Dhaka Metropolis.

The area is rich in merchandise and specialized in different crafts, but dismal in appearance. Since it is close to the Buriganga which serves as the principal means of communication, it caters to the needs of people living around and across the river.

3 Review of Past Studies

Water Supply Master Plan for Dhaka City

This project was undertaken by DWASA to prepare the Water Supply Master Plan for Dhaka City. The goal of the project according to the ToR was to prepare a Master Plan, to identify priority investment projects and to recommend an appropriate institutional framework.

It has been planned that DWASA will expand its service area from the present 401 sqkm to 617 sqkm in 2035, covering its entire jurisdiction and some additional areas. As a result of increase in domestic, industrial, commercial and other uses in the expanded service area of DWASA, the total demand will rise from 1,476 MLD in 2011 to 4,741 MLD in 2035. If we consider that leakage from the system will be reduced from the present level of 30% to 8% of the total supply in 2035, the total required production capacity will increase from the 2,108 MLD in 2011 to 5,268 MLD in 2035. For the period 2035 to 2060, the likely scenario is that there will be approximately 50% growth in demand. As a result, an additional 2,650 MLD production capacity will be required by 2060.

To meet the requirement, options for Dhaka WASA are limited to harnessing the water resources of Meghna and Padma rivers. Resource assessment study (IWM, 2006) shows that sufficient water of adequate quality is available in these two rivers. The two feasibility studies conducted for the Padma (Jashaldia) and Meghna (Gandharbapur) WTP also shows that these two plants are technically, socially and economically viable. Preliminary assessment made in the feasibility study of Saidabad WTP Phase III shows that, Meghna could also be a source for the three phases of the Saidabad WTP planned to be producing 900 MLD in total. Therefore, total supply from the Padma and Meghna could be planned for 900 MLD and 2,525 MLD respectively by the year 2035. For the period 2035 to 2060, the possible cost effective sources of water could be the Lakhya and Buriganga Rivers (if their conditions improve). The availability of suitable water from the Meghna River for additional use has some uncertainties. However, the Padma River should be a reliable source.

One of the key components of the Master Plan is dividing the service area into sectors based on main sources of supply and connected primary mains. Each sector will have a dedicated and independent major source and primary main to transmit treated water from the source to localities within the sector. Based on the available major sources of supply, the ongoing and proposed projects in near future, the entire DWASA service area is divided into eight sectors.

The current distribution system is based on supplying water from the 650 DTW of the City. Only major source of supply is the Saidabad SWTP. As result the distribution system lacks larger pipes to transmit water from one part of the City to another. The primary transmission main will have to be built in each sector to transmit the water from the plants. Secondary and tertiary distribution lines will be required to distribute water to the customer

end. Dhaka WASA has taken up DWSSDP project which establish DMA for the distribution system. DMA is essential to ensure a minimum amount of NRW and minimize the loss of precious water through system leakage. In each sector DMAs will be established to transmit water from the primary distribution. Using hydraulic model the primary distribution lines were designed in the Master Plan according to supplied water in different parts of the sector to the DMAs. Khilkhet sector will require the highest length of primary transmission as the SWTP is located in Char Gandharbapur, some distance from the City and it also supplies distant areas in different directions.

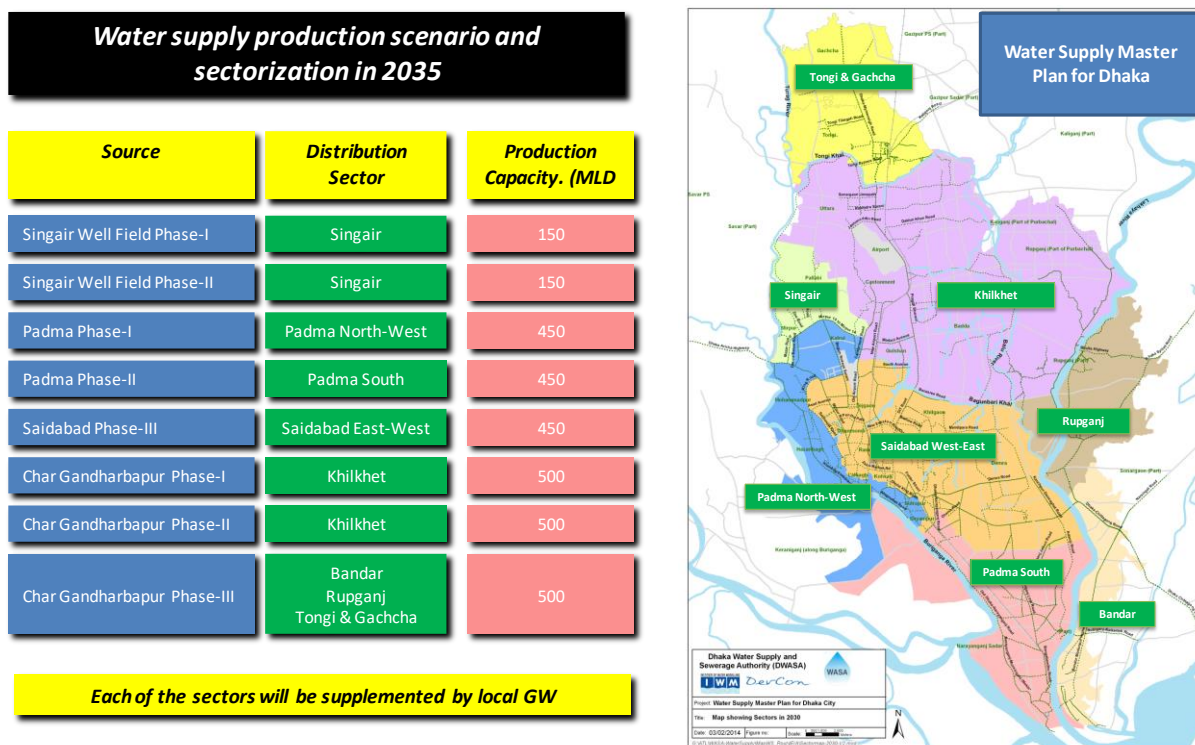


Figure 3-1: DWASA Sectorization of Service Area by 2035

The investment plan for Dhaka WASA for Water Supply in future was also developed in the Master Plan. The amount of all the investments was calculated in present value and the total amount required up to 2035 is 325 billion BDT or 4.17 billion USD. Some of these investments are already in progress as a part of ongoing development. These are DWSSDP, Singair Well Field, Padma SWTP and Gandharbopur SWTP which are in implementation phase and Saidabad Ph-III which is in tendering phase. During the analysis of tariff different pricing structures were considered and 3-block Increasing Block Tariff (IBT) structure was proposed. The first slab's price is the current 7.34 Tk/KL which will be incremented by 5% in 2015. Thus the basic flat rate expected in 2015 is 8.09 Tk/KL. The third slab's price is three times the first slab's price and is also the expected starting water tariff for commercial and industrial users in 2015 (based on annual 5% increases as per WASA rule). Based on the expected population proportion falling into each slab, the weighted average price will be

12.94 Tk/KL. However, the slab prices in the IBT should increase over time to take into account of inflation.

As part of Master Plan project, technical feasibility was also carried for primary distribution of the Sectors. Treated water from Padma SWTP Phase-I will be supplied to the Padma North-West sector. To distributed water just after injection point the main primary distribution line will follow the western flood protection embankment. The water will be distributed at different points on the way to Mirpur area. One another primary main will be stated from Babu Bazar and it will distribute water to the existing transmission and distribution main of Chadnighat Water Treatment Plant. The line will follow Islampur, Patuatuly, Sadarghat, Baglabazar, Rupla-Dash Lane to Gandaria. The nodal distribution quantity has been calculated based on the present and future population of year 2035. Total length of primary and secondary distribution line came to be 42.36 km. The distribution nodes of Padma North-West sector has been show in Figure 3.2. The cost to implement the primary and secondary mains came out to be 4828 million BDT or 60.3 million USD in 2012 price.

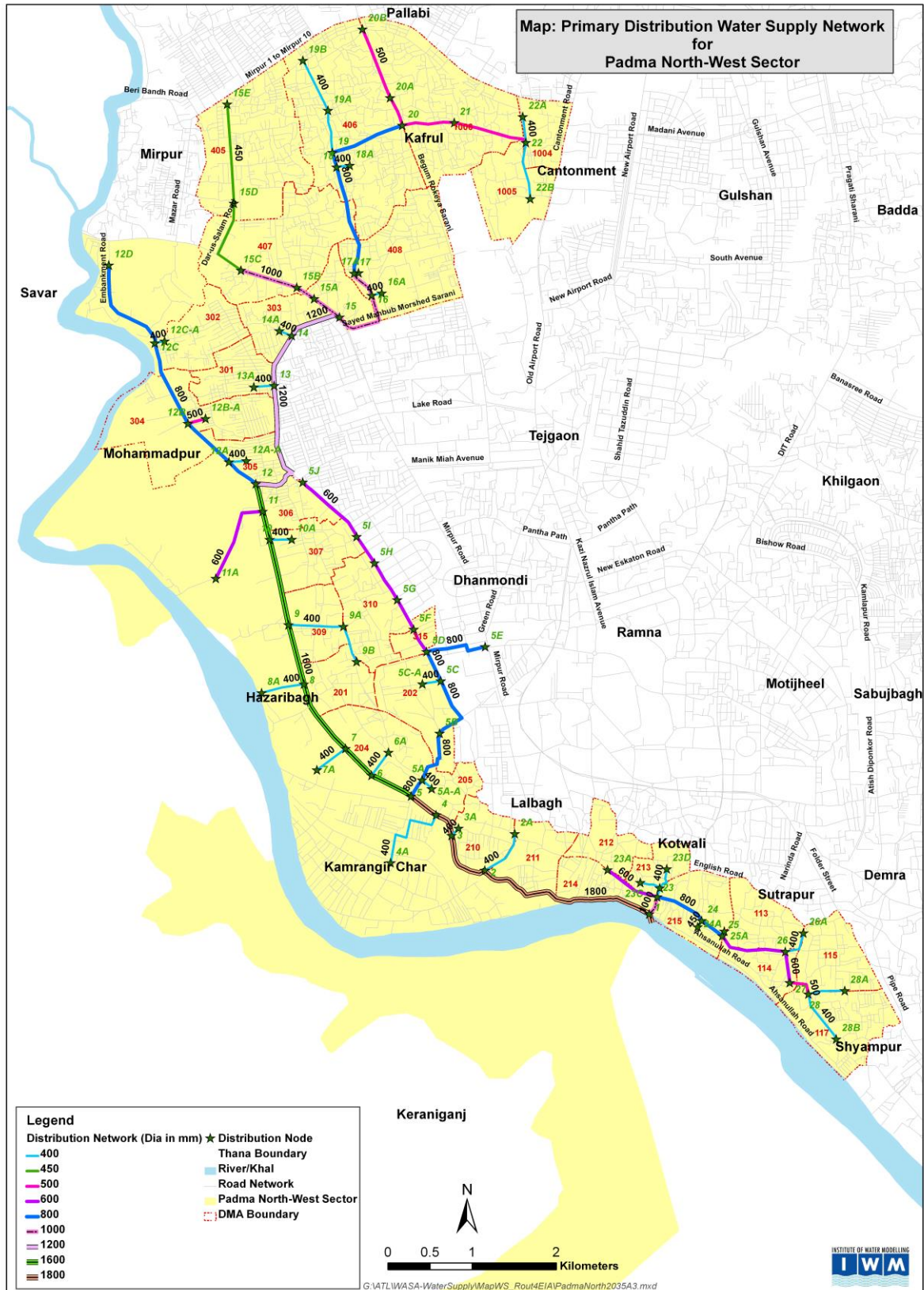


Figure 3.2: Distribution System of Padma North-West Sector from Master Plan

Feasibility Study of Pagla/Keraniganj WTP (now Padma-Jashaldia WTP)

There was an immediate need to initiate the feasibility study to draw water from the river Padma and new construction of surface water treatment plant which will allow 900 MLD in two phases, 450 MLD by 2015 and 450 MLD by 2020. The proposed water treatment plant will receive raw water from Padma River. To meet immediate need of DWASA the detailed feasibility study of the 'Pagla/Keraniganj Water Treatment Plant Project' was initiated and was assigned to IWM.

The Padma River has been identified as the most dependable surface water source for the proposed WTP Padma River as water source has been found suitable based on (i) detailed assessment of surface water as at Mawa point, considering long-term sustainability; (ii) detailed study on water quality, including sediment load and (iii) morphological study of the river to identify suitable site for intake and intake structure. As a part of the detailed feasibility study alternative sources were also considered for raw water source including Dhaleswari, Buriganga Rivers and Taltola khal. However, considering quality and quantity of raw water Dhaleswari and Buriganga Rivers were not found to be suitable as a raw water source for the proposed water treatment plant.

The distance from the proposed location of WTP at Jashaldia to the DWASA primary injection point at Mitford Bridge is over 32 km. In selecting this long route for treated water transmission line, efforts were made to select a route that would require least amount of land acquisition to avoid serious adverse socioeconomic impact. It was concluded that land acquisition would be minimum if the water transmission line could be carried along the barn of the roads and highways to Dhaka. It was decided that the treated water transmission line would be carried along the Sreenagar-Dohar road, then Sreenagar-Dohar bypass road, and then the Mawa-Dhaka highway. No acquisition of land would be required for installation of water transmission line along these roads and highways. Only small amount of land acquisition (2870m x 10m) will be required for carrying treated water from the WTP up to the Sreenagar-Dohar road at Rarikhal near the Damla Government Primary School. Any alternative route would require significant land acquisition and therefore not recommended.

The area to be served from "Jashaldia Water Treatment Plant" is mainly scarcity areas in northwestern and southwestern part of the city. The DMC Consultants of "Dhaka Water Supply Sector Development Project" have currently been engaged in analyzing the need assessment of demand by zoning the city into small zones. During preparation of Master plan, the same consultants have considered 1000 MLD of water production from Pagla in two phases along with other proposed plants and established a "Primary Distribution Network". The location of injection point to the primary main has been fixed at Midford Bridge.

The Project will significantly increase the supply of water in the south and western part of Dhaka City Corporation. The production capacity will increase by 450 MLD which is expected to serve nearly 19 million people in parts of Dhaka City. The total costs of the

project in phase I is 3338 crore as initial expenditure while the operating cost is approximately 65 crore taka per year. In phase II, however, there will be additional supply of 450MLD of water and the initial investment cost will be 2806 crore taka plus additional operating costs of 62 crore taka per year. Since part of the phase II expenditure is also built-in into the construction of phase I (because they are not mutually exclusive components), the cost-benefit analysis and the financial feasibility analysis is based on the whole project. The life time of the project is assumed to be 50 years.

Dhaka Water Supply Sector Development Project

The Dhaka Water Supply Sector Development Project (DWSSDP) was initiated in 2009 with an objective to build a pressurized water supply system, ensure 24 hour supply, reduce NRW to 15% or below, make the system consistent with DWASA future plan and increase customer satisfaction as well as make DWASA economically sustainable. The challenges were many: large percentage of very old pipes, inadequate metering, lack of supply, unplanned urban development, large number unauthorized customers, narrow streets with high traffic to name a few.

In order to achieve this goal the District Metered Area (DMA) concept for leakage management was adopted by DWASA. The project utilized internationally qualified contractors and introduced trenchless technology to minimize impact on traffic. For fast implementation at the same time quality control FIDIC yellow book system was adopted. Higher standard materials were used and internationally acceptable designs were adopted. Trainings were provided to build capacity of DWASA and improvement of O&M.

Out of the originally conceived 88 DMAs, 63 DMAs are in the process of being established in various parts of Dhaka. These include areas in MODS Zone 3, 4, 5, 8, 10 and part of 6 & 9. Among them 6 DMAs in Zone 5, 5 DMAs in Zone 8 and 2 DMAs in Zone 9 are already in operation and the loss has come down to 10% on an average. The project is carried out through 6 individual sub projects engaging 6 different international contractors. Work in sub-projects located in MODS Zone 8, 5 and 4 started earlier. Later on projects also got initiated in MODS Zone 10 and 3. There are multiple stages of project implementation in each of these sub projects. 16 DMAs are under pre-commissioning or commissioning stage. Another 16 DMA are under construction. 10 DMAs are ready for construction and in 9 DMAs survey and design is already completed.

The achievement of the project is many and for Dhaka WASA the project has brought dividends in many aspects. Some of them are mentioned below

- Achieved pressurized Water Supply in 24/7.
- 5% to 40% illegal house connections getting regularized,
- Water loss becomes within 2.27 % - 14.06 %
- Assured potable water
- No further use of suction pumps
- Reduced electricity cost by DWASA as well as consumers

- Improved Social Life
- Decreased Health Cost
- Increased Dhaka WASA Revenue

Preparing the Khilkhet WTP Project:

The consultancy was to review the previous Feasibility Study (FS) for a WTP to be built at Khilkhet. During the study it was suggested to investigate to build the plant in a new location at Gandharbapur, some 10km nearer the intake and also some 20 km of the raw water and to investigate rerouting treated water transmission pipe alignment. The consultancy was extended to carry out a new feasibility study and detailed surveys for these new proposals. The report contains the original review of the FS for a WTP at Khilkhet and also the new proposed system with WTP re-located to Gandharbapur with its associated new raw water supply and treated water delivery pipe routes.

The largest component of the Khilkhet Water Treatment Plant (WTP) Project (Phase 1) is the supply and construction of about 85 km large diameter raw and treated water transmission pipe lines connecting a 2000 MLD raw water intake and 1000MLD pump station on the Meghna River with the WTP (500MLD in Phase 1 and another 500MLD in Phase 2), as well as treated water transmission pipeline connecting with the water distribution system inside Dhaka, mostly benefitting Uttara, Gulshan/Banani, North Badda, and Mirpur districts. The project also includes provision of pumping equipment and pipelines to supply Saidabad WTPs (475 MLD in phase 1 and another 475 MLD in phase 2). The project comprises ten major components, some of which are recommended to be designed and constructed for the full Phase 2 capacity, are shown in Table 3-1.

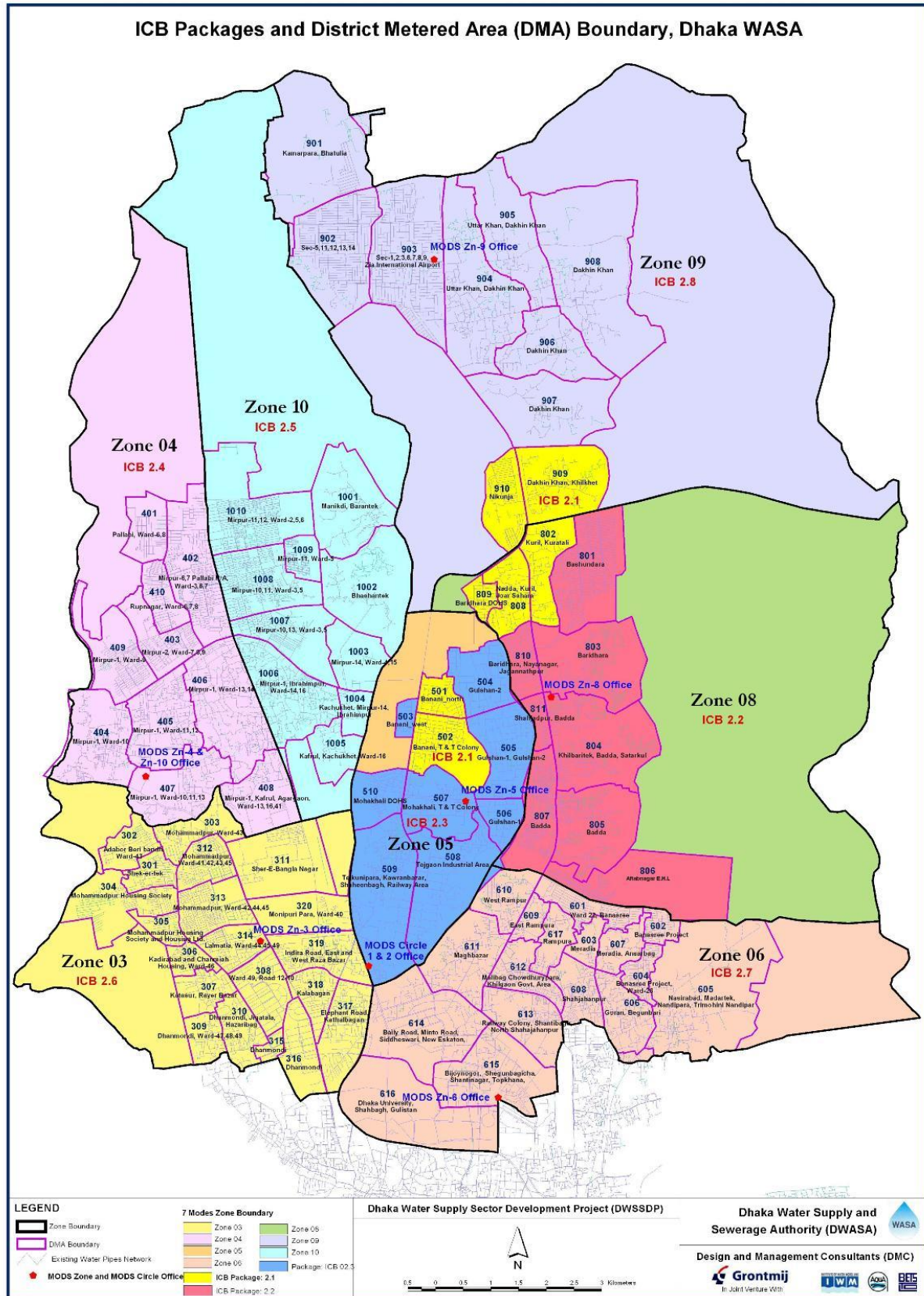


Figure 3-3: DMA locations and ICB packages under DWSSDP

Table 3-1: Khilkhet SWTP Phase 1 Project Components

Project Component	Design for Phase	MLD
Riverbank protection	2	n/a
Intake structure	2	2,000
Raw water pumping station	2	2,000
Raw water pipe to Gandharbpur	1	525
Gandharbpur WTP	1	500
Treated water pipes to + in Dhaka	1	500
Raw water pipe to Saidabad	1	475
Intake & pipeline route land purchase	2	n/a
Power supply connections	2	n/a
Plant + pumps at Intake	1	525 +
Plant + pumps at Gandh' WTP	1	500
Access roads to intake + along raw water pipelines	2	n/a

The project costs in this report cover all the project components above, sized for the design phase as stated above, which is 50,559 million BDT. This cost excludes all the costs associated with Saidabad pumps and pipes.

Feasibility Study of Saidabad SWTP Ph-III:

Saidabad plant operation with the two existing units (I & II) or with the additional one (III) is expected to be deeply disturbed without an alternative source of raw water supply, due to the fact that the water quality from the Lakhya River is irremediably deteriorating mainly in the dry season. Ammonia content for instance is far beyond the contractor's fixed target of maximum 15mg/l: it has reached 22 mg/l in 2013 while it was expected in the Feasibility Study of Saidabad Phase-II to reach 17-18mg/l in 2015. Therefore, the reliance on a new source of raw water supply for Saidabad, mainly in the dry season, should be secured as soon as possible and should be considered a top priority as without such source the provision of Dhaka City in water can be affected even on the short term. This issue had already been identified before implementation of Saidabad Phase-II. The Feasibility Report concluded the 2 recommendations:

- Implementing a pre-treatment consisting of a combination of nitrification denitrification combined with removal of organics and sulphides for Saidabad Phase-I & II under Saidabad Phase-II Project, to bring the pollution level down; this would be a temporary but rapidly implementable solution;
- Shifting to a new intake at Meghna River and a transmission main to the city; this was recommended as inevitable long term sustainable solution, to be implemented by 2017.

The present study aims at selecting the treatment process of Saidabad III drinking water treatment plant. Saidabad III plant will be constructed alongside the existing water treatment plants of Saidabad I and Saidabad II. It will have a 450,000 m³/day (450 MLD) production capacity which will equal the global capacity of the existing two plants and allow

reaching a 900,000 m³/day production capacity at Saidabad. Saidabad III plant will be located on the land where the sludge drying beds of the existing plants are located at present. In order to make space available for Saidabad III construction, the project includes also abandonment and levelling of sludge drying beds and construction of mechanical sludge dewatering installations designed to cope with the sludge production of the 3 plants.

Existing primary and secondary distribution network is designed for distribution of treated water, produced at Saidabad WTP Phases-I & II. Key portion of the network was built during execution of Saidabad WTP Phase-I. The total length of the network is 36 km and it includes 23 PRV's (Pressure Relief Valves) and 42 distribution nodes. Saidabad WTP Phase-II has been constructed recently with additional 10 km distribution network including 17 distribution nodes and 17 PRV's, leading to increase the total length of distribution network to 46 km. The numbers of PRV's and distribution nodes are also increased to 40 and 59 respectively. The diameter of the network varies from 300 mm to 1800 mm. The existing network is designed to distribute 450 MLD of water. From the model it was also observed that with this quantity, the velocity from WTP to node 1 rises to 2.1 m/sec. From node 1 to node 7a, the velocity in the pipe is also higher than the acceptable limit. Thus, injecting additional flow from Phase-III to the existing network would increase the velocity in the pipe which already exceeds the recommended limit, putting at stake the durability of the pipe. Therefore a new primary and secondary distribution network has been developed for Saidabad Phase-III.

Treated water from Saidabad Phase-III will be supplied mainly to the eastern part of Saidabad West-East sector in addition to some quantity to be directed to the western part. This sector comprises of 106.5 sq.km area. In western part, water will be distributed to the nearby location of Kamlapur, Outer Circular road (up to Shahjahanpur Circle) and Kakrail VIP road (up to Kakrail Mosque). In eastern part, water will be distributed fully or partially to Khilgaon, Goran, Madartek, Banasree, Demra and DND area. The nodal distribution quantity has been calculated based on the present and future population for the year 2035. Till year 2030, the whole area of Shyampur Thana will be within Saidabad sector. However, it is assumed that Padma Phase-II will be in operation in 2030 and will supply 58% of Shyampur Thana, while rest of the area will remain in Saidabad sector.

Sewer Master Plan

In developing the Sewerage Master plan, the target area is viewed taking into account the different states of urbanization with different population densities at the design horizon of 2035. Although the provision of sewerage services to cover the whole urban area is ideal, it is not realistic when technical, socio-economic and financial implications are fully taken into account. An application of different service levels by area was therefore deemed the most practical approach as an intermediate measure toward the realization and fulfilment of public sewerage service through the future. The Master Plan introduced a categorization of the target area, *incl.*: core area for sewerage service, transitional area from on-site treatment and/or hybrid systems to sewerage service, and on-site treatment area.

Within the Greater Dhaka Area the following priorities regarding sanitation and sewerage services and treatment facilities are recommended under the Master Plan:

- Install septic tanks and latrines in households within areas of low to medium density and in rural areas. Preference is given to on-site effluent disposal, however if soil conditions are unsuitable, then other options for disposal of septic tank effluents may be required, *e.g.* “small bore” sewerage systems or “simplified” (condominium) sewerage systems.
- Install sewerage system and associated wastewater treatment in densely populated urban centres of the largest municipalities, *esp.* Savar, Tongi/Gazipur, Purchabal and Narayanganj.

Under the proposed investment plan, the following are considered immediate priority investments (Phase 1, nominally for the period 2011-2015):

- Existing Sewerage System: (1) The system of trunk mains is proposed to be replaced as an immediate priority. (2) In order to increase the capacity of the sewer mains, the construction depth may be different to existing conditions hence there will be an effect on the lateral mains which will require to be relayed or sewage lift stations will be required to lift the flow from the lateral mains to the higher depth of the new trunk mains. Construction of such modifications to the lateral sewers (or associated pump stations) will be a high priority. (3) Rehabilitation of the existing secondary sewers or replacement of such sewers will be a high priority.
- Existing Pump Stations: Of all the pumping stations in the sewerage system, those located on the main (eastern) trunk sewer are priority investments. However due to the lack of capacity and the design weaknesses of the existing pump stations which does not facilitate maintenance, it is not recommended to rehabilitate the existing civil works. It is recommended to construct new pump stations according to international practice. The priority pump stations for replacement include: Golapbagh (near Swamibagh), Bashaboo, Tejgaon and Gulshan.
- Existing Wastewater Treatment Facilities: Due to the inefficient use of land of the facultative pond process, it is not recommended to rehabilitate and augment the capacity of the existing treatment process at Pagla Sewage Treatment Plant (capacity, $Q_A=96,000\text{m}^3/\text{day}$). Replacement with trickling filter process is recommended with phased modules of $100,000\text{m}^3/\text{day}$.
- Dasherbandi Catchment: The Hartejheel lake rehabilitation system has commenced construction with the objective of intercepting stormwater drains (which also have household sewage connections) and transport the combined storm water and sewage to a new wastewater treatment plant located at Dasherbandi. Subsequently, this will include the re-direction of the wastewater from the Gulshan and Tejgaon areas.

The secondary priorities for investments (Phase 2, nominally covering 2015-2025) include:

- Reconstruction/replacement of secondary trunk mains (laterals) and associated sub-catchments due to raising the elevation of the main eastern sewer mains in Pagla catchment.
- Development of the Dhaka East catchment (Dasherbandi), *incl.* re-direction of the Gulshan and Tejgaon sub-catchments to the Dasherbandi system.
- Development of the Baridhara sub-catchment.

Drainage Master Plan

The present drainage facilities of Dhaka city are quite less than inadequate and most of the natural drains not functioning properly due to blocked by improperly handled construction material along the road sides, choked by garbage and poor maintenance. Dhaka Water Supply and Sewerage Authority (DWASA) mainly responsible for stormwater drainage, has taken a step forward to alleviate the last longing storm drainage problems of Dhaka City by preparing a master plan. Types of structural measures will vary with accordance to the location of application.

The entire Master Plan area has been divided into 13 Drainage Zones, which are based on the delineation of the catchment areas. Each of the Zones is divided in a number of sub-catchments. The zones are Goranchatbari, Kallayanpur, Dolaikhal & Old Dhaka, DND, Kamalapur, Hatirjheel, Badda, Uttarkhan, Gazipur & Tongi, Savar, Keraniganj, Narayanganj and Purbachal. In all the 13 zones, some 255 numbers of projects have been identified in this Stormwater Drainage Master Plan. Gazipur Tongi zone has maximum number of projects (46 nos). Next in order are Purbachal, Keraniganj, Narayanganj and Savar zones (with 34, 27, 24 and 20 projects in the list). For better understanding the whole area has been divided into three main categories which are:

1. Core City East
2. Core City West, and
3. Fringe Areas

The structural measures for these areas are mentioned below.

Core City East

- Embankment: Raise to 100-year ARI flood protection level @ ~12-13m PWD
- New pumps: Construct new at Norail Khal, Dumni Khal and Kashaibar-Boalia Khal outlets (Balu River)
- Existing pumps: Increase capacities, improve operation
- Sluice gates: Increase capacities, improve operation
- Khals and Box Culverts: Remove obstructions, clear blockages, increase conveyance, reduce total lengths, provide new lines, improve conveyance of Norail, Dumni and Kashaibar-Boalia Khals
- Storages: Demarcate surface areas specified in DAP, reclaim area lost to encroachment and illegal development, provide new storage facilities

Core City West

- Embankment: Construct to 100-year ARI flood protection level @ ~12-13m PWD

- Pumps: Increase capacities, improve operation
- Sluice gates: Increase capacities, improve operation
- Khals and Box Culverts: Remove obstructions, clear blockages, increase conveyance, reduce total lengths, provide new lines
- Storages: Demarcate surface areas specified by DAP, reclaim area lost to encroachment and illegal development, provide new storage facilities

Fringe Areas

- Flood flow zones: Preserve area specified in DAP, reclaim area lost to encroachment and illegal development
- Embankment: Where affected, construct to 100-year ARI flood protection level @ ~12-13m PWD.
- Pump Station: Construct three new pump stations at Adamjee Nagar, Fatullah and Pagla for improving the drainage condition of DND area.

The total project cost to upgrade the city's storm water drainage infrastructure to meet minimum current drainage criteria for the entire City is estimated to be about Tk. 16,000 Crore (BDT 159,272.65 million or USD 1,990.95 million). The majority of investments need to be planned in DND Zone (approx. 15%) and Gazipur zone (14%). Hatirjheel and Dholai Khal zones in the core area have least numbers of projects identified (6 nos.) and also invest-wise these are on the bottom side (with approx. 0.7 and 2.5% investment proposal).

4 Data collection

4.1 Topographic data collection

RTK-GPS Survey

Reference Bench Mark

Survey of Bangladesh has a number of Geodetic Bench Mark (BM) in and around Dhaka City. These BM Pillars were used as reference for conducting the RTK Survey.

Establishment of Base Station

A base station was established by static survey from the Reference benchmark. The survey was conducted keeping 2 dual frequency RTK-GPS receiver simultaneously at the reference station and proposed base station location. The data was processed by using post processing software supplied from the manufacturer (GNSS Solution). A high rise building close to Gabtoli Bus Station was the location for setting up base station as the location is obstruction free and the distance of survey area is within 50km. Ashtech ProFlex 500 dual frequency GPS receiver with GLONASS option is ideal as a base station which was used as base receiver. The receiver is capable of logging raw GPS data and simultaneously transmitting RTCM correction message using Radio Link or GSM Technology.

RTK-GPS Setup for Field

Ashtech ProMark 200 dual frequency RTK-GPS was used as rover system. Ashtech GNSS RTK-GPS system is specially designed for the similar type of works. It uses Fast Survey Software for configuration of the equipment as well as monitoring GPS condition and recording data. The survey was done using procedures mentioned below:

- a) Real time survey using RTCM Correction message received from the base station through GSM/GPRS Technology. It is expected that the fixed solution will be achieved if the site condition is favourable. In this case, the point locations at RTK-Fix conditions was recorded in the specified format by the Surveyor as well as logging the point in the GPS. No post processing was required in this method.
- b) The raw GPS data was logged in the field using stop and go kinematic technique. In this method, GPS observations are taken on desired points without stopping data logging in the rover. In each occupation, GPS observations were logged for around 10 to 15 minutes (as recommended by the manufacturer). The data was post processed offline by GNSS Solution (version 3.60) in the office.

Total Station Survey

Total station survey was conducted at places where it was not possible to conduct RTK-GPS survey with desired accuracy. In such case, total station was used to supplement RTK-GPS Survey. Known points derived from RTK-Survey was used as control point for Total Station orientation.

Conventional Level Survey

Auto levels will be used to check sample points surveyed by RTK-GPS Survey. This was done to ensure the quality of GPS Survey works. Figure 4-1 shows the level survey that was carried out to get details of the cross drainage structures along the proposed route of Padma primary distribution system. Level survey was also carried out to determine elevation of road crest levels to get more spot elevations along the route. Figure 4-4 shows the locations of the drainage structures along the western embankment that were surveyed



Figure 4-1: Western embankment structure location (a) drainage structures (b) road level crest

Co-ordinate System

The survey output will be given in Bangladesh Transverse Mercator (BTM) Projection system. The parameter are:

Everest-1830 ellipsoid

Semi-major axis $a = 6,377,276.34518$ m

Semi-minor axis $b = 6,356,075.41511$ m

Inverse flattening $1/f = 300.8017$

Seven Parameter datum shift:

Translation $X = -283.729$ m,

Translation $Y = -735.942$ m,

Translation $Z = -261.143$ m

Rotation of $X = 0$

Rotation of $Y = 0$

Rotation of $Z = 0$

Projection Parameter:

Latitude of origin = 0°
 Central meridian = 90°
 False Northing = -2000,000m
 False Easting = 500,000m
 Scale factor = 0.9996

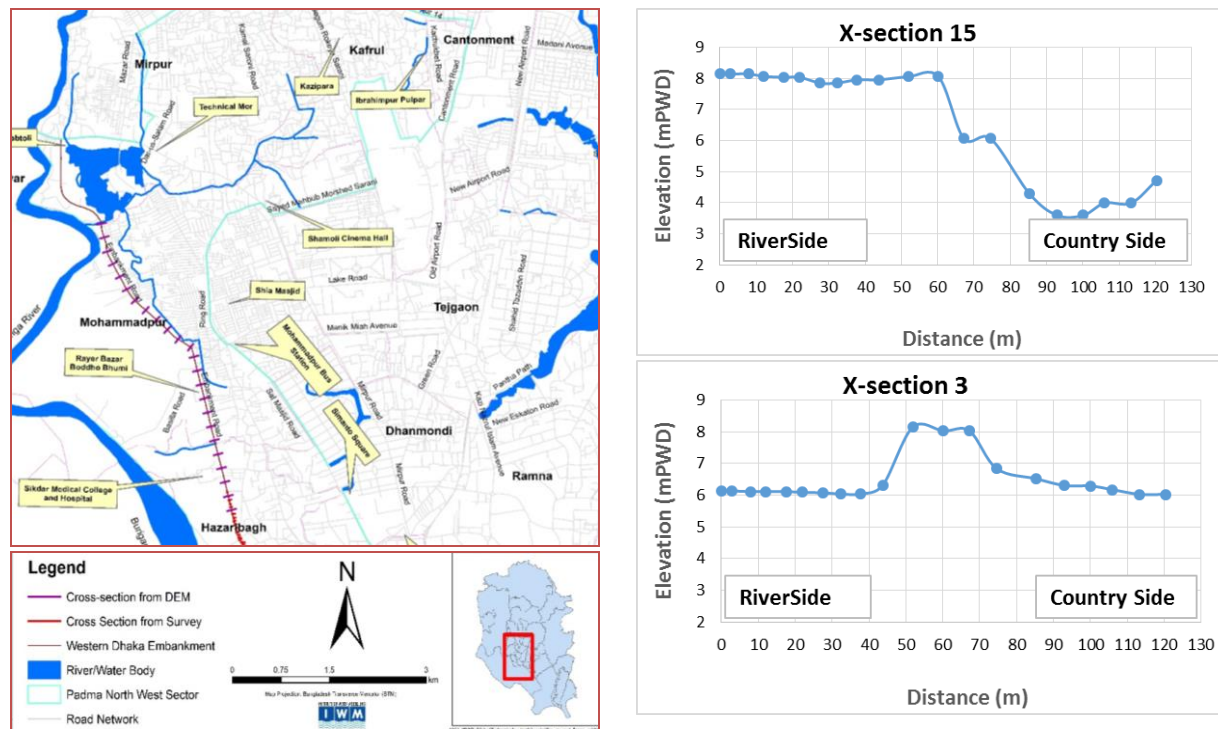


Figure 4-2: Cross Section of Embankment Along Kallyanpur and Bosila Area

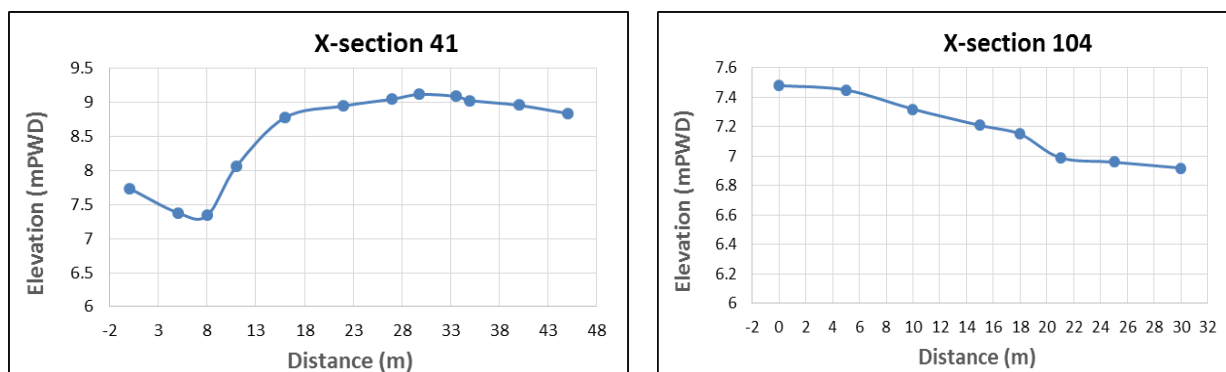


Figure 4-3: Cross Section of Embankment Along Hazaribag and Kamrangir Char Area

The data collected from survey were processed to generate cross sections perpendicular to the embankment. Figure 4-2 and Figure 4-3 shows the cross section generated after processing the survey data. It can be seen that the embankment height is 8 meters in Kallyanpur and Bosila area. The areas on both side of the embankment are raised varying 4m to 8m. The embankment height in Hazaribagh area is 9 m and Old Dhaka area is 7.4 m. The areas on both side of the embankment in this part are raised varying 7.5m to 9m.

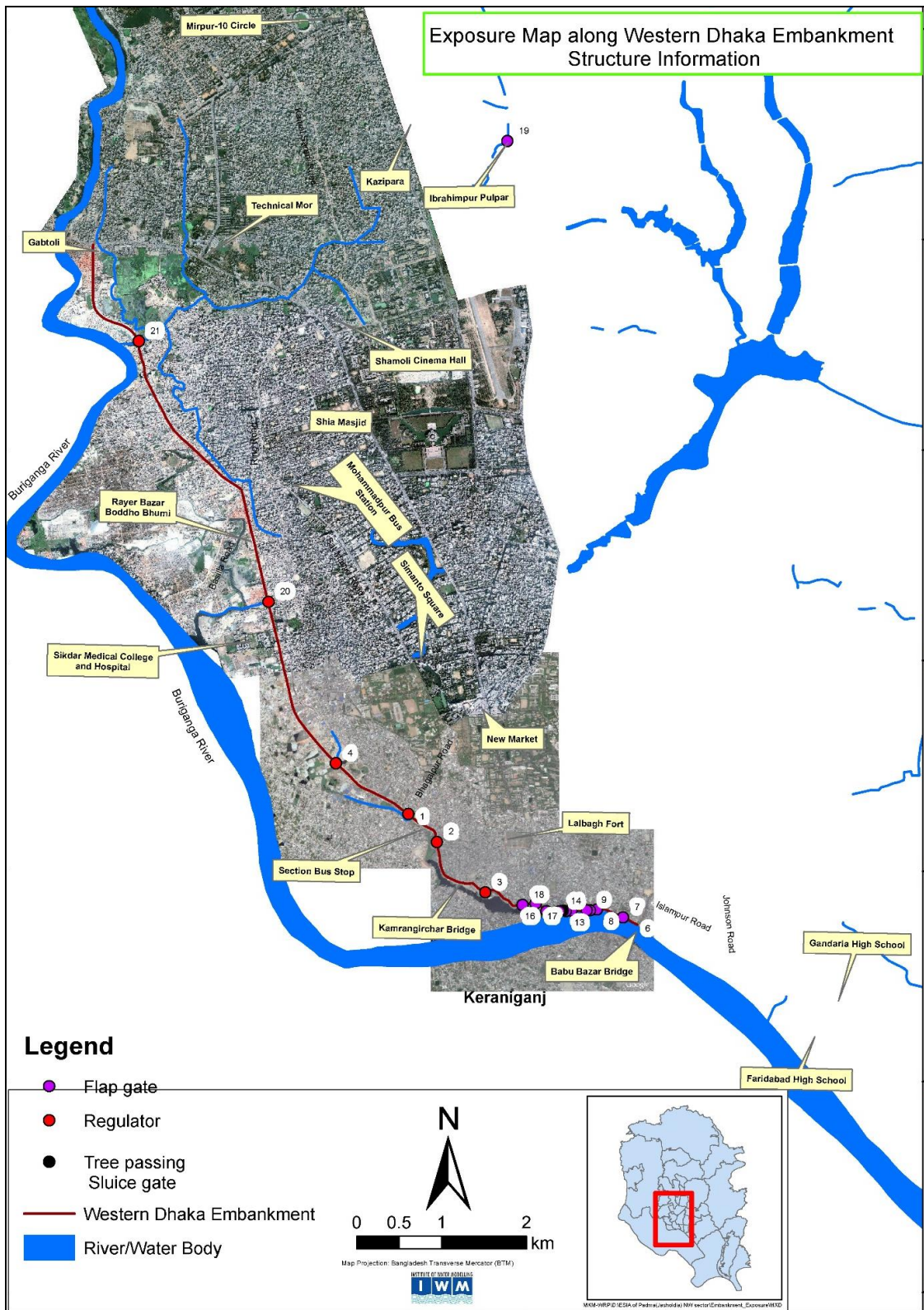


Figure 4-4: Western embankment structure location

4.2 Socio-economic and environmental survey

Target Settlements

Target settlements are, formal or informal, legal or illegal, located on the proposed site/right of way (ROW) of the project, IWM conducted field visits and consulted with people for rapport building and getting actual information during survey.

Establish Demarcation of Survey Boundaries

Census/socio-economic survey boundaries were demarcated for respective target settlements/communities/entities identified by the above sub-task, as per drawing of the proposed alignments/ROW.

Organizing Information and Consultation Meeting (ICM)

In coordination with the Padma WTP Project Office, IWM planned, organized and implemented community-wise stakeholders' meetings at various locations along the ROW.

Focused Group Sessions

To complement the formal community meetings mentioned above, focus group sessions (FGS) were organized and implemented at selected sites. The purpose of FGS was to collect opinions of various stakeholders, in particular those of vulnerable people obliged to occupy the land without titles. The task focused on current means of livelihood, desirable terms of compensation & resettlement benefits, etc. All the proceeding and interactions of FGS sessions were recorded and session minutes were drafted to illustrate community peoples' needs, desires and expectations with regards to the proposed project. FGS were conducted in four locations, details of the locations are given below

FGD 1:

Venue : Jahir Raihan Cultural Center
90, K B Road, Gendaria
Dhaka South City Corporation
Dhaka-1204

FGD 2:

Venue: Ahmed Bawani School and College
3/4/5, K P Ghosh Street, Armanitola
Dhaka South City Corporation
Dhaka-1100

FGD3 :

Venue: E, 2, Chand Mia Housing
Chand Community Center,
Mohammadpur,
Dhaka North City Corporation,
Dhaka-1207

FGD4:

Venue: Ma Manzil -2
930, Ibrahimpur Bazar Road, Ibrahimpur
Dhaka North City Corporation,
Dhaka-1216

Field Survey

The questionnaire survey (sample size 207+) on social environment was carried out in between October and November 2015 in order to collect first-hand information on socio-economic aspects of the project study sites. The questionnaire covered major socio-economic aspects though some basic social aspects of Dhaka city including the project sites are available in the Population and Housing Census 2011 of Bangladesh Bureau of Statistics

(BBS, 2012). Some baseline socioeconomic data were also collected from this and other secondary sources.



Figure 4-5: Questionnaire survey on existing social environment of the project study sites

(a) interviewing a small businessman beside a road who live here around 10 years, (b) interviewing a small food shop manager who is operating business around 2 years, (c) interviewing a small local garment retailer businessman who is operating business around 3 years, and (d) interviewing a timber businessman who is operating business around 5 years.

Environmental Field Investigations

The EIA study team members will collect relevant data on possible impacts of the project after obtaining details of the ROW, including alternative options. Data on the Important Environmental and Social Components (IESCs) will be collected from the field. In this case, information on the IESCs will be gathered through a qualitative method including FGSs using checklists. Intensive consultations with the local people will be carried out in each case for securing people's participation. The multidisciplinary EIA/SIA study team members also will make professional observations and assessments during the field visits.

4.3 Secondary data collection

Data was collected from several secondary sources. In order to assess the demand population data is required. This is based on Census carried out by Bangladesh Bureau of Statistics (BBS) in 2011. Administrative boundaries by City Corporation were also used to analyze the BBS data. Similarly land use information by RAJUK, cadastral maps by DLRS were used for various assessments. Information from other DWASA projects i.e. DWSSDP, GIS data of water, sewer and drainage, Saidabad Ph-III, Water Supply Master Plan, Gondharbapur Ph-I, Singair Well-field were collected. This provided information on distribution system, as wells as proposed transmission from ongoing and planned projects. The list of important secondary data that will be required is given below

- Population and other information from Census
- Ward-wise administrative boundary
- Pipe network and other related information from upcoming projects by DWASA
- Land-use information of Detailed Area Plan by RAJUK
- Cadastral maps from DLRS
- Information from BWDB on embankment and adjacent land registration

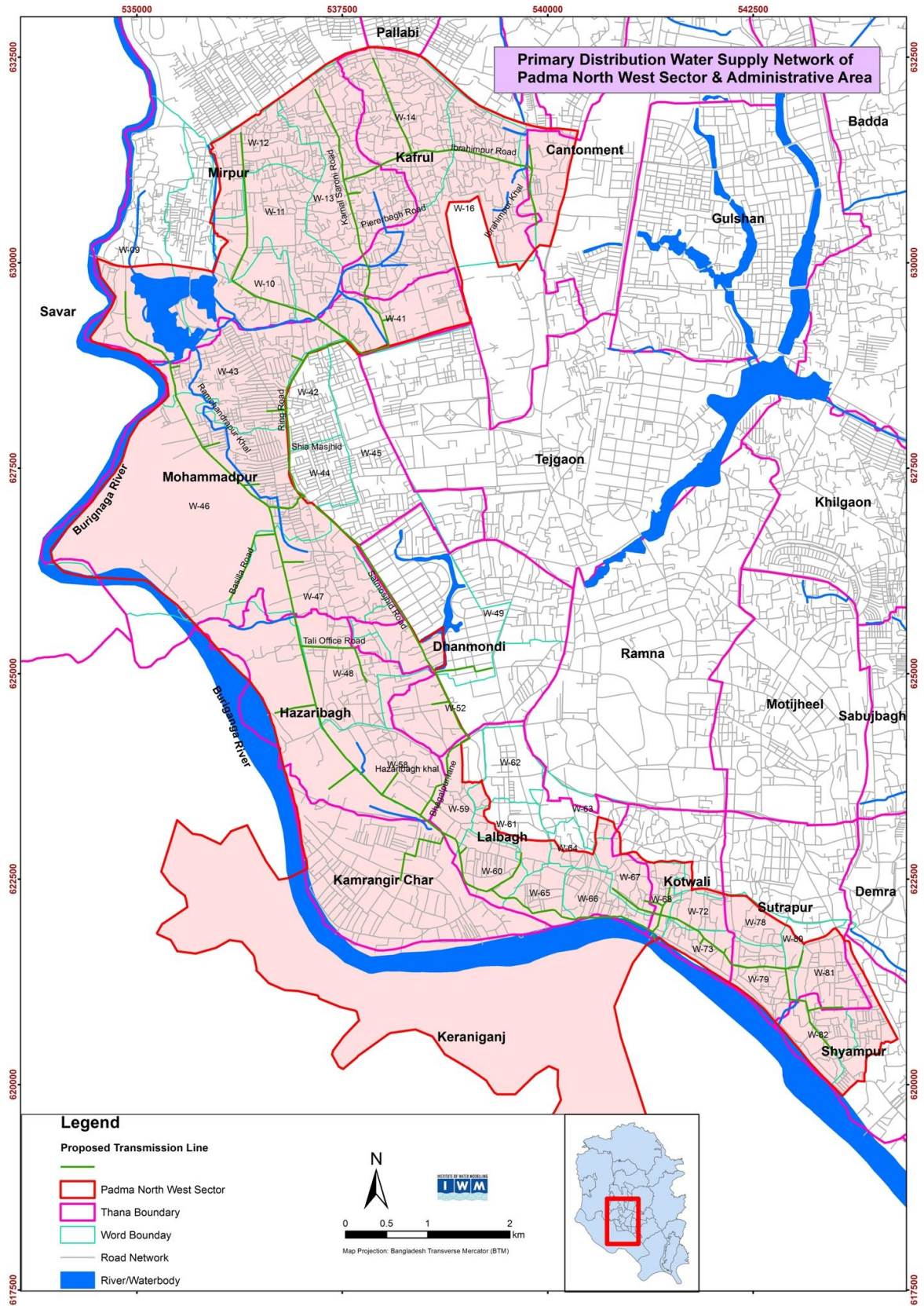


Figure 4-6: Administrative boundaries within Padma North West Sector

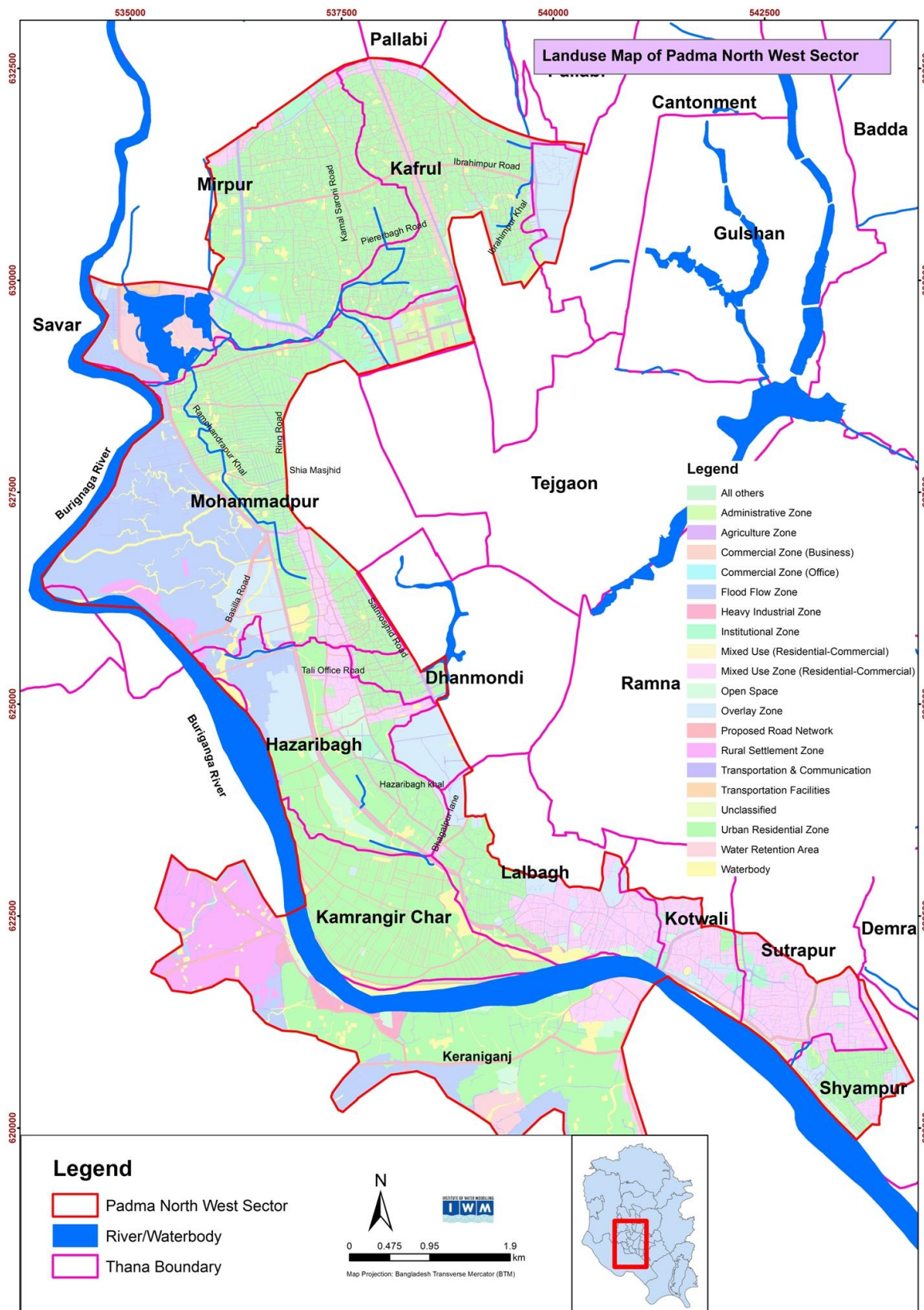


Figure 4-7: Land-use map of Padma North West Sector based DAP by RAJUK

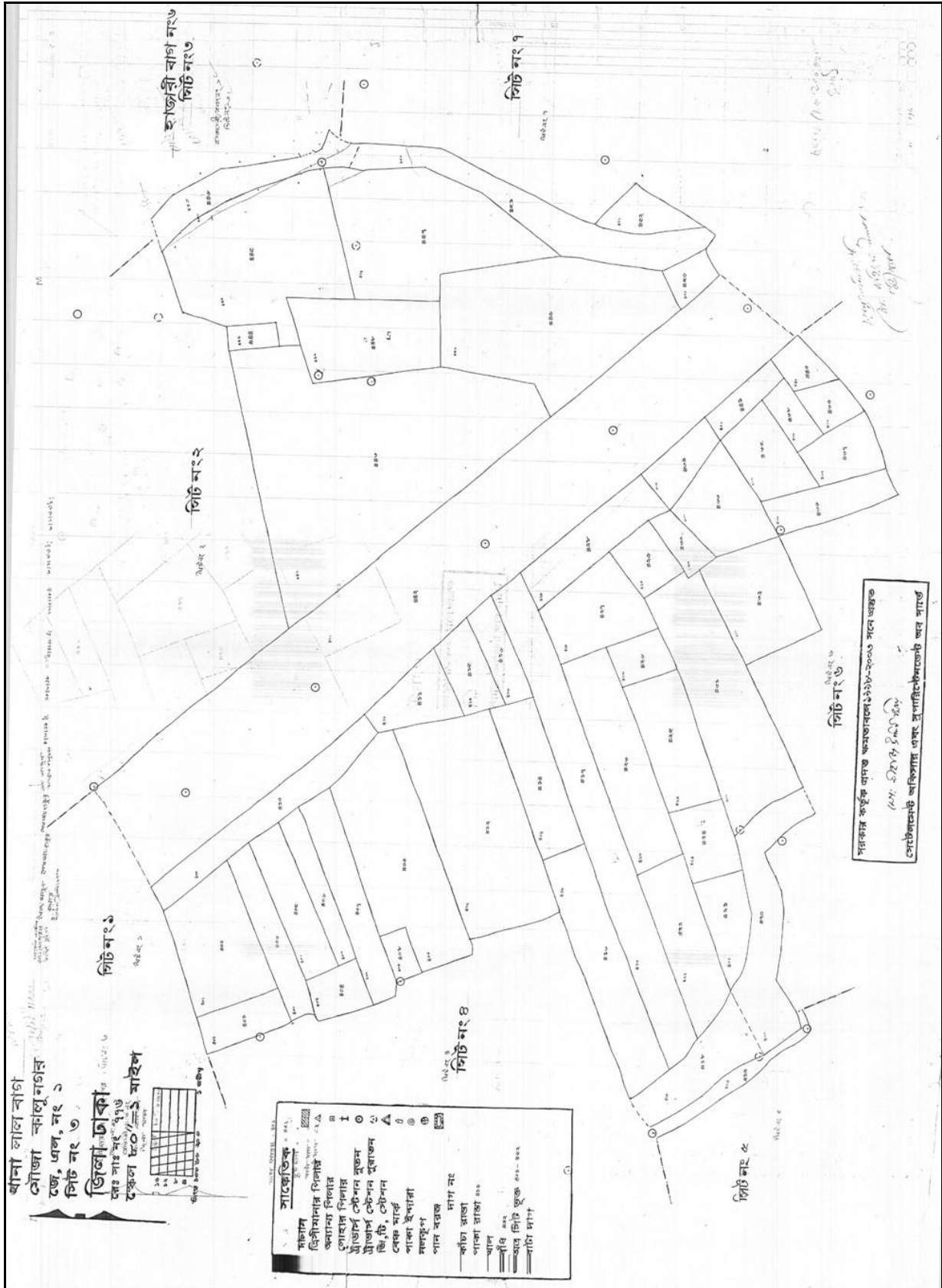


Figure 4-8: City Census Cadastral Map from DLRS

4.4 Cadastral Map Collection and Geo-processing

For identification of ROW along the western embankment (from Gabtoli area to Babu bazar bridge) cadastral maps were collected from DLRS office. The cadastral maps were produced in the year 1998-2004 by DLRS. About 50 mouza maps along western embankment were collected to check the present land status along western embankment. The Right of Way (ROW) of western embankment from Gabtoli area to Babu bazar bridge is under different thana and different mouza. There are four thanas which are found in this present study such as Lalbagh, Mohammadpur, Dhanmondi, Mirpur. There are different mouzas under four thanas namely Hazaribagh, Char Kamrangi, Enayetganj & Kalunagar mouza under Lalbagh thana, Ramchandrapur, Katasur, Soraijafrabad & Mohammadpur Abasik Elaka mouza under Mohammadpur Thana, Dakshin Sona Tengor, Uttor Sona Tengor & Rajmushuri mouza under Dhanmondi Thana and Mirpur mouza under Mirpur Thana. All these collected mouza maps were then scanned in the same scale for geo-referencing in Arc-GIS. Geo-referencing of the mouza maps were done carefully and compared with different existing GIS information. After Geo-referencing it has been found that the extent of ROW beyond the existing road on both sides varies place to place and it is approximately 40-60m. Figure 4-9 shows a geo-referenced cadastral map. It also highlights the extent of ROW along the embankment in different locations. Annex is provided with detail map of ROW along the embankment. It has to be mentioned the accuracy of the ROW extent can be improved with further spot verification, which outside the scope of this project. Cadastral mapping along the western embankment of Dhaka city is given in another volume named **Outline Drawing**.



Figure 4-9: Geo-processed Cadastral Map from DLRS

5 Assessment of Supply Area

Water Supply Master Plan (WSMP) project of DWASA estimated demand for each sector as well as DMA of Dhaka city. Demand in WSMP was calculated using average Thana population density. However for this study, potential growth pattern has been investigated for existing major vacant/unoccupied land (e.g. play ground, developing area, markets, etc) within each Thana. This was done by analysis of images, proposed landuse, road network and nature of surrounding area. For example, 0.9 sq. km. area will be remaining as open land in Dhanmondi Thana (Table 5.1). It has been assumed that 50% of developing area will unoccupied in 2020 and 25% of the developing area will be unoccupied in 2025 and by 2030 all developing area will be occupied. Calculation of vacant/unoccupied land and identifications of trend of development were just an assumption by engineering and professional knowledge, which is sufficient for planning purpose. However, actual value can be estimated by detail field survey and consultation with stakeholders.

Table 5.1: List of main Area where potential growth pattern investigated

Thana	Area Identified (sq. km.)	Description	Area Developed in 2015 (sq. km.)	Area will be Remain empty in Future (sq. km.)	Remain Area to Develop (sq. km.)
Dhanmondi	0.52	Pilkhana	0.21	0.31	
	0.30	Lake and Park	0.00	0.30	
	0.42	New Market/Collage	0.21	0.21	
	0.07	Science Laboratory	0.03	0.03	
	0.05	Play Ground		0.05	
Hazaribagh	0.85	Developing Area	0.17	0.00	0.68
	0.15	Water Body		0.15	
Kafrul	1.50	Old Airport	0.30	1.20	
Lalbagh	0.06	Grave Yard	0.01	0.05	
	0.60	Collage/Staff Quarter	0.30	0.30	
	0.08	Jail	0.04	0.04	
	0.06	Lalbagh Fort	0.01	0.06	
	0.20	Water Body		0.20	
Mirpur	0.80	Kallanpur Retention Pond	0.00	0.80	1.97
	0.57	Collage and Surrounding Area	0.20	0.37	
	0.23	Developing Area	0.06	0.00	
	2.11	Developing Area	0.32	0.00	
Mohammadpur	3.17	Developing Area Outside Embankment and DMA	0.79	0.00	2.38
	0.33	Grave Yard		0.33	
	0.70	Water Body and Outside of River		0.70	
	0.13	Residential Model		0.13	

Total area of Padma North-West sector is 50.2 sq. km, which become 47.2 sq. km if permanent open land considered (Table 5.2). Population density has been recalculated based

on modified area (open land and development trend). Analysis showed that weighted average density of the sector in 2020 will be about 64,000 /sq. km. However in areas within DMA this value will be about 90,000 /sq. km in 2020.

Overall system demand of the sector will be about 540 MLD in 2020, which will rise to 697 MLD in 2035. For areas within DMA, system demand is 424 MLD in 2020 and 479 MLD in 2035 (Table 5.2).

Table 5.2: Total Sector Area and Average Population Density

Location	Total Area (sq.km.)	Area without Permanent Open Land (sq. km.)	Weighted Average Population Density (Person/Sq. Km.)				Total System Demand (MLD)			
			2020	2025	2030	2035	2020	2025	2030	2035
DMA	25.1	24.4	90,034	96,065	101,337	108,124	424	431	443	479
Outside Embankment	25.0	22.8	36,923	42,257	48,517	57,479	116	144	178	218
Grand Total/Average	50.2	47.2	64,339	70,033	75,783	83,622	540	575	621	697

5.1 System Demand Assessment

Demand of DMA in Zone-1

Four DMA's of Zone-1 will be in this sector. Total area of these four DMA is 2.5 sq. km. Total system demand of this part of the sector will be about 47 MLD in 2020 and about 54 MLD in 2035 (Table 5.3). Therefore, about 7 MLD additional water will be required for this area in 15 years.

Table 5.3: System Demand in Zone-1 of Padma North-West Sector

DMA ID	Area (sq.km)	System Demand			
		2020	2025	2030	2035
113	0.55	11.1	10.9	10.8	11.2
114	0.39	8.0	7.9	7.9	8.1
115	0.67	12.7	12.8	12.9	13.6
117	0.93	14.8	16.9	18.5	20.8
Total	2.54	46.6	48.4	50.1	53.6

Demand of DMA in Zone-2

Ten DMA's of Zone-2 will be in this sector. Total area of these ten DMA is 5.4 sq. km. Total system demand of this part of the sector will be about 117 MLD in 2020 and about 120 MLD in 2035 (Table 5.4). Therefore, about 3 MLD additional water will be required for this area in 15 years.

Table 5.4: System Demand in Zone-2 of Padma North-West Sector

DMA ID	Area (sq.km)	System Demand			
		2020	2025	2030	2035
201	0.51	4.4	4.3	4.1	4.2
202	0.8	7.2	7.5	7.9	8.6
204	0.82	7.1	6.8	6.6	6.8
205	0.37	10.8	10.7	10.7	11.1
210	0.49	16.4	16.2	16.2	16.9
211	0.56	16.6	16.4	16.5	17.1
212	0.44	12.7	12.5	12.6	13.0
213	0.32	9.3	9.1	9.1	9.4
214	0.43	14.1	13.9	14.0	14.5
215	0.68	18.6	18.3	18.3	18.8
Total	5.42	117.2	115.6	116	120.4

Demand of DMA in Zone-3

Nine DMAs of Zone-3 will be in this sector. Total area of these nine DMA is 6.6 sq. km. Total system demand of this part of the sector will be about 106 MLD in 2020 and about 122 MLD in 2035 (Table 5.5). Therefore, about 16 MLD additional water will be required for this area in 15 years.

Table 5.5: System Demand in Zone-3 of Padma North-West Sector

DMA ID	Area (sq.km)	System Demand			
		2020	2025	2030	2035
301	0.51	8.9	9.0	9.2	10.2
302	0.66	11.4	11.6	11.8	13.1
303	0.88	15.3	15.5	15.9	17.5
305	0.37	6.4	6.5	6.7	7.4
306	0.39	6.9	7.0	7.1	7.9
307	0.67	11.8	12.0	12.2	13.5
309	0.54	5.2	5.0	4.9	5.2
310	0.79	11.5	11.9	12.3	13.6
315	0.2	2.0	2.1	2.2	2.4
Total	6.55	106.3	107.8	110.4	121.7

Demand of DMA in Zone-4

Four DMAs of Zone-4 will be in this sector. Total area of these four DMA is 7.5 sq. km. Total system demand of this part of the sector will be about 112 MLD in 2020 and about 132 MLD in 2035 (Table 5.6). Therefore, about 20 MLD additional water will be required for this area in 15 years.

Table 5.6: System Demand in Zone-4 of Padma North-West Sector

DMA ID	Area (sq.km)	System Demand			
		2020	2025	2030	2035
405	1.8	25.7	26.3	27.2	29.9
406	2.52	38.8	40.2	42.0	46.1
407	1.73	23.7	24.3	25.2	27.6
408	1.42	23.6	24.3	25.4	27.9
Total	7.47	111.9	115.1	119.8	131.5

Demand of DMA in Zone-10

Three DMAs of Zone-10 will be in this sector. Total area of these DMAs is 3.2 sq. km. Total system demand of this part of the sector will be about 42 MLD in 2020 and about 51 MLD in 2035 (Table 5.7). Therefore, about 9 MLD additional water will be required for this area in 15 years.

Table 5.7: System Demand in Zone-10 of Padma North-West Sector

DMA ID	Area (sq.km)	System Demand			
		2020	2025	2030	2035
1004	0.42	1.7	1.9	2.0	2.3
1005	0.77	9.1	9.5	10.2	11.1
1006	1.98	30.8	32.4	34.5	37.9
Total	3.17	41.6	43.8	46.7	51.3

Demand Assessment in Areas Outside Embankment

Area between western embankment and Buriganga River and part of Keraniganj Thana will be part of Padma North-West sector. This part of the sector is mostly developing area. Total area outside embankment is about 25 sq. km. System demand for this part of area of sector will be 116 MLD in 2020 (Table 5.8). However, this demand will rise to 218 MLD in 2035. Therefore, 102 MLD additional demand will be generated in 15 years.

Table 5.8: System Demand for Outside of DMA of Padma North-West Sector

Thana	Area (sq.km)	System Demand			
		2020	2025	2030	2035
Kamrangir Char	3.24	27.2	31.5	36.8	44.3
Mirpur	1.47	10.3	10.5	10.9	11.9
Mohammadpur	4.27	35.9	46.9	58.8	65.1
Hazaribagh	2.21	15.0	15.8	16.6	17.1
Keraniganj (along Buriganga)	13.6	28.0	39.3	55.2	79.8
Total	25.03	116	144	178	218

5.2 Supply Scenario Strategy of Padma North-West Sector

Currently DMA-308 and DMA-314 of Saidabad West-East sector have not receiving sufficient water supply. Therefore, two nodes from Padma North-West sector will keep for supplying water to this two DMA. One node with 7 MLD will supply water to DMA-308 and another node with 5.4 MLD will supply water to DMA-314. This node can be remaining closed when Saidabad Phase-III SWTP commenced and water can be supply in other area of Padma North-West sector.

Supply-Demand Strategy in DMA of Zone-1

This part of the sector is highly dense area of Dhaka city and it is very difficult to carry construction works in this part. Therefore, it has been decided to supply 46.6 MLD water from surface water in this part, which is 100% demand of 2020 (Table 5.9). Deficiency in water supply in 2035 in this part will be about 7 MLD. This additional future demand can be meet by closing the node which will supply water to DMA-308/DMA-14 in 2020, or from ground water. Alternatively, Chadnighat water treatment plant can be upgraded and additional treated water can be served in this part of the sector. In this study, it is assumed that production capacity of Chadnighat WTP is 12 MLD.

Table 5.9: Demand-Supply Scenarios of Zone-1 of Padma North-West Sector

DMA ID	Area (sq.km)	System Demand				Supply from SWTP				Ground water			
		2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
113	0.55	11.1	10.9	10.8	11.2	11.1	11.1	11.1	11.1	0.0	0.2	0.3	0.1
114	0.39	8.0	7.9	7.9	8.1	8.0	8.0	8.0	8.0	0.0	0.1	0.1	0.1
115	0.67	12.7	12.8	12.9	13.6	12.7	12.7	12.7	12.7	0.0	0.1	0.2	0.9
117	0.93	14.8	16.9	18.5	20.8	14.8	14.8	14.8	14.8	0.0	2.1	3.7	6.0
Total	2.54	46.6	48.4	50.1	53.6	46.6	46.6	46.6	46.6	0.0	1.8	3.5	7.0
Percentage of SW						100%	96%	93%	87%				

Supply-Demand Strategy in DMA of Zone-2

About 111 MLD water will be served in this part of the sector, which is 95% of total system demand in 2020. Deficiency of this part of the sector will be 6.3 MLD in 2020 and 9.5 MLD in 2035 (able 5.10). This deficiency can be makeup by groundwater. Alternatively, Chadnighat water treatment plant can be upgraded and additional treated water can be served in this part of the sector.

Table 5.10: Demand-Supply Scenarios of Zone-2 of Padma North-West Sector

DMA ID	Area (sq.km)	System Demand				Supply from SWTP				Ground water			
		2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
201	0.51	4.4	4.3	4.1	4.2	3.3	3.3	3.3	3.3	1.1	1.0	0.8	0.9
202	0.8	7.2	7.5	7.9	8.6	7.2	7.2	7.2	7.2	0.0	0.3	0.7	1.4
204	0.82	7.1	6.8	6.6	6.8	5.9	5.9	5.9	5.9	1.2	0.9	0.7	0.9
205	0.37	10.8	10.7	10.7	11.1	10.2	10.2	10.2	10.2	0.6	0.5	0.5	0.9
210	0.49	16.4	16.2	16.2	16.9	15.5	15.5	15.5	15.5	0.9	0.7	0.7	1.4
211	0.56	16.6	16.4	16.5	17.1	15.7	15.7	15.7	15.7	0.9	0.7	0.8	1.4
212	0.44	12.7	12.5	12.6	13.0	12.0	12.0	12.0	12.0	0.7	0.5	0.6	1.0
213	0.32	9.3	9.1	9.1	9.4	9.1	9.1	9.1	9.1	0.2	0.0	0.0	0.3
214	0.43	14.1	13.9	14.0	14.5	13.4	13.4	13.4	13.4	0.7	0.5	0.6	1.1
215	0.68	18.6	18.3	18.3	18.8	18.6	18.6	18.6	18.6	0.0	0.3	0.3	0.2
Total	5.42	117.2	115.6	116	120.4	110.9	110.9	110.9	110.9	6.3	4.7	5.1	9.5
Percentage of SW						95%	96%	96%	92%				

Supply-Demand Strategy in DMA of Zone-3

About 91 MLD water will be served in this part of the sector, which is 86% of total system demand in 2020. Deficiency of this part of the sector will be 15.1 MLD in 2020 and 30.5 MLD in 2035 (Table 5.11). This deficiency will be fulfilled by groundwater. Alternatively, Chadnihat water treatment plant can be upgraded and additional treated water can be served in Zone-2 and Zone-1. Surplus water from Zone-2 and Zone-1 can be distributed in DMA of Zone-3.

Table 5.11: Demand-Supply Scenarios of Zone-3 of Padma North-West Sector

DMA ID	Area (sq.km)	System Demand				Supply from SWTP				Ground water			
		2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
301	0.51	8.9	9.0	9.2	10.2	7.8	7.8	7.8	7.8	1.1	1.2	1.4	2.4
302	0.66	11.4	11.6	11.8	13.1	10.1	10.1	10.1	10.1	1.3	1.5	1.7	3.0
303	0.88	15.3	15.5	15.9	17.5	13.5	13.5	13.5	13.5	1.8	2.0	2.4	4.0
305	0.37	6.4	6.5	6.7	7.4	6.0	6.0	6.0	6.0	0.4	0.5	0.7	1.4
306	0.39	6.9	7.0	7.1	7.9	5.7	5.7	5.7	5.7	1.2	1.3	1.4	2.2
307	0.67	11.8	12.0	12.2	13.5	10.0	10.0	10.0	10.0	1.8	2.0	2.2	3.5
309	0.54	5.2	5.0	4.9	5.2	4.0	4.0	4.0	4.0	1.2	1.0	0.9	1.2
310	0.79	11.5	11.9	12.3	13.6	10.1	10.1	10.1	10.1	1.4	1.8	2.2	3.5
315	0.2	2.0	2.1	2.2	2.4	2.0	2.0	2.0	2.0	0.0	0.1	0.2	0.4
Total	6.55	106.3	107.8	110.4	121.7	91.2	91.2	91.2	91.2	15.1	16.6	19.2	30.5
Percentage of SW						86%	85%	83%	75%				

Supply-Demand Strategy in DMA of Zone-4

About 104 MLD water will be served in this part of the sector, which is 93% of total system demand in 2020. Deficiency of this part of the sector will be 8.3 MLD in 2020 and 27.9 MLD

in 2035 (Table 5.12). This deficiency will be fulfilled by groundwater. Alternatively, Chadnihat water treatment plant can be upgraded and additional treated water can be served in Zone-2 and Zone-1. Surplus water from Zone-2 and Zone-1 can be distributed in DMA of Zone-4.

Table 5.12: Demand-Supply Scenarios of Zone-4 of Padma North-West Sector

DMA ID	Area (sq.km)	System Demand				Supply from SWTP				Ground water			
		2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
405	1.8	25.7	26.3	27.2	29.9	24.0	24.0	24.0	24.0	1.7	2.3	3.2	5.9
406	2.52	38.8	40.2	42.0	46.1	36.6	36.6	36.6	36.6	2.2	3.6	5.4	9.5
407	1.73	23.7	24.3	25.2	27.6	22.0	22.0	22.0	22.0	1.7	2.3	3.2	5.6
408	1.42	23.6	24.3	25.4	27.9	21.0	21.0	21.0	21.0	2.6	3.3	4.4	6.9
Total	7.47	111.9	115.1	119.8	131.5	103.6	103.6	103.6	103.6	8.3	11.5	16.2	27.9
Percentage of SW						93%	90%	86%	79%				

Supply-Demand Strategy in DMA of Zone-10

About 38 MLD water will be served in this part of the sector, which is 92% of total system demand in 2020. Deficiency of this part of the sector will be 3.3 MLD in 2020 and 13 MLD in 2035 (Table 5.13). This deficiency will be fulfilled by groundwater. Moreover, Water Supply Master Plan kept provision to supply water in this part of the sector from Char Ghandharbapur Phase-I. Therefore, after commencement of Char Ghandharbapur Phase-I deficiency of this part can be partly makeup.

Table 5.13: Demand-Supply Scenarios of Zone-10 of Padma North-West Sector

DMA ID	Area (sq.km)	System Demand				Supply from SWTP				Ground water			
		2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
1004	0.42	1.7	1.9	2.0	2.3	1.7	1.7	1.7	1.7	0.0	0.2	0.3	0.6
1005	0.77	9.1	9.5	10.2	11.1	8.1	8.1	8.1	8.1	1.0	1.4	2.1	3.0
1006	1.98	30.8	32.4	34.5	37.9	28.5	28.5	28.5	28.5	2.3	3.9	6.0	9.4
Total	3.17	41.57	43.8	46.74	51.28	38.3	38.3	38.3	38.3	3.3	5.5	8.4	13.0
Percentage of SW						92%	87%	82%	75%				

Supply Scenario Strategy in areas outside of Embankment

About 59 MLD water will be served in this part of the sector, which is 51% of total system demand in 2020. Deficiency of this part of the sector will be 57 MLD in 2020 and 159 MLD in 2035 (Table 5.14). This deficiency will be fulfilled by groundwater. If water quality of Buri Ganga River can be improved than another small water treatment plant can be constructed to supply water in this part of the sector.

Table 5.14: Demand-Supply Scenarios for Area's Outside of Embankment

Thana	Area (sq.km)	System Demand				Supply from SWTP				Ground water			
		2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
Kamrangir Char	3.24	27.2	31.5	36.8	44.3	16.0	16.0	16.0	16.0	11.2	15.5	20.8	28.3
Mirpur	1.47	10.3	10.5	10.9	11.9	0.0	0.0	0.0	0.0	10.3	10.5	10.9	11.9
Mohammadpur	4.27	35.9	46.9	58.8	65.1	20.0	20.0	20.0	20.0	15.9	26.9	38.8	45.1
Hazaribagh	2.21	15.0	15.8	16.6	17.1	8.0	8.0	8.0	8.0	7.0	7.8	8.6	9.1
Keraniganj (along Buriganga)	13.6	28.0	39.3	55.2	79.8	15.0	15.0	15.0	15.0	13.0	24.3	40.2	64.8
Total	25.03	116	144	178	218	59	59	59	59	57	85	119	159
Percentage of SW						51%	41%	33%	27%				

5.3 Summary of Supply Scenario Strategy in Padma North-West Sector

Total production from surface water treatment plant for Padma North-West sector will be 462 MLD, in which 450 from Jashaldia water treatment plant and 12 from Chadnighat water treatment plant. It has been decided to deliver 12 MLD water from this sector to Saidabad East-West sector. However, 83% of total system demand of 2020 will be fulfilled by surface water treatment plant. Deficiency of this will be 90 MLD in 2020 and 247 MLD in 2035 (Table 5.15). This deficiency will be fulfilled by groundwater, improvement of Chadnighat treatment plant (if feasible), implement of new small treatment plant if Buriganga River water quality improved and supplementary supply from Khilkhet sector.

Table 5.15: Summary of Demand-Supply Scenarios for Padma North-West Sector

Location	Area (Sq. km)	System Demand				Supply from SWTP				Ground water			
		2020	2025	2030	2035	2020	2025	2030	2035	2020	2025	2030	2035
DMA	25.2	424	431	443	479	391	391	391	391	33	40	52	88
Outside Embankment	25.0	116	144	178	218	59	59	59	59	57	85	119	159
Total	50.2	540	575	621	697	450	450	450	450	90	125	172	247
Percentage of SW						83%	78%	72%	65%				

6 Alignment of pipe line

6.1 Coverage Area and Route

Treated water from Padma SWTP Phase-I will be supplied to the Padma North-West sector. To distributed water just after injection point the main primary distribution line will follow the western flood protection embankment. The water will be distributed at different points on the way to Mirpur area. One another primary main will be stated from Babu Bazar and it will distribute water to the existing transmission and distribution main of Chadnighat Water Treatment Plant. The line will follow Islampur, Patuatuly, Sadarghat, Baglabazar, Rupla-Dash Lane to Gandaria. The nodal distribution quantity has been calculated based on the present and future population of year 2035. The distribution nodes of Padma North-West sector has been show in Figure 3.2.

Treated water from the Padma water treatment plant will be injected at Mitford point. From Mitford water will be distributed to the different points of the Padma North West sectors. The existing roads & lanes of the Padma sectors are narrow particularly in the old part of the city. More over the roads & lanes are remained busy throughout the day & night. In the day times roads are basically busy with the rickshaws & light vehicles. But in the night time a numbers of trucks are entered into the old part of the city, for transportations of the goods as this part of the city is a trade centre. Considering the problems stated above the route of the primary distribution mains has been selected. The details of the proposed routes are described below as segment wise (Figure 6-1) for better understanding:

6.1.1 Segment-1

From the injection point water line will follow the Western Flood protection embankment up to Gabtoli point (Figure 6-1). On the way to Gabtoli the water will be distributed at 13 points. The pipe diameter will be 1,800mm at injection point and will be reduced after depending on the distribution of water on its way to Gabtoli.

The segment-1 is 1800mm diameter water main from injection point (near Midford Hospital water pump/ Babu Bazar bridge) to Bhagalpur Lane intersection (from intake point to distribution node 5) along western flood protection embankment. This segment supplies water to DMA nos. 214, 211, 210 and Kamrangir Char area. Water will be supplied to DMA nos. 214, 211 & 210 through distribution node 1, 2 & 3 respectively. There have been kept provision to supply water to Kamrangirchar area through distribution node 4 & 5. In segment-1, 1800mm distribution mains will be laid on the embankment road in the country side. About 4 nos. sluice gate and 11 nos. other structure (Flap gate) are found in this segment. At Bhagalpur Lane intersection, 1800 mm diameter pipe will be reduced and will be divided into two parts. One part follows Bhagalpur lane totalitmohon das lane to BGB gate-1 (Segment-3) and another part follows western flood protection embankment (Segment-2).

6.1.2 Segment-2

Segment-2 is 1600mm diameter water line from Bhagalpur lane intersection to Basila road intersection. This segment supplies water to some part of Mohammadpur, Hazaribagh, New housing (Chad housing). The DMA nos. 204, 201, 309 are covered from this segment. Water will be supplied to DMA nos. 201, 204, 309&Hazaribagh area (riverside of embankment) through distribution node 8, 6, 9& 7 respectively. There have been kept provision to connect two injection point of DMA 307 & 309 through parallel pipe of 200 mm diameter. At Basila intersection, 1600 mm water main will be divided into three parts. One part (600 mm) follows embankment road (Segment-4), 600 mm water mains follow Basila road and another part follows new constructed road which has connected Basila road intersection with Mohammadpur Bus Station then continue along Ring road to Shamoli Cinema Hall(Segment-5). Four numbers distribution nodes have been provided for distributing water to western part of the embankment for the areas like Kamrangir Char, Shikdar Housing area, Dhaka Housing area and Bosila areas, by assuming that this embankment will be treated as main road of the western part and distribution system will have to be extended to those areas.

6.1.3 Segment-3

This segment will distribute water to DRA, Lalmatia, Mohammadpur & adjacent areas. This segment continues from Bhagalpur road intersection to Lalit Mohon Das Lane to BGB Gate-1 to Gate-3 to Gate-4 then continue along Sat Masjid Road upto Mohammadpur bus station (from distribution node 5 to 5J). The diameter of water mains from Bhagalpur Lane (from node 5 to 5D) is 800 mm which reduced to 400 mm at the end of this segment. From BGB Gate-4 (near Simanto Square) a 800 mm diameter pipe will connect with Saidabad pipe line near Science Laboratory Police Box. It can be stated that as distribution arrangement has already provided at node 26 of Saidabad main. Therefore, without disturbing the network, this connection can be used. This will help to transfer water from one system to another if necessary. From node 5D to 5F, diameter of water mains is 600 mm and from 5F to 5J, diameter is 500 mm. This segment supplies water to DMA nos. 205, 202, 315, 310, 307, 306 and 308 (Saidabad), 314 (Saidabad) and their adjacent areas with some distribution nodes. Water will be supplied to DMA nos. 205&202 through distribution node 5A&5B respectively. Water will be supplied to DMA nos. 315&310 through distribution node 5C&5D respectively. Water will be supplied to DMA nos. 307 through distribution node 5F&5G. Water will be supplied to DMA nos. 306 through distribution node 5H&5J. Water will be supplied to DMA nos. 308 of Saidabad network through distribution node 5E&5G. Water will be supplied to DMA nos. 314 of Saidabad network through distribution node 5I. There have been kept provision to connect other injection point of DMA 310 & 315 through parallel pipe of 200 mm diameter.

6.1.4 Segment-4

This segment is from Basilaroad intersection to Kallanpur pump station (to distribution node 10E). On its way to Gabtoli, water will be distributed to near way localities with some distribution nodes. From Basila road intersection to distribution node 10C, diameter of water mains is 600 mm and from 10C to 10E, diameter of water mains is 400 mm. This segment supplies water to DMA nos. 305, 304, 302. Water will be supplied to DMA nos. 305, 301 & 302 through distribution node 5B, 5D & 5E respectively. There have been kept a distribution node 5C to supply water riverside of the embankment (flood plain) where settlement is increasing day by day.

6.1.5 Segment-5

1200 mm diameter water mains from Basila road intersection to Mohammapur bus stop to Shia mosque to Shamoli (along ring road) intersection. This segment supplies water to DMA no. 305, 301, 302 & 303. Water will be supplied to DMA nos. 305 & 301 through distribution node 11 & 12 respectively. There have been kept provision to connect other injection point of DMA 301 & injection point of 302 & 303 through parallel pipe line of 200 mm diameter. There have been a provision to connect with 400mm diameter pipe laid on Satmasjid Road (from segment-3) near Mohammapur bus stop. At shamoli, water main is divided into two parts. One part follows Mirpur road (segment-6) and another part follows Sayed Mahbub Morshed Ave to Shahid Shahabuddin Road to Kamal Sarani Road (segment-7).

6.1.6 Segment-6

Saidabad Primary main from Mirpur-Agargaon point to Dar-us-Salam (Technical morh) road has been proposed to include in the Padma North-West network. To isolate this part of the network from Saidabad, a butterfly valve in Mirpur road at the south of the junction point of Agargaon & Mirpur road need to be installed. This segment is actually the existing 1000mm diameter pipe of Saidabad network from Shamoli (near Shishumela) to Technical morh. From Technical morh to distribution node 13F, the diameter of pipe line is 600mm which needs to be constructed and from distribution node 13F to 13I, the diameter of pipe line is 450 mm which is existing. Both the existing pipe lines will be disconnected from Saidabad network and will be under Padma North-West sector. There is a provision to connect Padma North West sector network with Saidabad network near Shamoli Shishumela. This segment supplies water to DMA nos. 303, 407, 405 with some distribution nodes through different distribution nodes in accordance with DMA injection point.

6.1.7 Segment-7

This segment is from Shamoli (near Shishumela) through Sayed Mahbub Morshed Sarani to Shahid Shahabuddin road, then this segment is divided into two parts. From Agargaon Road, a new road has been developed up to BIBM (Mirpur-2) which is Kamal Sarani Road (60 ft road). One part of 500 mm diameter distribution main will follow Kamal Sarani Road (60 ft road) up to Monipur. From this part, there have been kept provision of distribution node to supply water to DMA nos. 408, 407 & 406 in consistence with DMA injection point. Another

part of 800 mm diameter distribution main will follow Shahid Shabuddin sorok to Statistics road to Begum Rokeya Ave. On its way to Mirpur circle 10, the water will be distributed to Kazipara, Part of Pirerebag & part of Monipur & their adjacent areas. From Kaziparabus station, a branch of transmission line follows Kazipar Madrasha road to Ibrahimpur Bazar road to Kachuket road to supply water to Ibrahimpur and Kafrul area. Along this segment, from distribution node 14 to 15A, the diameter of water main is 1000 mm, from distribution node 15A to 18, the diameter of water main is 800 mm, from distribution node 18 to Kachukhet road, the diameter of water main is 500 mm and rest of the distribution network is 400mm diameter. There are no need to provide distribution node for all DMA injection point as there is already existing 450 mm pipeline along Begum Rokeya Ave. This segment supplies water to DMA nos. 408, 406, 1006, 1005, 1004 with some distribution nodes in consistence with DMA injection point. There is a provision to connect Padma North West sector network with proposed Char Gandhabpur network of Khilkhet sector near Shadheenata sharoni. There is also another provision to connect Padma North West sector network with Singair network near Mirpur-10 junction.

6.1.8 Segment-8

This segment continues from injection point (near Midford Hospital water pump) to Naya Bazar bus station to Dholaikhal road, then Murgitola bus stop to Kather pool bus stop to Sutrapur bus stop then continues along Keshab Banarjee road and Satish Sarkar road. From the injection point at Mitford a 1000 mm diameter pipe will be laid up to Mitford road & a part of the water will be distributed to the primary main of Chadnighat Water treatment plant for the improvement of water supply condition of Armanitola, Begum Bazar, Moulavi Bazar, Nazira Bazar & their adjoining areas.

Existing 600mm diameter pipeline from Saidabad network will be disconnected at Naya Bazar bus station and will be included in Padma sector Existing

Existing 500mm pipe laid for Chadnighat WTP from Chadnighat will be disconnected at Islampur road and will be connected with Padma North west sector. These distribution mains will distribute water to the adjacent areas of Patopatoly, Islampur, Farashganj, Luxmi Bazaar, Gandaria, Postagola & their adjoining areas.

This segment supplies water to DMA nos. 213, 215, 113, 114, 115 & 117. Water will be supplied to DMA nos. 213 through distribution node 21A & 21B. Water will be supplied to DMA nos. 215 through distribution node 22A & 22B. Water will be supplied to DMA nos. 113 through distribution node 23A & 23B. Water will be supplied to DMA nos. 114 through distribution node 24. Water will be supplied to DMA nos. 213 through distribution node 21A & 21B. Water will be supplied to DMA nos. 115 & 117 through distribution node 25A, 25B & 26A, 26B respectively. From existing line of chadnighat which is included in Padma North West sector will supply water to DMA no. 212 from two nodes. There is a provision to connect Padma North west sector network with Saidabad network near Naya bazar bus stop.

It may be pointed out here that the locations of the distribution nodes to the areas stated above have been selected based on the DMA established by the DMC consultants working under DWSSDP project.

Furthermore, In the near future, Keraniganj will be developed as the part of the city. DWASA will have no alternative rather to include this area under its jurisdiction. Water supply in the projects such as Jhilmil, Basundhara river view, Priangan and South Town will be the prime importance of DWASA. Moreover, Keraniganj Upazila town also needs planned water supply and sanitation. Under the circumstances stated above, 4 (Four) numbers of distribution nodes for Keraniganj area have been provided during preparation of the feasibility study of the Pagla/Keraniganj WTP projects. Approximately 15 MLD of water will be distributed to those areas & this distribution will be made before injecting the water at Mitford point. Another volume named “**Outline Drawing**” has been provided along with this main report for better understanding of the plan of distribution line and nodes.

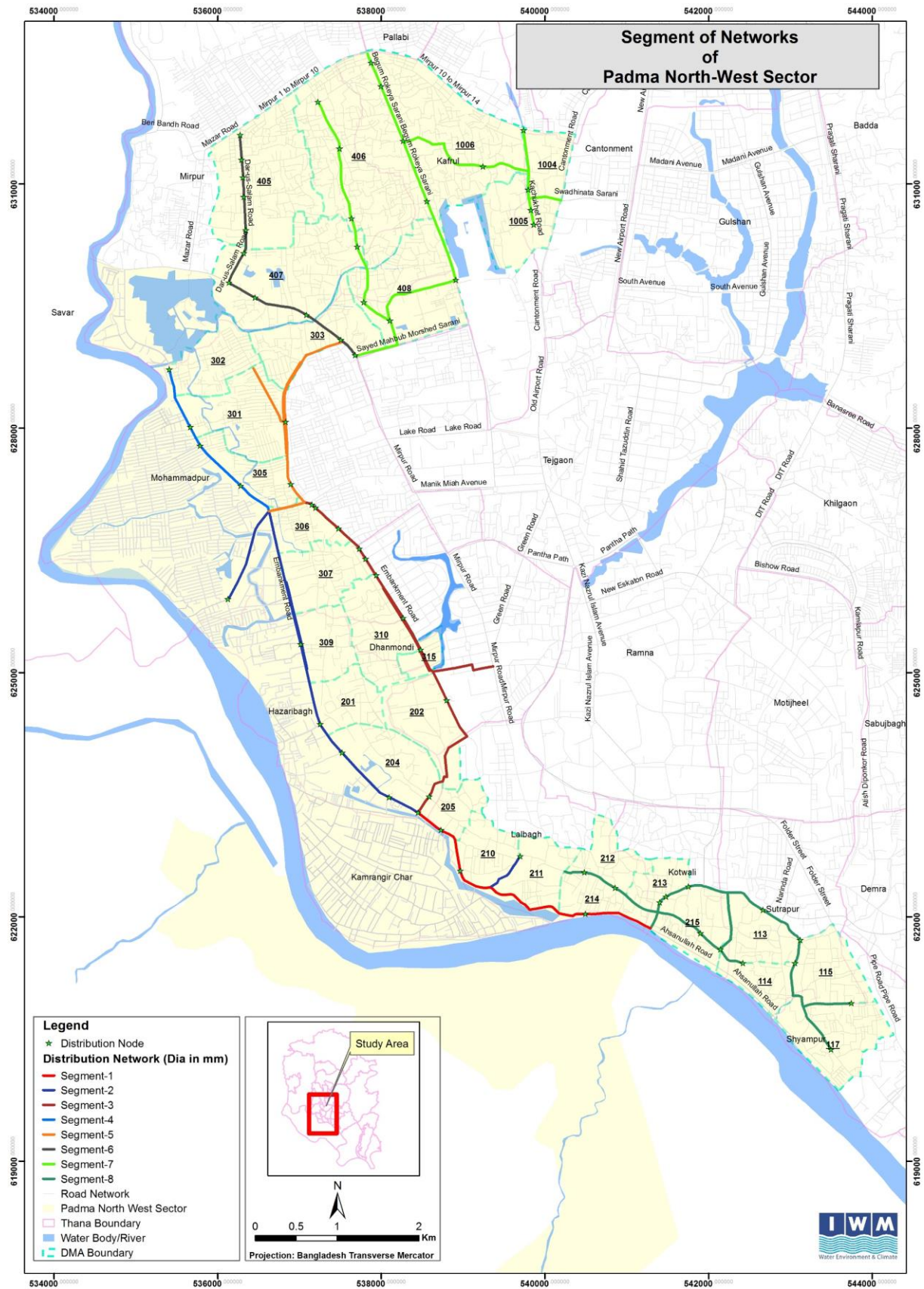


Figure 6-1: Segment of Primary Distribution Network of Padma North-West Sector

6.2 Evaluation of Alternate Routes

6.2.1 Criteria of Selection for Primary & Secondary Distribution Route

Route of primary and secondary distribution networks have been selected based on following consideration:

- Avoiding areas which are presently supplying by the existing surface water treatment plant and the areas which will be supplied by other sources which are under construction or proposed sources
- Avoid land acquisition
- Minimum under and above ground obstruction
- Minimum disturbance of traffic movement
- Straightness of pipe line to minimize head loss
- Distribution of water with minimum number of sub-distribution node
- To bring the area under this network which are presently suffering acute shortage of water
- Follow wider roads so that the line can be laid by not disturbing existing other utilities network

6.2.2 Issues along Western Flood Protection Embankment (beribadh):

The main concern for this area is whether to construct the pipe on the embankment or outside the embankment. There may be issues of embankment failure if the construction is not done properly. There is a wide ROW available along the embankment which can be used to construction of the pipe. However, these available lands are mostly occupied by unauthorized settlements with permanent and temporary structures. Some points from field visit for this area are:

- Settlement/Land filling activities in both country side and river side along the embankment are on-going in most of the places.
- A new wide road (approx. 6m) opposite direction of the Basilla road is being constructed by Bangladesh Army connecting Shadargat-Gabtoli Beribadh road to Mohammadpur bus station which may be an alternative options for distribution
- The Bhalgalpur lane along which 800mm pipe has been proposed is a wide road
- There are several bridges on the river side of the embankment like kamrangirchar baily bridge
- At some places, along the western Dhaka flood protection embankment on the river side there are khals, so for distribution network on the river side special arrangement needed to cross the khals

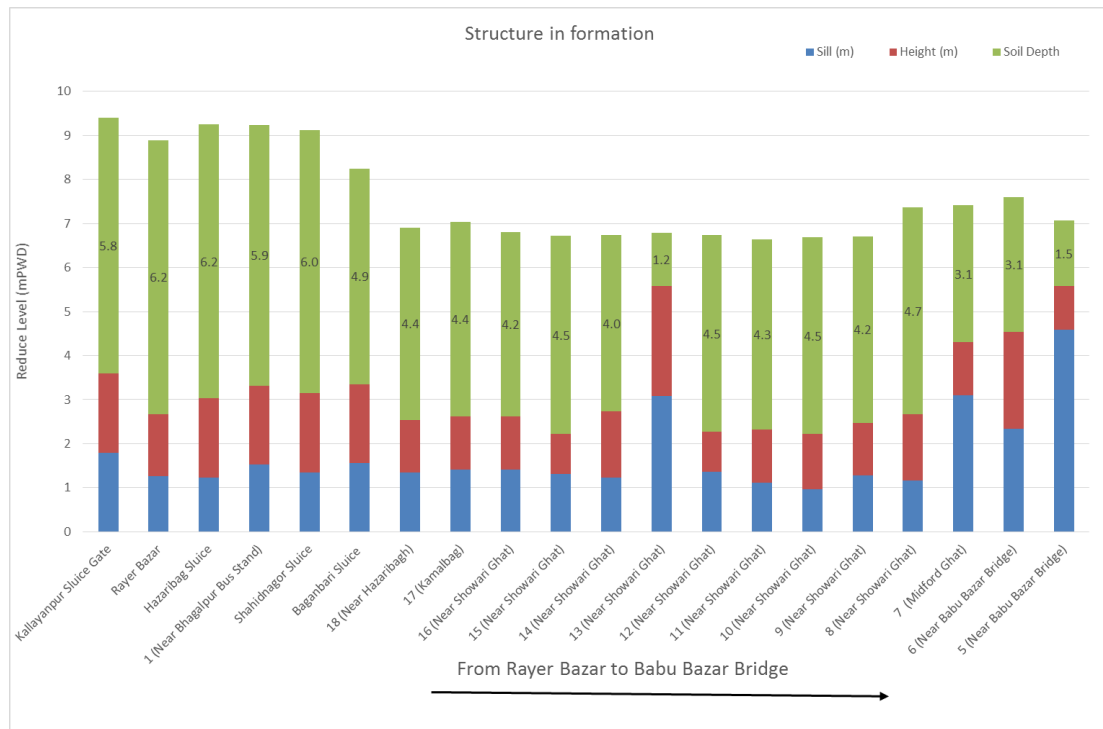


Figure 6-2: Invert and crown elevation of drainage structures along embankment

- 20 cross drainage structures were surveyed along the embankment. Figure 6-2 shows the crown and invert information of these drainage structures.
- It can be seen that most of the crowns are below 5m elevation and the ground level extends up to 7m. This indicates there is 2m coverage of soil between top of the embankment and crown of the drainage structures. Pipes can be laid above these structures and in between top of the embankment
- The structures in Older Part of the city are flap gates. There are 12 of these gates along the embankment. Flap gates are used for local drainage. If required these flap gates can be temporarily closed after discussion with BWDB during construction period.
- Figure 6-3 shows the settlements and land level along the embankment. Areas were classified based on high or low settlement and high and low elevation. It can be seen that most of the areas along the embankment has high elevation at least on one side of the embankment. This indicates the embankment has become a part of land developed area and the river floods do not reach up to embankment if water level goes above 6.5 m. Even then large area outside the embankment will be inundated before reaching the embankment.
- Only two small sections along the embankment have low land on both side of the embankment. These areas still have low lands as they are located along the passage of the khals.

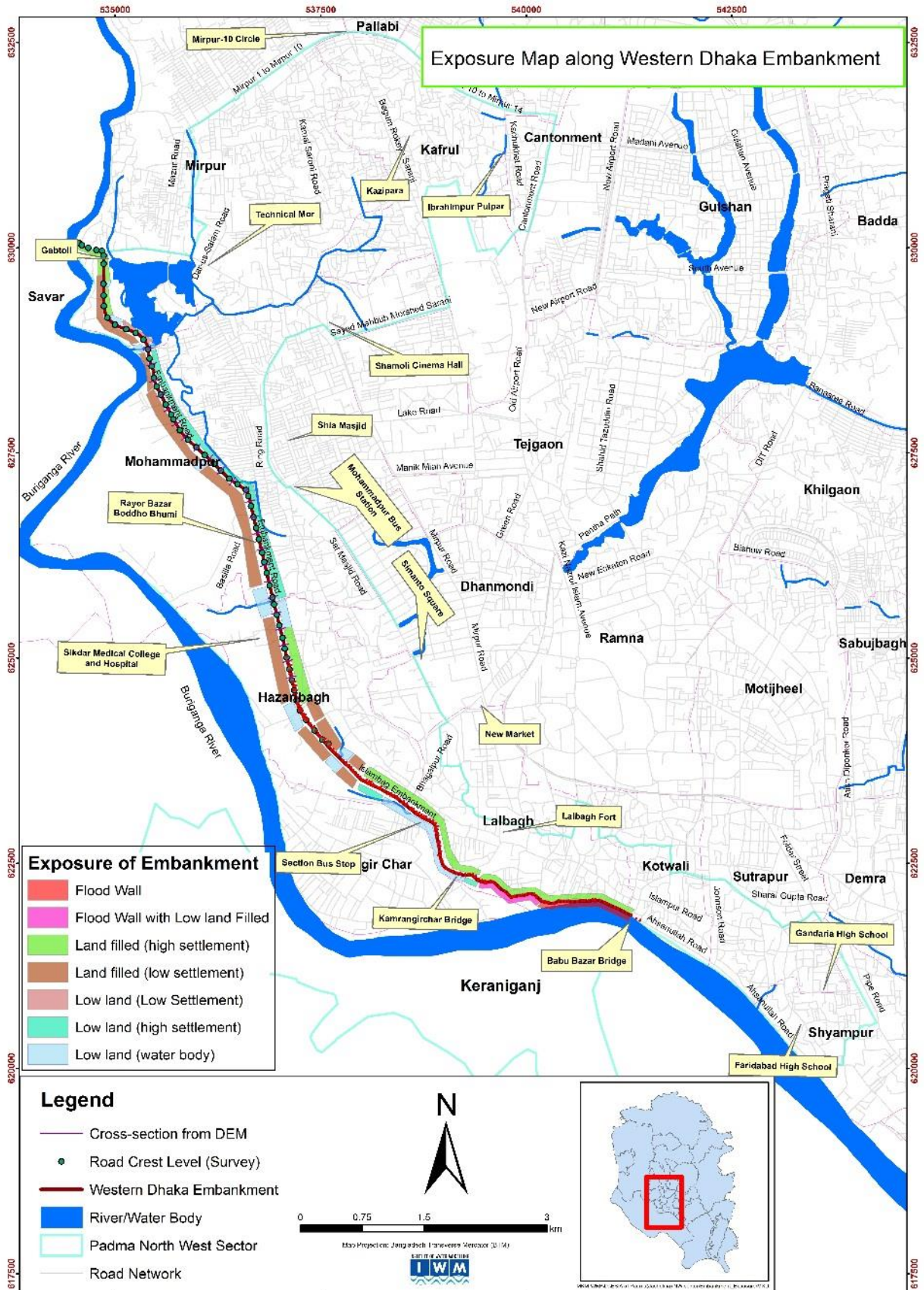


Figure 6-3: Settlement and land level along Embankment

6.2.3 Alternatives in Mirpur Area

The area is densely populated with mostly residential use. The ground floors of these buildings are shops for different kind of businesses. Roads are just wide enough for construction of the pipeline. Some points from field visit for this area are:

- A transmission line from Padma Jashaldia supply will be joined with Gandhabapur network through cantonment, a meeting with cantonment authority for this purpose is needed as they are also consumer of DWASA
- A 500mm dia transmission line is proposed along the Ibrahimpur Bazar road (Ibrahimpur Pulpar), the road is wide enough for 500mm dia transmission line from Ibrahimpur khal to about 1km in the west direction. Construction along this road should be done by open excavation and manually, as road is not wide enough to construct by equipment

Evaluation of alternates to distribute water in the Mirpur area of the Sector is given below (Figure 6-4):

- After 1 km of the Ibrahimpur road from Kachukhet road, there are two possible options for distribution from Begum Rokeya Soroni road to Ibrahimpur road
- Option 1: Transmission line from Shewrapara (road in the north side of Pubali Bank limited) to Ibrahimpur road, length is about 1760m
- Option 2: Transmission line from Kazipara Bus stand (Kazipara overpass) along the Kazipar Madrasha road to Kachukhet road along the Ibrahimpur road, length is about 1817m
- A proposed transmission line of 800mm dia will connect from newly constructed Kamal Soroni road to Begum Rokeya Avenue road, in this case there also two options
- Option 3: Transmission line along the Pিরerbagh road from Kamal Soroni road to Begum Rokeya Avenue road which length is about 850m
- Option 4: Transmission line from Mannan Molla Bus station on the Kamal Soroni road along the Kazipar Masjid road from Kamal Soroni road to Begum Rokeya Avenue road which length is about 900m
- Along the Pিরerbagh road (Option 3) construction of drainage line is going on, so collection of drawings of drainage plan from DWASA along this road is needed
- A culvert crossing is needed as there is a khal named Kollanpur khal near bazar of Pochim Shewrapara (Oli mia market) whose Latitude-23° 47' 21.8" & Longitude-90° 22' 13"
- Road width of Option 3 (Pিরerbagh road) is wider than the Option 4 but option 4 is more straight than option 3 for the transmission line from newly constructed Kamal Soroni road to Begum Rokeya Avenue
- Zone 10
 - Option 1: Transmission line from Shewrapara (road in the north side of Pubali Bank limited) to Ibrahimpur road, length is about 1760m

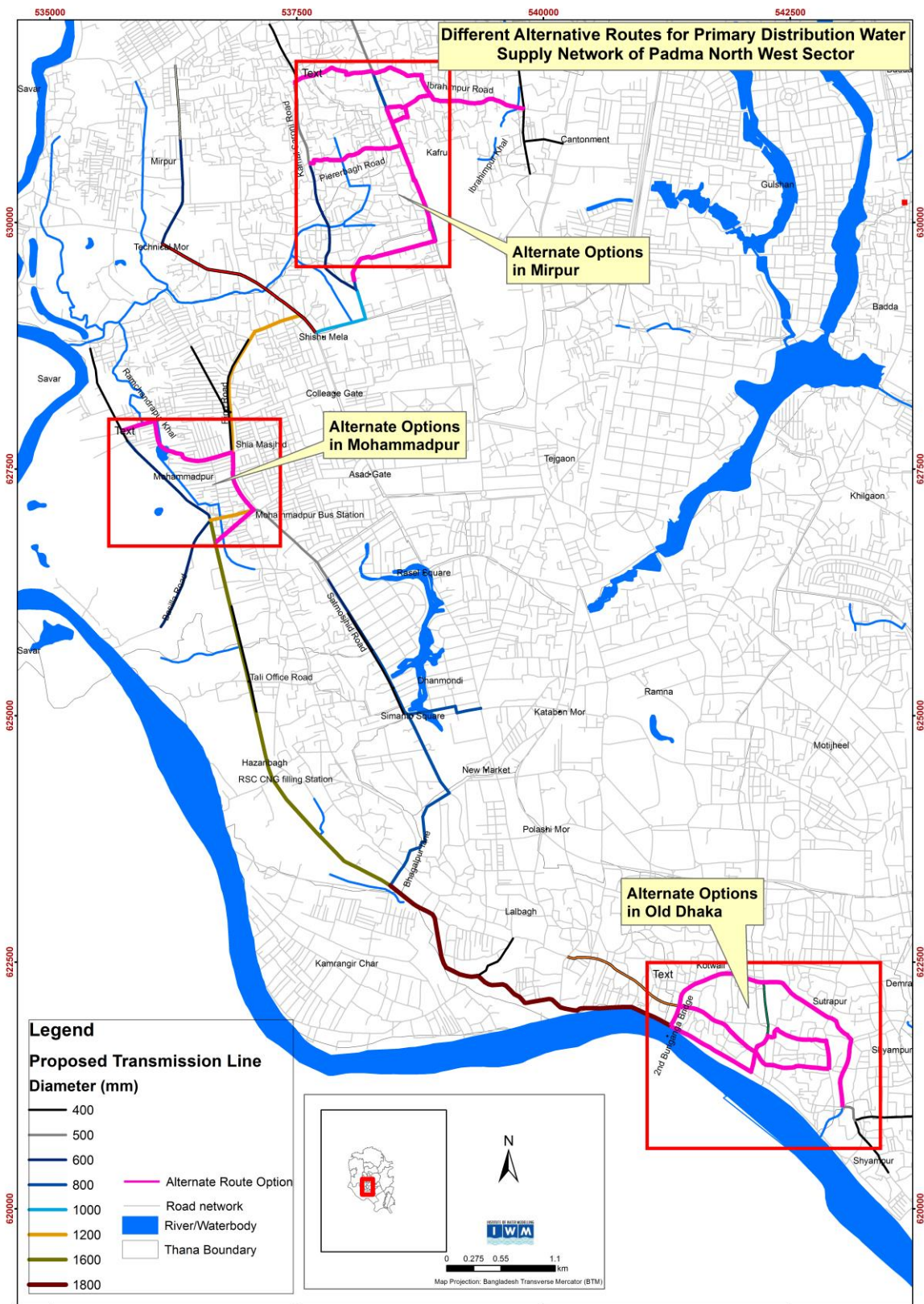


Figure 6-4: Alternate routes of Padma North West Sector primary distribution

- Option 2: Transmission line from Kazipara Bus stand (Kazipara overpass) along the Kazipar Madrasha road to Kachukhet road along the Ibrahimpur road, length is about 1817m
- Option 2 better as it has less bends and wider roads
- Zone 4
 - Three alternate routes were considered
 - Route chosen considering major lines in Rokeya Soroni and Kamal Soroni ; as these are wide roads



Figure 6-5: Discussion during site visit to assess different alternative routes

6.2.4 Alternatives in Mohammedpur Area

Several alternate routes were considered to distribute water embankment to Shaymoli Rngi road. One alternative options of distribution network may be along the Ramchandrapur Khal to Shia Masjid. Currently it is proposed from Bosila road intersection to Moahammedpur Bus stand.

- The width of the road from Shia Mosjhid to Mohammadpur Bus station is about 25 feet initially then the width is constricted to 15 feet
- There are electric poles on the both side of the road from Shia Mosjhid to Mohammadpur bus station
- There are drainage/sewerage line along this road and its need to be checked
- The alternative route of the above stated road is from shia mosjhid to embankment road along the Ramchandrapur khal/Katasur khal for 1200 mm proposed pipeline
- The width of this road is about 12-14 feet but someplace it is narrow
- There are more bends, narrow road section along ramchandrapur khal, so it will be more costly than other alternative

- A wide new two lane road is connected from embankment to Mohammadpur Bus station, so it is a good option for 1200 mm proposed pipeline. This route is recommended instead of using the road along Ramchandrapur khal/Katasur khal
- A concern for design in this section of the primary distribution main, is the possibility of constructing two acute bends. The bends can be a big cause of head loss. Several options were investigated in order to avoid these bends. If some land acquisitions is carried out the angle of these bends can be reduced, which will be minimize the head loss in this section. Figure 6-6 shows the alternate options and the land acquisition requirement associated them.

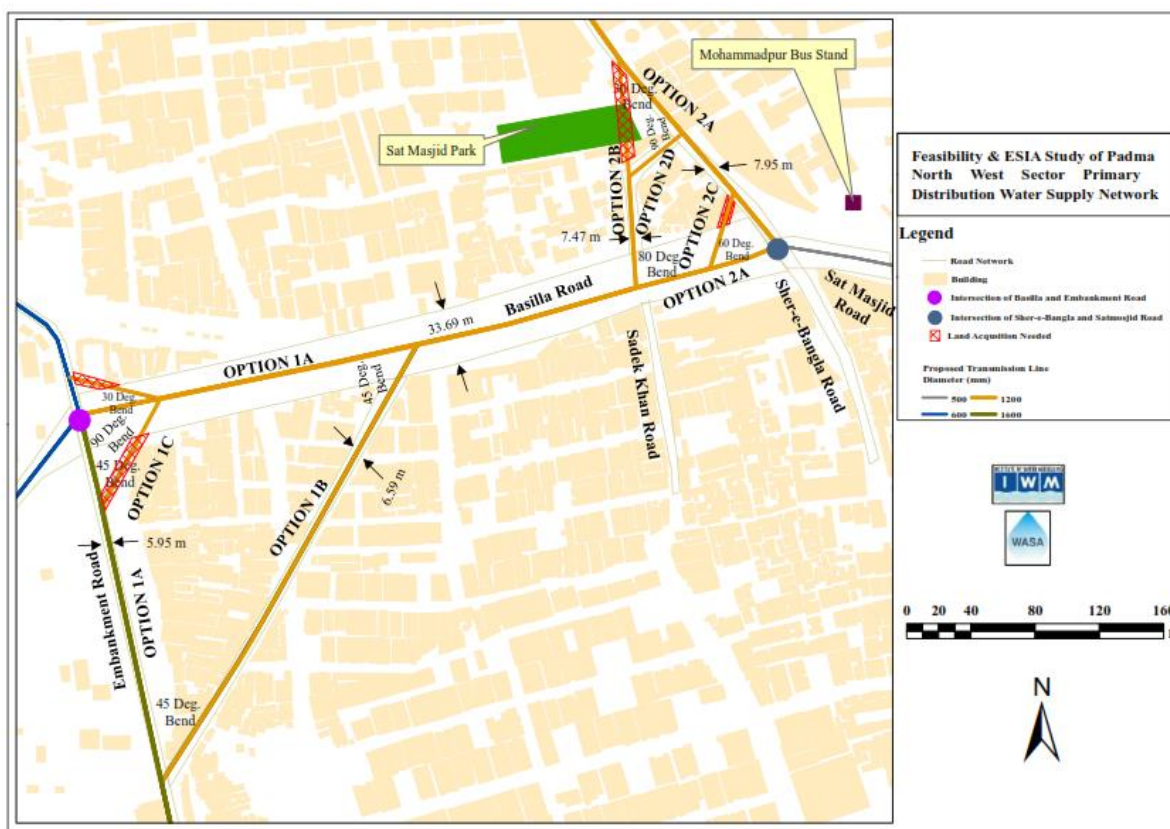


Figure 6-6: Land acquisition requirement to avoid acute bends along Bosila Rd

6.2.5 Alternatives in BGB Area

Following are the key observations for the transmission line From Embankment to Sat Mosjhid Road:

- There are not suitable alternatives route from embankment road to Sat mosjhid road, as the route along Bhagalpur lane-Nawabganj road-Lalit mohon das lane has to cover a lot of areas (DMA)
- There is a road along Shahid nagar but this road is not enough for construction of 800 mm pipeline

- The width of Bhagalpur lane from embankment to Nawabganj road is about 23 feet and in the right side (from embankment to Nawabganj road direction) there are drainage line, so width of this drainage line has to be checked
- At $23^{\circ} 43.412''$ N and $90^{\circ} 22.51''$ E location, the width of the Bhagalpur lane is about 17 feet
- At $23^{\circ} 43.558''$ N and $90^{\circ} 22.582''$ E location, the width of the Nawabganj road is about 25 feet
- Construction of transmission pipeline along this road has to be done during night time
- Construction along this road should be done by open excavation and manually, as road is not wide enough to construct by equipment
- It has to cover a lot of distance for transmission of pipeline other than through the BGB facility

Advantage/ Disadvantage

- The route along Bhagalpur lane-Nawabganj road-Lalit Mohon das lane is important to supply water in DMAs along Sat Masjid Rd
- Other alternative routes are not feasible due to lack of width

6.2.6 Alternatives in Old Dhaka

There are 3 (three) options for transmitting water from Babubazar bridge (2ndBuriganga Bridge) towards sutrapur and shyampurthana DMA area.

- Option 1: Transmission along embankment (Ahsan Ullah road). The advantage is more convenient as the embankment is wide enough for construction of DN 800 mm transmission pipe. Disadvantage is Sadarghat access road is very traffic congested.
- Option 2: Transmission of water along the Islampur road. This road is straighter than any other road, so bend can be avoided. However, Islam road is not wide enough for smooth construction of DN 800 mm transmission pipe and also this road is major whole sale clothing market. So this road is to be paralyzed by traffic most of the time of the day. Therefore the business community beside this road will be affected during construction interruption. Down to the pyaridas road is very narrow to construct a transmission pipe.
- Option 3: Transmission of water along Nawab Yusuf road to Engelsih road. The road is wide enough for construction. However, it is the longest route compare to other two options. It also requires discussion with bridge authority as construction should be done carefully, so that it does not affect bridge piers. A DN 400 mm pipe from Saidabad network is connected with Padma Jashaldia network along Johnson road, so overlap can happen.

Option 1

Advantage/ Disadvantage

- More convenient as the embankment is wide enough for construction of DN 800 Mm transmission pipe.
- Sadarghat access road is very traffic congested.

Option 2

Advantage/ Disadvantage

- This road is more straight than any other road, so bend can be avoided
- Islampur road is not wide enough for smooth construction of DN 800 mm transmission pipe and also this road is major whole sale clothing market. So this road is to be paralyzed by traffic most of the time of the day. Therefore the business community beside this road will be affected during construction interruption.
- Down to the Pyaridas road is very narrow to construct a transmission pipe.

Option 3

Advantage/ Disadvantage

- Wide enough for construction
- Longest route compared to other two options.
- Need discussion with bridge authority as construction should be done carefully, so that it does not affect bridge piers.
- A DN 400 mm pipe from Saidabad network is connected with Padma Jashaldia network along Johnson road, so overlap can be happen

7 Modelling and Design

7.1 Design Principle

The aim of network systems design is to prepare a lay-out for primary & secondary distribution system will:

- Guarantee continuous delivery of a sufficient quantity of safe drinking water to the consumers
- Be economically and financially viable, ensuring sufficient income for the upkeep and extension of the system

This aim can be considered as the first priority for the design of the system. The second priority is that the system:

- Have sufficient spare capacity to operate in an emergency situation (power failure, pipe bursts, fires)
- Have a sufficient degree of “flexibility”

The capacity of the major components of a distribution system is generally such that the component will perform satisfactory for at least up to 2035.

7.1.1 Design Objective

The construction of primary and secondary network will be designed in a manner that will provide a fully functional pipe line with:

- Upon completion alleviate the consequences of the present systems short coming in the of the City
- Effectively transmit water from water treatment plants at capabilities that will address as minimum the current needs but will also consider the development of the system up to the design horizon year 2035

Design should carefully consider the significant constructions difficulties and provide tangible solution, taking due consideration of the limited funds.

Design Horizon

According to growth and demand forecast about 6% population of the city are living below poverty line. This population will be served by pipe water. The water demand for this population has been calculated considering 130 lpcd.

Assumptions

Design Horizon: 2035

Total connected population with combination of GW & SW sources: 100%

Average domestic water demand: 130lpcd (with demand management measures)

Non-residential demand: 27% of Total residential demand

Hazen-William Co-efficient: 120

Maximum velocity: 1.5 m/s

Maximum head loss: 2 m/km

Minimum head at far point of primary distribution network: 1 bar

7.1.2 Design Philosophy

While designing the water supply system following considerations has been adopted for the project:

Design approach

- To distribute safe potable water produced from Water Treatment Plants
- Ensure efficient distribution of water to the different DMAS under this sector
- Ensure minimum head in the distribution networks to maintain minimum pressure at consumers end
- Easy operation and maintenance of primary and secondary distribution networks
- Minimize imported operation and maintenance items
- Maximize local labor during construction and operation
- Use local materials wherever possible and provide adequate flexibility

Reliability

- The network must distribute water continuously with required head and subsequently must ensure to produce water from the treatment plant and as well as to ensure the effective operation of the Booster Pumping Station
- The staff must understand the process and equipment
- The mechanical and electrical equipment must be durable
- Spare parts and ability of local personnel to make repair must exist
- Process of distribution networks must be designed to perform under varying water pressure and forgive occasional oversights of operation personnel
- Reliable local suppliers of equipment with dependable local agents must be available

Simplicity

- A less complex primary and secondary distribution system will be better to understand and easier to operate.
- When labor costs are high automation is a positive factor, but automation means complex equipment and costly maintenance. If less expensive labor is available, primary and secondary distribution system operation can be handled manually and with minimum automation. Instrumentation and remote control will be proposed to measure the flow of different distribution nodes. This will help in the maintaining of DMAs.

Imports & Mechanization

- Imported items will be limited and local materials will specify where possible
- All the equipment used in primary and secondary distribution system must be imported into Bangladesh
- Selection of equipment will be made considering the feasibility of less need to mechanical and electrical equipment for O&M purposes

Use of Local Materials & Labour

- Local Materials will be used to the greatest extent as possible
- Cement and Re-bar, Bricks, Stone etc will not be allowed for import
- Local skilled labor must be given preference in construction works
- Local labors should be employed in operation and maintenance works

7.1.3 Choice of Pipes for Primary & Secondary Mains

The pipe materials considered for inclusion on this project are as follows:

- a) Ductile iron (DI)
- b) Steel
- c) Glass fibre reinforced plastic (GRP)

Availability

The pipes are not locally available but available in international market. The summary of the advantages and disadvantages of different proposed types of pipes are follows:

Ductile Iron

- a) High mechanical strength and toughness, easy jointing, flexible joints can tolerate same deflection, easy to repair
- b) Can be cut in the field
- c) Restrained can be accomplished with restrained joints
- d) Required little support from pipe surround materials
- e) Possibility of corrosion if internal and external protection system are damaged

Steel Pipe

- a) High mechanical strength and toughness
- b) Flexible
- c) Welded joints requires skilled welders and special equipment
- d) Susceptible to corrosion if protection system is damaged
- e) Require cathodic protection
- f) Reliant on stable soil support

Glass Fibre Reinforced Plastic Pipe

- a) Corrosion resistant

- b) Relatively light weight
- c) Easy of jointing
- d) Flexible joint can tolerate some deflection
- e) Susceptible to impact damage
- f) Reliant on support soil
- g) Retrospective installation of fittings/ repair complicated
- h) Susceptible to structural degradation by certain organic contaminants

Recommendation

- a) Ductile pipes (K-9 pipe) are considered semi rigid pipes are characteristically strong and tough
- b) These materials are able to withstand earth and live loads with little support from soils
- c) Ductile pipe do not rely on support from soil
- d) GRP and steel pipes are both flexible pipes that rely heavily on soil support and are therefore not recommended for the project
- e) Steel pipes will only be used in case of cannel/culvert crossings

7.1.4 Pipe Laying

For pipe laying the trench location, depth, pipe cover, etc. would be analyzed. The location, size of manholes would be given due consideration. Allowance for Surchage Pressure a safer margin of 2 bars for surcharge over pressure will be used to size the pipe and appurtenances. Again, for surge protection air vents will be used at different location of the Primary & secondary mains as required. This air vent will release great quantities of air under low pressure when filling the mains, small quantities of air under pressure during normal operation. Such Air vents will also play an important role in the field surge protection by preventing any water column separation in case of power failure occurs in Booster pumping station. Water column separation can also occur during operation of valves by creating vacuum condition. Therefore, to operate under low and normal pressures double air valves with large orifice for low pressure and a small orifice for normal pressure will be used. In addition to these isolating valves, washout valves & PRV's will be used with the pipe line depending on the requirements. Clear cover between the crest of the pipe & the road surface will be at least 1 meter.

In the flood protection embankment, pipe will be laid in the countryside of the embankment to keep undisturbed of the embankment facilities. The sluice gates of the embankment will not be damaged during pipe laying. It will be wise to overcome this situation by laying pipe above the sluice gates & surround the pipe by cement mortar. Standard of pipe laying drawings for different situations, are enclosed herewith.

Bedding

Determination of pipe bedding will be made on a case by case during final design depending on the soil condition. However following bedding can be used:

- a) Backfill material will be soil removed from the trenches or any materials suggested or directed by engineer in charge
- b) Pipe bedding will consists of either gravel or crushed bricks
- c) Pipe surround material will be crushed bricks

Allowable velocity of Pipes

- a) Maximum velocity will be considered 1.5 m/sec,
- b) Maximum head loss gradient will be considered 2 m/km.
- c) Minimum head at Injection Point

Pressure Reducing Valves & Flow Limiters

PRV have to provide at the area where a high pressure supply is connected directly to the existing distribution system. The PRV's continue to be an essential control feature for DWASA investment, and they will be installed at every primary-secondary connection point.

The additional benefit of the PRV's is that they also "double" as flow limiters so that, in addition to varying the supply zone pressures, the daily volume can also be controlled according to actual demand and the condition of the existing distribution system. Furthermore the primary mains have been designed for a constant flow 24 h/day in order to reduce the investment costs, and such a constant flow can only be achieved by using flow limiters as long as elevated reservoirs acting as buffers are not used.

Valve Chamber or Manholes

All valves and appurtenances will be installed in valve chamber or manholes, the type of each of them being chosen among standardized types.

Washout Arrangements

For cleaning of the transmission main washout chambers with necessary valve will need to be provided at suitable location.

Thrust Block Arrangements

Gentle bents have been recommended for crossings of khals, rivers and highways to minimize head loss.

Method of River/Khal Crossings

According to the field investigation, primary & secondary pipelines will cross some canals, Box Culverts. Pipe can be laid by open excavation during dry period to cross khals / canals.

For crossing Box Culverts & Khals pipe jacking method may be recommended for avoiding disturbance of structures.

Auxiliary Facilities

Auxiliary facilities of the pipeline mainly include washout valve, isolating valves, air valves etc.

Washout valves will be fitted on the primary & secondary lines for cleaning the pipe line. These washout valves can be used in 6 points of the pipelines where pipe will cross khals. Isolating valves on the primary Main will be of the butterfly type and will only be proposed at strategic locations. This will be limited because of the high cost.

Air valve will be used at each high point in the transmission main specially at crossing of khals and rivers.

Pressure Reducing Check Valves (PRV) will be used in its distribution nodes along with the isolating valve & flow meter.

Allowance for Surge Pressure

A safer margin of 2 bars for surge over pressure will be used to size the pipe and appurtenances. For surge protection air vents will be used at different location of the Transmission main as required.

This air vent will release great quantities of air under low pressure when filling the Mains, small quantities of air under pressure during normal operation. Such Air vents will also play an important role in the field surge protection by preventing any water column separation in case of power failure occurs in Booster pumping station. Water column separation can also occur during operation of valves by creating vacuum condition. Therefore, to operate under low and normal pressures double air valves with large orifice for low pressure and a small orifice for normal pressure will be used.

Excavation of Trenches

Trenches for pipe laying by excavating paved road both flood protection embankment & other roads will be necessary, because of heavy traffic movement of the roads the works will need to be executed during night time. Major excavation for pipe laying particularly on embankment may not be necessary. Necessary access by levelling and dressing will be needed for equipment movement.

7.2 Modelling

A Water Distribution (WD) model was developed to design the water supply network of of Padma North-West Sector. Schematization of the network model was supported by GIS datasets collected from various sources.

7.2.1 Data on Network Components

The source of the network data are the GIS datasets of DWASA developed under various projects. The two main sources of data came from the Water Supply Master Plan Project and

Dhaka Water Supply sector Development Project. A preliminary model was already developed under the Water supply master plan project. The model had 42.36 km pipe with diameter range of 400 to 1800mm. This network was updated based on analysis of alternate routes mentioned in the previous section. The following data from the DWSSDP project was also used during model development in order to identify nodal distribution points for the model.

- Existing network
- Proposed network under DWSSP
- Surface water injection points for each DMA
- DMA boundary

7.2.2 Data on Water Demand

Computation of water demand for the next 20 years has been based on population and per capita water demand computations carried by Dhaka Water Supply Master Plan Project (Carl Bro, 2007). The demand from the Master Plan was further analyzed for more detail nodal distribution of demand. Detailed discussion on the use of water demand figures is presented in *Section 5*. Demand for each DMA of different MODS Zones within Padma North West Sector was estimated, which further redistributed to surface water injection points of respective DMAs. Table 7.1 shows the nodal allocation of demand for DMAs. It has to be mentioned 5 nodes were used to distribute water to areas outside the embankment. These areas are not currently served by DWASA, but kept as a future provision of supply.

7.2.3 Data on Node Elevation

There are around 73 nodes connecting the pipes in different segments mentioned in *Section 6*. The elevations of these nodes have been estimated from the Digital Elevation Model (DEM) of greater Dhaka (cell size 250 cm) developed using Spatial Analyst software. The DEM was developed by inverse distance weighted (IDW) method based on data from the 1:5000 scale SOB topographic maps and GIS data from DWSSDP project. WaterGEMS tool T-Rex was used to assign the elevation information from the DEM to individual nodes.

7.2.4 Modelling option

Two modelling options have been considered during the feasibility study of the Padma North West Sector. In the first option, demand of each DMA was calculated and assigned to a single distribution node on the transmission line. Other surface water injection point of the same DMA was connected through parallel line. The amount of supply and pressure on each distribution from modelling Option 1 are given in Table 7.1.

Table 7.1: Distribution and Connectivity Nodes of Padma North-West Sector, Option 1

Node ID	Supply (ML/day)	Pressure (m H₂O)	Remarks
1	13.4	41.7	Supply to DMA214
2	15.7	37.6	Supply to DMA211
3	15.5	39.5	Supply to DMA210
4	9	39.2	Supply to Kamrangir Char
5	7	38.9	Supply to Kamrangir Char
5A	10.2	38.4	Supply to DMA205
5B	7.2	36.5	Supply to DMA202
5B-B	0	36.1	Connection to Saidabad near Science lab police box
5C	2	35.8	Supply to DMA315
5D	10.1	35.5	Supply to DMA310
5E	3.5	34.6	Supply to DMA308
5F	3.33	34.1	Supply to DMA307
5G	6.84	33.6	Supply to DMA307 & 308
5H	2.85	33.4	Supply to DMA306
5I	5.4	33.1	Supply to DMA314
5J	2.85	33.1	Supply to DMA306
5K	0	33.8	Inter Connection Node
6	5.9	38.3	Supply to DMA204
7	8	37.5	Supply to Hazaribagh (Outside Embakment)
8	3.3	36.9	Supply to DMA201
9	8.33	36.3	Supply to DMA307 & 309
11	3	33.1	Supply to DMA305
12	21.7	31.4	Supply to DMA301,302 & 303
13	0	29.2	Connection with 35 (Saidabad) node
14	3.38	28.9	Supply to DMA303
16	6.6	24.3	Supply to DMA408
17	11.8	22.9	Supply to DMA406 & 1006
18	11.8	22.2	Supply to DMA406 & 1006
19	5.7	20.8	Supply to DMA1006
20	2.7	19.9	Supply to DMA1005
22	0	41.5	Connection node with Saidabad East-West Sector
24	8	39.1	Supply to DMA114
10A	20	33.3	Supply to Outside Embankment near Chad Housing
10B	3	33.9	Supply to DMA305
10C	9	32.8	Future provision for outside embankment
10D	9.9	32	Supply to DMA301
11E	5.05	31.4	Supply to DMA302
13A	3.37	29.1	Supply to DMA303
13B	5.5	28.9	Supply to DMA407 (Saidabad node 36)
13C	5.5	28.8	Supply to DMA407

Node ID	Supply (ML/day)	Pressure (m H₂O)	Remarks
13C-A	5.5	28.7	Supply to DMA407
13D	2.5	28	Supply to DMA407
13E	4.3	27.6	Supply to DMA405
13F	4.3	27.3	Supply to DMA405
13G	4.3	26.9	Supply to DMA405
13H	4.3	26.6	Supply to DMA405
13I	4.3	26.5	Supply to DMA405
15A	10.2	27.2	Supply to DMA408
15B	4.2	26	Supply to DMA408
15C	5.5	25	Supply to DMA407
15D	6.1	24.6	Supply to DMA406
15E	6.1	23.6	Supply to DMA406
15F	6.1	23	Supply to DMA406
18A	11.8	20.8	Supply to DMA406 & 1006
18B	5.7	20.2	Supply to DMA1006
18B-A	0	20.2	Connection with Singair Network
19A	1.7	20.2	Supply to DMA1004
20A	2.7	19.7	Supply to DMA1005
20A-B	0	19.8	Connection to Khilkhet Network
20B	2.7	19.6	Supply to DMA1005
21A	5	42.4	Supply to DMA213
21B	4.1	42.3	Supply to DMA213
22A	9	41.9	Supply to DMA215
22B	9.6	39.8	Supply to DMA215
23A	4	39.1	Supply to DMA113
23B	7.1	39.3	Supply to DMA113
25A	6	37.8	Supply to DMA115
25B	6.7	37.4	Supply to DMA115
26A	7.4	35.5	Supply to DMA117
26B	7.4	35.5	Supply to DMA117
Chad-1	6	22.6	Supply to DMA212 (Chadnighat)
Chad-2	6	22.5	Supply to DMA212 (Chadnighat)

It was suggested during Draft Final Report to review any option which can minimize construction of parallel lines to the primary distribution system. For a City like Dhaka with narrow streets and heavy traffic volume construction of parallel lines is quite difficult. Thus a second option was analyzed, in which demand of each DMA was taken from DWSSDP project by DWASA and distribution node is considered according to surface water injection point designed by the DWSSDP project. The amount of supply and pressure on each distribution from modelling Option 2 are given in **Table 7.2**.

Table 7.2: Distribution and Connectivity Nodes of Padma North-West Sector, Option-2

Node ID	Supply (MLD)	Pressure (m H₂O)	Remarks
1	13.4	41.7	Supply to DMA214
2	15.7	37.6	Supply to DMA211
3	15.5	39.5	Supply to DMA210
4	6	39.2	Supply to Kamrangir Char
5	5	38.8	Supply to Kamrangir Char
6	5.9	38.3	Supply to DMA204
7	8	37.5	Supply to Hazaribagh
8	3.3	36.8	Supply to DMA201
9	1.574	36.1	Supply to DMA309
11	4.12	32.5	Supply to DMA305
12	4.191	30.9	Supply to DMA301
13	2.871	28	Supply to DMA303
14	2.868	27.5	Supply to DMA303
16	9.15	22.9	Supply to DMA408
17	10.41	21.8	Supply to DMA406 & 1006
18	10.47	21.3	Supply to DMA406 & 1006
19	10.864	20.3	Supply to DMA1006
20	2.157	19.6	Supply to DMA1005
22	0	41.5	Connection node with Saidabad
24	8	39.1	Supply to DMA114
10A	15	33.7	Supply to New Housing
10B	2.828	34.1	Supply to DMA305
10C	9	33.5	Future provision for riverside of embankment
10D	4.173	33.3	Supply to DMA301
11A	4.836	31.9	Supply to DMA301
11E	3.424	33	Supply to DMA302
12A	4.715	37.4	Supply to DMA302
12B	4.425	30	Supply to DMA301
12C	3.584	29.7	Supply to DMA303
12D	3.17	29.2	Supply to DMA303
13B	7.913	27.6	Supply to DMA407
13C	9.094	27.3	Supply to DMA407
13C-A	4.715	27.2	Supply to DMA407
13D	6.782	25.8	Supply to DMA407
13E	7.332	25.3	Supply to DMA405
13F	6.737	24.8	Supply to DMA405
13G	1.195	24.4	Supply to DMA405
13H	8	24	Supply to DMA405
13I	3.668	23.9	Supply to DMA405
15A	4.355	25.8	Supply to DMA408
15B	4.537	23.9	Supply to DMA408
15C	3.685	22.4	Supply to DMA407

Node ID	Supply (MLD)	Pressure (m H₂O)	Remarks
15D	10.312	21.6	Supply to DMA406
15E	6.825	19.9	Supply to DMA406
15F	9.768	18.4	Supply to DMA406
16A	4.976	22.7	Supply to DMA408
18A	2.918	21	Supply to DMA406 & 1006
18B	4.685	20.6	Supply to DMA1006
18B-A	0	20.6	Connection with Singair
19A	3.11	19.7	Supply to DMA1004
20A	2.173	19.5	Supply to DMA1005
20B	1.995	19.4	Supply to DMA1005
21A	5	42.4	Supply to DMA213
21B	4.1	42.3	Supply to DMA213
22A	9	41.9	Supply to DMA215
22B	9.6	39.8	Supply to DMA215
23A	4	39.1	Supply to DMA113
23B	7.1	39.3	Supply to DMA113
25A	6	37.8	Supply to DMA115
25B	6.7	37.4	Supply to DMA115
26A	7.4	35.5	Supply to DMA117
26B	7.4	35.5	Supply to DMA117
5A	10.2	38.4	Supply to DMA205
5B	7.2	36.5	Supply to DMA202
5B-A	1.021	36.1	Supply to DMA315
5B-B	0	36.1	Connection to Saidabad
5B-C	1.83	35.9	Supply to DMA315
5C	2.19	35.8	Supply to DMA310
5C-A	0.834	35.7	Supply to DMA310
5D	3.097	35.5	Supply to DMA310
5E	2.225	34.5	Supply to DMA310
5E-A	3.5	34.1	Supply to DMA308
5F	2.644	33.8	Supply to DMA307
5G	6.84	33.3	Supply to DMA308
5G-A	2.698	33.2	Supply to DMA307
5H	1.946	33	Supply to DMA306
5I	5.4	32.7	Supply to DMA314
5J	2.668	32.7	Supply to DMA306
5K	0	33.4	Connection Node
8A	1.329	36.4	Supply to DMA309
9A	3.988	35.6	Supply to DMA307
Chad-1	6	22.6	Supply to DMA212 (chadnighat)
Chad-2	6	22.5	Supply to DMA212 (Chadnighat)

7.2.5 Model Scenarios and Simulation

After setting up the model some alternate scenarios were simulated to design and analyze the performance of the system. Pipe was designed based on criteria mentioned in design principles mentioned in *Section 7.1*. After initial design the following scenarios were considered to finalize the pipe diameters. Figure 7-1 shows the velocity in pipes if water is supplied to Keraniganj and Chadnighat SWTP supplying in Zone 2 from modelling option 1.

- If water is supplied to core City area with Keraniganj
- If part of the demand is met through supply from Chadnighat SWTP

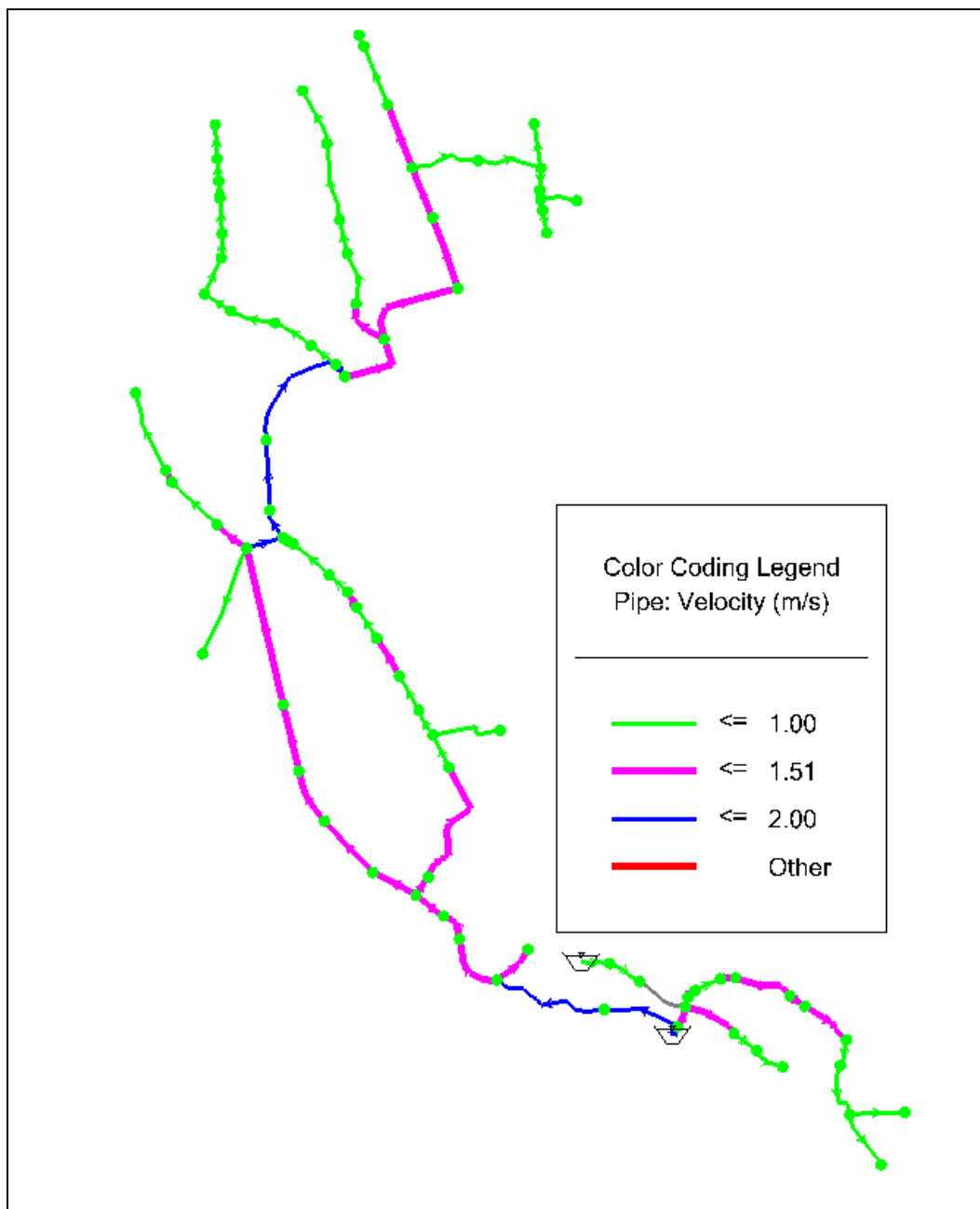


Figure 7-1: Model output showing velocity of Primary Distribution Network, Option 1

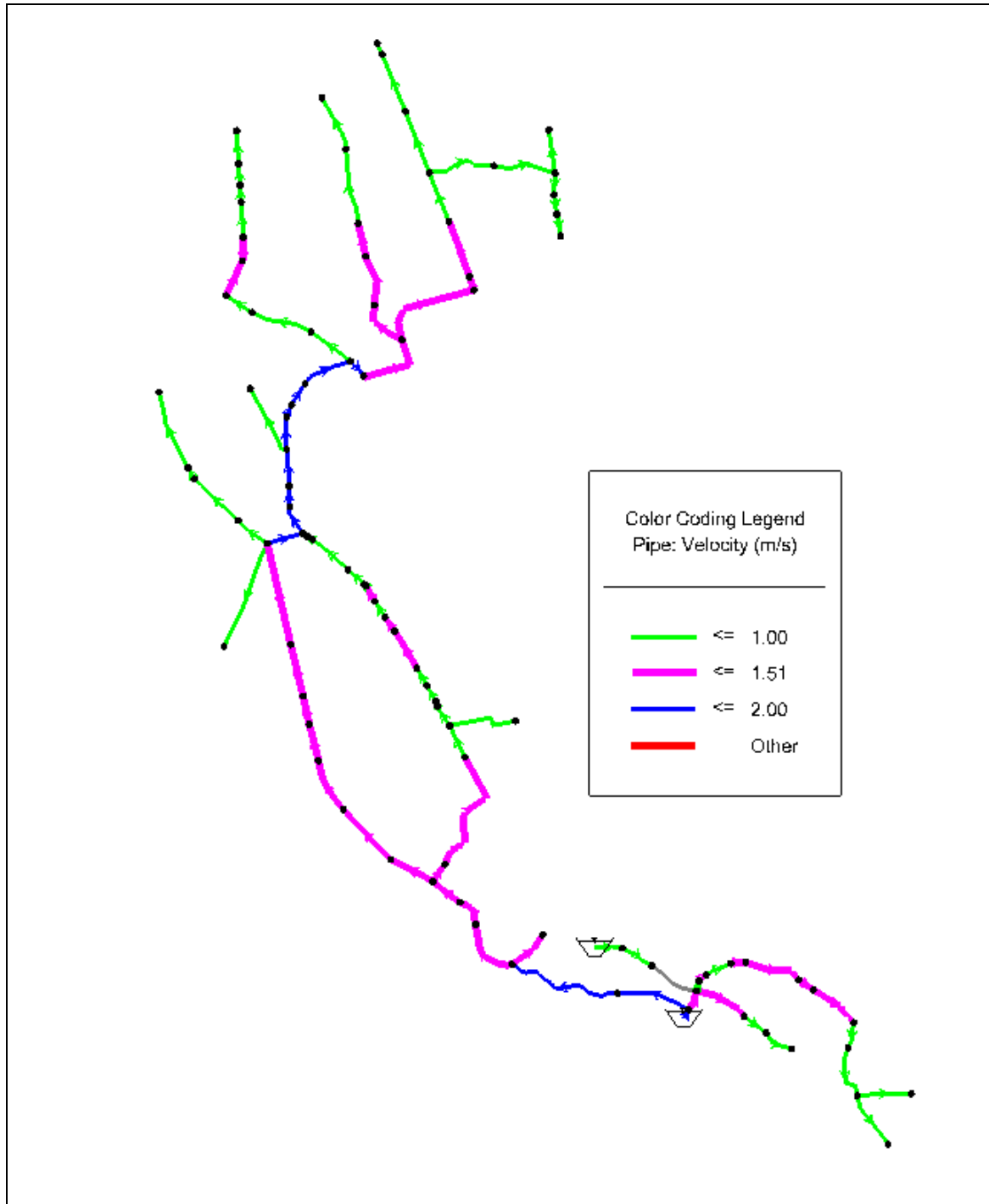


Figure 7-2: Model output showing velocity of Primary Distribution Network, Option-2

Summary of pipe line diameter and length for the modelling option 1 and option 2 are given the Table 7.3 & Table 7.4.

Table 7.3: Summary of Length of Pipe line, option 1

Serial No.	Diameter (mm)	Length (m)
1	400	9696
2	500	5045
3	600	6894
4	800	6636
5	1000	839
6	1200	2929
7	1600	4338
8	1800	3569
Total		39964

Table 7.4: Summary of Length of Pipe line, option 2

Serial No.	Diameter (mm)	Length (m)
1	400	5836
2	500	4035
3	600	8115
4	800	7043
5	1000	1181
6	1200	2929
7	1600	4338
8	1800	3569
Total		37046

7.2.6 Comparison of two modelling option

It has been observed that velocity in the transmission line are almost same for the two modelling options. Distribution node pressure are not significantly different from each other and sufficient pressure are ensured in the both case. For option 1, total pipe length is about 40 km and for option 2 total length is about 38 km. In case of option 2, some parallel pipe line have been reduced but number of connections on transmission line increased. Less interruption to the transmission system is better for operation, so Option 1 can be considered among the two. However, both options needs to be reevaluated during detail design. The selected diameter and final routes/alignments (Option 1) of primary and secondary distribution network of Padma North West sector is shown in Figure 7-5.

7.3 Connectivity with Network

7.3.1 Ensure connectivity for distribution

An important part of this review was validating the proposed water distribution system of Padma Phase-I with ongoing and proposed DMA projects and future plan of Dhaka City. The Water Supply Master Plan for Dhaka City carried by DWASA suggests future water demand

for the Sector. This water needs to be transmitted to individual DMAs through surface water injection points of those DMAs. As there is significant number of injection points, it may not be possible to directly connect all of the points to the Primary Distribution. So Parallel was recommend to ensure connectivity in Option-1. In Option-2 additional distribution nodes were considered on the primary distribution pipeline to ensure connectivity. Figure 7-3 shows one of the project areas and the proposed connectivity to supply water in those areas. The following approach was taken to ensure the connectivity:

- Study networks and surface water inlet points of ongoing and proposed DMA
- Suggests recommendation for areas which are not currently under DMA rehabilitation
- Review and update proposed water distribution network of Padma Phase-1 distribution from the Master Plan study in order to meet future distribution network

7.3.2 Connectivity with other Sectors

It is already mentioned that 12.5 MLD water from Padma North-West sector will be served in Saidabad East-West sector till commencement of Saidabad Phase-III or onward. There will be a provision to connect Padma North-West sector with Saidabad East-West sector at Science Lab road junction (Figure 7-4) Moreover, at Shamoli intersection, there will be a closed connection between Padma North-West sector and Saidabad East-West sector with 1,000 mm pipe.

Another node with 400 mm pipe will have provision to connect with Singair sector at Mirpur-10 junction. In addition, provision to connect between Padma North-West and Khilket sector through 400mm pipe was also considered.

Moreover, the 600mm pipe, along Nabab Yusuf rd at Old Dhaka, of Saidabad East-West sector will disconnect from Saidabad Phase-II and will be connected with Padma North-West sector networks. A new node will be created in above Saidabad 600mm network at Bangshal Road intersection to distribute water (which will be available after disconnecting node 19a from Saidabad networks) around Bangshal road.

A separate volume named “**Outline Drawing**” has been provided along with this main report for better understanding of the plan of alignment of distribution line, distribution nodes and connection with other sectors.

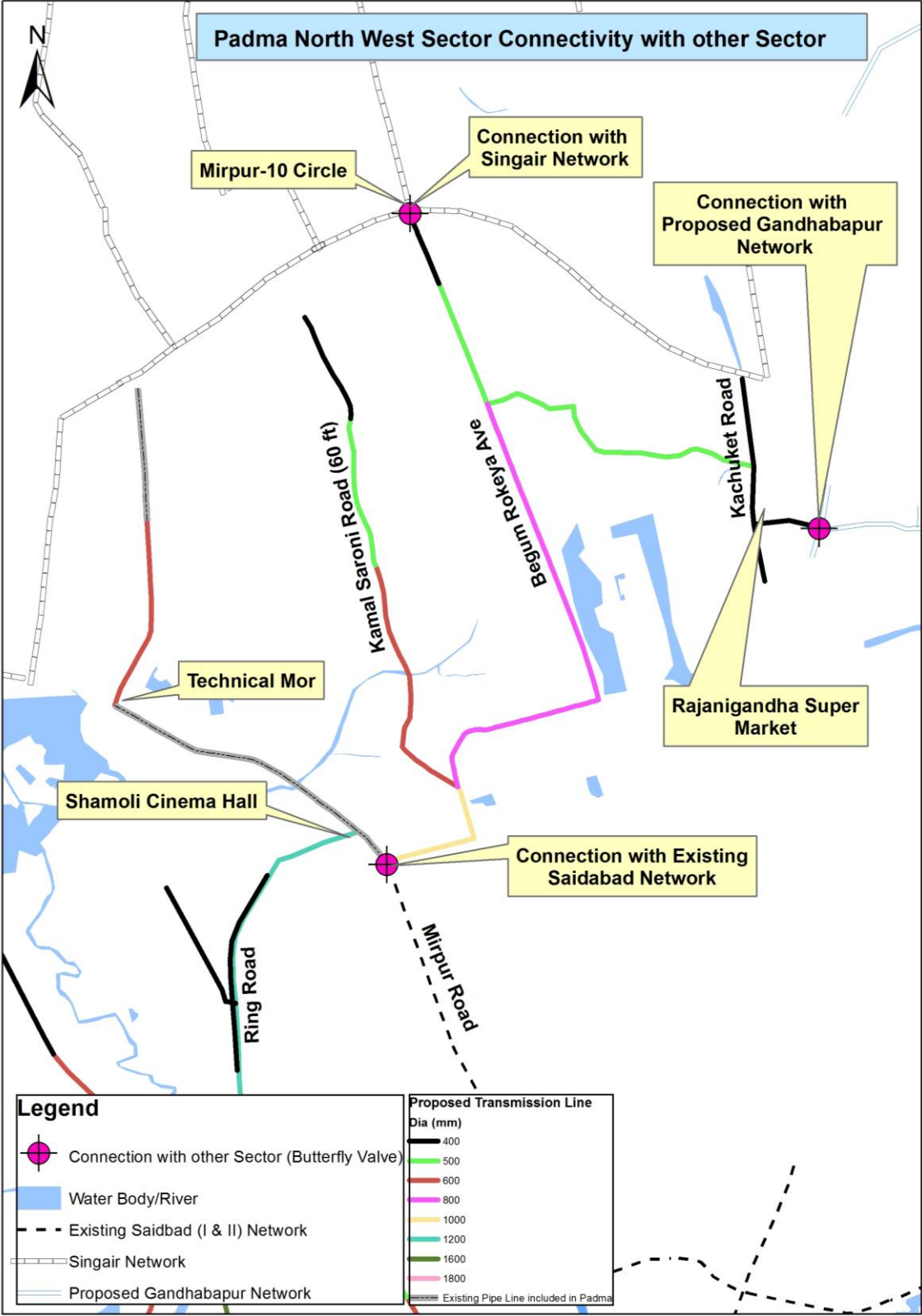


Figure 7-3: Connection of Padma North West Sector with other sector (3 locations)

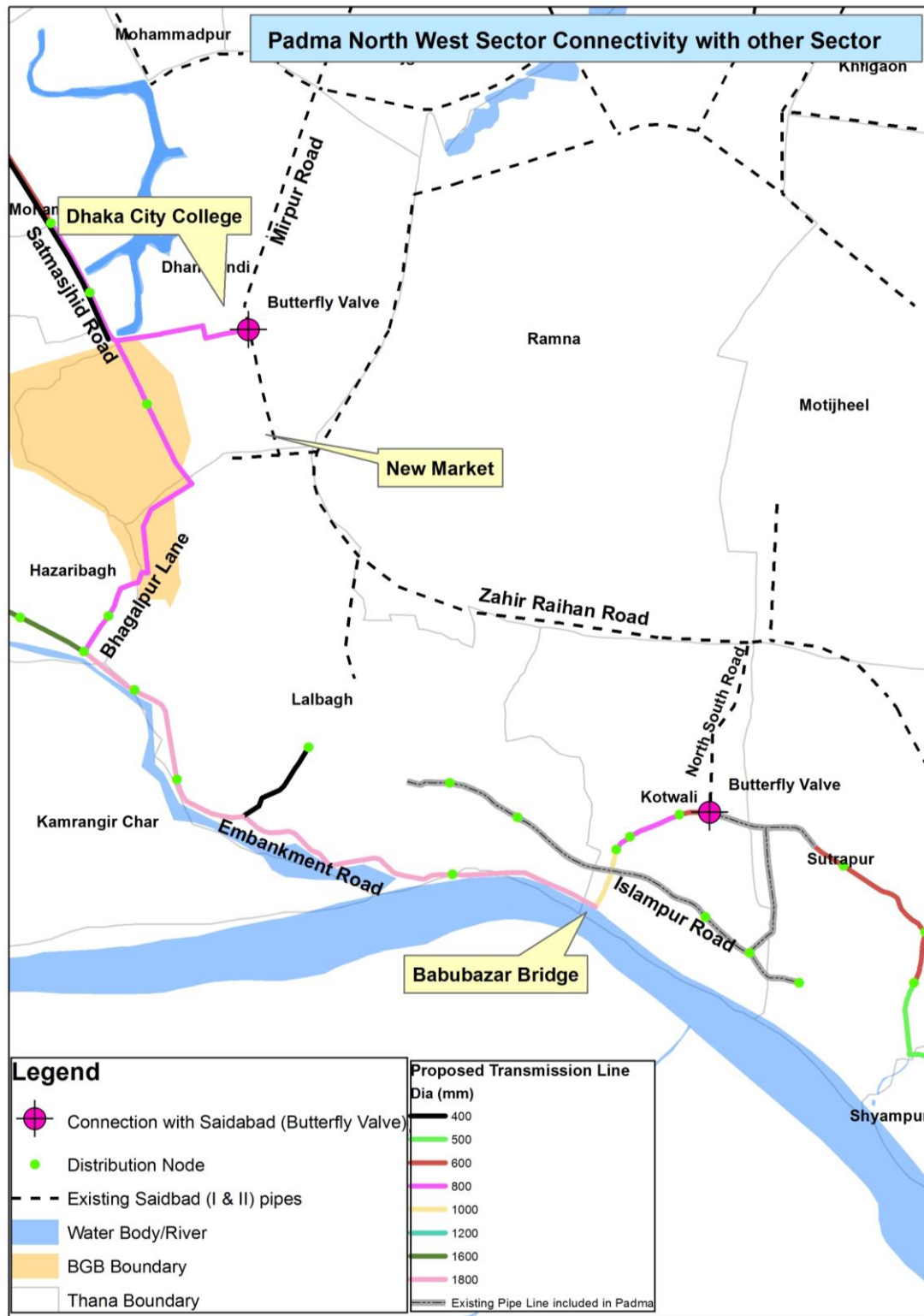


Figure 7-4: Connection of Padma North West Sector with other sector (2 locations)

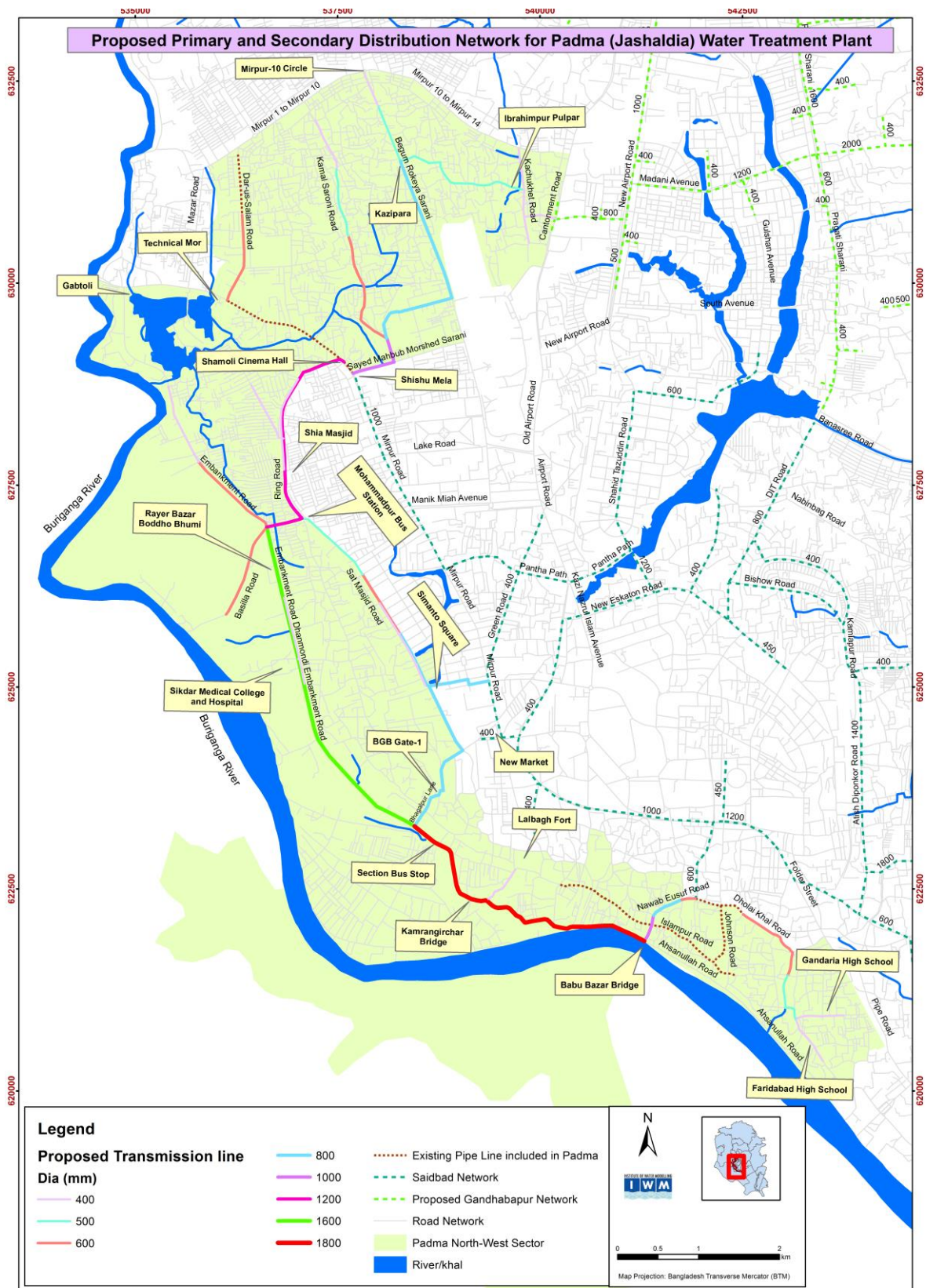


Figure 7-5: Proposed Primary & secondary Distribution Network of Padma (Jashaldia) WTP

8.9 PROJECT IMPLEMENTATION

The Executing Agency

DWASA under the Ministry of Local Government, Rural development and Cooperatives will be executing agency of the project, responsible for the overall technical supervision and execution of the project. A project management unit (PMU) headed by a project Director will be set up in DWASA. The staffing of the PMU will include expertise in project management, water supply and sanitation engineering, installation and finance. The PMU will also incorporate all consultancy services under the project including liason and discussion with the consultants of the other projects of water supply of DWASA.

Implementation Arrangement

The overall coordination, monitoring and guidance on the policy aspects related to the project will be provided by LGD. An inter-ministerial project steering committee (PSC), chaired by the Secretary Local Government Division will be set up. Its membership will include the Managing Director DWASA, the Project Director, representatives from external division, the Finance division of the Ministry of Finance, the Planning Commission, Deputy Commissioner Dhaka, Deputy Commissioner, Munshigonj District, Planning, Monitoring and Evaluation division and representative of Dhaka City Corporation. The PSC will hold its first meeting within three months of the effectiveness of the project and meet at least quarterly thereafter, to coordinate any resolve any issues in the project implementation.

DWASA will setup a PMU head by a Project Director (PD). The PD will be charged exclusively with its project execution and will have no other duty with DWASA. The PD supported by the PMU will be directly responsible for overall project implementation, monitoring, supervision, under the guidance of the Deputy Managing Director and will report the Managing Director. The PMU shall be responsible to process international/local tenders, issue of work orders for respective packages and the selected consultants will assist PMU during evaluation of tenders, selection of contractors and suppliers.

The PMU will be responsible for day to management of the project including but not limited to the following

- Prepare overall project implementation plan (PIP)
- Provide overall construction supervision works of the project components
- Initiate tendering and executing contracts
- Monitor and supervise all project management activities
- Organize monitoring and evaluation activities
- Prepare project progress report (PPR) and project completion report (PCR)
- Ensure full compliance with resettlement, environmental and other safe guard issues and policies

- The PMU will be assisted by the consultants for design supervision and construction supervision

Other responsibilities of the Project Director are handing over site to the line contractor. Any dispute arises in the sites for instances, land dispute, access road and the route of the transmission main will be solved by the PD without any delay with the assistance of PMU. An Organ gram of the PMU structure is illustrated below:

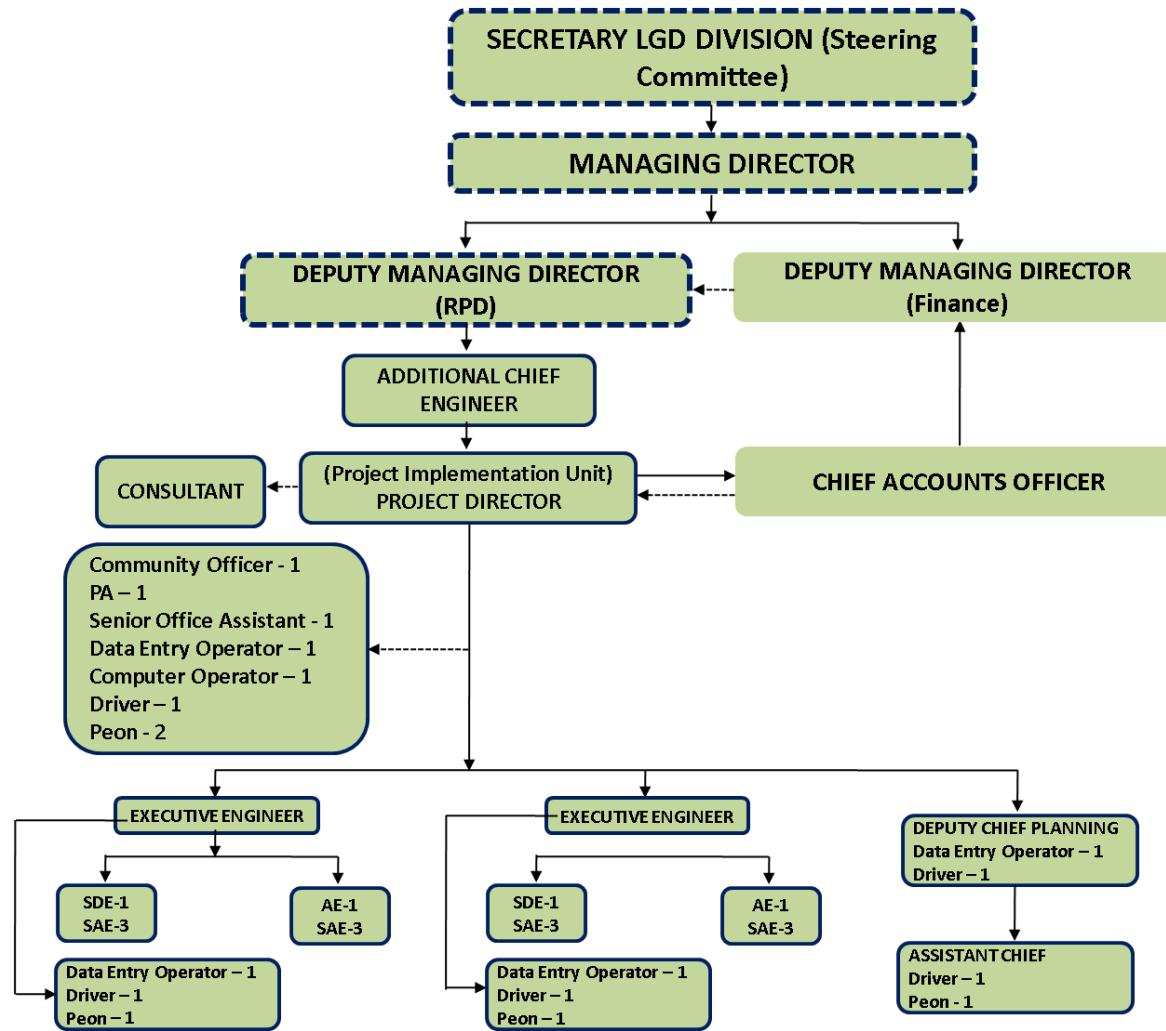


Figure 8-1: Organogram of Project Management Unit (PMU)

9 Stakeholder Consultation

9.1 Consultation with Stakeholders

The proposed alignment in the Water Supply Master Plan study recommends route through some critical areas of the City. One of them is through Pilkhana Area where the head quarter of Bangladesh Border Guard (BGB) is located. Another important consideration is constructing the transmission along Dhaka Western Embankment. Currently this embankment is maintained by Bangladesh water development board (BWDB). Govt. of Bangladesh (GoB) is also considering constructing a four lane highway along the embankment in the west. The roads where the pipe lines will be constructed are maintained by the City Corporations. It is important to know the feedback of these important agencies regarding the project and also to know their plan in the future. Consultation with these agencies is very important to finalize the alignment of the distribution network. The following agencies were consulted

- Bangladesh Water Development Board (BWDB)
- Border Guard Bangladesh (BGB)
- Dhaka South City Corporation (DSCC)
- Roads and Highways Department (RHD)

9.2 Consultation with BWDB

- BWDB officials have informed that along the berm of embankment, there are some storm/sewer lines at some locations (Shirnirtek, Abdullahpur etc)
- BWDB officials have informed that the acquisition width of western Dhaka embankment is not uniform along the embankment
- The acquisition width near Gabtoli is about 500 ft and near Midfort it is about 120 ft
- During this feasibility study, a survey for all structures have to be done and how transmission line will cross structures/regulator it has to be included
- BWDB officials have suggested that if the transmission line is laid along the edge of the acquisition width (by BWDB) it will ensure the followings
 - Demarcation line for embankment
 - No disturbance to structures
- A comprehensive proposal about the transmission line along the western embankment is needed for BWDB committee approval
- BWDB officials have informed that the land width shown in the city survey map (mouza map) along the western embankment is not correct
- BWDB officials have informed that along the western embankment (from Babubazar Bridge to Kallayanpur pump house), a four lane highway road proposal have been made already by RHD, so they have transferred documents to RHD.
- A letter can be given to BWDB officials for BWDB land plan for western embankment



Figure 9-1: Consultation with BWDB

9.3 Consultation with BGB

- BGB officials have informed that the proposed road of BGB gate-1 to gate-3 to gate-4 which is the main road of BGB.
- Along the proposed road, there are some existing facilities like sewer line/drainage line and electric lines, so a good working methodology is needed for working along this road
- There are three schools and hospitals along this road, so any kind of obstruction would not be acceptable
- Construction of pipeline along this road could be done during night time and after each night works, road should be usable during day time
- After permission for construction of pipeline detail survey of this road is needed
- A comprehensive detail proposal about the project has to be submitted to BGB for the approval of construction
- BGB welcomed the project, as it will improve water supply system of the Dhaka City. A detail proposal about the project along with working methodology needs to be submitted to BGB authority for their approval of the proposed road.
- BGB assured all sort of co-operation during implementation of the project.

9.4 Consultation with RHD

- RHD officials have informed that a proposal has been submitted for a four lane highway along the western embankment
- The embankment road width near Old Dhaka is approximately 6.5m to 10m which is wider near Gabtoli, Mohammadpur area
- RHD has planned to utilize the ROW considering width of about 30m from existing embankment central line. If ROW do not exist in parts of this route, land will be acquired

- There will be a inter district bus stand for southern part of the country near Rayer Bazar Bhodhobhumi. The four lane will connect southern part of the country up to Dhaka City through Padma Bridge
- Discussion meeting with RHD, BWDB and DWASA is needed

9.5 Stakeholder Discussion and FGD

FGD 1: Ward 46, Gendaria

Councilor present: Shahidullah Minu

- Shortage of water, water with high iron and odorous
- Construction of pipeline has to be done during night and in monsoon season
- They have said that sometimes contractor fill the cutting area with soil instead of sand
- Metal sheet or other means of passage system may be provided during construction work for less suffering to people
- The contractor must be monitored by DWASA in above two issues
- Work can be done phase by phase, segment by segment so that the work will not be physically visible to people hence less suffering to them
- Communication by media, door to door lift let system may be useful

FGD 2: Ward 32, Armanitola

Councilor present: Md. Billal Shah

- Soil should be removed immediately after digging hole
- Construction of pipeline has to be done quickly
- Delaying of work will come in to effect in huge traffic load in this area, as this a commercial area, subsequently this will impact on whole Dhaka City.
- Construction of work can be done by modern technology, so to finish the work quickly
- As there are huge traffic jam, so construction of work by tunnel system may be implemented
- Work has to be done by expert contractor

FGD3 : Ward 33, Mohammadpur

Councilor present: Md. Tarekujjaman Raquib

- After work, quick carpeting is mandatory
- Coordination with different agencies is needed for the swiftness of work
- Soil should be covered by metal sheet, so that there are no obstruction in traffic flow
- Public awareness by miking
- Sign of work at suitable location, so that people can take alternative route
- Bypass road arrangement is important to minimize traffic load

FGD4: Ward 16, Ibrahimpur

Councilor present: Md. Moti Mollah

- There are no alternative road/bypass road for this area, so work has to be done so fast
- Construction work can be done at night and in daytime the road should be repaired for traffic
- Damaged/disrupted facility line during construction work should be repaired immediately
- The contractor should be monitored, so that he will fill the cutting area by sand
- Work has to be done delicately, as there are 4-5' drainage line along this road
- There are about 60 feet khal which can be an alternative options



Figure 9-2: Focus Group Discussions in the project area

10 Environmental and Social Impact Assessment

10.1 Background

The proposed project deals with the construction of Primary Distribution Water Supply Network in the above mentioned sites in Dhaka. It will distribute the treated 450 MLD water of Padma SWTP (Phase 1) to the above mentioned areas by covering about 40.41 km long pipes with 400 to 1800 mm diameter at different places. The useable pipes will be High Density Polyethylene (HDPE), size varies from 400mm to 600mm and Ductile Iron (DI), size varies from 600mm to 1800mm in diameter. Some valve, chamber, meter etc will also be installed as an auxiliary work.

The proposed project fall under “Red Category” according to ECR 1997 of the Department of Environment (DoE) of Bangladesh Government (GoB); hence, require to carry out a full scale Environmental Impact Assessment (EIA). This report presents the EIA of the proposed construction of primary distribution water pipeline network: Padma North West sector project of DWASA.

10.2 Project Activities

During construction phase, the major project activities include the following: (1) Mobilization of personnel, material and equipment and (2) Laying of primary distribution water pipelines (including Ductile Iron, Steel, HDPE, and GI pipes) under the existing roads and embankments. DWASA requires ensuring that the Contractor should use the “trenchless technology” to the largest extent possible for laying of pipes. In some cases, the existing water mains will be rehabilitated using a pipe bursting system whereby a new pipe of equal or larger diameter will be inserted into an existing pipeline by fragmenting of grinding the existing pipe and forcing material into the surrounding soil. At some locations the proposed pipelines would cross box culvert that would be accomplished by two methods: (a) Pipes are attached to the box culvert: The pipe may be fastened on the outside of the box culvert or suspended below; (b) The pipe is supported by a dedicated pipe-bridge alongside the main box culvert (box culvert span is more than 22m) or with the supports of concrete columns (box culvert span of 8m to 22m).

During operation phase, the major activities include regular operation and maintenance of the water transmission lines such as (a) Leaks (detected by flow monitoring & audio) should only occur at air valve locations; (b) Repair of pipeline will involve trenching as in construction period but will be infrequent and affect small areas; (c) PRV and flow meter will be used in the distribution nodes; (d) Washout valves will be used for cleaning; and (e) Butterfly valve will be used for controlling etc.

10.3 Baseline Environment

An environmental baseline survey has been carried out along and surrounding the proposed water distribution pipeline routes of the above mentioned project sites. The specific objectives of the baseline study were to gather information on the existing environment (physical, ecological and social) of the areas within and surrounding the project sites, and also to assess peoples' perception on different aspects of the proposed project.

10.3.1 Physicochemical environment

Detail survey was carried out along the route of the proposed water distribution pipelines. Locations of various aspects such as roads, drainage channels, water bodies, electric poles, human settlement, and other permanent structures were identified. The pipelines would be laid under some major wide roads and also narrow roads within the city and also under the embankment roads. In some areas, the roads are quite narrow, making them susceptible to traffic congestion during pipeline construction. In some areas, houses and other establishments are located very close to the alignment of the pipelines. Relevant data on climate, geology and seismicity, air quality, noise level, and water quality were collected through field investigation as well as secondary sources. Air quality in old Dhaka is characterized by high concentrations of SPM and PM₁₀ during the dry season. Measures noise level at some project locations exceeded the sound level standards by a big margin.

10.3.2 Ecological environment

As assessment of the baseline of ecological aspects of the proposed project areas were collected through field research, consultation with local people, and literature review. The baseline ecological survey primarily focused on identifying floral and faunal diversity and their distribution and abundance as well as their biological status in Bangladesh (e.g. threatened flora and fauna). Protected areas, wildlife sanctuaries, game reserves and ecologically critical areas (ECA) were also reviewed. A total of 14 terrestrial faunal species (mostly bird) and 1 aquatic faunal species have been identified from the project areas. No fish species identified. A total of 23 terrestrial floral species have identified, of which 18 are tree species and 5 are herb species. No shrubs species identified. A total of 3 aquatic floral species have been identified and all of them are herb species. No threatened floral and faunal species have been identified in the project areas. A little portion of the highly polluted Buriganga River, an ECA, exists very close to Zone 1 of this project. No protected areas, wildlife sanctuaries and game reserves exists along or adjacent to the route of proposed pipeline network.

10.3.3 Socio-economic environment

An assessment of the baseline of socio-economic aspects of the proposed project sites was made. A socio-economic questionnaire survey was carried out in between October and November 2015. Assessment of major social aspects of the questionnaire respondents, and their attitudes regarding the proposed project was prepared. People of diverse socio-economic background live in the project sites. All respondents of the questionnaire survey

expressed their strong support for the proposed project, which they believed would improve the water supply situation in their localities.

10.3.4 Consultation and Communication

A stakeholder analysis was carried out as a part of the socio-economic study in order to: (1) identify the key stakeholders; (2) assess the power relationships as well as influence and interests of stakeholders involved in the proposed project, and (3) analyze and categorize the most important actors for preparation, design, implementation and monitoring of the proposed project. Identification of key stakeholders and their interest, importance and influence on the project at an early stage of project implementation would facilitate successful and timely completion of the project through involvement and support of these key stakeholders. Also, four FGDs were conducted during November 2015 at: (a) Jahir Raihan Cultural Center, Gandaria, Dhaka, (b) Ahmed Bawany School and College, Armanitola, Dhaka, (c) Chandmia Housing Complex, Mohammadpur, Dhaka, and (d) Ma Manjil 2, Ibrahimpur Bazar Road, Dhaka . A wide range of stakeholders including ward councilors, businessmen, land/house owner, housewife, retired officials, contractors, laborers, teachers, students, drivers, foreign workers, unemployed people, and religious leaders attended these FGDs and shared their opinion on different environmental aspects of the project, including expected benefit of the project, possible adverse impacts of project activities and remedial measures.

10.4 Environmental Impacts

10.4.1 Physicochemical Impacts

During construction phase, the important physicochemical aspects that are likely to be impacted by the proposed project activities include traffic, drainage congestion, air pollution, noise pollution, solid waste disposal, and water pollution. Most location at old Dhaka have been identified along the alignment of the water pipelines that are susceptible to drainage congestion; at these locations, the pipe laying works should be initiated and completed during the dry season. Besides, local drainage congestion may result from possible obstruction to natural flow of drainage water due to the storage of materials, excavating / back-filling of pipeline trenches. During box culvert / bridge crossing of pipes, care should be taken to make sure that no disruption of flow of the water courses occurs.

Noise and air pollution may result from a range of construction activities, including excavation, movement of vehicles carrying construction materials, equipment to and from the site. Such noise and air pollution may cause discomfort to the people at close proximity of the project areas, especially if such activities are continued during the night. However, noise and air pollution generated due to the project activities are likely to be moderate and of short-term in nature. Besides, a number of physicochemical environmental parameters could be adversely affected by the mobilization activities (of personnel and materials), and these parameters include pollution resulting from solid waste disposal.

10.4.2 Ecological Impacts

During construction phase, the proposed project activities, such as clearing of right of way, excavation (for making trenches/pits of pipe laying), earth filling, box culvert / bridge crossing, civil construction, movement of people and vehicle, etc. would have direct or indirect impacts, though minor, on the existing ecological environment. According to the baseline survey few scattered vegetation exist near the ROW that are used by certain type of fauna. Removal of the vegetation would create some direct or indirect adverse impact to its dependent fauna; some areas adjacent to the pipeline alignment are also use by certain types of fauna, and these may be impacted indirectly due to project activities. The highly polluted Buriganga River exists near the Zone 1 of the proposed alignment of the water distribution pipelines with no fish and faunal diversity except few common floral species. During operation phase, no impact are anticipated on the ecological environment.

10.4.3 Socio-Economic Impacts

During construction phase, loss of income may result from inability to use a particular piece of land / establishment (e.g. road-side shops). However, considering the nature of project activities, such impacts are likely to be minor and short duration. The pipe laying activities, especially those involving excavation of trenches, would cause / aggravate the traffic congestion in the narrow roads of old Dhaka, either by reducing road width or inducing side friction. Increased movement of people and materials at the project sites may result in traffic problem. Storage of materials (e.g. pipes, excavated soil) by the side of roads could also significantly affect traffic movement. Movement of trucks loaded with construction materials and heavy construction equipment may damage the roads surrounding the project sites. Digging and excavation works could result in unintentional damage to utility lines (e.g. existing water, electricity, and gas lines; cable / internet lines). Safety (including occupational safety) is an important issue particularly during construction of water distribution lines. Due to the proposed project, significant job opportunities will be created for labors, e.g. for pipe laying activities. In addition, there is also significant scope for employment of skilled workforce, including engineers in different project works.

During operational phase, the proposed project would play a major role in improving coverage, reliability and quality of DWASA water supply. These in turn would have significant benefit on public health. Other beneficial effects include employment of people for O&M of the expanded facilities.

10.5 Mitigation Measures

During construction phase, mitigation measures for the specific adverse impacts of the proposed construction of primary distribution water pipeline network project are shown in Table ES. 1. The Table reveals that most of the adverse impacts could be minimized or even removed if appropriate mitigation measures are taken. During operational phase, no specific adverse impacts are anticipated; however, regular and routine O & M of the developed facilities should be carried out diligently.

During construction phase, the environmental management should focus on addressing the possible negative impacts arising from: (a) Traffic / communication problems; (b) Air pollution; (c) Noise pollution; (d) Drainage congestion; (e) Water and Soil pollution; (f) Cutting / clearing of vegetation along RoW of water distribution lines; (g) Employment of labor force giving priority to local people with required skills; and (i) Safety and accidents. The mitigation measures for addressing the above issues are listed in Tables ES.1. It must be ensured that these measures are implemented in the field under the supervision of the PD of the proposed project. The environmental management during the operation phase should primarily be focused on regular/ routine operation and maintenance of the installed pipelines.

Specific monitoring requirements for the construction phase are presented in Table ES.2. Table ES.3 shows monitoring plan for water quality, air quality and noise level during construction phase of the project. Table ES.4 presents a preliminary cost estimate for monitoring and other measures during construction phase of the proposed project.

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ANNEX I
TERMS OF REFERENCE (TOR)

Padma North-West Sector Distribution System

Terms of Reference

Introduction:

Dhaka Water Supply and Sewerage Authority (DWASA) is entrusted with the responsibility to supply piped potable water to dwellers of Dhaka City and its adjacent area. It may be mentioned here, DWASA since its inception has a vision to adopt more surface water treatment plant to meet its demand. Due to the constraint of the resources, vision of DWASA has been being hampered. As a result, DWASA is in true sense compelled to extract water from groundwater sources to meet the day to day demand of the mega city. So as mentioned above, DWASA and GoB have taken a firm decision to produce major portion of city water demand from surface water source and thereby reduce the dependency on groundwater source to protect the environment as well as to reduce the risk of water supply in the capital.

Currently DWASA is extracting about 1900MLD water from Ground Water Sources (GWS) within its service area encircled by about 500sqkm through about 650 nos Deep Tube Wells which is neither environment friendly nor techno-economical. This excessive GW extraction is imparting a tremendous pressure to the GWS in all respects resulting GW mining i.e. depletion of the ground water table.

Recently Dhaka WASA has prepared a Water Supply Master Plan aiming to develop a sustainable and environment friendly water supply system in its services area. Assessment of demand shows that by the year 2035 the total demand is expected to be 5,268 MLD in the 617 sq km of Dhaka WASA jurisdiction area. Considering all relevant factors, the master planning consultant, IWM recommended to develop water supply infrastructures sector wise depending on the sources of water. Padma North-West Sector is one the Sectors which includes significant part of old city, Dhanmondi, Mohamdpur etc where the treated water to be obtained from the 1stPhase of the Padma (Jashaldia) Water Treatment Plant (WTP) which is 450 MLD will be supplied. It was also identified by IWM that the existing water distribution network in this sector is inadequate to cope 450 MLD water.

The construction of Padma WTP (Phase-1) has already been started on EPC/Turnkey basis with the financial assistance of China Exim Bank. The scope of work under this ongoing project includes construction of WTP and ancillary structures and treated water transmission line up to Mitford of Dhaka city. It is expected that the project will be completed by mid of 2018. So the importance and urgency for strengthening of the existing water supply network under the command area of this WTP is aggravating day by day. On the other hand, an order has been issued by the government to conduct feasibility study before proposing any development project. So a detail feasibility with a full scale ESIA study is now required to prepare a project for strengthening the existing water supply system of the command area of Padma (Jashaldia) WTP (Phase-1), Padma North-West Sector Distribution System.

Objective:

The main objective of this assignment is to conduct feasibility study of “Padma North-West Sector Distribution System” project including a full scale ESIA study to finalize the most sustainable cost effective primary and secondary distribution network to distribute the Water of Padma (Jashladia) WTP (Phase 1) considering all relevant technical, social, economic & institutional aspects.

The specific objectives are as follows:

- h) To develop a sustainable distribution network for Padma North-West Sector of the Water Supply Master Plan.
- i) To validate the ongoing DMA work with Padma North-West Sector network to be constructed.
- j) To further detailing of the outline design delineated in WSMP for the relevant Sector
- k) To prepare an analytical cost estimates.
- l) To evaluate financial viability of the proposed improvements.
- m) To conduct detail ESIA following acceptable international format.
- n) To check requirement of land acquisition along primary and secondary distribution mains.

Scope of Work:

1. Collection of all secondary data and reports which include
 - d. DWASA sewer, drainage, water supply Master Plan
 - e. Population census data 2011
 - f. Topographic and GIS data from DMC of DWSSDP and SDCC
2. Primary data acquisition
 - c. Conduct topographic survey for the alignments of the different size water supply pipelines delineated in WSMP and canals to be crossed by the proposed water pipeline where required.
 - d. Socio-economic survey
3. Update alignment of the primary and secondary distribution pipeline and their ROW based on survey information
4. Review the outline design of the distribution system delineated in WSMP and provide necessary updating details.
5. Validate the proposed water distribution system with ongoing and proposed DMA projects
6. Investigate canal crossings along the embankment and outline design of crossing structures
7. Assessment of connectivity with other Sectors
8. Update the mathematical model of the primary and secondary distribution system for any changes due to survey
9. Update cost estimate and financial analysis made in the Master Plan based on analysis and design under the current study
10. Identify any land acquisition requirements along the alignment of the primary and secondary distribution mains

11. Conduct ESIA study

g. *Environmental Reconnaissance of the Project Site*

Environmental reconnaissance of the project area, including alignment of the primary and secondary distribution network, canal crossings, injection points to observe the overall setting of the pre-project condition.

h. *Environmental Baseline Study*

A detailed environmental baseline study of the entire project area. The main objective of the baseline study is to assess the pre-project socio-economic and environmental conditions of project area, against which possible impacts of the proposed project will be analyzed.

i. *Identification and Analysis of Possible Impacts*

The potential impacts on various socio-economic & environmental parameters with respect to project activities. Both qualitative and quantitative impact assessments will be made. Identification of impacts based on the following:

- Location of Project Components:
- Construction Phase:
- Operational Phase:
- Design inadequacy and /or failure due to natural disaster or non acceptance by the citizens, etc.

j. *Design of Mitigatory Measures*

To offset adverse impacts on the socio-economic and environmental condition due to the project, mitigation measures would be suggested depending on impact characteristics. Methods of rectifying the impact by repairing, rehabilitating, resettling or restoring the affected socio-economic & environmental settlements will also be included here.

k. *Preparation of Environmental Management Plan (EMP)*

l. *Environmental Monitoring*

An environmental monitoring program will be developed which will include:

- Monitoring location
- Parameters to be monitored
- Frequency of monitoring
- Resources required.

Duration of the Study

Duration of the project will be 4 months

Reporting Requirements

- Inception Report – after one month of contract signing
- Draft Final Report – after three months of contract signing
- ESIA report - after four months of contract signing
- Final Report – after four months of contract signing

Team Composition

The consultant shall ensure that a team of experts and professional with necessary education, skill and experience is engaged for all tasks in the assignment. A summary of the minimum team requirements for the assignment and indicative level of effort is given below. The team aligning with the consultant shall be responsible to fulfill the requirement of the employer as mentioned in the scope of works but not limited too. Indicative professional staff months to be required for the assignment are as follows:

Position	Qualification and experience	Job description	Staff man month
Key Expert			
Team Leader	Graduate Civil or Environmental Engineer with at least 15 yrs working experience. Practical experience as Team Leader for minimum 2 similar assignments. Should have good computer knowledge, report writing and communication skills.	<ul style="list-style-type: none"> • Full responsibility for all aspects of activity planning, liaison and reporting; • Prepare project plan, schedules and time frame work for the preparation of reports; • Attend meetings as and when required; • Responsible for quality control of output of the study; • Contribute and review the reports and give suggestions for improvement. 	2
Water Supply Engineer	Graduate Civil or Environmental Engineer with at least 10 yrs working experience. Practical experience in water supply and sanitary engineering projects.	<ul style="list-style-type: none"> • Carry out hydraulic analyses using model output; • Plan and designing distribution mains; • Specify and design distribution mains and components • Contribute in reporting and supervise draftsman. 	2
EIA expert	Graduate Civil or environmental engineer. He/She should have at least 10 years experience in EIA studies,	Conduct environmental study and prepare EIA; Indicate whether potentially adverse environmental effects are significant or whether mitigation measures can be	3

	Environmental Management. Previous experience in coordinating sanitation management studies will be preferred.	adopted to reduce or eliminate these adverse effects. Provide recommendations on proposed project sites, resource demand, waste production and regulation, policies and guidelines for implementation.	
Sociologist	Graduate degree in related discipline. Minimum 15 years working experience in the relevant discipline. Experienced in SIA studies, resettlement projects.	He has to design and plan needs assessment and SIA surveys of communities in the project area; To identify future probable social negative impacts of the project and social imbalance; Arrange interaction meeting with different stakeholders; Contribute in the report	2
Economic and Financial Specialist	Graduate degree in economics. Minimum 15 years working experience in economic and financial analyses and evaluation of different option plans including experience in sanitation and environment related discipline.	He has to identify all costs and benefits of different option plans; Collect all related information for carrying out economical and financial analyses; Carry out economical and financial analyses for the proposed investment; Conduct necessary socio-economic survey and demographic assessments;	1
Survey Specialist	Minimum B.Sc. in civil engineering. He/she should have at least 10 years of working experience in related field. Should have at least 5 years experience in organizing field survey, data collection and processing using the modern satellite based survey equipment. He/She should have adequate experience in supporting mathematical modelling team.	Supervision and quality control of the field survey and data collection activities; Guide and monitor the preparation / production of drawings, maps and reports; Interaction with DWASA officials in the matters of survey and data collection specification and quality control; Contribute in reporting.	1
GIS /AutoCAD Specialist	Minimum of Bachelor degree on Civil Engineering / Water Resources Engineering / Urban and Rural	Prepare ArcGIS based geo-referenced maps of the project area; Prepare maps of water supply improvement projects; Prepare maps and presentation materials for	2

	Planning / Hydrology or Masters degree in Geography. Minimum 10 years experience in working with GIS. He/She should have adequate experience in pre and post processing of data required for model application and result interpretation.	reporting and discussion meeting;	
Non Key Experts			
Junior Engineer	B.Sc. Civil or Environmental Engineer with at least 2 yrs working experience in water supply and related projects.	<ul style="list-style-type: none"> • Carry out hydraulic modelling activities; • Assist in plan and designing distribution mains; • Assist in design distribution mains and components 	4
Drafts man	Diploma in Engineer with at least 5 yrs working experience in water supply and related projects.	Prepare maps of water supply improvement projects; Prepare maps plan and profile sheets for outline design, maps etc	2
Surveyor	Diploma in survey with at least 5 yrs working experience in water supply and other municipal projects.	Field survey and data collection activities for topographic data; Guide and monitor the preparation / production of drawings, maps and reports;	2

Responsibility of the client

For carrying out the assignment successfully within the stipulated period DWASA will provide the following support:

- Communicating with all stakeholder offices in the study area to provide all support to the consultant in order to make the study a success
- Providing all data and information in possession with DWASA offices
- Assisting the consultant to collect all associated data and information in possession with various GoB offices
- Providing necessary assistance in connection with field activities such as primary data collection, setting up field offices etc., to the consultants
- Assigning a responsible officer to supervise the activities of the consultant

The consultants shall have regular meetings with the DWASA professional staff to discuss technical and contract management issues. Any unresolved technical or otherwise should be taken up with the responsible officer of the client and shall provide the available data, as per its own system.

a) Legal Documents

DWASA will provide all necessary assistance in seeking permission or requesting through application to different agencies to supply data and to provide support to the consultants for their work.

DWASA will provide, if required, the staffs of Consultant ID cards or any form of legal document to visit to the required sites.

b) Timely Approval of Deliverables

For successful completion of the assignment in stipulated time frame the Client shall promptly review and put their comments/suggestions (if any) and approve the documents/deliverables in time.

Responsibility of the consultant

- The consultant shall assure sufficient support staffs including mid-level and junior engineers, logistics, office equipment and other necessary support on their own cost to deliver the services in an effective manner.
- The consultant shall carry out the services as detailed in the “Scope of Work” in the best interest of DWASA for the successful realization of the assignment with reasonable care, skill and diligence with sound technical, administrative and financial practices and shall be responsible to DWASA for discharging responsibilities.
- The consultant will provide the required human resources.
- The consultant shall abide by existing rules and regulations of Dhaka City Corporations, Rajdhani Unnayan Kartripokhya, Dept. of Environment and other allied organizations.

The recommendation of these organizations may be adopted wherever relevant and necessary.

- The consultant shall submit a detailed work schedule in inception report and follow it ardently.
- The consultant shall occupy office accommodation at IWM office in New DOHS, Mohakhali Dhaka.
- The consultants shall mobilize their team at a date agreed upon in the contract.
- The consultant will prepare reports in English and submit them to DWASA. They are responsible for incorporating the comments of DWASA, if there is any, in the report.
- The consultant will arrange workshop/seminar after submission of Inception Report and Draft Final Report.

ANNEX II
MEETING MINUTES OF DRAFT FINAL REPORT

Minutes of Meeting on Draft Final Report (DFR) by IWM for “Feasibility and ESIA study for Strengthening of the Existing Water Supply Distribution System of Dhaka to cope with the Production of Padma Water Treatment Plant Project (Phase-1) at Jashaldia”

The meeting on the Draft Final Report of “*Feasibility and ESIA study for Strengthening of the Existing Water Supply Distribution System of Dhaka to cope with the Production of Padma Water Treatment Plant*” took place in the DWASA Conference Room on 6th December, 2015 at 11:00 am. The meeting was chaired by Mr. Md. Serajuddin, Deputy Managing Director (RP&D), DWASA. The list of attendees of the meeting is attached in **Annex-A**.

The Chairperson of the meeting welcomed all participants and initiated the meeting. At the beginning, Mr. Md. Bazlur Rahman, Project Director, PJWTPP, gave introduction and briefed on the purpose of the meeting. He then requested the consulting team of Institute of Water Modelling (IWM) to present the study and its findings. A power point presentation was made on the following topics of the project.

- Water demand assessment for Padma North West sector and supply strategy in different zone area
- Existing situation analysis with survey information along western embankment and mapping activities carried out under the study
- Different transmission route’s alternative analysis and hydraulic modelling of the network
- Discussion with different stakeholders of the projects
- Different activities for the Environmental & Social Impact Assessment
- Cost estimate of the primary and secondary water supply distribution network of the Padma North West sector.

The meeting concluded by suggesting to consider the comments discussed in the meeting and incorporate them in the Study Report. The following suggestions were given by the committee during the presentation of the Draft Final Report:

Comments of DWASA	Responses of the Consultant
It was asked whether ToR of EIA & SIA study is approved or not.	ToR of ESIA study is already approved and the report has been prepared accordingly.
Suggestion for consultation with different stakeholders are needed as permission from these	Consultation has been carried out with BWDB, BGB and DSCC. In accordance

Cost Estimate of Padma Strengthening

Comments of DWASA	Responses of the Consultant
organization is important to carry out the project.	with the decision of the meetings, official proposal has been sent through DWASA for their permission.
Which side of the embankment is being used for laying transmission line?	Transmission line will follow the country side of the embankment and will be laid on top of embankment road.
Consultation with RHD is also needed, as along the embankment, a 4 (four) lane highway is proposed.	An official letter has been sent to RHD for consultation. A meeting with RHD was held and project brief was provided.
Checking of costing of the project is needed for the consistency with DPP. It was brought up that DWASA management should decide whether DWASA is going to supply water in the fringe area of embankment which can affect costing.	Provision for supply water in the outside area of embankment has been considered. The cost of the project has been re-evaluated and it is found that cost has increased what is found in water supply master plan.
What will be the end pressure of the transmission line like mirpur-10, kachuket areas, whether water pressure will be sufficient or not.	Sufficient pressure at the end point is confirmed by modelling and it will be approximately 1.9 bar.
In the meeting it was pointed out that nodal distribution from this study should be used for each DMA design so that consistency can be maintained.	The end pressure in distribution nodes in different part of the sector are provided in the report, which can be shared with other projects.
Reduction of sharp bend in the transmission line is important in the Basilla area.	Different alternative options has been analysed for the reducing of sharp bend.
Whether in this study 60-feet road (Agargoan-Mirpur Road) is used for pipe line layout or not.	Both 60-feet (Kamal Sarani Rd) & Rokeya Sarani Rd is used for pipe line layout and there is a provision for connection with the Singair transmission main at Mirpur-10.
It was asked how to maintain connection with the Ring Road area from the high dia transmission main.	A 400 mm parallel line is provided from the transmission main for connection with the area.
Will water from Padma be supplied to Zone-6 and	Zone-6 is outside Padma supply area.

Comments of DWASA	Responses of the Consultant
how water will be supplied?	The Master Plan suggests, water will be supplied to Zone-6 from Saidabad Phase-III network in the future.
Why Padma distribution system does not extend to Gabtoli?	Singair TP water transmission passed through the Gabtoli Bus stand Road, so no need to supply water from Padma.
Is water being distributed from transmission main on the both side of Begum Rokeya Avenue or not?	Water will be supplied on the both side of Begum Rokeya Ave and the line extends up to Ibrahimpur area.
Is Gendaria area is included in the project area or not?	Water will also be supplied in some parts of Gendaria area.
Is there any alternative way of transmitting water through BGB facility?	Alternatives to supply water through routes other than BGB are not feasible.

Md. Bazlur Rahman,
 Adviser & Project Director, PJWTPP
 DWASA, Dhaka

Distribution:

1. Managing Director, DWASA
2. Deputy Managing Director (RP&D), DWASA
3. Deputy Managing Director (O&M), DWASA
4. DPD, PJWTPP
5. Director, Water Resources Planning Division, IWM
6. Team Leader, Strengthening of Existing Distribution System of Padma North-West Sector project
7. Office Copy

Cost Estimate of Padma Strengthening

Annex-A: List of Participants in the Presentation of Draft Final Report






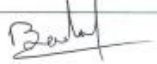
Presentation On
 "Feasibility and ESIA study for Strengthening of the Existing Water Supply Distribution System of Dhaka to cope with the
 Production of Padma Water Treatment Plant Project (Phase-1) at Jashaldia"

List of Participants; Venue: DWASA Conference Room; Date: 06/12/2015

Sl. No.	Name of Participants	Designation	Contract Number	Signature
1.	Md. Saifuddin	JMD (PPD)		
2.	Md. Barakur Rahman	Adviser and Project Director	01718105129	
3.	Md. Abul Kashem	CE		
4.	Md. Anifur Islam	EE / PJWTP	01715006326	
5.	Md. Amirul Islam	EE, PJWTP	01712524618	
6.	Md. Mostafa Kamal	SE MODS-2	01792-162625	
7.	Taufique Hasan	SAE / PJWTPP	01729-581589	
8.	Mehedi Hasan Bhuiyan	SAE / PJWTPP	01712-999596	
9.	Md. Nur-E-Neyamat Khan	SAE / PJWTPP	01915628638	

Sl. No.	Name of Participants	Designation	Contract Number	Signature
10.	Md. Enadul Hossain	SAE PJWTPP	01912585456	
11.	Md. Riaguddin	EE, MODS-2 zone-1 D. W.A.S.A.	01671025172	
12.	Mustafizur Rahman	Sociologist, IWM	0114040544	
13.	DR. MD. MOHSIN MUZZAMAN CHAUDHURY	Environmental Consultant - IWM	01715017372	
14.	S.R. Brothar	WRS, IWM	01715017372	
15.	Muhsinur Rahman	JE, IWM	01675968254	
16.	Md. Khalakuzzaman Mitha	JE, IWM	01737-260030	
17.	A.K.M. Shahid Uddin	PD, DWSDP	01916668325	
18.	BAHRUL ISLAM	DPD / DESWSP	01711584893	
19.	Md. Rahul Amin	SE, MOBS Circle - 1	01819221482	

18 e

Sl. No.	Name of Participants	Designation	Contact Number	Signature
20	H. Abdul Wahab	Executive Engineer	01819229418	
21	Md. Emdadul Haq	Executive Engineer	01810229415	
22	Benny Senen	DTL, DMC	01777246466	
23	Engr. Wazir Khan	EE, DWSSDP		
24	Md. Rafiqul Islam	SE & DPD, PJWTP	0171158251	
25	MOHAMMAD BADRUL ALAM	SDE, PJWTP	01558325423	

ANNEX III
MEETING MINUTES OF FINAL REPORT

Minutes of Meeting on Final Report for “Feasibility and ESIA study for Strengthening of the Existing Water Supply Distribution System of Dhaka to cope with the Production of Padma Water Treatment Plant Project (Phase-1) at Jashaldia”

The meeting on the Final Report of “*Feasibility and ESIA study for Strengthening of the Existing Water Supply Distribution System of Dhaka to cope with the Production of Padma Water Treatment Plant*” took place in the DWASA Conference Room on 23th February, 2016. The meeting was chaired by Engr. Taqsem A Khan, Managing Director, DWASA. The list of attendees of the meeting is attached in **Annex-A**.

The Chairperson of the meeting welcomed all participants and initiated the meeting. With the permission of Chairperson the consulting team of Institute of Water Modelling (IWM) presented the final study report and its findings. A power point presentation was made on the following topics of the project.

- Water demand assessment for Padma North West sector and supply strategy in different zone area
- Existing situation analysis with survey information along western embankment and mapping activities carried out under the study
- Different transmission route’s alternative analysis and hydraulic modelling of the network
- Discussion with different stakeholders of the projects
- Different activities for the Environmental & Social Impact Assessment
- Cost estimate of the primary and secondary water supply distribution network of the Padma North West sector.

The meeting concluded by suggesting to consider the comments discussed in the meeting and incorporate them in the Study Report. The following suggestions were given by the meeting during the presentation of the Final Report:

Comments of DWASA	Responses of the Consultant
It was asked whether provision of distribution node for the riverside of embankment area has been kept or not.	Provision for distributing water in the outside of embankment area (like Kamrangir Char etc.) has been kept.
Along the embankment road, there will be railway line, so transmission along this route should consider this and need to consult with concerned authority.	Alignment of pipe will follow west edge of embankment road.
Which side of the embankment is being used for	Countryside of the embankment will be

Cost Estimate of Padma Strengthening

Comments of DWASA	Responses of the Consultant
laying transmission line?	used for laying transmission line.
Whether during estimation of cost, connection fittings with other section (Saidabad, Gandharbpur etc.) has been included or not.	All fittings and connections are included in the estimated cost.
Whether water from Padma will be supplied to Mirpur-14 or not?	Padma will not supply water to Mirpur-14. Gandhabpur line will cover this area.
Details about pipe should be included in the study report (Pipe materials, class, standard etc.)	Pipe materials and other information has been included in the report.
There should be provision of two-way flow in connection point with other sector.	There are provision for two-way flow in connection with other sectors.
Executive summary should be updated with proper tense.	Updated
Whether provision for connection with Bhakurta transmission line has been kept or not.	Provision for Connection with Saidabad, Gandhabpur and Bhakurta transmission line has been kept in the Padma North west sector transmission line.
During cost estimation base year has to be mentioned, so that cost adjustment would be easy in future.	During cost estimation 2015 is considered as base year.
There are provision for parallel line along with transmission line in some areas, but road width are not enough (already there are many facilities). There should be some recommendation/other option about parallel line where space not available.	A separate analysis has been included in the report to minimize the provision of parallel lines
Road cutting and restoration charge is updated in every 3 year, cost of road restoration should include estimation year, so that adjustment can be done.	2015 is considered as base year.
What is the situation of stakeholder discussion	Initial stakeholder discussion has been done and proposal has been sent to

Comments of DWASA	Responses of the Consultant
(BGB, RHD, WDB, City corporation etc.)	BWDB, BGB. Further follow-up will be carried out for project preparation and implementation.
Checking of costing of the project is needed. It is informed that cost of the project is high. So investigation for lower cost is needed.	Alternative cost has been provided considering the newly proposed primary distribution with reduced parallel lines
Is water being distributed from transmission main on the both side of Begum Rokeya Avenue or not?	Water will be distributed on the both side of Begum Rokeya Avenue.
Whether ESIA study for this project has been approved or not?	ESIA study has been completed in accordance with approved ToR from DoE and final report has to be approved from DoE.

Md. Bazlur Rahman,
 Adviser & Project Director, PJWTTP
 DWASA, Dhaka

Distribution:

8. Managing Director, DWASA
9. Deputy Managing Director (RP&D), DWASA
10. Deputy Managing Director (O&M), DWASA
11. DPD, PJWTTP
12. Director, Water Resources Planning Division, IWM
13. Team Leader, Strengthening of Existing Distribution System of Padma North-West Sector project
14. Office Copy

ANNEX IV
LETTER TO DIFFERENT STAKEHOLDERS

Letter to Bangladesh Water Development Board

etc



ঢাকা পানি সরবরাহ ও পয়ঃ নিষ্কাশন কর্তৃপক্ষ

ব্যবস্থাপনা পরিচালকের কার্যালয়
ওয়াসা ভবন (৩য় তলা)

৯৮, বাগী নজরুল ইসলাম এভিনিউ, কাওরান বাজার, ঢাকা-১২০৫

স্মারক নং-৪৬.১১৩.৬১৯.০০.০০.০৮৬.২০১৫-১০২

তারিখঃ /০৯/২০১৫ ইং

মহাপরিচালক
বাংলাদেশ পানি উন্নয়ন বোর্ড

বিষয়ঃ পদ্মা (যশলদিয়া) পানি শোধনাগার নির্মাণ (ফেজ-১) প্রকল্প এর মাধ্যমে পরিশোধিত পানি সুষ্ঠুভাবে বিতরণের জন্য ঢাকা শহরের বিদ্যমান পানি সরবরাহ ব্যবস্থা শক্তিশালীকরণ প্রসঙ্গে।

উপর্যুক্ত বিষয়ের ক্ষেত্রে জানানো যাচ্ছে যে, ঢাকা শহরে বসবাসকারী মানুষের জন্য পরিশোধিত পানি বিতরণের নিমিত্তে ঢাকা ওয়াসা কর্তৃক 'পদ্মা (যশলদিয়া) পানি শোধনাগার নির্মাণ (ফেজ-১)' শীর্ষক প্রকল্পটি বাস্তবায়নাবধি রয়েছে। যার মূল উদ্দেশ্য হল পদ্মা নদীর পানি শোধনপূর্বক ঢাকা শহরের মানুষের জন্য বর্তমান সরবরাহের অতিরিক্ত দৈনিক ৪৫.০০ কোটি লিটার সুপেয় পানি সরবরাহ করা। উক্ত পানি পুরাতন ঢাকা এবং ঢাকা শহরের পশ্চিম-উত্তর অঞ্চলে সরবরাহ করা হবে। কিন্তু ঢাকা শহরের পানি সরবরাহ ব্যবস্থায় বিদ্যমান অবকাঠামোসমূহ উক্ত দৈনিক ৪৫.০০ কোটি লিটার পানি সরবরাহের জন্য একেবারেই অপ্রতুল। ফলে শোধনাগার হতে উৎপাদিত পানি সরবরাহ করার জন্য বিদ্যমান পানি সরবরাহ ব্যবস্থাকে শক্তিশালী করা প্রয়োজন। তৎক্ষণাত্বে উক্ত পরিশোধিত পানি বিতরণের জন্য ঢাকা শহরের বিদ্যমান পানি সরবরাহ ব্যবস্থাকে শক্তিশালীকরণের উদ্দেশ্যে ঢাকা ওয়াসা কর্তৃক 'Strengthening of The Existing Water Distribution System of Dhaka City to Cope the Production of Padma Water Treatment Plant (phase-1) at Jashaldia' শীর্ষক প্রকল্পের প্রস্তাব করা হয়েছে। উক্ত প্রকল্পের Feasibility and ESIA Study সম্পাদনের জন্য পানি সরবরাহ ও স্যানিটেশন সেটরে বিবল অতিজ্ঞহাসদপ্তর IWM (Institute of Water Modeling) - কে নিয়োজিত করা হয়েছে। প্রস্তাবিত নেটওয়ার্কের রুট সিঙ্গেকশন করতে গিয়ে প্রাথমিকভাবে দেখা যায় যে, একটি পানির লাইন ঢাকা শহরের পশ্চিম বধি (বেড়বধি) বরাবর স্থাপন করতে হচ্ছে। বাংলাদেশ বাংলাদেশ পানি উন্নয়ন বোর্ডের সঞ্চিত কর্মকর্তাদের সহিত আলোচনা করে বিষয়টির উপর সিদ্ধান্ত গ্রহণ করা প্রয়োজন।

এই অবস্থায়, উপরিত্তক কর্তৃক প্রস্তুতকৃত প্রকল্পের Feasibility and ESIA Study সম্পাদনের উদ্দেশ্যে ঢাকা ওয়াসা কর্তৃক নিয়োগকৃত পরামর্শক প্রতিষ্ঠান IWM - কে প্রয়োজনীয় সহযোগিতা করার জন্য অনুরোধ করা হল। ঢাকা শহরের পানি সরবরাহ ব্যবস্থা উন্নয়নের জন্য বিষয়টি ত্বরান্বিত।



প্রকৌশলী তাকসিম এ খান
ব্যবস্থাপনা পরিচালক
ঢাকা ওয়াসা

বিতরণঃ (প্রয়োজনীয় কার্যার্থে)

১. জনাব শহীদুল রহমান প্রধান, টিম লিডার, IWM (Institute of Water Modeling)

Detail Proposal Letter to Bangladesh Water Development Board



ঢাকা পানি সরবরাহ ও পয়ঃ নিষ্কাশন কর্তৃপক্ষ

ব্যবস্থাপনা পরিচালকের কার্যালয়
ওয়াসা ভবন, ঢাকা ওয়াসা

৯৮, কাজী নজরুল ইসলাম এভিনিউ, কাওরান বাজার, ঢাকা-১২১৫।

ফোন নং-৮৮-০২-৮১৮৯২৫; Website: www.dwss.org.bd; E-mail: mddwssa@bangla.net

স্মারক নং- ৪৬.১১৩.৬১৯.০০.০০.০৮৬.২০১৫-১৬৭

তারিখঃ ১৫/১১/২০১৫

মহাপরিচালক

বাংলাদেশ পানি উন্নয়ন বোর্ড
ওয়াপদা ভবন, মতিঝিল বা/এ
ঢাকা।

বিষয়ঃ ঢাকার পশ্চিম শহর রক্ষাবীথ (বেড়িবাঁধ) বরাবর পানির লাইন স্থাপনের অনুমোদন প্রদান প্রসংগে।

সূত্রঃ স্মারক নং- ৪৬.১১৩.৬১৯.০০.০০.০৮৬.২০১৫-১০২, তারিখ ১৫.০৯.২০১৫ এর পত্র এবং মোহাম্মদ আলী, তত্ত্বাবধায়ক প্রকৌশলী, ঢাকা এর সাথে অনুষ্ঠিত আলোচনা।

উপরোক্ত বিষয় ও সূত্রের প্রেক্ষিতে সদয় অবগত করানো যাচ্ছে যে, ঢাকা শহরের পুরান ঢাকা, শহরের পশ্চিম অঞ্চল এবং মিরপুর এলাকায় পানি সরবরাহ করার জন্য ঢাকা ওয়াসা দৈনিক ৪৫.০০ কোটি লিটার পানি উৎপাদনের লক্ষ্যে মুন্সীগঞ্জ জেলার লৌহজং উপজেলায় যশোলদিয়া এলাকায় পম্বার পাড়ে একটি পানি শোধনাগার স্থাপনের কাজ হাতে নিয়েছে। চীনা সরকারের অর্থায়নে বাস্তবায়নায়ী এই প্রকল্পটি গণপ্রজাতন্ত্রী বাংলাদেশ সরকারের মাননীয় প্রধানমন্ত্রী গত ২৮ অক্টোবর ২০১৫ তারিখে উদ্বোধন করেছেন। আলোচ্য শোধনাগারের উৎপাদিত পানি ঢাকা শহরের বর্ষিত এলাকায় সরবরাহের লক্ষ্যে Feasibility Study সম্পন্ন করার জন্য Institute of Water Modelling (IWM)-কে নিয়োগ করা হয়েছে এবং তারা উক্ত শোধনাগার হতে উৎপাদিত পানি সরবরাহ করার জন্য Primary এবং Secondary Distribution Network স্থাপনের নিমিত্তে Feasibility Study এর কাজ শুরু করেছে।

IWM ইতিমধ্যে প্রস্তাবিত Primary এবং Secondary Distribution Network-এর একটি খসড়া নকশা প্রণয়ন করেছে। উক্ত নকশায় দেখা যায় যে, মূল লাইনটির প্রায় দশ কিলোমিটার অংশ পশ্চিম দিকের শহর রক্ষা বাধের ওপর স্থাপন করা হবে। মূল লাইনটি বাবু বাজার ব্রিজ হতে শহর রক্ষা বাধের ওপর দিয়ে কল্যাণপুর পাম্প হাউস (টুইট গেট) পর্যন্ত স্থাপন করা হবে। পানির লাইন স্থাপনের কাজটি সতর্কতার সাথে করা হবে এবং প্রয়োজনীয় সতর্কতামূলক ব্যবস্থা নেয়া হবে যাতে বাধের ওপর বিদ্যমান টুইট গেট ও অন্যান্য স্থাপনাসহ মূল বাধের কোনো অংশ ক্ষতিগ্রস্ত না হয়।

এমতাবস্থায়, ঢাকা শহরের পানি সরবরাহ ব্যবস্থা উন্নয়নের লক্ষ্যে ঢাকার পশ্চিম শহর রক্ষাবীথ (বেড়িবাঁধ) বরাবর পাইপ লাইন স্থাপনের নিমিত্তে অনুমতি প্রদানসহ বাংলাদেশ পানি উন্নয়ন বোর্ডের বর্ষিত বিষয়ে দায়িত্বপ্রাপ্ত সংশ্লিষ্ট কর্মকর্তাকে আলোচনার প্রয়োজনীয় নির্দেশনা প্রদানের জন্য বিশেষভাবে অনুরোধ করা হল।

সংযুক্তিঃ প্রকল্পের সংক্ষিপ্ত বিবরণী ও পানির লাইনের প্রস্তাবিত নকশা।



১৫/১১/১৫
প্রকৌশলী তাকসিম এ খান
ব্যবস্থাপনা পরিচালক
ঢাকা ওয়াসা।

Feasibility and ESIA Study of the Project “Strengthening of the Existing Water Supply
Distribution System of
Dhaka to Cope with Production of Padma
Water Treatment Plant Project (Phase-1) at Jashaldia”

Introduction

Dhaka Water Supply and Sewerage Authority (DWASA) is entrusted with the responsibility to supply piped potable water to dwellers of Dhaka City and its adjacent area.

Currently DWASA is extracting about 1900MLD water from Ground Water Sources (GWS) within its service area encircled by about 500sqkm through about 700 nos Deep Tube Wells which is neither environment friendly nor techno-economical. This excessive GW extraction is imparting a tremendous pressure to the GWS in all respects resulting GW mining i.e. depletion of the ground water table.

Recently Dhaka WASA has prepared a Water Supply Master Plan aiming to develop a sustainable and environment friendly water supply system in its services area. Assessment of demand shows that by the year 2035 the total demand is expected to be 5,268 MLD in the 617 sq km of Dhaka WASA jurisdiction area. Considering all relevant factors, the master planning consultant, IWM recommended to develop water supply infrastructures sector wise depending on the sources of water. Dhaka North-West Sector is one the Sectors which includes significant part of old city, Dhanmondi, Mohamdpur etc where the treated water to be obtained from the 1stPhase of the Padma (Jashaldia) Water Treatment Plant (WTP) which is 450 MLD will be supplied.

The construction of Padma WTP (Phase-1) has already been started on EPC/Turnkey basis with the financial assistance of China Exim Bank. The scope of work under this ongoing project includes construction of WTP and ancillary structures and treated water transmission line up to Mitford of Dhaka city. It is expected that the project will be completed by mid of 2018. So Construction of Primary and Secondary Distribution Network under this command area of this WTP has become urgent for distribution of treated water in this part of the City. On the other hand, an order has been issued by the government to conduct feasibility study before proposing any development project. So a detail feasibility with a full scale ESIA study is now required to prepare a project for strengthening the existing water supply system of the command area of Padma (Jashaldia) WTP (Phase-1), Padma North-West Sector Distribution System.

Study area

The water from Padma/Jashaldia Phase-1 SWTP will be distributed to the Padma North West Sector according to the Water Supply Master Plan of DWASA. The Sector comprises of 50.9 sq.km area covering most of the area of Hazaribagh, Kamrangir Char and Mohammadpur Thana; parts of Kafrul, Keranigan, Kotwali, Lalbagh, Sutrapur, Dhanmondi, Shyampur and Cantonment Thana areas. For easy understanding, Padma North-West Sector has been subdivided into four subsectors named Subsector-North, Subsector-Old Dhaka, Subsector-Kamrangir Char and Subsector-Keraniganj. Primary Distribution network of water supply of Padma North-west pass through eight different Detail Planning Zones of

DMDP (2010). The average land level of this sector is around 6.5 mPWD. The river Buriganga flows through the west side of this sector. The present (2011) average density of population of Padma North-West sector is about 44,000/sq.km which will rise to around 76,000/sq.km in 2035. Total length of road and water supply pipe network is 722 km and 364 km respectively.

A technical feasibility study for the distribution system was carried out for the study under the Water Supply Masterplan carried out by DWASA. The alignment of the distribution system is shown in Figure. The study determined 42.5 km of primary distribution line will be required to supply the sector. Among this length 32% is more than 1000 mm dia pipe and also 9.5 km of 800 mm dia pipe. The major sections of the primary distribution and their alignments are shown in Table below.

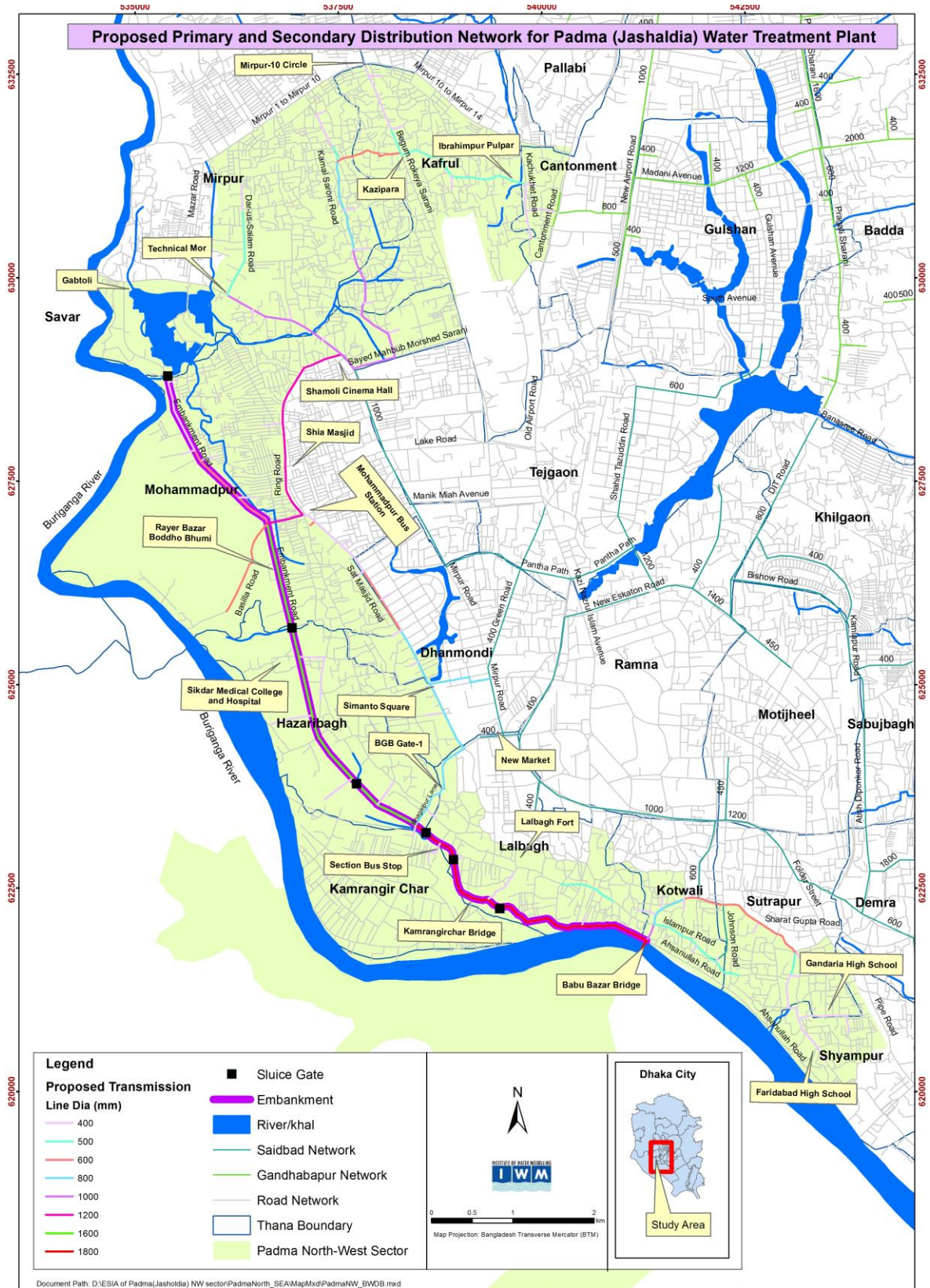
The main treated water transmission line will be along embankment from Babu Bazar Bridge to Kallayanpur Pump House. The length of this proposed route is about 10 kilometers. 1800 mm diameter transmission pipeline will be laid from Babu Bazar Bridge to Bhagalpur Lane (along embankment), which is about 3.5 km long. 1600 mm diameter transmission pipeline will be laid from Bhagalpur Lane to Basilla Road (along embankment), which is about 4.3 km long. 800 mm diameter transmission pipeline will be laid from Basilla Road to Kallayanpur Pump House (along embankment), which is about 2.2 km long.

It has been found that there are 6 (six) regulators and around 14 others cross structures (i.e. flap gate) along the embankment within the project area. We have examined that during construction of primary and secondary distribution mains sufficient space will be available to to avoid any disturbance to these structures. For the protection of the embankment necessary actions will be taken as per requirement of the Bangladesh Water Development Board.

Table: Summary of Primary Distribution Network that will be reviewed

Location	Dia (mm)	Length (m)	Location	Dia (mm)	Length (m)
Babu Bazar Bridge to Bhagalpur Lane (along embankment)	1800	3570	Shia Masjid to Shamoli Cinema hall	1200	1780
Bhagalpur Lane to Basilla Road (along embankment)	1600	4338	Bhagalpur Lane (from embankment) to Simanto Square (through BGB)	800	2130
Basilla Road to Kallayanpur Pump House (along embakment)	800	2193	Simanto Square to Mohammadpur Bus Station	600	2547
Total Along Embankment		10,100			
Basilla Road to Mohammadpur Bus Station	1200	518	Through BGB	800	2131
Mohammadpur Bus Station to Shia Masjid	1200	580	Through Kamal Saroni	800	3363

Cost Estimate of Padma Strengthening



Letter to Border Guard Bangladesh (BGB)

০৫



ঢাকা পানি সরবরাহ ও পয়ঃ নিষ্কাশন কর্তৃপক্ষ

ব্যবস্থাপনা পরিচালকের কার্যালয়

ওয়াসা ভবন (৩য় তলা)

৯৮, কাঙ্গালী নজরুল ইসলাম এভিনিউ, কাওরান বাজার, ঢাকা-১২০৫

স্মারক নং-৪৬.১১৩.৬১৯.০০.০০.০৮৬.২০১৫-১০৩

তারিখঃ ১৫/০৯/২০১৫ ইং

মহাপরিচালক

বর্তায় গার্ড বাংলাদেশ

বিষয়ঃ পদ্মা (ফেজ-১) পানি শোধনাগার নির্মাণ (ফেজ-১) প্রকল্প এর মাধ্যমে পরিশোধিত পানি সুষ্ঠুভাবে বিতরণের জন্য ঢাকা শহরের বিদ্যমান পানি সরবরাহ ব্যবস্থা শক্তিশালীকরণ প্রসঙ্গে।

উপর্যুক্ত বিষয়ের প্রেক্ষিতে জানানো যাচ্ছে যে, ঢাকা শহরে বসবাসকারী মানুষের জন্য পরিশোধিত পানি বিতরণের নিমিত্তে ঢাকা ওয়াসা কর্তৃক 'পদ্মা (ফেজ-১) পানি শোধনাগার নির্মাণ (ফেজ-১)' শীর্ষক প্রকল্পটি বাস্তবায়নাবধীন রয়েছে। ধার মূল উদ্দেশ্য হ'ল পদ্মা নদীর পানি শোধনপূর্বক ঢাকা শহরের মানুষের জন্য বর্তমান সরবরাহের অতিরিক্ত দৈনিক ৪৫.০০ কোটি লিটার সুপেয় পানি সরবরাহ করা। উক্ত পানি পুরাতন ঢাকা এবং ঢাকা শহরের পশ্চিম-উত্তর অঞ্চলে সরবরাহ করা হবে। কিন্তু ঢাকা শহরের পানি সরবরাহ ব্যবস্থায় বিদ্যমান অবকাঠামোসমূহ উক্ত দৈনিক ৪৫.০০ কোটি লিটার পানি সরবরাহের জন্য একেবারেই অঙ্গতুল। ফলে শোধনাগার হতে উৎপাদিত পানি সরবরাহ করার জন্য বিদ্যমান পানি সরবরাহ ব্যবস্থাকে শক্তিশালী করা প্রয়োজন। তৎপ্রেক্ষিতে উক্ত পরিশোধিত পানি বিতরণের জন্য ঢাকা শহরের বিদ্যমান পানি সরবরাহ ব্যবস্থাকে শক্তিশালীকরণের উদ্দেশ্যে ঢাকা ওয়াসা কর্তৃক 'Strengthening of The Existing Water Distribution System of Dhaka City to Cope the Production of Padma Water Treatment Plant (phase-1) at Jashaldia' শীর্ষক প্রকল্পের প্রস্তাব করা হয়েছে। উক্ত প্রকল্পের Feasibility and ESIA Study সম্পাদনের জন্য পানি সরবরাহ ও স্যানিটেশন সেট্টরে বিবল অভিজ্ঞতাসম্পন্ন IWM (Institute of Water Modeling) - কে নিয়োজিত করা হয়েছে। প্রস্তাবিত নেটওয়ার্কের রুট সিঙ্গেলেশন করতে গিয়ে প্রাথমিকভাবে দেখা যায় যে, একটি পানির লাইন বিজিবি হেড কোর্টারের তিনতর দিয়ে সাত মসজিদ রেডের লাইনের সাথে সংযোগ স্থাপন করতে হচ্ছে। এ বিষয়ে বর্তায় গার্ড বাংলাদেশের সংশ্লিষ্ট কর্মকর্তাদের সহিত আলোচনা করে বিষয়টির উপর সিদ্ধান্ত গ্রহণ করা প্রয়োজন।

এই অবস্থায়, উপরিউক্ত বর্ণনার অ্যালোকে প্রস্তাবিত প্রকল্পের Feasibility and ESIA Study সম্পাদনের উদ্দেশ্যে ঢাকা ওয়াসা কর্তৃক নিয়োগকৃত পরামর্শক প্রতিষ্ঠান IWM - কে প্রয়োজনীয় সহযোগিতা করার জন্য অনুরোধ করা হল। ঢাকা শহরের পানি সরবরাহ ব্যবস্থা উন্নয়নের জন্য বিষয়টি গুরুত্বপূর্ণ।


15/9/15

প্রকৌশলী তাকসিম এ বাস
ব্যবস্থাপনা পরিচালক
ঢাকা ওয়াসা

বিতরণঃ (স্বাক্ষরিত কার্যক্রমে)

১. জনাব শহীদুর রহমান প্রধান, টিম লিডার, IWM (Institute of Water Modeling)

Received 15/9/15

Ar. Rahman Md
20/9/15

কর্তৃপক্ষ ডাক গ্রহণ/বিতরণ শাখা
সদর দপ্তর বিজিবি ঢাকা

Detail Proposal Letter to Border Guard Bangladesh (BGB)



ঢাকা পানি সরবরাহ ও পয়ঃ নিষ্কাশন কর্তৃপক্ষ

ব্যবস্থাপনা পরিচালকের কার্যালয়
ওয়াসা ভবন, ঢাকা ওয়াসা

৯৮, কাজী নজরুল ইসলাম এভিনিউ, কাওরান বাজার, ঢাকা-১২১৫।
ফোন নং: ৯৮৭৬৫৪৩২১০; Website: www.dwasa.org.bd; E-mail: mddwasa@bangla.net

স্মারক নং- ৪৬.১১৩.৬১৯.০০.০০.০৮৬.২০১৫-১৫৮

তারিখঃ ১৫/১১/২০১৫

মহাপরিচালক
বর্ডার গার্ড অব বাংলাদেশ
বিজিবি হেডকোয়ার্টার
পিলখানা, ঢাকা।

বিষয়ঃ পিলখানার ভেতর দিয়ে পানির লাইন স্থাপনের অনুমোদন প্রদান প্রসঙ্গে।

সূত্রঃ স্মারক নং- ৪৬.১১৩.৬১৯.০০.০০.০৮৬.২০১৫-১০৩, তারিখ ১৫.০৯.২০১৫ এর পত্র এবং সোঃ কঃ শাহরিয়ার আহমেদ আমিন, ডিরেক্টর ওয়ার্কস ব্রাঞ্চ এর সাথে অনুষ্ঠিত আলোচনা।

উপরোক্ত বিষয় ও সূত্রের প্রেক্ষিতে সদয় অবগত করানো যাচ্ছে যে, ঢাকা শহরের পুরান ঢাকা, শহরের পশ্চিম অঞ্চল এবং মিরপুর এলাকায় পানি সরবরাহ করার জন্য ঢাকা ওয়াসা দৈনিক ৪৫.০০ কোটি লিটার পানি উৎপাদনের লক্ষ্যে মুন্সীগঞ্জ জেলার লৌহজং উপজেলাধীন যশোলদিয়া এলাকায় পদ্মার পাড়ে একটি পানি শোধনাগার স্থাপনের কাজ হাতে নিয়েছে। টানা সরকারের অর্থায়নে বাস্তবায়নধীন প্রকল্পটি গণপ্রজাতন্ত্রী বাংলাদেশ সরকারের মাননীয় প্রধানমন্ত্রী গত ২৮, অক্টোবর ২০১৫ তারিখে উদ্বোধন করেছেন। অসোচ্য শোধনাগারের উৎপাদিত পানি ঢাকা শহরের বর্ষিত এলাকায় সরবরাহের লক্ষ্যে Feasibility Study সম্পন্ন করার জন্য Institute of Water Modelling (IWM)-কে নিয়োগ করা হয়েছে এবং তারা উক্ত শোধনাগার হতে উৎপাদিত পানি সরবরাহ করার জন্য Primary এবং Secondary Distribution Network স্থাপনের নিমিত্তে Feasibility Study এর কাজ শুরু করেছে।

IWM ইতিমধ্যে প্রস্তাবিত Primary এবং Secondary Distribution Network-এর একটি খসড়া নকশা প্রণয়ন করেছে। উক্ত নকশায় দেখা যায় যে, মূল লাইনটি পশ্চিম দিকের শহর রক্ষা বাঁধের ওপর স্থাপন করা হবে। শহর রক্ষা বাঁধ হতে একটি ৮০০ মি. মি. ব্যাসের লাইন জগলপুর লেন, ললিত মোহন দাস লেন এবং পিলখানার ১নং গেট দিয়ে বিদ্যমান রাস্তা বরাবর ৪নং গেটের মাধ্যমে সাত মসজিদ রোডের সাথে সংযোগ স্থাপনের প্রস্তাব করা হয়েছে। লাইনটির প্রায় দুই কিলোমিটার অংশ পিলখানার ভেতর দিয়ে স্থাপন করতে হবে। বর্ডার গার্ড অব বাংলাদেশ এর হেড কোয়ার্টারের নিরাপত্তা বজায় রেখে শুধুমাত্র রাতের বেলা কাজ করে এবং দিনের বেলা রাস্তাগুলো যানবাহন চলাচলের উপযোগী করে দেয়া হবে।

এমতাবস্থায়, ঢাকা শহরের পানি সরবরাহ ব্যবস্থা উন্নয়নের লক্ষ্যে পিলখানার ভেতর দিয়ে বিদ্যমান রাস্তা বরাবর পাইপ লাইন স্থাপনের জন্য প্রয়োজনীয় অনুমতি প্রদান করার জন্য বিশেষভাবে অনুরোধ করা হল। BGB হেড কোয়ার্টারের নিরাপত্তা রক্ষার স্বার্থে সংশ্লিষ্ট BGB কর্মকর্তাদের সাথে আলোচনা করে পানির লাইন স্থাপন করা হবে।

সংযুক্তিঃ প্রকল্পের সংক্ষিপ্ত বিবরণ ও পানির লাইনের প্রস্তাবিত নকশা।



প্রকাশিনী তাকসিম এ খান

ব্যবস্থাপনা পরিচালক

ঢাকা ওয়াসা, ঢাকা

Received by

স্বাক্ষরিতঃ
১১/১১/১৫
সদস্য তাকসিম এ খান/বিতরণ শাখা
সদর দফতর বিজিবি ঢাকা

**Feasibility and ESIA Study of the Project “Strengthening of the Existing
Water Supply Distribution System of
Dhaka to Cope with Production of Padma
Water Treatment Plant Project (Phase-1) at Jashaldia”**

Introduction

Dhaka Water Supply and Sewerage Authority (DWASA) is entrusted with the responsibility to supply piped potable water to dwellers of Dhaka City and its adjacent area.

Currently DWASA is extracting about 1900MLD water from Ground Water Sources (GWS) within its service area encircled by about 500sqkm through about 700 nos Deep Tube Wells which is neither environment friendly nor techno-economical. This excessive GW extraction is imparting a tremendous pressure to the GWS in all respects resulting GW mining i.e. depletion of the ground water table.

Recently Dhaka WASA has prepared a Water Supply Master Plan aiming to develop a sustainable and environment friendly water supply system in its services area. Assessment of demand shows that by the year 2035 the total demand is expected to be 5,268 MLD in the 617 sq km of Dhaka WASA jurisdiction area. Considering all relevant factors, the master planning consultant, IWM recommended to develop water supply infrastructures sector wise depending on the sources of water. Dhaka North-West Sector is one the Sectors which includes significant part of old city, Dhanmondi, Mohamdpur etc where the treated water to be obtained from the 1stPhase of the Padma (Jashaldia) Water Treatment Plant (WTP) which is 450 MLD will be supplied.

The construction of Padma WTP (Phase-1) has already been started on EPC/Turnkey basis with the financial assistance of China Exim Bank. The scope of work under this ongoing project includes construction of WTP and ancillary structures and treated water transmission line up to Mitford of Dhaka city. It is expected that the project will be completed by mid of 2018. So Construction of Primary and Secondary Distribution Network under this command area of this WTP has become urgent for distribution of treated water in this part of the City. On the other hand, an order has been issued by the government to conduct feasibility study before proposing any development project. So a detail feasibility with a full scale ESIA study is now required to prepare a project for strengthening the existing water supply system of the command area of Padma (Jashaldia) WTP (Phase-1), Padma North-West Sector Distribution System.

Study area

The water from Padma/Jashaldia Phase-1 SWTP will be distributed to the Padma North West Sector according to the Water Supply Master Plan of DWASA. The Sector comprises of 50.9 sq.km area covering most of the area of Hazaribagh, Kamrangir Char and Mohammadpur Thana; parts of Kafrul, Keranigan, Kotwali, Lalbagh, Sutrapur, Dhanmondi, Shyampur and Cantonment Thana areas. For easy understanding, Padma North-West Sector has been subdivided into four subsectors named Subsector-North, Subsector-Old Dhaka, Subsector-Kamrangir Char and Subsector-Keraniganj. Primary Distribution network of water supply of Padma North-west pass through eight different Detail Planning Zones of DMDP (2010). The average land level of this sector is around 6.5 mPWD. The river Buriganga flows through the west side of this sector. The present (2011) average density of population of Padma North-

West sector is about 44,000/sq.km which will rise to around 76,000/sq.km in 2035. Total length of road and water supply pipe network is 722 km and 364 km respectively.

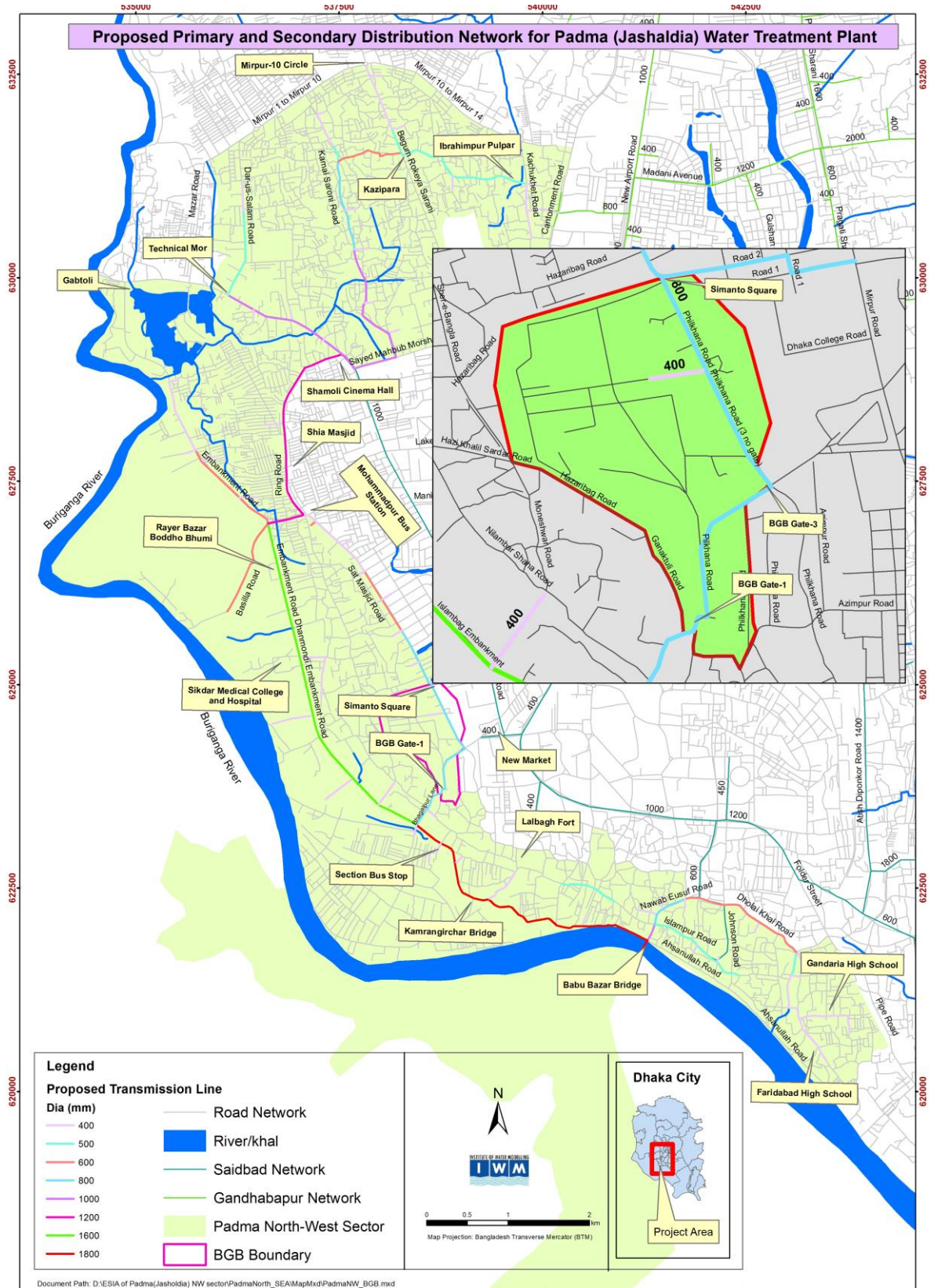
A technical feasibility study for the distribution system was carried out for the study under the Water Supply Masterplan carried out by DWASA. The alignment of the distribution system is shown in Figure. The study determined 42.5 km of primary distribution line will be required to supply the sector. Among this length 32% is more than 1000 mm dia pipe and also 9.5 km of 800 mm dia pipe. The major sections of the primary distribution and their alignments are shown in Table below.

A proposed treated water transmission line diameter of 800 mm will follow the main road of BGB along Gate-1 to Gate-3 to Gate-4 (near Simanto Square). The length of proposed route is about 1700 m. There will be provision for water supply inside BGB through a pipe of 400 mm diameter. Construction of pipeline will be carried out according to the guidelines from BGB which includes working at night, following road sides suggested by BGB and any other recommendation.

Table: Summary of Primary Distribution Network that will be reviewed

Location	Dia (mm)	Length (m)	Location	Dia (mm)	Length (m)
Babu Bazar Bridge to Bhagalpur Lane (along embankment)	1800	3570	Shia Masjid to Shamoli Cinema hall	1200	1780
Bhagalpur Lane to Basilla Road (along embankment)	1600	4338	Bhagalpur Lane (from embankment) to Simanto Square (through BGB)	800	2146
Basilla Road to Gabtoli (along embankment)	800	2193	BGB Gate-1 to BGB gate-3 to BGB Gate-4 (near Simanto Square)	800	1666
Basilla Road to Mohammadpur Bus Station	1200	518	Simanto Square to Mohammadpur Bus Station	600	2547
Mohammadpur Bus Station to Shia Masjid	1200	580	Through Kamal Saroni	800	3363

Cost Estimate of Padma Strengthening



Letter to Dhaka South City Corporation

etc



ঢাকা পানি সরবরাহ ও পয়ঃ নিষ্কাশন কর্তৃপক্ষ

ব্যবস্থাপনা পরিচালকের কার্যালয়
ওয়াশা জবন (৩য় তলা)

৯৮, কাশী নজরুল ইসলাম এভিনিউ, কাওরান বাজার, ঢাকা-১২০৫

স্মারক নং-৪৬.১১৩.৬১৯.০০.০০.০৮৬.২০১৫-৯৯

তারিখঃ ১৫/০৯/২০১৫ ইং

প্রধান নির্বাহী কর্মকর্তা
ঢাকা দক্ষিণ সিটি কর্পোরেশন

বিষয়ঃ পদ্মা (যশলদিয়া) পানি শোধনাগার নির্মাণ (ফেজ-১) প্রকল্প এর মাধ্যমে পরিশোধিত পানি সুষ্ঠুভাবে বিতরণের জন্য ঢাকা শহরের বিদ্যমান পানি সরবরাহ ব্যবস্থা শক্তিশালীকরণ প্রসঙ্গে।

উপর্যুক্ত বিষয়ের ক্ষেত্রে জানানো যাচ্ছে যে, ঢাকা শহরে বসবাসকারী মানুষের জন্য পরিশোধিত পানি বিতরণের নিমিত্তে ঢাকা ওয়াশা কর্তৃক 'পদ্মা (যশলদিয়া) পানি শোধনাগার নির্মাণ (ফেজ-১)' শীর্ষক প্রকল্পটি বাস্তবায়নাবধীন রয়েছে। যার মূল উদ্দেশ্য হ'ল পদ্মা নদীর পানি শোধনপূর্বক ঢাকা শহরের মানুষের জন্য বর্তমান সরবরাহের অতিরিক্ত দৈনিক ৪৫.০০ কোটি লিটার সুপেয় পানি সরবরাহ করা। উক্ত পানি পুরাতন ঢাকা এবং ঢাকা শহরের পশ্চিম-উত্তর অঞ্চলে সরবরাহ করা হবে। কিন্তু ঢাকা শহরের পানি সরবরাহ ব্যবস্থায় বিদ্যমান অবকাঠামোসমূহ উক্ত দৈনিক ৪৫.০০ কোটি লিটার পানি সরবরাহের জন্য একেবারেই অপর্যাপ্ত। ফলে শোধনাগার হতে উৎপাদিত পানি সরবরাহ করার জন্য বিদ্যমান পানি সরবরাহ ব্যবস্থাকে শক্তিশালী করা প্রয়োজন। অতঃপ্রসঙ্গে উক্ত পরিশোধিত পানি বিতরণের জন্য ঢাকা শহরের বিদ্যমান পানি সরবরাহ ব্যবস্থাকে শক্তিশালীকরণের উদ্দেশ্যে ঢাকা ওয়াশা কর্তৃক 'Strengthening of The Existing Water Distribution System of Dhaka City to Cope the Production of Padma Water Treatment Plant (phase-1) at Jashaldia' শীর্ষক প্রকল্পের প্রস্তুতি করা হয়েছে। উক্ত প্রকল্পের Feasibility and ESIA Study সম্পাদনের জন্য পানি সরবরাহ ও স্যানিটেশন সেক্টরে বিদ্যমান অভিজ্ঞতাসম্পন্ন IWM (Institute of Water Modeling) - কে নিয়োগিত করা হয়েছে। প্রস্তাবিত সেটিংগার্বের ত্রুটি সিলেকশন করতে গিয়ে প্রাথমিকভাবে দেখা যায় যে, উক্ত রকমের জন্য ঢাকা দক্ষিণ সিটি কর্পোরেশনের আওতাধীন কিছু ব্যক্তি ব্যবহার করতে হবে। শহরের মুখ্য স্ট্রিকচারের হিসাবে ঢাকা দক্ষিণ সিটি কর্পোরেশনের মতামত প্রকল্পটির জন্য গুরুত্বপূর্ণ। এ বিষয়ে ঢাকা দক্ষিণ সিটি কর্পোরেশন এর সর্বশ্রেষ্ঠ কর্মকর্তাদের সহিত আলোচনা করে বিষয়টির উপর সিদ্ধান্ত গ্রহণ করা প্রয়োজন।

এই অর্থায়ন, উপরিত্তক বর্ণনার আদ্যে প্রস্তাবিত প্রকল্পের Feasibility and ESIA Study সম্পাদনের উদ্দেশ্যে ঢাকা ওয়াশা কর্তৃক নিয়োগিত পরামর্শক প্রতিষ্ঠান IWM - কে প্রয়োজনীয় সহযোগিতা করার জন্য অনুরোধ করা হল। ঢাকা শহরের পানি সরবরাহ ব্যবস্থা উন্নয়নের জন্য বিষয়টি গুরুত্বপূর্ণ।



প্রকৌশলী তাকসিম এ খান
ব্যবস্থাপনা পরিচালক
ঢাকা ওয়াশা



বিতরণ (প্রয়োজনীয় কার্যার্থে)

১. জনাব শহীদুল রহমান প্রধান, টিম লিডার, IWM (Institute of Water Modeling)

Letter to Dhaka North City Corporation

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ঢাকা পানি সরবরাহ ও পয়ঃ নিষ্কাশন কর্তৃপক্ষ

ব্যবস্থাপনা পরিচালকের কার্যালয়

ওয়াসা ভবন (৩য় তলা)

৯৮, কাপ্তানী নজরুল ইসলাম এভিনিউ, ফারওয়ান বাজার, ঢাকা-১২০৫

স্মারক নং-৪৬.১১৩.৬১৯.০০.০০.০৮৬.২০১৫-১০০

তারিখঃ ১৫/০৯/২০১৫ ইং

প্রধান নির্বাহী কর্মকর্তা
ঢাকা উত্তর সিটি কর্পোরেশন

বিষয়ঃ পদ্মা (যশলদিয়া) পানি শোধনাগার নির্মাণ (ফেজ-১) প্রকল্প এর মাধ্যমে পরিশোধিত পানি সুষ্ঠুভাবে বিতরণের জন্য ঢাকা শহরের বিদ্যমান পানি সরবরাহ ব্যবস্থা শক্তিশালীকরণ প্রসঙ্গে।

উপর্যুক্ত বিষয়ের প্রেক্ষিতে জানানো যাচ্ছে যে, ঢাকা শহরে বসবাসকারী মানুষের জন্য পরিশোধিত পানি বিতরণের নিমিত্তে ঢাকা ওয়াসা কর্তৃক 'পদ্মা (যশলদিয়া) পানি শোধনাগার নির্মাণ (ফেজ-১)' শীর্ষক প্রকল্পটি বাস্তবায়নাবীন রয়েছে। যার মূল উদ্দেশ্য হ'ল পদ্মা নদীর পানি শোধনপূর্বক ঢাকা শহরের মানুষের জন্য বর্তমান সরবরাহের অতিরিক্ত দৈনিক ৪৫.০০ কোটি লিটার সুপের পানি সরবরাহ করা। উক্ত পানি পুরাতন ঢাকা এবং ঢাকা শহরের পশ্চিম-উত্তর অঞ্চলে সরবরাহ করা হবে। কিন্তু ঢাকা শহরের পানি সরবরাহ ব্যবস্থায় বিদ্যমান অবকাঠামোসমূহ উক্ত দৈনিক ৪৫.০০ কোটি লিটার পানি সরবরাহের জন্য একেবারেই অপ্রকৃত। ফলে শোধনাগার হতে উৎপাদিত পানি সরবরাহ করার জন্য বিদ্যমান পানি সরবরাহ ব্যবস্থাকে শক্তিশালী করা প্রয়োজন। অপ্রেক্ষিতে উক্ত পরিশোধিত পানি বিতরণের জন্য ঢাকা শহরের বিদ্যমান পানি সরবরাহ ব্যবস্থাকে শক্তিশালীকরণের উদ্দেশ্যে ঢাকা ওয়াসা কর্তৃক 'Strengthening of The Existing Water Distribution System of Dhaka City to Cope the Production of Padma Water Treatment Plant (phase-1) at Jashaldia' শীর্ষক প্রকল্পের প্রস্তাব করা হয়েছে। উক্ত প্রকল্পের Feasibility and ESIA Study সম্পাদনের জন্য পানি সরবরাহ ও স্যানিটেশন সেক্টরে বিবল অভিজ্ঞতাসম্পন্ন IWM (Institute of Water Modeling) - কে নিয়োগিত করা হয়েছে। প্রস্তাবিত নেটওয়ার্কের কণ্ট্রোলিং পিলেবকশন করতে গিয়ে প্রাথমিকভাবে দেখা যায় যে, উক্ত কণ্ট্রোলিং পিলেবকশনের আওতাধীন কিছু রাস্তা ব্যবহার করতে হবে। শহরের মুখ্য স্ট্রিকচারের হিসাবে ঢাকা উত্তর সিটি কর্পোরেশনের মতামত প্রকল্পটির জন্য গুরুত্বপূর্ণ। এ বিষয়ে ঢাকা উত্তর সিটি কর্পোরেশন এর সংশ্লিষ্ট কর্মকর্তাদের সহিত আলোচনা করে বিষয়টির উপর সিদ্ধান্ত গ্রহণ করা প্রয়োজন।

এই অবস্থায়, উপরিউক্ত বর্ণনার আলোকে প্রস্তাবিত প্রকল্পের Feasibility and ESIA Study সম্পাদনের উদ্দেশ্যে ঢাকা ওয়াসা কর্তৃক নিয়োগিত পরামর্শক প্রতিষ্ঠান IWM - কে প্রয়োজনীয় সহযোগিতা করার জন্য অনুরোধ করা হল। ঢাকা শহরের পানি সরবরাহ ব্যবস্থা উন্নয়নের জন্য বিষয়টি গুরুত্বপূর্ণ।

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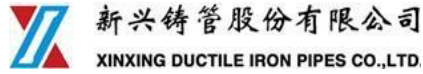


15/9/15
প্রকৌশলী তাকসিম এ বাস
ব্যবস্থাপনা পরিচালক
ঢাকা ওয়াসা

বিতরণঃ (প্রয়োজনীয় কার্যার্থে)
১. জনাব শহীদুল রহমান প্রধান, টিম লিডার, IWM (Institute of Water Modeling)

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Appendix-1: Price Quotation of Xing Xing Pipe, 2019



TO: FROM: XINXING DUCTILE IRON PIPES CO., LTD.

INQUIRER: MR.Shahidur Rahman Prodhan CONTACTOR: ZHOU YU

MOBILE: MOBILE: +86 18701082833

AIL: E-MAIL: zhouyu@xinxingpipes.com.cn

INQUIRY DATE: 20190124 QUOTE DATE: 20190303

QUOTATION

No.	Description	Size	Class	Unit	Qty	CIF FILO Chittagong USD/M	AMOUNT USD
	Pipe						
1	Ductile iron socket and spigot pipe, T type	DN400	K9	M	6	\$99.96	\$599.76
2	Ductile iron socket and spigot pipe, T type	DN500	K9	M	6	\$139.92	\$839.52
3	Ductile iron socket and spigot pipe, T type	DN600	K9	M	6	\$186.28	\$1,117.68
4	Ductile iron socket and spigot pipe, T type	DN800	K9	M	6	\$301.72	\$1,810.32
5	Ductile iron socket and spigot pipe, T type	DN1000	K9	M	6	\$449.54	\$2,697.24
6	Ductile iron socket and spigot pipe, T type	DN1200	K9	M	6	\$615.54	\$3,693.24
7	Ductile iron socket and spigot pipe, T type	DN1400	K9	M	6	\$833.45	\$5,000.70
8	Ductile iron socket and spigot pipe, T type	DN1600	K9	M	6	\$1,094.47	\$6,566.82
9	Ductile iron socket and spigot pipe, T type	DN1800	K9	M	6	\$1,443.04	\$8,658.24
	Fitting						

Cost Estimate of Padma Strengthening

10	All Socket Tee	DN400	k14	Unit	1	\$630.00	\$630.00
11	All Socket Tee	DN500	k14	Unit	1	\$982.80	\$982.80
12	All Socket Tee	DN600	k14	Unit	1	\$1,440.60	\$1,440.60
13	All Socket Tee	DN800	k14	Unit	1	\$2,751.00	\$2,751.00
14	All Socket Tee	DN1000	k14	Unit	1	\$4,603.20	\$4,603.20
15	All Socket Tee	DN1200	k14	Unit	1	\$7,194.60	\$7,194.60
16	All Socket Tee	DN1400	k14	Unit	1	\$11,121.60	\$11,121.60
17	All Socket Tee	DN1600	k14	Unit	1	\$15,960.00	\$15,960.00
18	All Socket Tee	DN1800	k14	Unit	1	\$20,823.60	\$20,823.60
19	Double Socket Bends 22.5°	DN400	k12	Unit	1	\$310.80	\$310.80
20	Double Socket Bends 22.5°	DN500	k12	Unit	1	\$466.20	\$466.20
21	Double Socket Bends 22.5°	DN600	k12	Unit	1	\$659.40	\$659.40
No.	Description	Size	Class	Unit	Qty	CIF FILO Chittagong USD/M	AMOUNT USD
22	Double Socket Bends 22.5°	DN800	k12	Unit	1	\$1,390.20	\$1,390.20
23	Double Socket Bends 22.5°	DN1000	k12	Unit	1	\$2,310.00	\$2,310.00
24	Double Socket Bends 22.5°	DN1200	k12	Unit	1	\$3,574.20	\$3,574.20
25	Double Socket Bends 22.5°	DN1400	k12	Unit	1	\$5,212.20	\$5,212.20
26	Double Socket Bends 22.5°	DN1600	k12	Unit	1	\$6,837.60	\$6,837.60
27	Double Socket Bends 22.5°	DN1800	k12	Unit	1	\$8,555.40	\$8,555.40
28	Double Socket Bends 45°	DN400	k12	Unit	1	\$373.80	\$373.80
29	Double Socket Bends 45°	DN500	k12	Unit	1	\$583.80	\$583.80
30	Double Socket Bends 45°	DN600	k12	Unit	1	\$848.40	\$848.40
31	Double Socket Bends 45°	DN800	k12	Unit	1	\$1,587.60	\$1,587.60
32	Double Socket Bends 45°	DN1000	k12	Unit	1	\$2,667.00	\$2,667.00

33	Double Socket Bends 45°	DN1200	k12	Unit	1	\$4,141.20	\$4,141.20
34	Double Socket Bends 45°	DN1400	k12	Unit	1	\$6,337.80	\$6,337.80
35	Double Socket Bends 45°	DN1600	k12	Unit	1	\$8,891.40	\$8,891.40
36	Double Socket Bends 45°	DN1800	k12	Unit	1	\$10,983.00	\$10,983.00
37	Double Socket Bends 90°	DN400	k12	Unit	1	\$541.80	\$541.80
38	Double Socket Bends 90°	DN500	k12	Unit	1	\$856.80	\$856.80
39	Double Socket Bends 90°	DN600	k12	Unit	1	\$1,272.60	\$1,272.60
40	Double Socket Bends 90°	DN800	k12	Unit	1	\$2,499.00	\$2,499.00
41	Double Socket Bends 90°	DN1000	k12	Unit	1	\$4,389.00	\$4,389.00
42	Double Socket Bends 90°	DN1200	k12	Unit	1	\$6,984.60	\$6,984.60
43	Double Socket Bends 90°	DN1400	k12	Unit	1	\$10,159.80	\$10,159.80
44	Double Socket Bends 90°	DN1600	k12	Unit	1	\$14,464.80	\$14,464.80
45	Double Socket Bends 90°	DN1800	k12	Unit	1	\$17,988.60	\$17,988.60
	Valve						\$0.00
46	1800mm Dia Butterfly Valve		PN16	Unit	1	\$35,599.70	\$35,599.70
47	1600 mm Dia Butterfly Valve		PN16	Unit	1	\$24,608.00	\$24,608.00
48	1400 mm Dia Butterfly Valve		PN16	Unit	1	\$15,616.30	\$15,616.30
49	1200 mm Dia Butterfly Valve		PN16	Unit	1	\$11,253.50	\$11,253.50
No.	Description	Size	Class	Unit	Qty	CIF FILO Chittagong USD/M	AMOUNT USD
50	1000 mm Dia Butterfly Valve		PN16	Unit	1	\$7,514.40	\$7,514.40
51	800 mm Dia Butterfly Valve		PN16	Unit	1	\$4,266.20	\$4,266.20
52	600 mm Dia Butterfly Valve		PN16	Unit	1	\$2,457.00	\$2,457.00
53	500 mm Dia Butterfly Valve		PN16	Unit	1	\$1,835.40	\$1,835.40
54	400 mm Dia Butterfly Valve		PN16	Unit	1	\$1,200.50	\$1,200.50

Cost Estimate of Padma Strengthening

55	PRESSURE REDUCE VALVE 600 mm Dia Tape A		PN16	Unit	1	\$7,401.50	\$7,401.50
56	PRESSURE REDUCE VALVE 500 mm Dia Tape A		PN16	Unit	1	\$7,049.90	\$7,049.90
57	PRESSURE REDUCE VALVE 400 mm Dia Tape A		PN16	Unit	1	\$4,559.50	\$4,559.50
58	PRESSURE REDUCE VALVE 350 mm Dia Tape A		PN16	Unit	1	\$3,260.90	\$3,260.90
59	PRESSURE REDUCE VALVE 300 mm Dia Tape A		PN16	Unit	1	\$2,401.30	\$2,401.30
60	PRESSURE REDUCE VALVE 600 mm Dia Tape B		PN16	Unit	1	\$33,776.30	\$33,776.30
61	PRESSURE REDUCE VALVE 500 mm Dia Tape B		PN16	Unit	1	\$28,631.20	\$28,631.20
62	PRESSURE REDUCE VALVE 400 mm Dia Tape B		PN16	Unit	1	\$23,606.80	\$23,606.80
63	PRESSURE REDUCE VALVE 350 mm Dia Tape B		PN16	Unit	1	\$18,961.20	\$18,961.20
64	PRESSURE REDUCE VALVE 300 mm Dia Tape B		PN16	Unit	1	\$17,350.10	\$17,350.10
65	Sluice Valve 600 mm Dia		PN16	Unit	1	\$3,747.70	\$3,747.70
66	Sluice Valve 500 mm Dia		PN16	Unit	1	\$2,292.30	\$2,292.30
67	Sluice Valve 400 mm Dia		PN16	Unit	1	\$1,243.50	\$1,243.50
68	Sluice Valve 350 mm Dia		PN16	Unit	1	\$1,077.10	\$1,077.10
69	Sluice Valve 300 mm Dia		PN16	Unit	1	\$532.00	\$532.00
Total							\$481,620.22

Items:

Pipes offered will be ductile iron as per ISO2531-1998, push-on joint, class K9, Internal cement mortar lining comply with ISO4179-2005,

external sprayed metallic Zinc coating (min.130g/m²) according to ISO8179-2004 + black final coating (min.70µm) according to ISO8179.

- ¹ Matched 102% EPDM rubber gasket in accordance with ISO4633-2002. The effective length of pipe below DN1000 is 6m/pcs, the effective length of pipe above DN1200 is 6m/pcs or 8.15m/pcs.

Fittings offered will be ductile iron as per ISO2531-1998,, Internal cement mortar lining comply with ISO4179-2005, external rich Zinc

- ² coating according to ISO8179-2004 + black final coating (min.70µm) according to ISO8179. The thickness of bends is of K12, tee is of

- K14. The valve is PN16.
- 2 Country of Origin: **P.R. China.**
- 3 Manufacturer: **Xinxing Ductile Iron Pipes Co., Ltd**
- 4 Validity of Quotation: **90** days till June 03th 2019. Prices remain valid only during the validity of the offer.
- 5 Price item: CIF FILO Chittagong Port in USD dollars, unloading fee is included
- 6 Delivery: Negotiation by two parties before the contract
- 7 Payment: by TT or irrevocable 100% L/C at sight issued by first-class international bank.
- 8 Inclusion of Price: The price includes 102% EPDM rubber gaskets, 2% necessary accessories for spare parts.
- 9 Third Party Inspection: Allowed and inspection will be the final. Inspection fee is not included in the offer.
- 10 Other: The drawing about Valve

Butterfly Valve



Sluice Valve



PRV Tape A



PRV Tape B



Best Regards

Signed:



Cost Estimate of Padma Strengthening

Name: ZHOU YU

Title: Sales Manager

On behalf of Xinxing Ductile Iron Pipes Co., Ltd.

Appendix-2: National Tariff, 2022-23

Government of the People's Republic of
Bangladesh National Board of Revenue

Segunbagicha, Dhaka
National Tariff:2022-2023

HSCODE	DESCRIPTION	CD	SD	VAT	AIT	RD	A	TTI
01012100	Pure-bred breeding animals of horses..	5	0	0	5	0	0	10.00
01012900	Other horses	5	0	0	5	0	0	10.00
01013000	Asses	5	0	0	5	0	0	10.00
01019000	LIVE HORSES,ASSES,MULES AND HINNIES,NES	5	0	0	5	0	0	10.00
01022100	Pure-bred breeding animals of cattle	0	0	0	0	0	0	-
01022900	Other cattle	0	0	0	0	0	0	-
01023100	Pure-bred breeding animals of buffalo	0	0	0	0	0	0	-
01023900	Other buffalo	0	0	0	0	0	0	-
01029010	Other pure-bred breeding animals	0	0	0	0	0	0	-
01029090	Other live bovine animal	0	0	0	0	0	0	-
01031000	Live Pure-Bred Breeding Swine	5	0	0	5	0	0	10.00
01039100	Live Swine Weighing <50kg (Excl. Pure-Bred Breeding)	5	0	0	5	0	0	10.00
01039200	Live Swine Weighing >=50kg (Excl. Pure-Bred Breeding)	5	0	0	5	0	0	10.00
01041000	Live sheep	5	0	0	5	0	0	10.00
01042000	Live Goats	5	0	0	5	0	0	10.00
01051110	Fowls Of The Species Gallus Domestic(Parent Stock One Day Chick)	0	0	0	0	0	0	-
01051190	Live Fowls Gallus,Domestic<=185g, Excl.Parent Stock Of One Day Chick	25	0	0	5	3	0	33.00
01051210	Live Turkeys Weighing <=185g, (Parent Stock Of One Day Chick)	0	0	0	0	0	0	-
01051290	Live Turkeys Weighing <=185g, (Excl.Parent Stock Of One Day Chick)	25	0	0	5	3	0	33.00
01051310	Parent stock of one day chick of ducks	0	0	0	0	0	0	-
01051390	Other ducks	25	0	0	5	3	0	33.00
01051410	Parent stock of one day chick of geese	0	0	0	0	0	0	-
01051490	Other Geese	25	0	0	5	3	0	33.00
01051510	Parent stock of one day chick of guinea fowls	0	0	0	0	0	0	-

Cost Estimate of Padma Strengthening

01051590	Other fowls	25	0	0	5	3	0	33.00
01059400	Fowls of the species Gallus domesticus	25	0	0	5	3	0	33.00
01059900	Live Ducks, Geese, Turkeys And Guinea Fowls Weighing >185g	25	0	0	5	3	0	33.00

HSCODE	DESCRIPTI	CD	SD	VAT	AIT	RD	A	TTI
73044110	Capillary Tube Of 16 Bwg To 29 Bwg, Of Stainless Steel,Circular Cross...	5	0	15	5	0	5	31.00
73044190	Capillary Tube (Excl.16 Bwg To 29 Bwg), Of S.Steel, Circular Cross Section	25	0	15	5	3	5	58.60
73044910	Other Capillary Tube Of 16 Bwg To 29 Bwg, Of S.Stell, Circular,Nes	5	0	15	5	0	5	31.00
73044990	Other Tubes,Pipes,Profiles,Circular,Nes(Excl.Capillary Tube Of 16 Bwg To..	25	0	15	5	3	5	58.60
73045100	Seamless Alloy Tubes/Pipes/Profiles, Cold-Drawn/Rolled	25	0	15	5	3	5	58.60
73045900	Seamless Alloy Tubes/Pipes/Profiles, Nes	25	0	15	5	3	5	58.60
73049000	Seamless Iron/Steel Tubes/Pipes/Profiles Of Non-Circular X-Section	25	20	15	5	3	5	89.32
73051100	Iron/Steel Line Pipe,Longitud.Submerged Arc Welded,Circ.X-Section >406.4mm	25	0	15	5	3	5	58.60
73051200	Iron/Steel Line Pipe,Longitudnly Welded,Nes,Circ.X-Sect.>406.4mm Ext.Diam	25	0	15	5	3	5	58.60
73051900	Iron/Steel Line Pipe,Spirally Welded,Circular X-Section,>406.4mm Ext.Diam	25	0	15	5	3	5	58.60
73052000	Iron/Steel Casing For Drilling For Oil Or Gas, >406.4mm External Diameter	25	0	15	5	3	5	58.60
73053100	Longitudinally welded	25	0	15	5	3	5	58.60
73053900	Iron/steel tubes and pipes, spirally welded, >406.4mm external diameter	25	0	15	5	3	5	58.60
73059000	Iron/steel tubes, riveted, >406.4mm external diameter	25	0	15	5	3	5	58.60
73061110	Line pipe of a kind used for oil/gas pipelines:Welded, of stainless steel Excee	15	0	15	5	0	5	43.00
73061120	Line pipe of a kind used for oil/gas pipelines:Welded, of stainless steel, 8 in	25	20	15	5	3	5	89.32
73061910	Line pipe of a kind used for oil/gas pipelines:Excl. Wel, of stainless steel Ex	15	0	15	5	0	5	43.00
73061920	Line pipe of a kind used for oil/gas pipelines:Excl.Welded,of stainless steel,	25	20	15	5	3	5	89.32
73062110	Casing and tubing of a kind used in the dril for oil/gas,Welded,of stainless st	15	0	15	5	0	5	43.00
73062120	Casing and tubing of a kind used in the dril for oil/gas,Welded,of stainless st	25	20	15	5	3	5	89.32
73062910	Casing and tubing of a kind used in the dril for oil/gas,Excl.Weld,of s.less st	15	0	15	5	0	5	43.00
73062920	Casing and tubing of a kind used in the dril for oil/gas,Excl.Weld.,of s.less s	25	20	15	5	3	5	89.32
73063000	Other, welded, of circular cross-section of iron or non-alloy steel	25	20	15	5	3	5	89.32
73064000	Other, welded, of circular cross-section, of stainless steel	25	20	15	5	3	5	89.32
73065000	Other, welded, of circular cross-section, of other alloy steel	25	20	15	5	3	5	89.32
73066100	Othr,weld, of non-circu.cr.section Of square or rec.cross-sec., NES	25	20	15	5	3	5	89.32
73066900	Othr,weld, of non-circu. C.-sec.Of othr non-Circu.cr.-section ERW pipes&s.less	25	20	15	5	3	5	89.32
73069000	Tubes, pipes and hollow profiles, riveted, of iron or steel, nes	25	20	15	5	3	5	89.32
73071100	Cast Tube Or Pipe Fittings Of Non-Malleable Cast Iron	25	20	15	5	3	5	89.32
73071900	Cast Tube Or Pipe Fittings Of Iron,Oth.Than Non-Malleable Steel	25	20	15	5	3	5	89.32
73072100	Flanges Of Stainless Steel	25	0	15	5	3	5	58.60
73072200	Threaded Elbows, Bends And Sleeves Of Stainless Steel	25	0	15	5	3	5	58.60

Appendix-3: Road Restoration Rates of DSCC, 2021

রেজিস্টার্ড নং ডি এ-১

বাংলাদেশ



গেজেট

অতিরিক্ত সংখ্যা
কর্তৃপক্ষ কর্তৃক প্রকাশিত

বৃহস্পতিবার, সেপ্টেম্বর ৮, ২০২২

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
স্থানীয় সরকার, পল্লী উন্নয়ন ও সমবায় মন্ত্রণালয়
স্থানীয় সরকার বিভাগ
সিটি কর্পোরেশন-১ শাখা

প্রজ্ঞাপন

তারিখ : ২১ ভাদ্র ১৪২৯/০৫ সেপ্টেম্বর ২০২২

নং ৪৬.০০.০০০০.০৭০.২২.০০১.১৮-১০৪৩—স্থানীয় সরকার বিভাগ প্রণীত 'ঢাকা মহানগরীর সড়ক খনন নীতিমালা, ২০১৯' এর আলোকে অর্থ বিভাগের ২২-০৮-২০২২ তারিখের ০৭.০০.০০০০.১৫৫.১৪.০০১.২০-৫২০নং স্মারকের পরিপ্রেক্ষিতে সরকার ঢাকা দক্ষিণ ও ঢাকা উত্তর সিটি কর্পোরেশন অধিক্ষেত্রে 'সড়ক খনন ক্ষতিপূরণ ফি' নিম্নবর্ণিতরূপে নির্ধারণ করিল :

উন্মুক্ত খনন এবং এইচডিডি খনন ক্ষতিপূরণ ফি :

(ক) উন্মুক্ত খনন ক্ষতিপূরণ ফি :

ক্রমিক	রাস্তার প্রকৃতি	ব্যক্তিগত খনন গভীরতা ১.৫০ মিঃ পর্যন্ত	প্রস্তাবিত রাস্তা খনন ফি (প্রতি বর্গ মিটার)	
			সংস্থা	
১	২	৩	গভীরতা ১.৫০ মিঃ পর্যন্ত	গভীরতা ১.৫০ মিঃ এর অধিক
১।	কাঁচা রাস্তা	৪৮২.০০	৪৮২.০০	৪৮২.০০
২।	ব্রিক পেভমেন্ট (২০০ মিঃ মিঃ)	১৭৯২.০০	১৭৯২.০০	২০৩৩.০০
৩।	বিটুমিনাস রাস্তা (প্রাইমারী রোড)	৭৮৭১.০০	৭৮৭১.০০	৯৬১৯.০০
৪।	বিটুমিনাস রাস্তা	৬৩১২.০০	৬৩১২.০০	৭৬৮০.০০
৫।	সি সি রাস্তা	৪৯৪৬.০০	৪৯৪৬.০০	৬১৫১.০০

(১৫১২৫)

মূল্য : টাকা ৮.০০

১৫১২৬

বাংলাদেশ গেজেট, অতিরিক্ত, সেপ্টেম্বর ৮, ২০২২

১	২	৩	৪	৫
৬।	আরসিসি রাস্তা	৬৭০৪.০০	৬৭০৪.০০	৭৯৩০.০০
৭।	সি সি ফুটপাথ	৩০২১.০০	৩০২১.০০	৩৩৮৪.০০
৮।	এনশ্রেড সিসি টাইল (ফুটপাথ)	৪৩৫৬.০০	৪৩৫৬.০০	৪৯৬৮.০০
৯।	ইউনিব্রক পেভারস (ফুটপাথ)	৩৯২৮.০০	৩৯২৮.০০	৪৫৪৫.০০

(খ) এইচডিডি Horizontal Direction Drilling (with casing) পদ্ধতিতে সড়ক খননের ক্ষতিপূরণ ফি :

১। ১৫০ মিমিঃ (৬") পর্যন্ত ডায়া রাস্তা বোরিং ফি, টাকা/মিটার

ক্রমিক	রাস্তার প্রকৃতি	প্রস্তাবিত রাস্তা বোরিং ৬ ইঞ্চির চেয়ে কম ব্যাসের জন্য (প্রতি মিঃ)	
		গভীরতা ১.৫০ মিঃ এর কম পর্যন্ত (উন্মুক্ত পদ্ধতিতে খনন রেট×১০%)	গভীরতা ১.৫০ মিঃ এর অধিক (উন্মুক্ত পদ্ধতিতে খনন রেট×৫%)
১	২	৩	৪
১।	কাঁচা রাস্তা	৪৮.২	২৪.১
২।	ব্রিক পেভমেন্ট (২০০ মিমিঃ মিমিঃ)	১৭৯.২	৮৯.৬
৩।	বিটুমিনাস রাস্তা (প্রাইমারী রোড)	৭৮৭.১	৩৯৩.৫৫
৪।	বিটুমিনাস রাস্তা	৬৩১.২	৩১৫.৬
৫।	সি সি রাস্তা	৪৯৪.৬	২৪৭.৩
৬।	আরসিসি রাস্তা	৬৭০.৪	৩৩৫.২
৭।	সি সি ফুটপাথ	৩০২.১	১৫১.০৫
৮।	এনশ্রেড সিসি টাইল (ফুটপাথ)	৪৩৫.৬	২১৭.৮
৯।	ইউনিব্রক পেভারস (ফুটপাথ)	৩৯২.৮	১৯৬.৪

২। ১৫০ মিমিঃ (৬") এর অধিক ৩০০ মিমিঃ (১২") পর্যন্ত ডায়া রাস্তা বোরিং ফি, টাকা/মিটার

ক্রমিক নং	রাস্তার প্রকৃতি	প্রস্তাবিত রাস্তা বোরিং ৬ ইঞ্চির থেকে ১২ ইঞ্চির কম ব্যাসের জন্য (প্রতি মিঃ)	
		গভীরতা ১.৫০ মিঃ এর কম পর্যন্ত (উন্মুক্ত পদ্ধতিতে খনন রেট×১৩%)	গভীরতা ১.৫০ মিঃ এর অধিক (উন্মুক্ত পদ্ধতিতে খনন রেট×৭%)
১	২	৩	৪
১।	কাঁচা রাস্তা	৬২.৬৬	৩৩.৭৪
২।	ব্রিক পেভমেন্ট (২০০ মিমিঃ মিমিঃ)	২৩২.৯৬	১২৫.৪৪
৩।	বিটুমিনাস রাস্তা (প্রাইমারী রোড)	১০২৩.২৩	৫৫০.৯৭
৪।	বিটুমিনাস রাস্তা	৮২০.৫৬	৪১১.৮৪
৫।	সি সি রাস্তা	৬৪২.৯৮	৩৪৬.২২
৬।	আরসিসি রাস্তা	৮৭১.৫২	৪৩৬.২৮
৭।	সি সি ফুটপাথ	৩৯২.৭৩	২১১.৪৭
৮।	এনশ্রেড সিসি টাইল (ফুটপাথ)	৫৬৬.২৮	৩০৪.৯২
৯।	ইউনিব্রক পেভারস (ফুটপাথ)	৫১০.৬৪	২৭৪.৯৬

Cost Estimate of Padma Strengthening

বাংলাদেশ গেজেট, অতিরিক্ত, সেপ্টেম্বর ৮, ২০২২

১৫১২৭

৩। ৩০০ মিঃমিঃ (১২") এর অধিক ডায়া রাস্তা বোরিং ফি, টাকা/মিটার

ক্রমিক নং	রাস্তার প্রকৃতি	রাস্তা বোরিং ১২ ইঞ্চি থেকে ১৮ ইঞ্চি ব্যাসের জন্য (প্রতি মিঃ)	
		গভীরতা ১.৫০ মিঃ এর কম পর্যন্ত (উন্মুক্ত পদ্ধতিতে খনন রেট×১৭%)	গভীরতা ১.৫০ মিঃ এর অধিক (উন্মুক্ত পদ্ধতিতে খনন রেট×৯%)
১	২	৩	৪
১।	কাঁচা রাস্তা	৮১.৯৪	৪৩.৩৮
২।	ব্রিক পেভমেন্ট (২০০ মিঃ মিঃ)	৩০৪.৬৪	১৬১.২৮
৩।	বিটুমিনাস রাস্তা (প্রাইমারী রোড)	১৩৩৮.০৭	৭০৮.৩৯
৪।	বিটুমিনাস রাস্তা	১০৭৩.০৪	৫৬৮.০৮
৫।	সি সি রাস্তা	৮৪০.৮২	৪৪৫.১৪
৬।	আরসিসি রাস্তা	১১৩৯.৬৮	৬০৩.৩৬
৭।	সি সি ফুটপাথ	৫১৩.৫৭	২৭১.৮৯
৮।	এনগ্রোড সি সি টাইল (ফুটপাথ)	৭৪০.৫২	৩৯২.০৪
৯।	ইউনিব্রক পেভারস (ফুটপাথ)	৬৬৭.৭৬	৩৫৩.৫২

(গ) এইচডিডি Horizontal Direction Drilling (without casing) পদ্ধতিতে সড়ক খননের ক্ষতিপূরণ ফি :

১। ১৫০ মিঃমিঃ (৬") পর্যন্ত ডায়া রাস্তা বোরিং ফি, টাকা/মিটার

ক্রমিক নং	রাস্তার প্রকৃতি	প্রস্তাবিত রাস্তা বোরিং ৬ ইঞ্চির চেয়ে কম ব্যাসের জন্য (প্রতি মিঃ)	
		গভীরতা ১.৫০ মিঃ এর কম পর্যন্ত (উন্মুক্ত পদ্ধতিতে খনন রেট×১৩%)	গভীরতা ১.৫০ মিঃ এর অধিক (উন্মুক্ত পদ্ধতিতে খনন রেট×৭%)
১	২	৩	৪
১।	কাঁচা রাস্তা	৬২.৬৬	৩৩.৭৪
২।	ব্রিক পেভমেন্ট (২০০ মিঃ মিঃ)	২৩২.৯৬	১২৫.৪৪
৩।	বিটুমিনাস রাস্তা (প্রাইমারী রোড)	১০২৩.২৩	৫৫০.৯৭
৪।	বিটুমিনাস রাস্তা	৮২০.৫৬	৪৪১.৮৪
৫।	সি সি রাস্তা	৬৪২.৯৮	৩৪৬.২২
৬।	আরসিসি রাস্তা	৮৭৯.১৯	৪৭৩.৪১
৭।	সি সি ফুটপাথ	৩৯২.৭৩	২১১.৪৭
৮।	এনগ্রোড সি সি টাইল (ফুটপাথ)	৫৬৬.২৮	৩০৪.৯২
৯।	ইউনিব্রক পেভারস (ফুটপাথ)	৫১০.৬৪	২৭৪.৯৬

১৫১২৮

বাংলাদেশ গেজেট, অতিরিক্ত, সেন্টেম্বর ৮, ২০২২

২। ১৫০ মিমিমি (৬") এর অধিক ৩০০ মিমিমি (১২") পর্যন্ত ডায়া রাস্তা বোরিং ফি, টাকা/মিটার

ক্রমিক নং	রাস্তার প্রকৃতি	প্রস্তাবিত রাস্তা বোরিং ৬ ইঞ্চি থেকে ১২ ইঞ্চির কম ব্যাসের জন্য (প্রতি মিঃ)	
		গভীরতা ১.৫০ মিঃ এর কম পর্যন্ত (উনুক্ত পদ্ধতিতে সড়ক খনন রেট×১৬%)	গভীরতা ১.৫০ মিঃ এর অধিক (উনুক্ত পদ্ধতিতে খনন রেট×১৯%)
১	২	৩	৪
১। কাঁচা রাস্তা		৭৭.১২	৪৩.৩৮
২। ব্রিক পেভমেন্ট (২০০ মিমি মিমি)		২৮৬.৭২	১৬১.২৮
৩। বিটুমিনাস রাস্তা (গ্রাইমারী রোড)		১২৫৯.৩৬	৭০৮.৩৯
৪। বিটুমিনাস রাস্তা		১০০৯.৯২	৫৬৮.০৮
৫। সি সি রাস্তা		৭৯১.৩৬	৪৪৫.১৪
৬। আরসিসি রাস্তা		১০৮২.০৮	৬০৮.৬৭
৭। সি সি ফুটপাত		৪৮৩.৩৬	২৭১.৮৯
৮। এনগ্রোড সি সি টাইল (ফুটপাত)		৬৯৬.৯৬	৩৯২.০৪
৯। ইউনিটরক পেভারস (ফুটপাত)		৬২৮.৪৮	৩৫৩.৫২

৩। ৩০০ মিমিমি (১২") এর অধিক ডায়া রাস্তা বোরিং ফি, টাকা/মিটার

ক্রমিক নং	রাস্তার প্রকৃতি	রাস্তা বোরিং ১২ ইঞ্চি থেকে ১৮ ইঞ্চি ব্যাসের জন্য (প্রতি মিঃ)	
		গভীরতা ১.৫০ মিঃ এর কম পর্যন্ত (উনুক্ত পদ্ধতিতে খনন রেট×২১%)	গভীরতা ১.৫০ মিঃ এর অধিক (উনুক্ত পদ্ধতিতে খনন রেট×১১%)
১	২	৩	৪
১। কাঁচা রাস্তা		১০১.২২	৫৩.০২
২। ব্রিক পেভমেন্ট (২০০ মিমি মিমি)		৩৭৬.৩২	১৯৭.১২
৩। বিটুমিনাস রাস্তা (গ্রাইমারী রোড)		১৬৫২.৯১	৮৬৫.৮১
৪। বিটুমিনাস রাস্তা		১৩২৫.৬৬	৬৯৪.৩২
৫। সি সি রাস্তা		১০৩৮.৫২	৫৪৪.০৬
৬। আরসিসি রাস্তা		১৪২০.২৩	৭৪৩.৯৩
৭। সি সি ফুটপাত		৬৩৪.৪১	৩৩২.৩১
৮। এনগ্রোড সি সি টাইল (ফুটপাত)		৯১৪.৭৬	৪৭৯.১৬
৯। ইউনিটরক পেভারস (ফুটপাত)		৮২৪.৮৮	৪৩২.০৮

০২। বর্ষিত সড়ক খনন ক্ষতিপূরণ ফি অবিলম্বে কার্যকর হইবে।

রাষ্ট্রপতির আদেশক্রমে

মোহাম্মদ শামছুল ইসলাম

উপসচিব।

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হাছিনা বেগম, উপপরিচালক (উপসচিব), বাংলাদেশ ফরম ও প্রকাশনা অফিস, তেজগাঁও,
ঢাকা কর্তৃক প্রকাশিত। website: www.bgpress.gov.bd

ANNEX-2

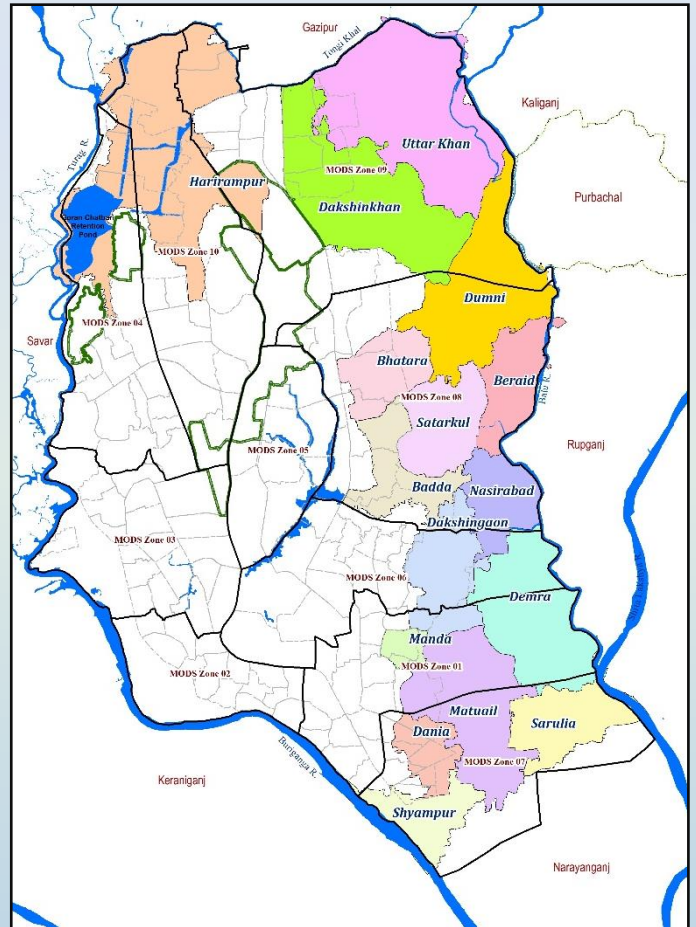
Feasibility study for water distribution system development in extended 16 (sixteen) union of Dhaka North and Dhaka South City Corporation under Interim Water Supply Project, Dhaka
WASA, Dhaka



Ministry of Local Government Rural Development and Co-Operatives

Dhaka Water Supply and Sewerage Authority (DWASA)

Feasibility study for water distribution system development in extended 16 (sixteen) union of Dhaka North and Dhaka South City Corporation under Interim Water Supply Project, Dhaka WASA, Dhaka



Final Report

Volume 1 of 4: Main Report

February 2022



Institute of Water Modelling

Final Report Volumes

- Volume 1 : Main Report
- Volume 2 : Design Drawings
- Volume 3 : Hydrogeological Investigation Report
- Volume 4 : Environmental and Social Impact Assessment Report

Executive Summary

Introduction and Background

The feasibility study is about water distribution system development in newly included 16 (sixteen) union of Dhaka North City Corporation and Dhaka South City Corporation. As per government decision, Beraid, Badda, Bhatara, Satarkul, Horirampur, Uttarkhan, Dakshinkhan and Dumni union have been included in the DNCC, while Shyampur, Matuail, Demra, Dania, Sarulia, Dakshingaon, Nasirabad and Manda union have been included with DSCC. Total study area is about 178.75 sq. km out of which 114.58 sq. km have been added into DNCC and 64.17 sq. km have been added into DSCC.

The main objective of the study is to carry out a feasibility study of the project aiming at extending sustainable water supply to newly included 16 unions of DNCC and DSCC considering all relevant technical, social, environmental, economic, and institutional aspects. For sustainable water supply in the study area, establishment of District Metering Areas (DMA) and harmonizing them with Dhaka Water Supply Master Plan and with the existing and proposed DMAs in the Dhaka city under ADB funded DWSSDP and DESWSP are necessary.

Existing Water Supply Situation in Study Area

Knowing the existing water supply system is the first requirement to develop sustainable water supply system in the study area. It will be a baseline for further study about water source selection especially about selection of ground water source. Existing water supply situation in the study area has been observed by conducting a reconnaissance survey. The survey team found that, DWASA has existing water supply coverage in some areas under 16 unions of study. Households which are not connected to DWASA water supply network are depending on private pumps installed in individual houses. People in some areas also have community water supply system. In that case, households get water supply from PTWs installed by local people or NGOs. However, the present water supply system in these areas is not sustainable. As the population in those areas is expected to increase rapidly in future, such individual or community water supply system will not work well. So, development of sustainable water supply system in those areas should be considered with priority.

Water Demand Estimation

Water demand in the project area has been calculated keeping compliant with Water Supply Master Plan. Projected population for 2040 has been estimated based on current population and

future development plan in respective areas. Per capita water consumption in the study area was found from social survey. Per capita consumption varies in between 30-350 lpcd within the study area. However, water demand has been calculated considering per capita domestic demand as 130 lpcd which is same as considered in moderate growth scenario of WSMP for the year 2035. Moreover, sensitivity analysis for demand has been carried out for three different scenario (High, Moderate and Low). In addition to domestic demand, certain percentage of non- domestic demand and water loss is considered in total demand calculation. The total demand for the study area is found as 950 MLD in moderate growth scenario for the year 2040. Whereas, for high and low growth scenario the total water requirement is found as 1,287 MLD and 825 MLD respectively. On the other hand, from analysis it has been found that, water supply master plan has kept provision of around 860 MLD water from surface water (Padma NW, Ghandharbapur Phase I and II, and Saidabad Phase III) or groundwater (Singair Phase I and II) transmission lines in the study area. That means more than 90% of the demand in the study area will be met from WSMP proposed transmission lines and the rest 10% of water demand will be met from locally installed PTWs.

DMA Demarcation and Strategic Plan

A large portion of area under study is currently low-lying agricultural land. Road networks in those areas could not be identified. Moreover, land development is ongoing in some parts of the area. The road network layout plan has been collected from respective land development authorities. From current land development pattern it can be observed that, water supply system development in some areas will not be feasible at present because population settlements in those areas will require few more years. Around 50% of the study area is considered for District Metering Area (DMA) development for providing water supply. Total 49 nos. DMA have been demarcated considering standard criteria. However, seven DMAs of MODS Zone 7 will be implemented under DWSNIP of DWASA. Rest 42 DMAs will be considered under the current study and included in ‘short term plan’ which are expected to be implemented by 2025.

The areas having moderate to low population settlements with undeveloped road networks are not recommended for DMA implementation at present situation. These areas are termed as ‘Small Scale DMAs’ in the report. Water supply system development in ‘Small Scale DMAs’ is also considered in ‘short term plan’. However, due to haphazard development pattern, only major roads are considered in pipe network layout finalization and these networks have been designed considering 2030 demand instead of 2040 demand. Water supply system development in rest of the areas except the in ‘DMAs’ and ‘Small Scale DMAs’ will be considered in

‘medium term plan’ which are expected to be implemented by 2030 depending on development of other facilities like road networks, power and gas supply.

Survey and Investigation

For hydraulic model development purpose demand data, elevation data, network data and water source data are required. DMA wise water demand has been estimated and used during hydraulic design. The elevation data for primary roads have been found from topographic survey. For secondary and tertiary roads, elevation data were extracted from RAJUK DEM. Water network layout finalization has been done considering proposed roads by RAJUK and different real estate developers within the study area and these were incorporated in the model. The aquifer condition within the study area has been assessed by hydrogeological investigation. Hydrogeological investigations include installation of test tube wells, long term pumping test and water quality test. Two test tube wells have been installed in Kawla of Dakshinkhan Union and Smritidhara of Dania Union.

Hydraulic Design of Water Distribution Networks

Water source for DMAs have been finalized keeping consistency with DWSMP. Surface water has been considered as primary source and ground water as supplementary source.

Locally installed PTWs will supplement in meeting the water demand in the study area. There are 51 nos. of existing PTWs within the study area and 29 of them are in MODS Zone 7 where there is existing water supply network. Other areas having existing PTWs are mainly housing areas like Mirpur DOHS, Sagufta Housing, Eastern Housing Pallabi and Civil Aviation Authority (CAAB) colony. From analysis it has been found that, total 122 nos. of PTW will be required to supplement the water that will be available from transmission lines from SW/GW sources. So, there is requirement of 71 new PTWs within the study area.

Simulation of hydraulic model has been done by incorporating the calculated water demand and collected primary and secondary data. Pipe sizing has been finalized on the basis of hydraulic design. Total length of water distribution pipelines has considered in 42 DMAs and 9 Small Scale DMAs under current study are around 900 Km and 160 Km respectively. In addition to this, the reticulation and secondary transmission main have been considered around 400 Km to facilitate house connection and connection with the transmission main. Other appurtenances for water supply system development have been estimated based on experience of other DWASA projects like DWSSDP, DESWSP, DWSNIP, IWSP etc.

Cost Estimation

Based on the quantities found from the model design, cost has been estimated for development options. Rate of items have been finalized after discussion with Project Director Office. Cost for pipeline installation has been found as around 8678.9 million BDT, for installation of 71 PTWs the estimated cost is 1483.9 million BDT. Total cost for the project implementation including pipeline and PTW installation, consultancy charge, land acquisition, road restoration charge and other items has been estimated as around BDT 18026.84 million BDT.

Moreover, a tentative cost estimate has been prepared for the O&M of the water distribution network and water pumps. The total O&M cost was estimated to be about 644.32 million BDT per year.

Environmental and Social Impact Assessment (ESIA)

A detailed environmental baseline study of the entire project site has been conducted. The main objective of the baseline study is to delineate the pre-project socio-economic and environmental conditions of areas in and around the project site, against which possible impacts of the proposed project has been analyzed. An Environmental Management Plan (EMP) describing the mitigation, protection and/or enforcement measures has also been prepared.

In order to pursue the social impact assessment, the consultant have carried out survey, FGD and public consultation methods. Before setting the survey framework the consultant at the outset had fixed the impact assessment criteria taking into account the possible impacts that the proposed project may entail. For that purpose, the consultants have carried out a reconnaissance survey to identify the nature and types of impact that likely to have due to implementation of the project. The survey has covered the corridor of impact and the area that will be utilized directly and indirectly by the project.

Project Implementation and Operation

Finally, a project implementation plan has been prepared. Project implementation plan includes an organizational structure for project implementation and a tentative schedule for activities ranging from project formulation to project handing over phase. It will require 04 (four) years to implement the project.

For operation and maintenance (O&M) of water networks and pumps, an organizational structure has been provided. DWASA will setup a Unit for operation and maintenance (O&M) of Water Distribution System and Water Pumps by an Executive Engineer. Responsibilities of O&M unit will include procurement of chemicals (chlorine), operation and maintenance of

water pumps, operation and maintenance of distribution network, providing service connection to the consumers, receive complains and provide emergency services.

Conclusion and Recommendation

Major portion of the study area is currently uninhabited. Water supply system development in those areas is subject to road network and other facilities development in those area. To ensure planned development in the area, inter organizational coordination among DWASA, DNCC, DSCC, RAJUK, PDB, DPDC, DESCO, GTCL and other respective stakeholder organizations will be required.

Due to considerable increase in the water supply service area, the existing nos. of MODS Zone may be increased, and intra-zonal adjustment may be done for better operation and maintenance in service area.

The water supply system development strategy in the study area has been developed keeping compliant with Dhaka Water Supply Master Plan (DWSMP). However, DWSMP is required to be updated and the strategy for water supply in the 16-union area will need to be updated accordingly during project implementation phase.

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Acronyms and Abbreviations

ADB	Asian Development Bank
BM	Bench Mark
BTM	Bangladesh Transverse Mercator
DESWSP	Dhaka Environmentally Sustainable Water Supply Project
DGPS	Differential Geographical Position System
DMA	District Metered Area
DMDP	Dhaka Metropolitan Development Plan
DNCC	Dhaka North City Corporation
DND	Dhaka-Narayanganj-Demra
DoE	Department of Environment
DPP	Development Project Proposal
DSCC	Dhaka South City Corporation
PTW	Production Tubewell
DWASA	Dhaka Water Supply and Sewerage Authority
DWSMP	Dhaka Water Supply Master Plan
DWSSDP	Dhaka Water Supply Sector Development Project
DWSNIP	Dhaka Water Supply Network Improvement Project
ECNEC	Executive Committee of the National Economic Council
ESIA	Environmental and Social Impact Plan
EMP	Environmental Management Plan
GIS	Geographical Information System
GPS	Geographical Position System
ICB	International Contract Bidding
IWM	Institute of Water Modelling
IWSP	Interim Water Supply Project
MLD	Million Liter Per Day
MoU	Memorandum of Understanding
NICAR	National Implementation Committee for Administrative Reforms
PC	Personal Computer
PMU	Project Monitoring Unit
PS	Pumping Station
RAJUK	Rajdhani Unnyan Kortipakkha
SWTP	Surface Water Treatment Plant
RoW	Right of Way
RTK	Real Time Kinetic
SoB	Survey of Bangladesh
SWIP	Surface Water Injection Point
TBM	Temporary Bench Mark
ToR	Terms of References
TS	Total Station
UNCHS	United Nations Centre for Human Settlements
WSP	Water Supply Project

Chapter 1: Introduction

1.1 Background

Dhaka Water Supply and Sewerage Authority (DWASA) is the entrusted organization with the responsibility of potable water supply piped to the dwellers of Dhaka City and its adjacent areas. Presently water supply coverage of DWASA includes around 60% of Dhaka and Narayanganj city. The areas which are left out from DWASA piped water supply coverage are mostly in the eastern Dhaka and at the outskirts of the Dhaka city area. These areas were outside the jurisdictions of Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC). In May 2016, the government decided to incorporate 16 more unions into the two city corporations of Dhaka. The decision was taken at the meeting of the National Implementation Committee for Administrative Reforms (NICAR) held at the Secretariat with Prime Minister Sheikh Hasina in the Chair. The LGRD ministry placed the proposal. Following the NICAR's approval of inclusion of the new union, an area of 178.75 sq. km has been added to the two city corporations; where 114.58 sq. km has been added into DNCC and 64.17 sq. km has been added into DSCC.

As per government decision, Beraid, Badda, Bhatara, Satarkul, Horirampur, Uttarkhan, Dakshinkhan and Dumni union have been included in the DNCC, while Shyampur, Matuail, Demra, Dania, Sarulia, Dakshingaon, Nasirabad and Manda unions have been included in the DSCC.

DWASA is presently providing water supply to a limited area of these union. DWASA has decided to extend its services to the entire area by implementing District Metered Area (DMA) for improved piped water supply. The project to be undertaken will conform to the DWASA Water Supply Master Plan and would be harmonized with the ADB funded DWSSDP and DWNIP. This would be a major initiative of DWASA which needs careful planning and execution. In this context, a full-scale Feasibility Study including Environmental and Social Impact Assessment (ESIA) is required.

1.2 Study Area

The study area consists of newly included 16 unions to Dhaka South City Corporation and Dhaka North City Corporation. The study area of the project has been shown in Map 1.

1.3 Study Objectives

The main objective of the study is to carry out a feasibility study of the project aiming at extending sustainable water supply to 16 unions recently included with Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC) considering all relevant technical, social, environmental, economic, and institutional aspects. The specific objectives are as follows:

- Different option study for a sustainable water supply system in 16 unions recently included to Dhaka North & South City Corporations.
- Harmonize the proposed 16 union project with the ADB funded Dhaka Water Supply Sector Development Project (DWSSDP).
- Demarcation of District Metered Areas (DMA) in the 16 unions similar to the concept used in the DWSSDP.
- Preparation of cost estimates of development options.
- Evaluation of financial viability of the proposed improvements.
- Conducting detail ESIA and institutional assessment.

1.4 Scope of Work

Scopes of works of this study are as follows:

1. Collection of all secondary data and reports which will include but not limited to:
 - a) Interim Water Supply Project of DWASA (2016-17)
 - b) Dhaka Water Supply Master Plan (2014)
 - c) Feasibility Study of Saidabad Water Treatment Plant Project Phase III (2014)
 - d) Transmission & Distribution system from Char Gandharbapur WTP
 - e) Dhaka Sewerage Master Plan and Sanitation Strategy (2013)
 - f) Population census data 2011
 - g) Topographic and GIS data from DWSSDP and other relevant projects (2010-16)
 - h) Resource Assessment and Monitoring of Water Supply Sources for Dhaka City (2007)
2. Primary Data Collection
 - a) Conduct land level survey along alignments of proposed water supply transmission and distribution lines
 - b) Socio-economic baseline survey
 - c) Environmental baseline survey
3. Population trend analysis and prediction of population and water demand for next 30 years in 16 union

4. Review of Dhaka water supply master plan report and mapping of alignments of proposed water supply pipelines and their Right of Way (RoW) based on survey information.
5. Identification of outline of DMAs for the 16 union and harmonizing with the proposed water supply sectors recommended in the water supply master plan and with the existing and proposed DMAs in the Dhaka city under ADB funded DWSSDP.
6. Hydrogeological investigation in the study area which include:
 - a) Observation well (37 mm dia. Up to 300 m depth) to monitor the groundwater table fluctuation and to identify the radius of influence.
 - b) Production wells will be installed at the sites selected by the consultants. These production wells will be used for long term aquifer test to calculate the specific capacity, well loss including determination of storage coefficient.
 - c) Analysis of groundwater quality and recommend possible treatment.
 - d) Groundwater resource assessment shall be performed by the consultants based on data to be obtained from aquifer tests, lithologs, groundwater level monitoring data, water quality analysis etc.
7. Assessing the connectivity with water supply sectors and supply sources as recommended in the water supply master plan.
8. Preparing outline design of distribution system based on mathematical models to be developed using survey data.
9. Estimating cost based on outline design for different project components such as PTW, distribution networks, equipment and chamber etc.
10. Economic and financial analysis for the project based on cost estimate for implementation and future operation and maintenance.
11. Conducting ESIA study
 - a) Environmental Reconnaissance of the Project Site
Environmental reconnaissance of the project area, including alignment of transmission and distribution network, injection points to observe the overall setting of the pre-project condition.
 - b) Environmental Baseline study
A detailed environmental baseline study of the entire project area will be conducted as per requirements. The main objective of the baseline study is to assess the pre-project socio-economic and environmental conditions of project area, against which possible impacts of the proposed project will be analysed.
 - c) Identification and Analysis of possible Impacts

Assessment of potential impacts on various socio-economic and environmental parameters with respect to project activities. Both qualitative and quantitative impact assessments will be made. Identification of impacts based on the following:

- Location of Project Components
- Construction Phase
- Operational Phase
- Design inadequacy and/or failure due to natural disaster or non-acceptance by the citizens, etc.

d) Design of Mitigation Measures

To offset adverse impacts on the socio-economic and environmental condition due to the project, mitigation measures would be suggested depending on impact characteristics, methods of rectifying the impact by repairing, rehabilitating, resettling or restoring the affected socio-economic and environmental settlements will also be included here.

e) Preparation of Environmental Management Plan (EMP)

f) Environmental Monitoring

An environmental monitoring program will be developed which will include:

- Monitoring Location
- Parameters to be monitored
- Frequency of monitoring
- Resources required

1.5 Structure of Report

The Report is structured as a main text and an annex. The main report provides detailed descriptions of specific topics and components related to the integrated project. The annex contains Environmental and Social Impact Assessment (ESIA) report. Chapters covered in main report are presented as follows:

Chapter-1: Introduction – a description of background and description of the project, description of the study area

Chapter -2: Institutional Analysis – a brief description about organizational set up and other regulatory frameworks.

Chapter-3: Existing Water Supply Information of the Study Area – A summary about present water supply source and the supply system.

Chapter-4: Water Demand Calculation for Study Area – This chapter specifies population trend analysis, union-wise population projection for the year 2040 and water demand calculation for different scenario, comparison with water supply master plan.

Chapter-5: DMA Demarcation and Strategic Plan – standard criteria for DMA demarcation and the applied strategy in DMA demarcation in the study area, short description on the DMAs, strategy for water supply system development in the study area;

Chapter-6: Survey and Investigation – Short description on conducted surveys and investigations like topographic survey, hydrogeological investigation, household survey, and environmental survey.

Chapter-7: Hydraulic Design of Water Distribution Networks – step by step procedure applied for hydraulic model development for outline design, design philosophy and criteria, source finalization for DMAs, DMA wise pipe length.

Chapter-8: Instrumentation & Controls, Artificial Recharge, Water Quality Improvements

Chapter-9: Cost Estimation – Cost estimation for the components of water supply network development.

Chapter-10: Financial and Economic Analysis: Brief description about project implementation cost, expected revenue to be earned by DWASA during operation phase and analysis of cost benefit ratio

Chapter 11: Stakeholders Discussion: Outcome from stakeholder discussion

Chapter 12: Environmental and Social Impact Assessment: A brief description about legislation, regulations and policy, baseline environmental condition of the study area and environmental and social management plan.

Chapter 13: Project Implementation Plan: A brief about the executing agency, organizational structure for project implementation, project investment and implementation phasing.

Chapter 14: Findings and Recommendations

Chapter 2: Institutional Analysis

2.1 General

Dhaka Water Supply and Sewerage Authority (DWASA) was created by the gazette Notification No.IE-50/63/1156-PHE, dated 7th November 1963 issued in exercise of powers conferred on the then Government of East Pakistan by sub-section (3) of Section 1 of East Pakistan Ordinance XIX of 1963.

At inception, assets, liabilities and connected manpower of the then existing waters supply and sewerage services in metropolitan Dhaka were transferred to DWASA by another Government order. Although Dhaka Drainage was a mandated function of DWASA, it was transferred from Department of Public Health Engineering to the Authority as late as in March 1989 by a GOB order. Water supply of Narayanganj city was transferred to DWASA with effect from July 1990.

The mandate of DWASA was comprehensively outlined in the pre-amble of the 1963 Ordinance, “To provide for construction, improvement, expansion, operation and maintenance of water and sewerage works and other facilities relating to environmental sanitation.”

The 1963 ordinance applies to all WASAs within Bangladesh. Sub-section (3) Section 14 of the Ordinance interpreted the mandate and ordained each of the WASAs to provide for the following specific services within respective jurisdiction:

- a) Production and supply of potable water
- b) Collection, treatment and disposal of sanitary sewage and industrial waste
- c) Discontinuance of useless drains
- d) Collection and disposal of garbage and trash
- e) Drainage

2.2 Legal Framework

From legal perspective, the initial framework of DWASA (1963 ordinance) was quite comprehensive. As a result, till 1996 few amendments were required. Moreover, the amendments that were introduced did not change the basic characteristics of the original ordinance.

2.3 Relevant National Policies, Laws and Masterplans etc.

Some of the most relevant national policies, laws and masterplans that will have implications upon DWASA’s institutional and legal frameworks are described below:

National Policy for Safe Water Supply and Sanitation, 1998

This policy, published by the Local Government Division of the Ministry of Local Government and Rural Development and Co-operatives goal is to ensure that all people have access to safe drinking water and sanitation services at an affordable cost.

Institutional Management: It recognized the inefficient nature of disjointed development activities in the water sector and specifically articulated a solution, “To ensure best use of limited resources for effective development, coordination is necessary among all tiers of the government, local government bodies, NGOs and other related parties including private sector”. In addition, it also promotes decentralization of decision making, and local initiatives for resource planning.

Capacity Building: The Capacity building policy principle within the law will have considerable impact upon DWASA’s institutional setup. The principle promotes capacity building to improve quality of service and accessibility to service. Specific actions suggested to attain the objective include: human resource development, training at the local level, implementation of appropriate institutional arrangements, active involvement of user groups, local initiatives for resource planning and new roles for the government, local government bodies, NGOs and private organizations.

Public Private Partnership: It was concluded that involvement of the private sector is essential to establish a closer relationship between the quality of services of the sector and its financial viability. Therefore, the act calls for administratively and financially enabling environment for the private sector to participate and contribute in water sector development.

National Water Policy, 1999

The Objectives related to urban water supply include:

- To ensure availability of water to all elements of the society including the poor and the underprivileged.
- To accelerate the development of sustainable public and private water delivery systems with appropriate legal and financial measures and incentives, including delineation of water rights and water pricing.
- To develop a legal and regulatory environment that will help the process of decentralization, sound environmental management, and improve the investment climate for the private sector in water development and management.
- To bring institutional changes that will help decentralize the management of water resources.

The Government policy with regards to urban water supply is articulated as: Facilitate availability of safe and affordable drinking water supplies through various means.

Stakeholder Participation: Emphasis was put upon stakeholder participation, decentralization of WSS management to local government institutions and community-based organizations, and involvement of NGOs and the private sector in WSS service delivery. To ensure such participation, adherence to "Guidelines for People's Participation (GPP) in Water Development Projects" is stated as a required policy of the Government.

Water Tariff: The policy suggests gradual transfer of tariff setting authority to relevant water supply agencies. It also adds, pricing structure should match the goals and needs of the water provider and the population served. Water rates will be lower for basic consumption, increasing with commercial and industrial use. The rates for surface and groundwater will reflect, to the extent possible, their actual cost of delivery.

Water and Sewerage Authority Rules, 2009

The law is enacted by Local Government Division of the Ministry of Local Government and Rural Development and Co-operatives. This law articulates in specific detail the procedures to be followed by water utility operators in all things related to water supply and sewerage services. It is less concerned about the organization as a whole and more focused upon day to day operational aspects of the service.

National Water Act, 2013

The Bangladesh Water Act 2013 has been issued for an integrated development, management, extraction, distribution, usage, protection and conservation of water resources in Bangladesh. Bangladesh Water Act (BWA) is a framework law to integrate and coordinate the water resources management in the country.

As per the Water Act, all forms of water (e.g. surface water, groundwater, sea water, rain water and atmospheric water) within the territory of Bangladesh belong to the Government on behalf of the people.

Dhaka Water Supply Masterplan, 2014

The Water Supply Master Plan recommended expansion of Water Supply services by DWASA from the present 401 sq. km. to 617sq. km. in 2035, covering its entire jurisdiction and some additional areas. As a result of increase in domestic, industrial, commercial and other uses in the expanded service area of DWASA, the total demand will rise from 1,476 MLD in 2011 to 4,741 MLD in 2035. If we consider that leakage from the system will be reduced from the present level of 30% to 8% of the total supply in 2035, the total required production capacity

will increase from the 2,108 MLD in 2011 to 5,268 MLD in 2035. For the period 2035 to 2060, the likely scenario is that there will be approximately 50% growth in demand. As a result, an additional 2,650 MLD production capacity will be required by 2060.

One of the key components of the Master Plan is dividing the service area into sectors based on main sources of supply and connected primary mains. Each sector will have a dedicated and independent major source and primary main to transmit treated water from the source to localities within the sector. Based on the available major sources of supply, the ongoing and proposed projects in near future, the entire DWASA service area is divided into eight sectors.

Dhaka Sewerage Masterplan, 2012

The Sewerage Master Plan of Dhaka City took into account the different states of urbanization with different population densities upto 2035. Different service levels for different areas have been proposed as intermediate measures till total public sewerage services can be achieved in the future. The Master Plan categorized the target area into core area for sewerage service, transitional area from on-site treatment and/or hybrid systems to sewerage service, and on-site treatment area.

The proposed 11 sanitation catchments are as follows:

- (i) Dhaka East - Dasherbandi Sewerage Catchment.
- (ii) Dhaka West - Mirpur Sewerage Catchment
- (iii) Rayerbazar (Kallyanpur) Sewerage Catchment
- (iv) Dhaka South - Pagla Sewerage Catchment
- (v) DND Sewerage Catchment
- (vi) Dhaka North - Uttara Sewerage Catchment
- (vii) Rupgonj (Purbachal) Sewerage Catchment
- (viii) Narayanganj Sewerage Catchment
 - (viii-a) Narayanganj Pourashava (west bank of Lakhya River)
 - (viii-b) Kadam Rasul Pourashava (east bank of Lakhya River)
- (ix) Savar Sewerage Catchment
- (x) Tongi/Gazipur Sewerage Catchment
 - (x-a) Tongi Pourashava area
 - (x-b) Gazipur Area
- (xi) Keraniganj Sewerage Catchment

Dhaka Drainage Masterplan, 2015

The present drainage facilities of Dhaka city are quite less than inadequate and most of the natural drains are not functioning properly due to blockage and obstruction of flow by dumping

of solid waste and poor maintenance. Dhaka Water Supply and Sewerage Authority (DWASA) mainly responsible for storm water drainage, has taken a step forward to alleviate the last longed storm drainage problems of Dhaka City by preparing a master plan. Types of structural measures proposed are location specific.

The entire Master Plan area has been divided into 13 Drainage Zones, which are based on the delineation of the catchment areas. Each of the Zones is divided in a number of sub-catchments. The zones are Goranchatbari, Kallayanpur, Dolaikhal & Old Dhaka, DND, Kamalapur, Hatirjheel, Badda, Uttarkhan, Gazipur & Tongi, Savar, Keraniganj, Narayanganj and Purbachal. Some 255 numbers of projects have been identified in the Storm Water Drainage Master Plan. Gazipur Tongi zone has maximum number of projects (46 nos.). Next in order are Purbachal, Keranignj, Narayanganj and Savar zones (with 34, 27, 24 and 20 projects in the list).

For better understanding the whole area has been divided into three main categories which are:

- i. Core City East
- ii. Core City West, and
- iii. Fringe Areas

2.4 Institutional Framework

To facilitate more autonomy in operations, the WASA act 1996 established the WASA Board consisting of members representing different stakeholders. The functions of DWASA are governed by the Dhaka WASA Board. Managing Director is the Chief Executive Officer (CEO) of DWASA and he controls four wings – i) Administration, ii) Finance, iii) Operation and Maintenance (O&M) and iv) Research, Planning and Development (RP&D). A Deputy Managing Director leads each wing.

Till now, only the top management, that is, the Managing Director and Deputy Managing Directors, are recruited from outside the organization on commercial terms and conditions. The salaries and the benefits of the staff at other levels are fixed as per the public service salary structure.

2.4.1 Area of Jurisdiction

Till June 1989, the jurisdiction of Dhaka WASA was limited only to Dhaka metropolitan area. Later on, Dhaka WASA had the responsibility for supplying water and operating sewerage system of Narayanganj city in early 1990. At present, mega city Dhaka and Narayanganj are included in Dhaka WASA service area. For easy operation, maintenance and providing better public service, Dhaka WASA service areas have been divided into 11 geographical zones. Among those, 10 zones are within Dhaka city and one in Narayanganj city. Technical

operation, maintenance and collection of revenue bills, and other related activities are managed by the zonal offices. As a result, public harassment has reduced significantly, and quality of public service has improved.

Zonal Office in DWASA is known as MODS which stand for “Maintenance, Operation, Distribution and Services.” The framework of an existing MODS Office is shown in figure below.

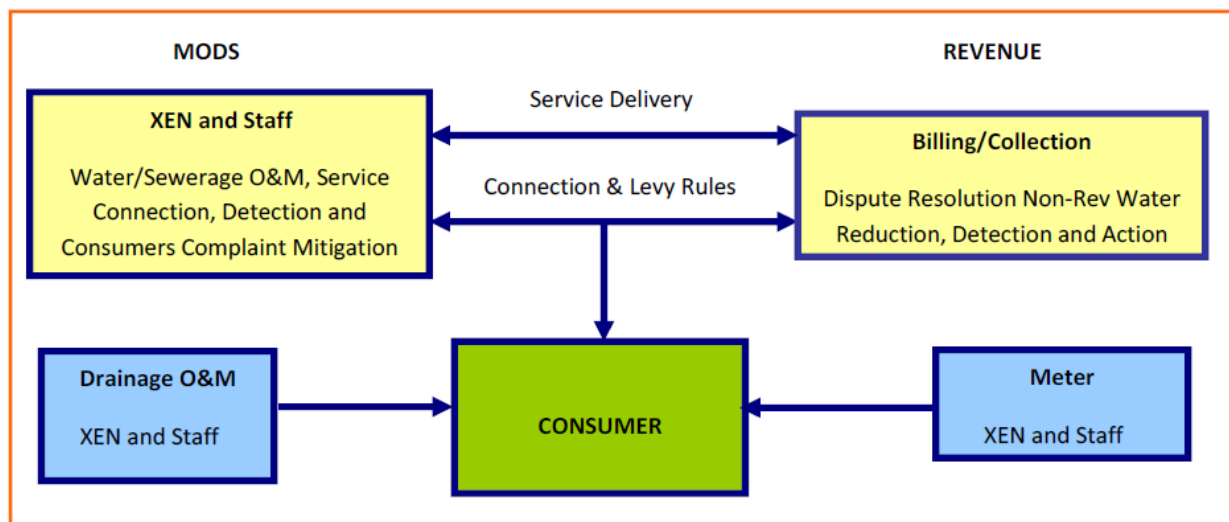


Figure 1: Framework of Existing MODS Office

2.4.2 Organizational Structure & Staffs

DWASA’s organizational structure is oriented around four major wings. Each wing is headed by a Deputy Managing Director (DMD). All DMDs report to the Managing Director. The subsequent sections will elaborate DWASA’s organizational structure in further detail.

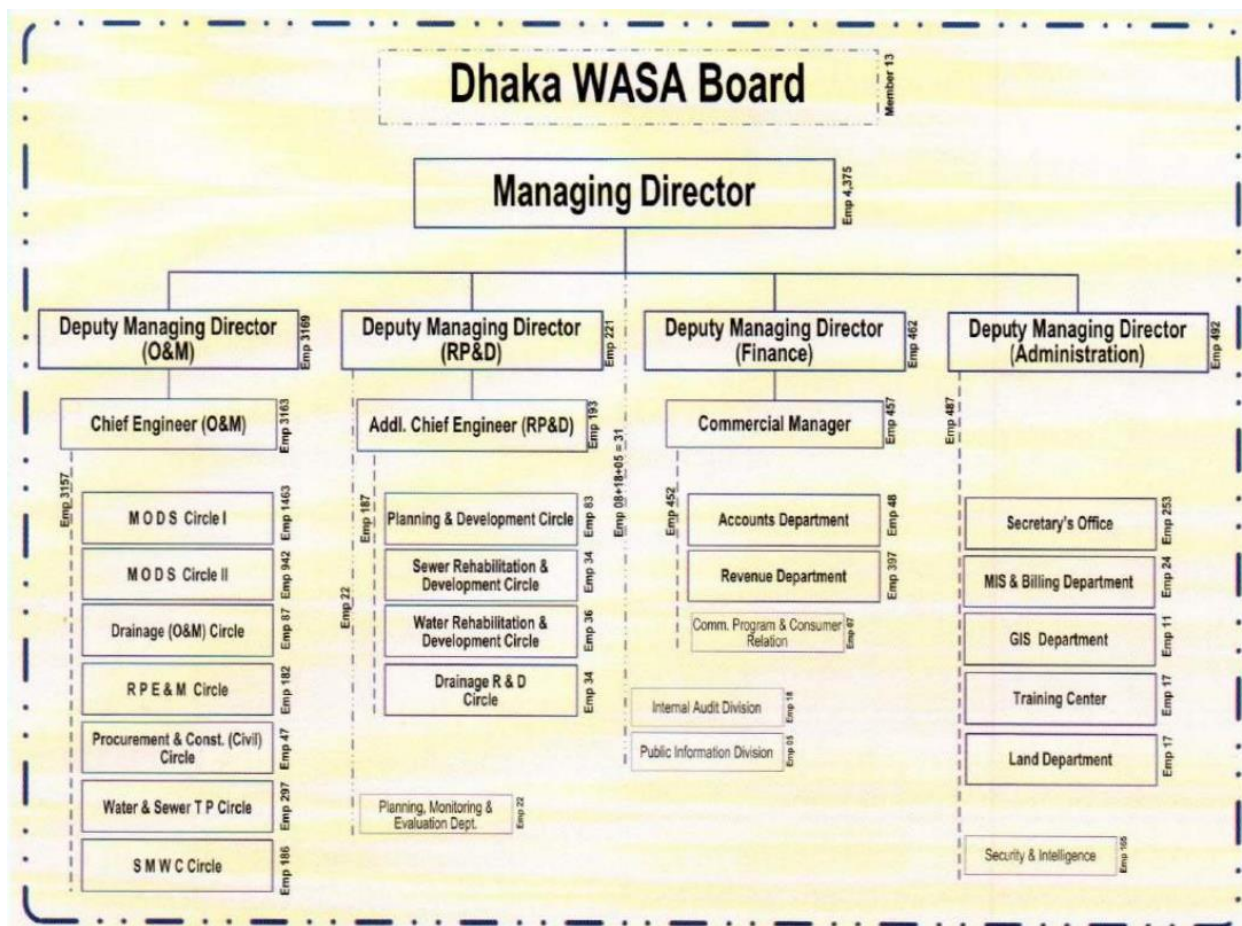


Figure 2: Current Organogram of DWASA (as of June 2016)

Table 1: Staffing Pattern of Dhaka WASA

Post Category	Class I	Class II	Class III	Class IV	Total
No. of approved positions	309	330	1917	2111	4667
No. of staff as of June 2016	258	277	1333	1381	3249
Vacant Posts	51	53	584	730	1418

2.5 Departmental Setup

2.5.1 Operation and Maintenance Wing

For operation and maintenance purposes, DWASA service area has been divided into 11 MODS zone (Maintenance, Operations, Development and Services). Operation and maintenance of water supply, sewerage and drainage are controlled by one (1) Chief Engineer along with seven (7) Superintending Engineers and twenty-eight (28) Executive Engineers under the leadership of DMD (O&M). There is provision of 3,163 officers and staffs for

operation and maintenance in the Organogram. The Organogram also allows increase in number of operational staffs with increase of work volume.

MODS Circle is responsible for the operation of the Production tubewells but can call on Field Maintenance Division for assistance in emergency situations. SMWC Circle provides a specialist service for water chlorination maintenance to the MODS group.

RPEM Circle manages the Field Maintenance Division which is responsible for the removal and installation of pumping plant and the M & E maintenance of all the Production tubewell installations including pumps, motor starters, etc.

2.5.2 Resource, Planning & Development Wing

This wing is responsible for research, design, planning and implementation of DWASA's capital improvement works for water supply, sewerage and drainage systems. There are rehabilitation and development circles for water supply and sewerage network. DMD (RP&D) leads one (1) Additional Chief Engineer, four (4) Superintending Engineers, one Deputy Chief Planning and twelve (12) Executive Engineers for design, planning and execution of project works. In the organogram there is provision of 221 officers and staffs under this wing.

These two wings are more closely associated with day to day operation, design and planning of DWASA's structural assets. A superintendent engineer is in charge of each circle while each zonal office and division is headed by an executive engineer.

2.5.3 Administration Wing

This wing is responsible for overall administration of the organization i.e. employment, transfer and posting, security of offices and installations, land procurement and maintenance, disciplinary actions etc. One (1) Secretary, one (1) Director, five (5) Deputy Secretaries, one (1) Deputy Chief Security, one (1) Intelligence Officer and one (1) senior medical officer are working under the leadership of DMD (Admn). There is provision of 548 officers and staffs under this wing.

2.5.4 Finance Wing

This wing is responsible for billing and collection for the services and preparation of annual revenue budget and maintenance of DWASA accounts. One (1) Commercial Manager, one (1) Chief Revenue Officer, one (1) Chief Accounts Officer, five (5) Deputy Chief Revenue Officers and three (3) Deputy Chief Account Officers are working under the leadership of DMD (Finance). There is provision of 462 officers and staffs in the Organogram under this wing.

In sum, the O&M wing and RP&D wings form the primary components of DWASA's value chain while Administration and Finance wing are the supporting components.

2.6 Regulatory Framework

2.6.1 Service Standard

The standards of service to be provided by DWASA are published in its Citizen Charter (see <http://www.dwasa.org.bd/>). The Citizen Charter specifies the agency's objectives, scope of services, procedures for obtaining utility connections, incl. water meter installation or replacement), approval process for constructing Productiontube wells, billing and tariff collection, water supply and sewerage tariffs, notice of damage to the system, emergency water delivery, quality assurance of water supply, supply of bottled water by DWASA, complaints, refund of security money for temporary connections, contact details.

2.6.2 Water Rate

As part of the Joint Partnership Framework, a regulatory body will be set up with the authority to control utility services tariff. Consultants are currently working to define the scope, structure of the regulatory body.

2.6.3 Water Quality

DWASA adheres to World Health Organization (WHO) guidelines for treated water quality. However, to acknowledge the local condition, it also considers Bangladesh Standardization and Testing Institute's (BSTI) standard for water quality.

Environmental Quality Standards of Bangladesh, 1991

The DOE prepared the Environmental Quality Standards (EQS) in 1991. EQS includes standards covering water pollution (incl. drinking water, recreational water, fishing water, industrial water, irrigation water, livestock water and coastal water) and other major sources of pollution.

Environment Conservation Act, 1995

The Environment Conservation Act of 1995, and all subsequent amendments, is currently the main legislative document relating to environmental protection in Bangladesh. The main objectives of the Act are conservation and improvement of the environment and control and mitigation of pollution of the environment. The act has the authority to produce of standards for quality of air, water noise and soil for different areas/purposes.

Environment Conservation Rules, 1997

The Environment Conservation Rules were published in 1997 under the power vested by the Environment Conservation Act of 1995 for creation of by-laws as a means of implementing the provisions of the Act. The Rules mainly consist of:

- Categorised list (green, amber and red) of projects
- Application format to take environmental clearance
- Standards relating to water pollution, air pollution and noise, as well as permitted discharge/emission levels of water and air pollutants and noise by industries

The ‘Rules’ incorporate “inclusion lists” of projects requiring varying degrees of environmental investigation, e.g. all the new projects under red category generally will require a two-step assessment procedure, firstly an Initial Environmental Examination (IEE) for site clearance, and secondly, if warranted, a full Environmental Impact Assessment (EIA) for technical clearance. Construction of a Sewage Treatment Plant (STP) falls under red category in the list.

Table 2: Surface Water Quality Standard (Source, DoE)

Sl. No.	Type of Use	Parameters			
		pH	BOD [mg/l]	DO [mg/l]	Total coliform [No./100m]
1	Drinking purpose with bleaching only	6.5 – 8.5	2 or less	6 or above	50 or less
2	Recreation purpose	6.5 – 8.5	2 or less	6 or above	50 or less
3	Drinking purpose through usual treatment practice	6.5 – 8.5	3 or less	5 or above	200 or less
4	Fish culture	6.5 – 8.5	6 or less	6 or above	500 or less
5	Industrial purpose	6.5 – 8.5	10 or less	5 or above	500 or less
6	Irrigation purpose	6.5 – 8.5	10 or less	5 or above	1000 or less

Source: Environment Conservation Rule, 1997

Chapter 3: Existing Water Supply Information of the Study Area

3.1 General

The area of 16 union are already within the boundary of MODS Zone 1, 4, 6,7,8,9 and 10. Dania, Shyampur, Sarulia and part of Matuail union are under MODS Zone 7; Manda and part of Matuail, Demra, Dakshingaon union are within MODS Zone 1; Part of Dakshingaon, Nasirabad and Demra union are within MODS Zone 6; Bhatara, Badda, Satarkul, Beraid and part of Dumni and Nasirabad union are within MODS Zone 8; Uttarkhan, Dakshinkhan and Harirampur (part) are within MODS Zone 9; Part of Harirampur is within MODS Zone 10 and another part is within MODS Zone 4.

DWASA has service coverage in parts of some of the unions like Harirampur, Dakshinkhan, Uttarkhan, Bhatara, Badda, Dakshingaon, Manda, Matuail, Dania and Shyampur. Most of the remaining areas are currently dependent on private Production tube wells. Moreover, community pumps were observed in some areas of Demra and Nasirabad union. Details about present water source and the network coverage area of DWASA within the study area has been discussed in following paragraphs.

3.2 Present Water Supply Source

Existing water supply condition in the study area has been assessed from reconnaissance survey. It is observed that, a large area under study do not have household settlements yet. In some areas, there are existing water supply network from DWASA. For instance, a significant portion of Harirampur, Uttarakhan, Dakshinkhan, Bhatara, Badda, Dakshingaon, Manda, Matuail, Dania and Shyampur unions have existing DWASA water lines. However, portions within the above-mentioned unions, which were not previously part of DNCC or DSCC have limited water supply coverage from DWASA. In most cases, people were found to be dependent on private wells in individual houses (Figure 3). People having DWASA connection have complains about the quality and quantity of water supplied by DWASA. Water supply is intermittent and the quality of water has not been meeting the expectation of the communities. For that reason, in some houses, submersible pumps and motor pumps were found in addition to DWASA connections.



Figure 3: Motor Pump in a House at Alubdi Area of Harirampur Union

Dumni, Beraid, Satarkul, Nasirabad, Demra and Sarulia union have no water supply coverage from DWASA. People living within these areas have individual pumps in most of the houses. Moreover, some areas in Nasirabad and Demra union were found to have community water supply system. In that case, 20-25 households collect water from a common pump through spaghetti pipes (Figure 4).



Figure 4: Community Pump with Spaghetti Pipes (at Nasirabad)

Some parts of Demra union have overhead reservoirs constructed just above the PTW headworks (Figure 5). Water is stored in the reservoir from PTW and then supplied to individual houses through locally developed distribution system. Area wise water supply source has been illustrated in Figure 6.



Figure 5: PTW with Overhead Reservoir (at Thulthulia bazar of Demra Union)

3.2.1 PTWs installed by DWASA

The study area covers areas from DWASA MODS Zones 1,4,6,7,8,9 and 10. It was observed that, most of the PTWs are within the implemented DMAs under DWSSDP and DESWSP. Moreover, there are existing PTWs in the areas where DMA implementation will be done under various projects like DWSNIP and IWSP. Zone wise PTW number is shown in Figure 7.

Most of the areas within the study are not served from DWASA installed PTWs. A small number of DWASA installed PTWs have been found in the study area. For instance, in Uttarkhan union there are 3 no. of DWASA installed PTWs. Out of which 2 PTWs are within the proposed DMAs 914 and 915 which will be implemented under DWSNIP of DWASA. The only PTW of Uttarkhan union which is outside of DWSNIP area is located at Uttarkhan Maddhya Para area.

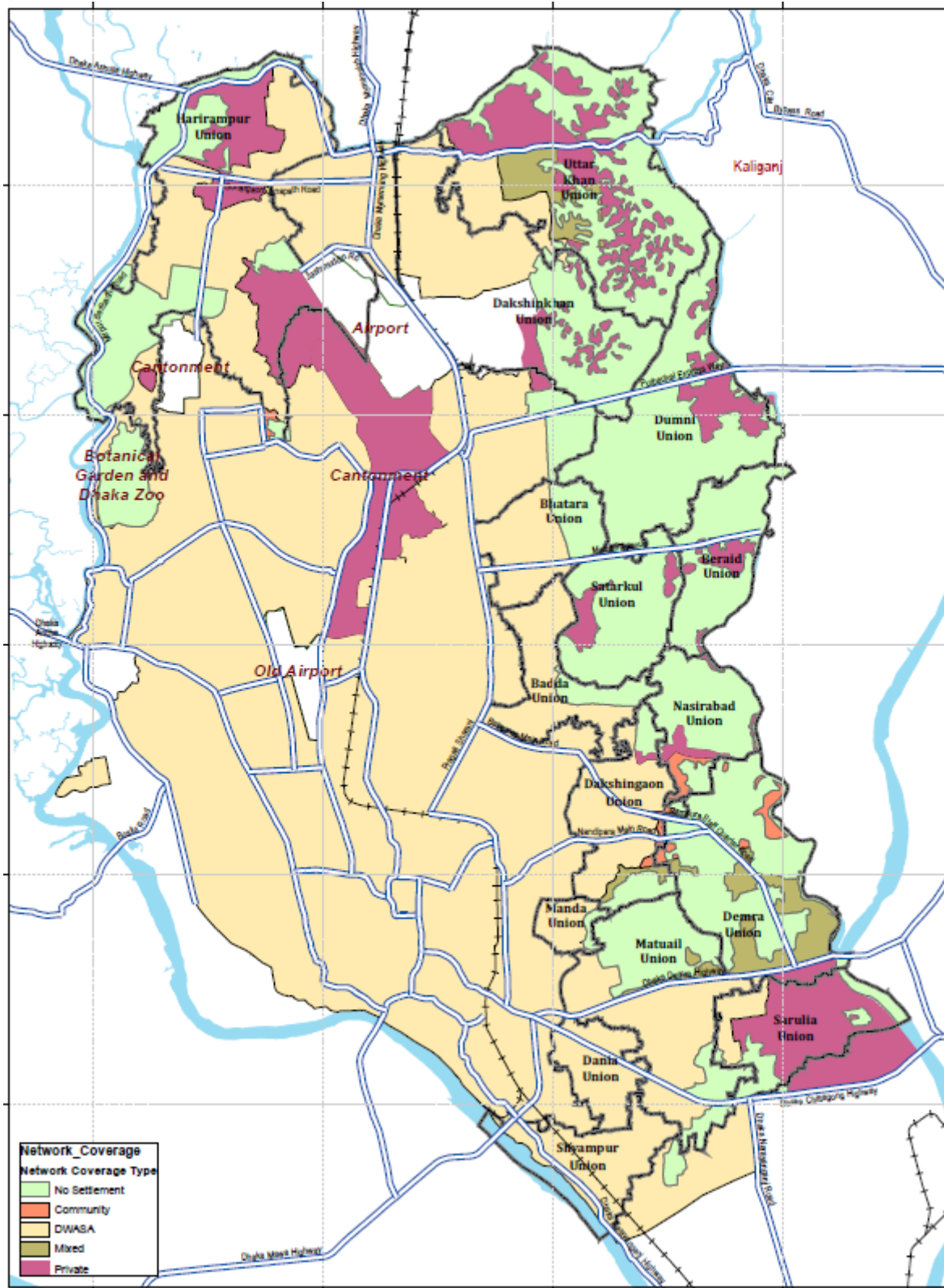


Figure 6: Water Supply Source in Different Areas of Dhaka City

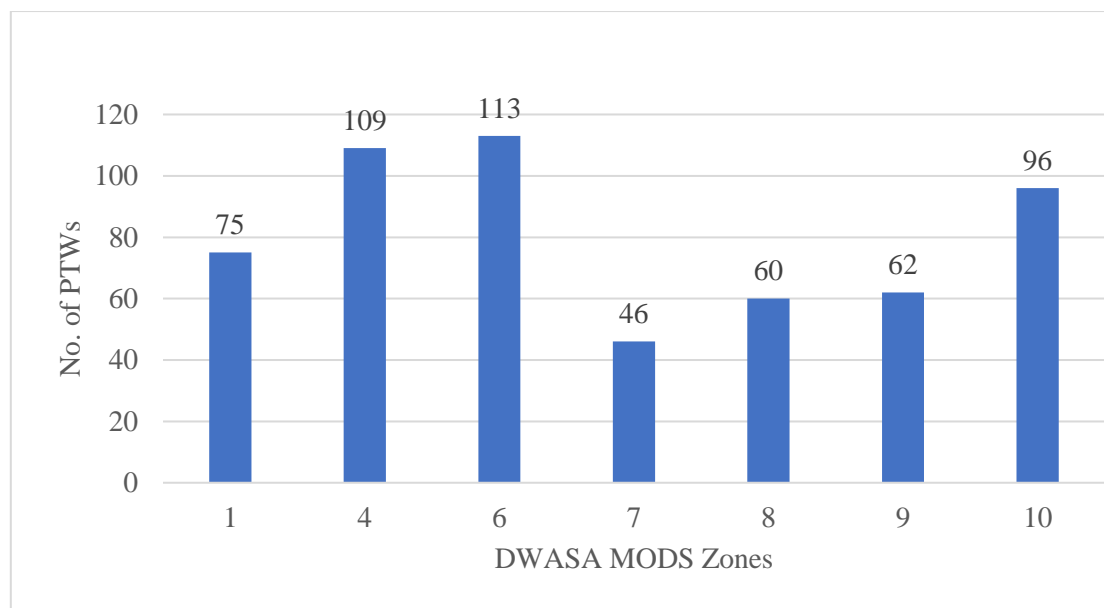


Figure 7: Total Number of PTWs in Different MODS Zones

In Dakshinkhan union, there are 19 PTWs installed by DWASA. Out of the existing PTWs, 5 PTWs are outside the DWSSDP proposed DMA boundaries. The proposed DMAs will be implemented under DWSNIP. Union wise PTW information is shown in Figure 8.

In Harirampur union, 13 no. of PTWs have been found. Out of the existing PTWs, 3 PTWs were found inside DWSSDP proposed DMAs which will be implemented under DWSNIP. Remaining PTWs are outside the DMA boundaries and are within this study area. Most of these PTWs are within any of the housing areas of Eastern Housing, Sagufta Haosing and Mirpur DOHS. Moreover, new PTWs are being installed in Uttara Model Town area under IWSP of DWASA.

Dumni, Beraid, Satarkul, Nasirabad, Demra and Sarulia unions have no DWASA installed PTW. On the other hand, most of the PTWs in Bhatara, Badda, Dakshingaon, and Manda unions are within the DWSSDP proposed DMAs.

Currently, in MODS Zone 7 (Dania, Shyampur, Matuail and Sarulia union), there is no implemented DMAs. However, pipeline rehabilitation program through DMA implementation will be done under DWSNIP (Figure 8).

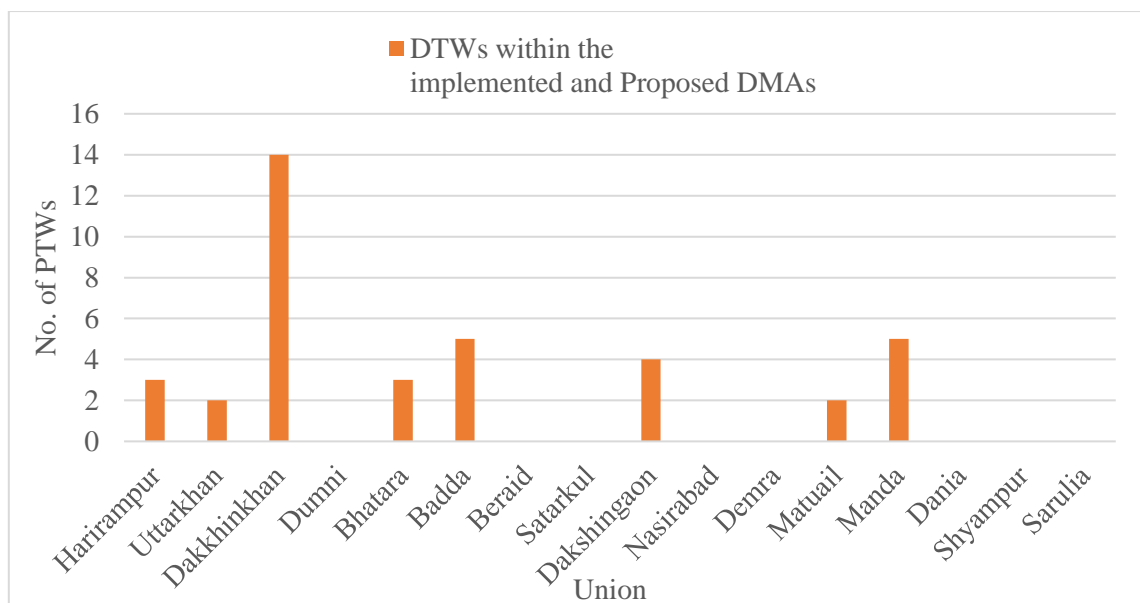


Figure 8: No. of DWASA Installed PTWs in Different Union

3.2.2 Community PTWs

Community water supply system have been observed in some areas of Demra and Nasirabad unions. In that system water is supplied to a community from a locally installed PTW. Two types of water supply source were found, Type A: PTWs without overhead reservoirs (Figure 4) and Type B: PTWs with overhead reservoirs (Figure 5). In “Type” A system, water is collected by 18-20 households from a locally installed submersible pump through spaghetti pipes directly connected with the pump head works. The average depth of the pumps was found 450 - 550 feet from ground level. “Type A” community pumps were found very frequent along the bank of Manda khal. However, exact number of “Type A” community pump could not be determined from reconnaissance.

In type B system, water is stored in overhead reservoirs from the adjacent pumps. The size of the reservoir depends on number of households to be served. The stored water is then distributed to the households by locally developed distribution system. “Type B” community system is common in the communities living along the bank of Balu River. Pump capacity of “Type B” system is normally higher than that of “Type A” system. In both systems, the electricity bill required for operating the pumps is shared by the consumers.

3.2.3 Private Wells

Areas without DWASA water supply coverage mostly depend on motor pumps or submersible pumps for water supply. Areas which are currently dependent on private wells are shown in Figure 6.

3.2.4 Combined System

Some areas within the study have both individual pumps and community pumps. In those areas, owners of high rise buildings and having a higher household income have private submersible pumps installed in their houses. Rest of the community is supplied with water from the community pumps through spaghetti pipes or locally developed distribution system. Mixture of private pumps and community pumps was found in Naraibagh and Amulia area of Demra union.

In Shyampur union, some houses were found to have private pumps in addition to DWASA connections. The quality of DWASA supplied water in that area is not satisfactory. Leakage in distribution system and low system pressure might be the reason behind that. So, people usually collect their drinking water from private submersible pumps. DWASA supplied water is used for other purposes.

3.2.5 Surface Water Transmission Lines

No surface water transmission line exists in the study area. However, there are provision for surface water supply in Dhaka Water Supply Master Plan.

3.3 Network Coverage by DWASA

Large percentage of areas under current study does not have DWASA network coverage. However, Dania union have full water supply network coverage from DWASA, while Shyampur, Matuail, Manda, Dakhshingaon and Dakshinkhan unions have DWASA water supply network coverage. But, quantity and quality of water is not satisfactory in those areas due to leaky pipes and low system pressure.

Uttarkhan, Badda, Bhatara, Uttarkhan and Harirampur unions have small portions where there is existing water network coverage from DWASA. Moreover, water network in Uttara residential area of Harirampur union is being developed under IWSP of DWASA.

Other unions like Dumni, Beraid, Satarkul, Nasirabad, Demra and Sarulia unions do not have existing DWASA water supply network coverage. DWASA network coverage can be found from Figure 6. A summary about DWASA network coverage in the 16 unions is provided in Table 3.

Table 3: Summary on Existing Water Supply situation in the Study Area

Union	Existing Water Supply Situation	Recommendation
Harirampur	About 47% area of Harirampur union is currently served by DWASA network coverage. This area includes newly	The area which is currently uninhabited contains a proposed private housing area named Uttaran

Union	Existing Water Supply Situation	Recommendation
	<p>developed Uttara Apartment Project area and the Uttara Residential Model Town Area (Uttara 3rd Phase). Around 20% area is currently dependent on private wells in individual houses. People living in Bihari Camp is served from community PTWs installed by Bangladesh Army. Rest of the areas (around 30%) under Harirampur union is currently uninhabited.</p>	<p>Housing. This area is expected to be populated in near future. Moreover, Dhour and Noanagar area in which water is currently supplied from individual motor pumps have moderate population density with well-defined road networks. So water distribution network in those area needs to be developed as soon as possible.</p>
Uttarkhan	<p>Around 12% of area of Uttarkhan union is currently served by DWASA networks. In Approximately 30% of total area, people are dependent on private pumps. Some portion (around 9%) of the union has both DWASA water supply connection and private pumps because of intermittent water supply from DWASA networks. Maximum portion (around 48% of total area) of Uttarkhan union is currently uninhabited. However, there are indication of some housing development projects like Uttara ABM city and Uttarkhan Model Town.</p>	<p>Areas with existing DWASA water supply network are not satisfied with quality and quantity of water supplied by DWASA. Mostly, water supply is intermittent and people have to wait for long time for water to be available in their underground reservoir. Some houses have suction pump since there is very low pressure in the network. Water distribution network rehabilitation for more reliable water supply is required in those areas. Moreover, areas with moderate population density which are adjacent to city area will require development of new supply system with priority</p>
Dakshinkhan	<p>Around 40% of Dakshinkhan union area is currently served by DWASA. About 30% area is currently uninhabited. People in rest of the area (approximately 30%) depend on private wells for water supply.</p>	<p>Maximum portion of Dakshinkhan union have moderate to high population density. Moreover, areas with existing DWASA water network needs rehabilitation of the old water lines with new pipes to ensure a pressurized system. Moreover, areas which will be developed under different housing development</p>

Union	Existing Water Supply Situation	Recommendation
		companies like Ashiyan City, Rahman Nagar and Swadesh Properties will need development of new water distribution system with priority.
Dumni	Most of the areas (approximately 85% of total area) under Dumni union is currently uninhabited. However different companies (mostly Bashundhara group) are developing land for real estate development. People living in rest 15% area mostly depend on private wells for their daily water need.	As most of the areas under Dumni union are expected to be developed by real estate development companies so it is expected that there will be a definite population settlement with good amenities. So, water supply network development in those areas should comply with the future plan of respective real estate developers.
Bhatara	Around 70% of area of Bhatara union has existing DWASA service coverage. Water distribution network rehabilitation in those areas were completed under DWSSDP. Rest of the area under Bhatara union is currently uninhabited but is expected to be developed by Bashundhara group in near future.	Water supply network development in the areas which are currently not inhabited should comply with the future development plan of respective real estate developers.
Badda	Maximum area (around 80% of total area) of Badda union has existing DWASA service coverage. Water network rehabilitation in those areas were carried out under DWSSDP of DWASA. Rest of the area of Badda union is being developed by a private housing development authority.	Water supply network development in the area which is currently not tenanted should comply with the future development plan of respective real estate developers.
Satarkul	At present there is no water supply network coverage by DWASA within Satarkul union. Most of the areas (around 85% of total area) currently do not have settlements. However, there are indication of some land development in these areas.	As most of the areas under Satarkul union is currently not inhabited, the water network development in that area should comply with the future development plan of real estate developers. At present, Satarkul bazar

Union	Existing Water Supply Situation	Recommendation
	People currently depends on private wells for their water requirements.	area has moderate population density. So, water supply system development in that area needs to be considered with priority.
Beraid	At present there is no water supply network coverage by DWASA within Beraid union. Around 88% of total area do not have settlements. Northern portion of Madani avenue under that union will be developed by Bashundhara group. According to RAJUK proposed DAP, a significant portion of Beraid union had been considered for retention pond (please refer MAP 2). Currently, private wells are the only source of water supply for the inhabitants of Beraid union.	Water network development in areas which will be developed by Bashundhara group should comply with the future development plan of real estate developers. Current inhabitants of the union are dependent on private wells for water. The area with inhabitants has moderate population density and quite far from main Dhaka city. So, water supply system development in that area is not a priority but should be considered after population settlement and development of definite road networks.
Nasirabad	Only small portion of Nasirabad union is currently supplied from DWASA networks. Two types (Private wells and Community wells) of water supply system were observed during reconnaissance. Presently, road networks are not well defined. However, a portion of the union is expected to be developed by a private housing society. Moreover, a significant portion of the union has been considered for retention pond in DAP of RAJUK.	The area to be developed by real estate developers should be given preference in water supply system development. Recently, distribution network improvement program of DESWSP of DWASA has rehabilitated some water distribution network in that union. Water distribution network development in rest of the union area is not an urgent requirement. However, once the road network in that area is developed the water supply system can be developed considering DMA concept.
Dakshingaon	Recently, water distribution networks have been rehabilitated in significant part	Aftabnagar area under Dakshingaon union is being developed by “Jahurul

Union	Existing Water Supply Situation	Recommendation
	<p>of the union under DESWSP of DWASA. Currently, around 70% of area of Dakshingaon is supplied from DWASA networks. Small portion of the union is served from community PTWs. Presence of private wells were also observed during reconnaissance.</p>	<p>Islam City”. Water distribution network development in that portion should be considered as priority.</p>
Demra	<p>At present there is no water supply network coverage by DWASA within Demra union. Current water supply system in the areas within that union are mostly private or community based.</p>	<p>Around 70% area of Demra union is currently not inhabited. Lower portion of the union (just below Dhaka Demra Highway) has very high population density. Rest of the area is not so dense and road networks in those area is not clearly defined. However, there are indication of future land development by some housing development societies are on both sides of Rampura Staff Quarter Road. Some of the rapid growing area under Demra union are Amulia Model town area and the housing developed by Amin Mohammad group. Water supply development in those area should be given preference. Water network in southern portion of Demra union will be developed under DWSNIP of DWASA.</p>
Manda	<p>Significant portion (above 80% of total area) of the union has DWASA service coverage. Recently a PTW has been installed in Green Model Town Area which will ensure 100% coverage in Manda union.</p>	<p>Though, Manda union has water supply coverage of almost 100%, rehabilitation of the water distribution network will be required because of leakage in the network. Water supply network development in Green model Town area should be set as priority.</p>

Union	Existing Water Supply Situation	Recommendation
Matuail	Around 50% of the area of Matuail union is currently supplied from DWASA water networks. Those areas are within MODS Zone 7. Portion of Matuail union which is under MODS Zone 1 is mostly uninhabited at present.	Water supply network in the portion of Matuail union within MODS Zone 7 will be rehabilitated under DWSNIP of DWASA. Water supply network development in Green Model Town which is under MODS Zone 1 should be set as priority. Water distribution network development in rest of the areas should be considered after population settlement in those area.
Sarulia	A small portion (around 15% of total area) of Sarulia union is currently served from DWASA networks. Rest of the area is dependent on private wells for water supply.	Water supply network development in Sarulia union will be carried out through DWSNIP of DWASA. Outline design of the water networks under MODS Zone 7 has already been started.
Shyampur and Dania	Shyampur and Dania unions have 100% coverage from DWASA networks. However, there are complaints from local people about the quality and quantity of water supplied by DWASA. The water supply is intermittent and the water is always associated with high turbidity and pollutants.	Rehabilitation of water distribution network in MODS Zone 7 will be carried out under DWSNIP of DWASA. Outline design of the water networks under MODS Zone 7 has already been started.

Chapter 4: Water Demand Calculation for Study Area

4.1 General

The assessment of demand for water, including realistically forecasting future levels of demand, is a critical step in the development of a water supply system in an area. Demand assessment requires data and assumptions on the:

- Present water demand pattern, tariff structure, facilities offered
- Urban growth – how the city has developed and will develop in the future
- Future growth of different segments of population, their household income and expenditure and change in lifestyle

Present water demand pattern of an area could be analyzed if the billing data is available. Most of the areas under study do not have existing DWASA network coverage. However, household surveys conducted under this study provides an estimate of per capita water use at household level. Details of the survey is presented in Social Survey Report.

In Dhaka Water Supply Master Plan study, a demand projection model was developed considering key water demand factors: population projection (including proportion below poverty line), per capita daily consumption and proportion of other (non-residential) demands. The model has been used to assess future demand for different scenarios consist of different rates of system losses. For the current study, demand assessment reports of Dhaka Water Supply Master Plan and Dhaka Sewerage Master Plan were reviewed and the outputs from the study have been used in demand assessment strategy.

The results of the demand assessment enable the:

- Determination of appropriate service level(s) to be provided;
- Determination of the size and timing of investments;
- Estimation of economic and financial benefits of priority investment projects.

4.2 Population Trend Analysis of Dhaka City

In general, variables affecting population growth in an urban area are:

- Rise in the standard of living (rise in income levels)
- Increase in literacy rates (provision of educational facilities)
- Increase of urbanization
- Increase of industrialization

- Increase in employment opportunities
- Decline in death rates (increased health facilities)
- Decline in birth rates (health and education consciousness)
- Increase in transportation and facilities
- Increase in amenities and recreational facilities

Changes in population of a particular area can be attributed particularly to three key factors; number of births, number of deaths and rate of migration. Study shows, much of the growth in Dhaka since independence can be attributed to the in-migration of rural, mostly poor people. The natural rate of increase in the population (births in the population) of Dhaka has been seen to be declining over recent years particularly due to: (i) family Planning (ii) decline in total fertility rate and adolescent fertility rate and (iii) increase in school attendance and literacy rates among both males and females.

Due to the provision of better health facilities and nutritional information dispersal, rates of mortality and morbidity have declined steadily over recent year. Provision of improved access to health facilities and nutritional information has increased the life expectancy to 72 years from 40 years in less than 5 decades. Thus, while the natural rate of increase in the population of Dhaka is indeed declining as a result lower birth rates and number of births per women, the population as a whole is living longer.

Most dominant factor in population growth of Dhaka city is rural to urban migration. Two types of factors – the “push” and the “pull” factors – are the key determinants which drive the rural-to-urban migration. Pull factors are essentially the mechanisms which are responsible for literally drawing, or luring, the population away from the countryside and into the cities. Push factors, on the other hand, are those which in essence compel persons to seek opportunities elsewhere (in cities), when the option to sustain oneself and/or one’s family in the countryside has for one reason or another become unattainable. The **primary pull factors** driving a growing population from the countryside into Dhaka are:

- Better employment opportunities
- Better educational facilities
- Better health facilities
- Better urban amenities (recreation and amusement facilities) and basic services & utilities (i.e. gas, electricity, water supply, etc.)

On the other hand, **factors pushing people out of the countryside** and into Dhaka are:

- Increase in poverty

- Decrease in land-man ratio
- Increased subdivision & fragmentation of land
- River bank erosion
- Natural hazards
- Lack of facilities
- Loss of breadwinner

It is also the case that migrants to the cities generally maintain their rural roots and frequently return to their villages when given the chance. However, it is less likely that those who do migrate to the cities ever permanently return to the countryside. Generally, the reasons which brought the persons to the city will tend to keep them there, or at least this has been the case in the short history of Dhaka's migrant population.

4.3 Population Projection Method

Population projection is inherently an uncertain exercise due to non-availability of accurate existing growth rate, determination of past trends and migration impact. This uncertainty increases with horizontal extension urban areas within the planning period. Therefore, it is better to be updated on the basis of monitoring results of key growth parameters and related indicators at the time of implementation.

For population projection, the geometric progression method is the most widely used method which is also known as empirical method suggested by Hardenberg. From the known population /dwellings of at least two last censuses, growth rate can be estimated by method using the equation:

$$P_f = P_p (1+r/100)^n$$

Where,

P_f = Future population or dwellings.

P_p = Present population or dwellings.

r = Growth rate of population or dwellings; and

n = Design period.

4.4 Previous Attempts of Forecasting Dhaka City Population Growth

Several previous population projections of Dhaka city have been prepared for various intervals and by different agencies. RAJUK prepared population projections for Dhaka city up to year 2016 under the DMDP (1995-2015). Other agencies involved in population projections include the ADB as part of the PPTA for the DWSSDP (2006), the Fourth Dhaka Water Supply Project

(WSP, 1998), the World Bank and Bangladesh Center for Advanced Studies (BCAS, 2000, 1998), the National Water Management Plan (NWMP, 2001) and the Dhaka Transport Co-ordination Board (DTCB). Two most recently prepared report containing population projection for Dhaka city are Dhaka Sewerage Master Plan (DSMP, 2011) and Dhaka Water Supply Master Plan (DWSMP, 2014). Overview and comparison of the previous population forecasts prepared by the various agencies are provided in Table 4.

Table 4: Population Projections - Summary of Previous Forecasts

Agency/Programme	Area Covered (km²)	Forecast Year	Projected Population	Average Annual Growth Rate
UNCHS	1528	2015	22,800,000	5.2
DWSSDP (PPTA)	604	2015	14,900,000	4.1
DTCB	1464	2015	16,668,000	4.0
DMDP	1528	2016	15,570,000	3.1
DWSSDP (PPTA)	604	2025	21,630,000	4.0
DTCB	1464	2025	24,300,000	3.9
NWMP	1339	2025	27,000,000	4.5
NWMP	1339	2050	50,000,000	3.5
DSMP	401	2035	25,422,390	3.6
DWSMP	617	2035	29,015,910	3.7

From review of the above previous forecasts prepared within the last 20 years it can be observed that all have arrived at quite different and considerably varying estimations of the future population for Dhaka city, no doubt underlying the stark unpredictability of such estimations in general.

4.5 The Planning Area

The Planning Area to be considered under the current project includes the newly included 16 Unions areas under DNCC and DSCC. However, some areas under current study already have recently developed water supply system under different projects. The water distribution networks in those areas were implemented considering DMA concept. Moreover, some areas under 16 Union's boundary has already been planned for implementation of water distribution system considering DMA concept under other DWASA projects. Areas with recently developed (or planned) water distribution system within the 16 Union boundary have been excluded from current study. The planning area along with recently implemented DMAs under other DWASA projects is shown in Map 2.

4.6 Population Projection for the Planning Area

4.6.1 Baseline Population

For the current study, latest population census (2011) and water supply master plan will be the base for water demand estimation. Current population for the unions were adopted from 2011 population census published by BBS. The baseline (2011~2015) growth rate for the areas have been considered same as the respective Thana growth rate found from Water Supply Master Plan report. The growth rate for the future years were selected after analyzing development pattern of the areas and keeping consistency with the Detail Area Plan (DAP) of RAJUK for future possible development.

For instance, Uttarkhan union is under Uttara Thana according to 2001 administrative thana boundary. So, baseline growth rate for the areas under Uttarkhan union has been considered as same as the growth rate (for 2011~ 2015) of Uttara Thana calculated in Dhaka Water Supply Master Plan. As a large portion of the areas under Uttarkhan union is currently have low population density so it is expected that future growth rate for those will rise gradually from the baseline growth rate. Similar consideration was applied in growth rates of other unions. Union wise population (Table 5) is available in latest BBS census (2011) report published in 2012.

Table 5: Main Features of 16 Unions (According to BBS Census 2011)

Union Name	Area (sq. Km)	Household (nos.)	Population (nos.)	Population Density (per sq. Km)
Harirampur	30.56	38,660	157,316	5,148
Uttarkhan	20.51	18,297	78,933	3,849
Dakshinkhan	22.92	67,745	272,807	11,903
Badda	8.02	43,690	180,554	22,513
Beriad	6.21	3,121	14,949	2,407
Bhatara	7.64	31,214	126,694	16,583
Satarkul	8.41	5,582	23,663	2,814
Dumni	9.32	3,559	16,862	1,809
Nasirabad	5.56	4,471	21,378	3,845
Dakshingaon	9.06	16,751	70,203	7,749
Demra	13.36	7,834	35,786	2,679
Manda	5.05	15,551	62,312	12,339
Sarulia	7.64	37,383	156,583	20,495
Matuail	11.03	42,865	183,295	16,618
Dania	5.56	61,036	261,074	46,956
Shyampur	6.91	28,111	116,954	16,925
Total	177.76	425,870	1,779,363	10,010

It is to be noted that, the population data available in census is for the whole area of unions. But there are some existing DMAs within the boundary of 16 unions which were implemented under DWSSDP of DWASA. Moreover, there are some proposed DMAs which will be implemented under DWSNIP of DWASA. Areas which will be implemented under other DWASA projects are shown in Map 2. Population projection for those areas had already been done during water demand calculations for the respective projects. So, these areas have been excluded for population projection and water demand calculations under current study. The baseline population has been adopted from BBS census 2011. Baseline population for each union has been calculated by applying an approximate density factor to the actual density found from 2011 census. The density factors for the unions has been assumed by analyzing recent satellite image for the current settlement pattern in respective unions. Baseline population (2011) used during population projection are provided in Table 6.

Table 6: Baseline Population for Different Unions under Current Study

Union Name	Area for Population Projection (sq. km)	Population in Base Year (2011) (nos.)	Population Density (per sq. km)
Harirampur	21.06	140,889	6,689
Uttarkhan	19.02	66,355	3,489
Dakshinkhan	17.69	54,570	3,086
Badda	3.49	0*	-
Beriad	6.21	14,091	2,269
Bhatara	4.05	0*	-
Satarkul	8.41	18,450	2,194
Dumni	9.32	24,138	2,590
Nasirabad	5.56	20,867	3,753
Dakshingaon	4.00	4,759	1,191
Demra	13.36	32,892	2,462
Manda	3.82	309	81
Sarulia	7.64	156,583	20,495
Matuail	9.78	183,295	18,734
Dania	5.56	261,074	46,956
Shyampur	6.91	116,954	16,925
Total	145.88	1,095,226	7,508

*Note: Portion of Badda and Beraid unions under the study currently doesn't have population settlement. The area will be developed by Real Estate Developers. So, population settlement will occur after the housing development.

4.6.2 Expected Developments over the Planning Horizon

In 2007, a 20-year development scenario (2005-2025), presented as part of the ADB PPTA preparations for the DWSSDP was prepared. This development scenario was devised according to the area-wise development foreseen to take place following five predefined development patterns: (1) only limited development by urban renewal; (2) vertical development, short to medium-term 2005-2025; (3) densification of low-density urban areas. Short to medium-term

horizontal and vertical development 2005-2025; (4) new planned developments, 2005-2025; and (5) expected new developments, 2005-2025.

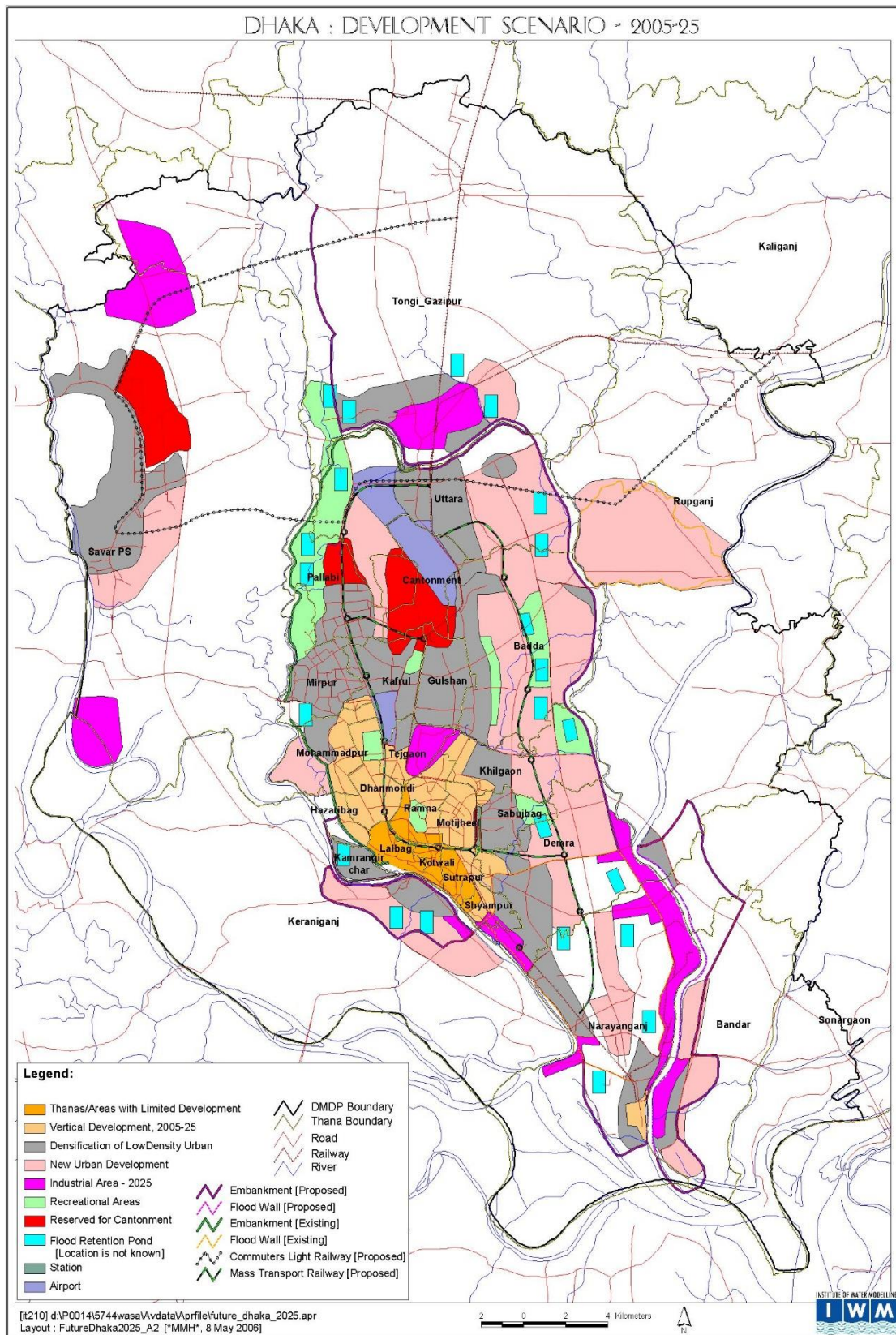


Figure 9: ADB FS 2007 Proposed Development Scenario for 2005-2025 [Source: ADB, 2007]

Figure 9 shows the proposed Development Scenario for 2005-2025, as prepared by the consultant to the ADB (2007). The Development Scenario illustrates the location and type of development expected to take place within the wider RAJUK DMDP area of Dhaka city. The five development categories are shown in Figure 9, applying different color schemes to each.

- **Category 1:** Only limited urban renewal is expected in the very densely populated three Thanas of Old Dhaka: Lalbag, Kotwali and Sutrapur.
- **Category 2:** Vertical development is expected in parts of Dhanmondi, Kafrul, Khilgaon, Mirpur, Mohamadpur, Motijheel, Pallabi, Ramna, Sabujbagh, Shyampur and Tejgaon.
- **Category 3:** Vertical and horizontal development, is expected in parts of Badda, Demra, Gulshan, Hazaribagh, Kamrangirchar, Mohammadpur, Narayanganj, Pallabi, Sabujbag, Shyampur, Uttara, Keraniganj, Savar and Tongi PS.
- **Category 4:** New planned developments 2005-2025 include: Uttara Model Town Phase 3, Purbachal, Rupganj, Jhilmil, Keraniganj, Bashundhara, Badda & DND, Narayanganj.
- **Category 5:** Expected new developments 2005-2025 are areas expected to be developed within the project planning period. Those are parts of Baddar. Bandar, Kaliganj, Narayanganj, Mohammadpur, Pallabi, Rupganj, Savar and Tongi PS.

The findings of the proposed 20-year development scenario, as identified above and in Figure 9, have been verified and also used as a basis for estimating growth under the current study. From Figure 9, it is seen that most of the areas under study is under ‘new urban developments’ category. Thus, it is foreseen under the current study that similar growth patterns will emerge and thus the areas represented in Figure 9 could be more-or-less equally transposed onto a map projecting development pattern up to year 2040.

4.6.3 Area-Wise Expected Developments

The characteristics and expected developments to take place within different Unions are briefly described in Table 7. During population projection of areas under the unions, the areas have been divided into sub sectors considering detailed area plan (DAP) proposed land use and primary roads. Different growth rates were adopted for different sub sectors after analyzing current and future development probabilities.

Table 7: Union Density Characteristics and Expected Growth Patterns

Union	Present Land Use Characteristics	Expected New Urban Developments
Harirampur	<p>Harirampur union has an area of 30.56 sq km. The union is bounded by Tongi Khal in the north, Turag River in the west and Uttara model town and the Hazrat Shajalal International Airport in the south-east and Mirpur in south. The area under Harirampur is mostly residential area (+ mixed use of commercial, educational, health purposes). According to 2011 census population density of Harirampur union is 5,148 people per sq. Km. Rapid developments in Uttara apartment project area and Uttara 3rd Phase (Uttara Model Town) area is currently ongoing.</p> <p>Newly developed residential areas under Harirampur union are Mirpur DOHS, Eastern Housing Ltd. (Pallabi), Sagufta Housing and Uttaran city.</p>	<p>Localities under Harirampur union having population settlements are Bawnia, Noanagar, Dhour, Kamarpara, Bhatuliya, Bamnartek, Rasdia and Phulbaria. There are little scope of horizontal expansion of settlements in Kamarpara, Bhatuliya, Bamnartek, Rasdia and Phulbaria. However, densification of these low-density urban areas will occur through vertical expansion.</p> <p>In Dhour and Noanagar, there are scope for both horizontal and vertical expansion. Moreover, newly developed housing areas like Uttara 3rd phase, Sagufta housing, Eastern housing (Pallabi) and Uttaran city will have rapid vertical developments and population settlements.</p> <p>Around 2.5 sq. Km of Harirampur union is reserved for water retention in recent DAP prepared by RAJUK.</p>
Uttarkhan	<p>Uttarkhan union has an area of 20.51 sq. Km. According to 2011 census, population density of Uttarkhan union is 3,849 people per sq. Km. Major portion of population is settled in north western part of the union. Chanbari, Masterbari, Bhuyan para, Madarbari and Mollapara areas have relatively higher population density than other areas like Mausaid, Mainartek, Chamurkhan, Dobadia, Kanchkura, Bhatira and Poradia. Major portion of these areas currently have agricultural and flood prone land.</p>	<p>There are room for horizontal and vertical expansion. Development in locality areas is expected to have natural growth. But, areas like in Mausaid which will be developed by real estate housing authorities (Uttarkhan Model Town) will have population migration from other areas.</p>

Union	Present Land Use Characteristics	Expected New Urban Developments
Dakshinkhan	<p>With 22.92 sq. Km. area, Dakshinkhan union has a population density of 11,903 people per sq. Km according to 2011 census. The northern parts of the union (Goaltek, Dewanpara, Azmpur, Chalabon, Ashkona, Aamtola, Nowapara, Naddapara and Taltola) currently has relative greater population settlements than the south and eastern parts (Sonakhola and Barua). Major portion in the south eastern side is currently agricultural and low lying land. Civil Aviation (CAAB) colony with an area of about 1.0 sq. Km. is situated in south western part of Dakshinkhan union.</p>	<p>The northern parts of the union have small scope for horizontal expansion but vertical expansion in these areas will most probably occur. The south eastern parts have room for both horizontal and vertical expansion of population settlements.</p> <p>A major portion of south eastern part of the union is currently being developed by Ashiyan City Ltd. Land developments in both sides of the Purbachal expressway are done by many other real estate developers. So, a rapid population settlement in these areas is expected in near future.</p>
Badda	<p>Badda union has an area of 8.02 sq. Km. According to 2011 census, the population density of Badda union is 22,513 people per sq. Km. Western side of Sutibhola khal has majority of the population settlements.</p>	<p>There is room for horizontal and vertical expansion of population settlements in Badda union especially in eastern part of the Sutibhola khal. Land in Aftabnagar area is currently developed by Eastern Housing Ltd. So, there will be rapid population growth in those areas in the future.</p>
Beraid	<p>Beraid union has a total population of 14,949. Its area is 6.21 sq. Km. The Balu River flows along its eastern boundary. Most of the areas under Beraid union is currently flood prone and agricultural land. However, there is indication of land developments by real estate developers in both sides of Madani avenue.</p>	<p>There is room for horizontal and vertical expansion within the union. As major portion of the union is currently flood prone so population settlements in these areas is expected to have slow growth pattern. In RAJUK proposed DAP, around 1.1 sq. Km. of the union area is reserved for flood retention pond. However, settlements in recently developed land is expected to have rapid growth rate.</p>
Bhatara	<p>According to 2011 census, total population of Bhatara union is 126,694. With an area of 7.64 sq. Km., Bhatara has a moderate population density (16,583 per sq. Km.) and most of the current population settlements is in the western half of the union.</p>	<p>The western part of the union has limited scope for horizontal expansion. Recently, land development in the eastern part is done by Bashundhara Housing Ltd. So, it is expected to have rapid population growth in the eastern part of the union once the road network is established with other basic facilities.</p>

Union	Present Land Use Characteristics	Expected New Urban Developments
Satarkul	Satarkul union has an area of 8.41 sq. Km. According to 2011 census, population density of Uttarkhan union is 2,814 people per sq. Km. Major portion of the current population is settled near Satarkul bazar in the western part of the union. Land development by United Housing in both sides of Madani avenue is currently ongoing. Rest of the areas of Satarkul union is currently low lying agricultural land.	Room for horizontal and vertical expansion. Rapid population settlements is expected after the completion of land development by real estate housing authorities.
Dumni	With an area of 9.32 sq. km, Dumni union has a total population of 16,862 according to 2011 census. The current settlement is mainly in the eastern part of the union (adjacent to the Balu River). Few years back, the western part of the union was low lying agricultural land in. However, massive land development by Bashundhara group is currently ongoing.	Room for horizontal and vertical expansion. Rapid population settlements is expected after the completion of land development by real estate housing authorities.
Nasirabad	According to 2011 census, Nasirabad union has a total population of 21,378. Its area is 5.56 sq. Km. The Balu River flows along its eastern boundary. Most of the areas under Nasirabad union is currently flood prone and low lying agricultural land.	According to RAJUK prepared DAP, More than 50% of area of Nasirabad union is reserved for flood retention pond. Rest of the area is currently low lying agricultural land. So, there is room for horizontal and vertical expansion in these areas.
Dakshingaon	Dakshingaon union has an area of 9.06 sq. Km. According to 2011 census, population density of Dakshingaon union is 7,749 people per sq. Km. The area has experienced spontaneous development with no planned road networks and utility services. Western part of the union is moderately dense but the eastern part has low population density. Among the existing households, there are very low percentage (below 10%) of high rise building.	Vertical expansion taking place in the western part. This area will be saturated within the next 10 years. Room for new development to the east.
Demra	Demra union has a low population density (2,679 people per sq. km) according to 2011 census. Northern part of the union is mostly low lying agricultural land and southern part is sparsely populated. However, there is indication of land development by real estate housing developers.	Room for horizontal and vertical expansion. Rapid population settlements is expected after the completion of land development and planned new main roads.

Union	Present Land Use Characteristics	Expected New Urban Developments
Manda	According to 2011 census, Manda union has a total population of 62,312. Its area is 5.05 sq. Km. At present, the western part has a relatively higher population density than the eastern part. However, some planned development is ongoing in the eastern part of the union.	Room for horizontal and vertical expansion. Rapid population settlements is expected after the completion of land development by real estate housing authorities (i.e. Green Model Town).
Sarulia	Sarulia union has an area of 7.64 sq. Km. According to 2011 census, total population of the union is 156,583. The Shitalakkhya River flows along its eastern boundary. The adjacent part of Shitalakkhya River is mainly industrial area. Other part of the union is residential area with a healthy percentage of multi storied building.	Room for vertical expansion as private investors tear down old 2-3 story houses and replace them with higher new buildings without permission.
Matuail	With an area of 11.03 sq. km, Matuail union has a total population of 183,295 according to 2011 census. The southern part of Dhaka-Demra highway has dense population settlement whereas the northern part is mainly low lying land. Matuail waste treatment plant covers an area of around 0.5 sq. km. However, there is indication of new land development in these area.	The southern part of Dhaka-Demra highway has limited room for horizontal expansion. However, vertical expansion in these area is possible. The northern part of Dhaka-Demra highway has high possibility of population settlements both in horizontal and vertical direction after the planned new roads are implemented. Land development is ongoing in these areas by real estate developers.
Dania	Dania union has highest population density among the 16 unions of current study. According to 2011 census, total population of Dania union is 261,074 and area of the union is 5.56 sq. Km.	Near saturation. No expansion can be undertaken without redevelopment by RAJUK or DSCC. However, without permission private investors tear down old 2-3 story houses and replace them with higher new buildings. Therefore, some vertical development is expected.
Shyampur	Shyampur union has an area of 6.91 sq. Km. According to 2011 census, total population of the union is 116,954. The Buriganga River flows along its western boundary. The adjacent part of Buriganga River is mainly industrial area. Other part of the union is residential area with a healthy percentage of multi storied building. Around 1.0 sq. Km of the union is occupied by Pagla sewage treatment plant.	Room for vertical expansion as private investors tear down old 2-3 story houses and replace them with higher new buildings without permission.

4.6.4 Population and Growth Forecasting

The population projections of the study area have been prepared on the basis of a “best estimate” approach for determining growth and future demand characteristics. In applying a “best estimate” approach for determining growth rates of population across the Study Area and up to the design year of 2040, the latest census data from 2011 has been utilized. The ‘Best Estimate’ population forecast has been prepared applying differential growth rates over 5-10 year intervals for the each of the unions.

There are two possible type of population settlement options. One is settlement within a locality by replacing old 2-3 story houses with higher new buildings plus some horizontal expansion. The other type of population settlement is in the areas which are newly developed by real estate developers. In that case, population settlement will be primarily governed by migration from other saturated areas. Population prediction in those areas requires assumptions with greater uncertainty.

Development within a locality has been considered as exponential and it is expected to follow the locally adopted growth rates for different years. But, development which will be done by real estate developers will be rapid and a consolidation of population is expected to occur within few years after development. Areas identified as ‘housing development area’ are assumed to have an average population density in the year 2025. The density will depend on development pattern (like location, availability of utility services, project completion time etc.) and rate of migration. The density data has been adopted from 2011 population densities of other recently developed residential areas like Bashundhara R/A, Baridhara R/A etc. Once the project (land development and building construction) is completed it is assumed that there will be saturation of population within few years. However, a growth rate is assumed which will be applied for population projection for the post-developed years up to 2040. This will provide some flexibility in demand and meet the uncertainties about vertical expansion of buildings to be built under different housing authorities.

Population base data (census data 2011) and projected population up to the planning year 2040 is provided in Table 8. The average annual growth rate of the entire planning area according to the ‘Best Estimate’ growth scenario, over the 29 year planning period, is approx. 5.91%. Taking into consideration the likelihood of variances arising between the actual future population and the projected ‘Best Estimate’ populations as shown in Table 8, a sensitivity analysis considering alternative low and high growth scenarios has been prepared. In the high growth scenario, initial growth (during 2020~2025) is assumed to be very high because of increase of facilities of being included into city corporation area. However, a moderate growth pattern is

assumed to be followed after the year 2025. On the other hand, in Moderate and low growth scenarios, it is assumed to follow a gradual decreasing trend in settlements after an initial high growth. The findings of sensitivity are summarized briefly in Table 9 and Figure 10.

Table 8: Union-Wise Population Projections and Assumed Growth Rates, 2011-2040, Over the Study Area

Union Name	Area	Area Under Current Study	Population, 2011	GR, 2011~2015	Population, 2015	GR, 2015~2020	Population, 2020	GR, 2020~2025	Population, 2025	GR, 2025~2030	Population, 2030	GR, 2030~2035	Population, 2035	GR, 2035~2040	Population, 2040
	(sq. Km)	(sq. Km)	(nos.)	(%)	(nos.)	(%)	(nos.)	(%)	(nos.)	(%)	(nos.)	(%)	(nos.)	(%)	(nos.)
Harirampur	30.56	21.06	140,889	7.2	186,061	7.2	263,409	11.4	451,819	6.6	621,462	6.5	851,209	4.5	1,061,156
Uttarkhan	20.51	19.02	66,355	7.2	87,630	7.2	124,059	7.4	177,252	11.4	304,448	8.7	462,675	8.5	695,625
Dakshinkhar	22.92	17.69	54,570	7.2	72,066	7.2	102,025	13.2	189,657	10.9	318,091	5.7	419,787	5.4	547,025
Badda	8.02	3.49	-	-	-	-	-	-	32,994	15.4	67,671	1.0	71,122	1.0	74,750
Beriad	6.21	6.21	14,091	7.0	18,470	6.7	25,605	-	88,189	13.4	165,107	1.7	179,769	1.6	194,794
Bhatara	7.64	4.05	-	-	-	-	-	-	48,747	15.4	99,981	1.0	105,081	1.0	110,442
Satarkul	8.41	8.41	18,450	7.0	24,184	6.7	33,525	-	114,876	14.2	222,779	3.3	262,677	3.2	307,799
Dumni	9.32	9.32	24,138	7.0	31,640	6.7	43,861	-	278,004	14.9	557,349	1.6	602,237	1.6	651,777
Nasirabad	5.56	5.56	20,867	4.5	24,884	4.2	30,568	10.1	49,524	8.7	75,164	9.1	116,390	9.6	184,142
Dakshingaor	9.06	4.00	4,759	4.5	5,675	4.2	6,971	-	39,503	2.7	45,215	3.5	53,624	4.3	66,232
Demra	13.36	13.36	32,892	5.5	40,747	4.5	50,779	-	124,838	6.6	171,819	8.2	254,707	9.0	392,601
Manda	5.05	3.82	309	2.5	341	2.0	377	-	14,066	1.0	14,785	1.0	15,541	1.0	16,335
Sarulia	7.64	7.64	156,583	5.5	193,981	4.5	241,736	3.5	287,107	2.7	328,016	1.8	358,620	1.5	386,335
Matuail	11.03	9.78	183,295	5.5	227,070	4.5	282,971	5.0	361,978	5.2	466,156	2.9	537,793	1.2	571,570
Dania	5.56	5.56	261,074	1.0	271,648	0.8	282,689	0.5	289,827	0.4	295,670	0.2	298,639	0.1	300,135
Shyampur	6.91	6.91	116,954	3.6	134,737	2.8	154,687	2.3	173,313	2.0	191,352	1.8	209,204	1.7	227,602
Total	177.76	145.88	1,095,226	4.8	1,319,137	4.5	1,643,260	10.6	2,721,693	7.7	3,945,066	4.0	4,799,076	3.8	5,788,322

Note: Growth rates for 2020-2025 in unions having a major portion of real estate housing have not shown here. Population projections in real estate housing areas have been done based on expected population density in housing areas.

Table 9: Comparison of Different Growth Scenarios

Area (2011 Census)	Area Under Current Study	Population, 2011	GR, 2011~2015	Population, 2015	GR, 2015~2020	Population, 2020	GR, 2020~2025	Population, 2025	GR, 2025~2030	Population, 2030	GR, 2030~2035	Population, 2035	GR, 2035~2040	Population, 2040	Overall GR, (2011~2040)
(sq. Km)	(sq. Km)	(nos.)	(%)	(nos.)	(%)	(nos.)	(%)	(nos.)	(%)	(nos.)	(%)	(nos.)	(%)	(nos.)	(%)
High Growth Scenario															
177.76	145.88	1,095,226	4.8	1,319,137	4.5	1,643,260	15.3	3,354,264	4.5	4,181,538	4.4	5,178,781	4.0	6,310,814	6.2
Moderate Growth Scenario (Best Estimate)															
177.76	145.88	1,095,226	4.8	1,319,137	4.5	1,643,260	10.6	2,721,693	7.7	3,945,066	4.0	4,799,076	3.8	5,788,322	5.9
Low Growth Scenario															
177.76	145.88	1,095,226	4.8	1,319,137	4.5	1,643,260	9.9	2,632,682	7.3	3,743,670	3.5	4,455,849	3.4	5,262,849	5.6

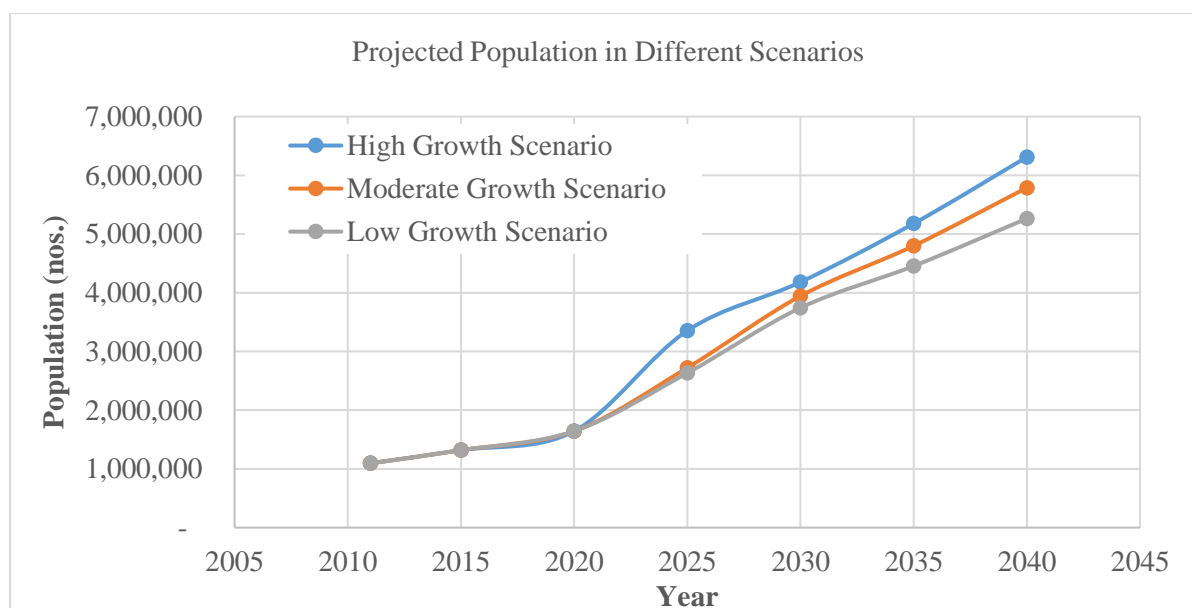


Figure 10: Projected Population in Different Growth Scenarios

4.7 Demand Assessment for the Planning Area up to the Year 2040

In Dhaka Water Supply Master Plan (DWSMP) study, future water demand scenarios have been developed taking into consideration several key factors:

- Population growth rates – three scenarios were used (as described in previous section) and changes in low-income community as proportion of total population.
- Nature of economic development – high growth rate leading to relatively higher migration rates, higher household incomes and higher water consumption rates and
- Demand management measures – tariff structure, annual price increment rates and use of water efficient gadgets and advocacy programs.

Based on these factors, the demand scenario have been defined as in Table 10.

Table 10: Water Demand Scenarios to 2040

Sl.	Scenario	Population Growth	Economic Development	Demand Management Measures
1.	High Demand	High	High	Flat tariff
2.	Moderate Demand with IBT, Gadgets& Advocacy	Moderate	Moderate	IBT, efficient gadgets& advocacy programs
3.	Low Demand	Low	Low	IBT, efficient gadgets& advocacy programs

4.7.1 Economic Development Scenario

The change in low-income population (as proportion of total population below the poverty line) was an important consideration in the demand projection. Three scenarios were used based on poverty reduction strategies and different economic growth expectations. With high economic

growth, it is expected that the proportion of LIC will decrease rapidly from approximately 18% of the total population in 2011 to about 5% by 2040. In the moderate scenario it is expected to decrease to around 7% and to 10% in the low economic growth scenario.

4.7.2 Per Capita Water Demand

Per capita water consumption depends on household structure type, water supply condition, number of bathrooms in a household, availability of washing machine, car, gardening and other facilities. According to the survey carried out for Dhaka Water Supply Master Plan study, there are wide variations in consumption rates within each structure type, a clear rising trend in consumption can be seen as the structure type increases from tin shed to 2-6 storied buildings. The average consumption in 2-6 storied and multi-storied buildings is similar.

Per capita water demand also depends on supply condition. People with sufficient water supply was found to have higher per capita demand compared to those with insufficient water supply. Again, the respondents stating that they have insufficient water supply and use suction pumps was found to have a higher consumption rate compared to those who do not have section pumps. Moreover, water consumption rate depends on number of bathrooms and availability of bathtub in the households. It was found from the survey conducted for water supply master plan, the higher the number of bathroom the higher is consumption rate. As expected, availability of bathtub in a house was found to have higher consumption rate compared to those without bathtub facility. Other factors those impact the consumption rate are availability of gardening facility, availability of cars and overall socio economic condition of the consumers. In Dhaka Water Supply Master Plan (DWSMP), per capita water demand for LIC was considered as in Table 11.

Table 11: LIC Daily per Capita Consumption Rate (L/C/D)

Sl.	Scenario	2011	2015	2020	2025	2030	2035
1.	High Economic Growth	60	70	80	100	120	140
2.	Moderate Economic Growth	60	60	70	80	90	100
3.	Low Economic Growth	60	60	65	70	75	80

However, for non-LIC population, per capita water demand was considered as in Table 12.

Table 12: Non-LIC Daily per Capita Consumption Rate (L/C/D)

Sl.	Scenario	2011	2015	2020	2025	2030	2035
1.	High Economic Growth	160	170	150	150	150	150
2.	Moderate Economic Growth	160	160	140	135	130	130
3.	Low Economic Growth	160	160	140	135	130	130

For the current study, similar considerations for per capita demand has been followed.

4.7.3 Non-Domestic Demand and System Loss

For estimation of non-domestic demand, previous studies have been reviewed which are summarized in Table 13. In all these studies, other demands were assessed as a percent of the total residential demand. The PPTA Study had higher estimates of other demands compare to the DMC study. The Sewerage Master Plan adopted the same estimates as the DMC study. All three studies considered commercial and industrial demands as part of other demands and did not include government/institutional nor community demands. These other demands have been included in the WSMP projections. Furthermore, in the WSMP it has been assumed that due to improved water supply services, there will be a shift away from private tube wells and more businesses, institutions, etc. will shift to DWASA supply. As a result, the WSMP has assumed higher consumption rates of non-residential demands compare to other studies.

Table 13: Assessment of Other Demands in Related Studies

Study	Demand Type	2011	2015	2020	2025	2030	2035
WSMP – Moderate	Indtl, Govt., Commcl, Community	15%	16%	20%	22%	25%	27%
ADB PPTA (2007)	Commercial/Industrial	12%	15%	17%	20%	n/a	n/a
DMC (2011)	Commercial/Industrial	10%	11.5%	13%	13.8%	14.5%	n/a
Grontmij (2012)	Commercial/Industrial	10%	11.5%	13%	13.8%	14.5%	14.5%

For the current study, percentage of non-domestic demand has been assumed to remain constant over the years. For high, moderate and low demand scenario, the non-domestic demand is considered as 20%, 15% and 12% of domestic demand respectively.

4.7.4 High Demand Scenario

The detailed breakdown of demand projection for the high demand scenario is provided in Table 14.

Table 14: Water Demand Projection in Study Area (High Demand Scenario)

Item	Unit	2011	2015	2020	2025	2030	2035	2040
Total Population	thousands	948	1,377	1,716	3,880	4,725	5,895	7,621
LIC (As per WSMP)	%	18%	12%	8%	7%	6%	5%	4%
Population Above poverty line	thousands	898	1,161	1,512	3,119	3,931	4,920	6,058
Population below poverty line	thousands	197	158	131	235	251	259	252
Per Capita water Demand for Network Population	lpcd	160	170	150	150	150	150	150
Per Capita water Demand for LIC	lpcd	60	70	80	100	120	140	140
Domestic water demand	l/s	1,800	2,412	2,746	5,687	7,172	8,961	10,927
Non-domestic water demand (20% of Domestic Demand)	l/s	360	482	549	1,137	1,434	1,792	2,185

Item	Unit	2011	2015	2020	2025	2030	2035	2040
Average water demand	l/s	2,160	2,895	3,296	6,825	8,607	10,753	13,112
Loss (12% of Total Demand)	l/s	295	395	449	931	1,174	1,466	1,788
Total water demand	l/s	2,455	3,290	3,745	7,756	9,781	12,220	14,901
	MLD	212	284	324	670	845	1,056	1,287

The combined effects of high population growth and low poverty levels lead to a high total residential consumption. Moreover, a high percentage of non-domestic demand (20% of domestic demand) and system loss (12% of total demand) will require approximately 1,290 MLD water by 2040.

4.7.5 Moderate Demand Scenario

The detailed breakdown of demand projection for the moderate demand scenario is provided in Table 15. The combined effects of modest economic growth, moderate population growth with effective demand management, moderate non-residential demand (15% of domestic demand) and a moderate system loss (10% of total demand) lead to a total water demand requirement of 950 MLD by 2040.

Table 15: Water Demand Projection in Study Area (Moderate Demand Scenario)

Item	Unit	2011	2015	2020	2025	2030	2035	2040
Total Population	thousands	948	1,377	1,716	3,880	4,725	5,895	7,621
LIC (As per WSMP)	%	18%	14%	10%	8%	7%	6%	5%
Population Above poverty line	thousands	898	1,134	1,479	2,504	3,669	4,511	5,499
Population below poverty line	thousands	197	185	164	218	276	288	289
Per Capita water Demand for Network Population	lpcd	160	160	140	135	130	130	130
Per Capita water Demand for LIC	lpcd	60	60	70	80	90	100	100
Domestic water demand	l/s	1,800	2,229	2,530	4,114	5,808	7,121	8,609
Non-domestic water demand (15% of Domestic Demand)	l/s	270	334	379	617	871	1,068	1,291
Average water demand	l/s	2,070	2,563	2,909	4,731	6,679	8,189	9,900
Loss (10% of Total Demand)	l/s	230	285	323	526	742	910	1,100
Total water demand	l/s	2,300	2,848	3,232	5,257	7,421	9,099	11,000
	MLD	199	246	279	454	641	786	950

4.7.6 Low Demand Scenario

The detailed breakdown of demand projection for the low demand scenario is provided in Table 16. The combined effects of low economic growth, low population growth with effective demand management, low non-domestic demand (12% of domestic demand) and a moderate

system loss (10% of total demand) lead to a total water demand requirement of 825 MLD by 2040.

Table 16: Water Demand Projection in Study Area (Low Demand Scenario)

Item	Unit	2011	2015	2020	2025	2030	2035	2040
Total Population	thousands	948	1,377	1,716	3,880	4,725	5,895	7,621
LIC (As per WSMP)	%	18%	14%	13%	12%	11%	10%	9%
Population Above poverty line	thousands	898	1,134	1,430	2,317	3,332	4,010	4,789
Population below poverty line	thousands	197	185	214	316	412	446	474
Per Capita water Demand for Network Population	lpcd	160	160	140	135	130	130	130
Per Capita water Demand for LIC	lpcd	60	60	65	70	75	80	85
Domestic water demand	l/s	1,800	2,229	2,477	3,876	5,371	6,447	7,672
Non-domestic water demand (12% of Domestic Demand)	l/s	216	267	297	465	644	774	921
Average water demand	l/s	2,016	2,497	2,775	4,341	6,015	7,220	8,593
Loss (10% of Total Demand)	l/s	224	277	308	482	668	802	955
Total water demand	l/s	2,240	2,774	3,083	4,823	6,684	8,022	9,547
	MLD	194	240	266	417	577	693	825

4.7.7 Union-wise Water Demand for Moderate Demand Scenario

Considering moderate water demand scenario, water demand has been calculated. The union-wise demand is summarized in Table 17.

Table 17: Union-wise Water Demand for Moderate Demand Scenario

Union Name	Demand, 2011	Demand, 2015	Demand, 2020	Demand, 2025	Demand, 2030	Demand, 2035	Demand, 2040
Harirampur	26	35	45	75	101	139	174
Uttarkhan	12	16	21	30	49	76	114
Dakshinkhan	10	13	17	32	52	69	90
Badda	-	-	-	6	11	12	12
Beraid	3	3	4	15	27	29	32
Bhatara	-	-	-	8	16	17	18
Satarkul	3	5	6	19	36	43	51
Dumni	4	6	7	46	91	99	107
Nasirabad	4	5	5	8	12	19	30
Dakshingaon	1	1	1	7	7	9	11
Demra	6	8	9	21	28	42	64
Manda	0	0	0	2	2	3	3
Sarulia	28	36	41	48	53	59	63
Matuail	33	42	48	60	76	88	94
Dania	47	51	48	48	48	49	49
Shyampur	21	25	26	29	31	34	37
Total	199	246	279	454	641	786	950

4.8 Remarks on Population and Demand Projections

The present Growth and Demand forecast has been prepared primarily on the basis of previous reports and synthesized data. Population projections have been based on the most recent available population figures, as retrieved from the 2011 Census Report. Thus the data for which the population projections over the next 25 years have been based are already 8 years outdated. Thus it is possible that gross under- or over-estimations of the current population have been made but this will not be known until the 2021 Census is published.

For future design and planning purposes corrections should be made to the data contained within this report, if necessary, once the 2021 Census data is made available.

Due to the very nature of population projections in general, as well as the limited and piecemeal availability of information available on the existing situation and particulars of individual commercial and industrial entities, these population projections should be used for 'high level planning purposes only and any future investments will require full feasibility and detailed design undertaken. This study has involved many assumptions which should be reviewed and updated as new data and information is made available.

4.9 Compliance with DWSMP

In Dhaka Water Supply Master Plan (DWSMP), the DWASA jurisdiction area (617 sq. Km) had been divided into eight major sectors namely Singair, Bandar, Khilkheta, Padma North-west, Padma South, Rupganj, Saidabad West & East, Tongi and Gachcha (Figure 11). Areas under current study had also been included within the sectors of DWSMP. Figure 12 shows the study area with respect to the WSMP sector map. From the figure it is observed that, Uttarkhan, Dakshinkhan, Dumni, Beraid, Bhatara, Satarkul, Badda and maximum part of Harirampur and Nasirabad unions are within Khilkheta sector. The Khilkheta sector will be supplied with surface water from Char Ghandharbapur Surface Water Treatment Plant (SWTP).

Matuail, Manda, Sarulia, Dania, Demra and part of Shyampur and Dakshingaon will be supplied from Saidabad SWTP. Moreover, major portion of Shyampur union will be supplied from Padma Phase II SWTP and southern portion of Harirampur union will be supplied from Singair well field. The layout of the transmission mains from different SWTPs are shown in Figure 13. Implementation year for the transmission mains are provided in Table 18.

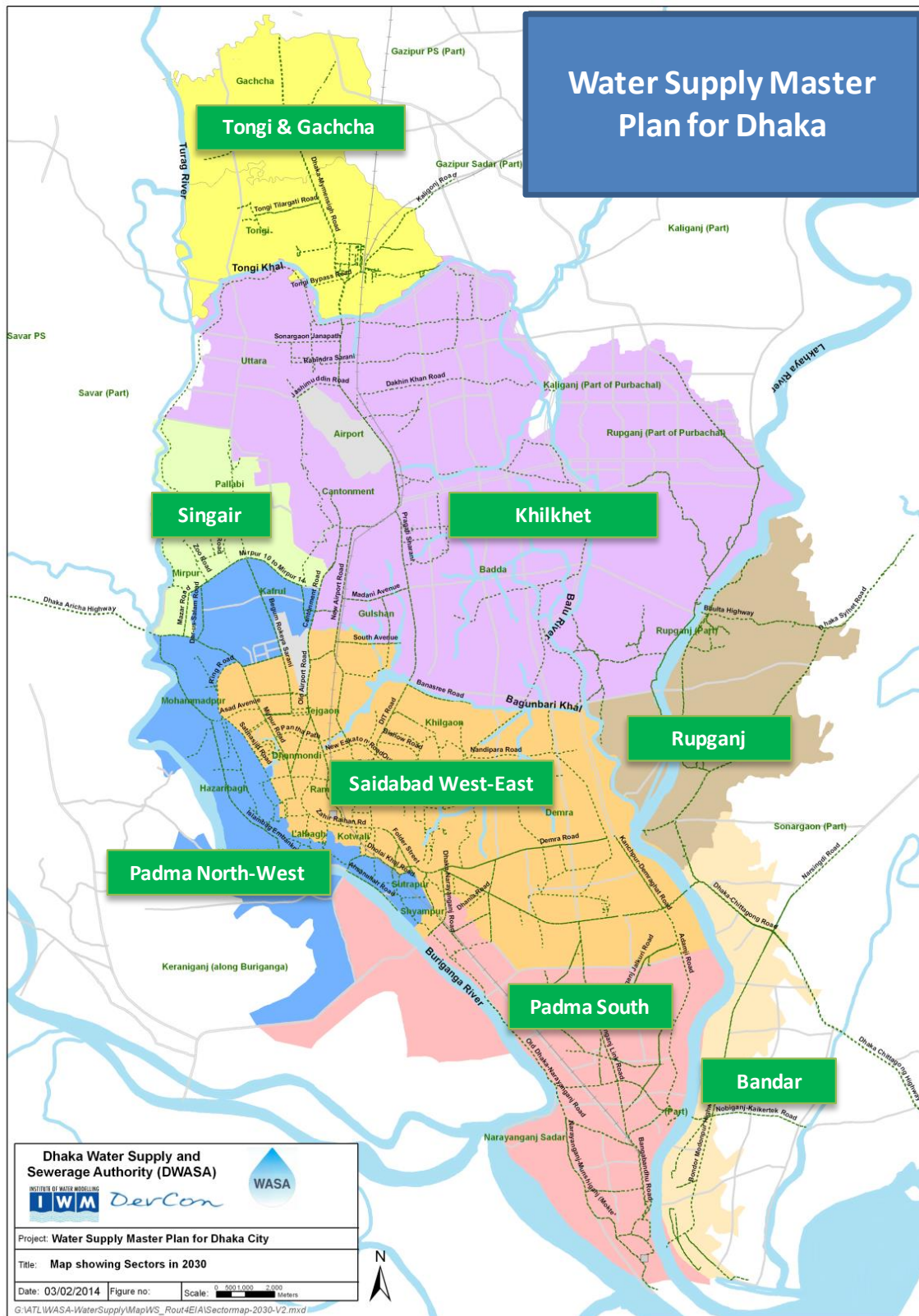


Figure 11: Water supply Sectors According to Dhaka Water Supply Master Plan

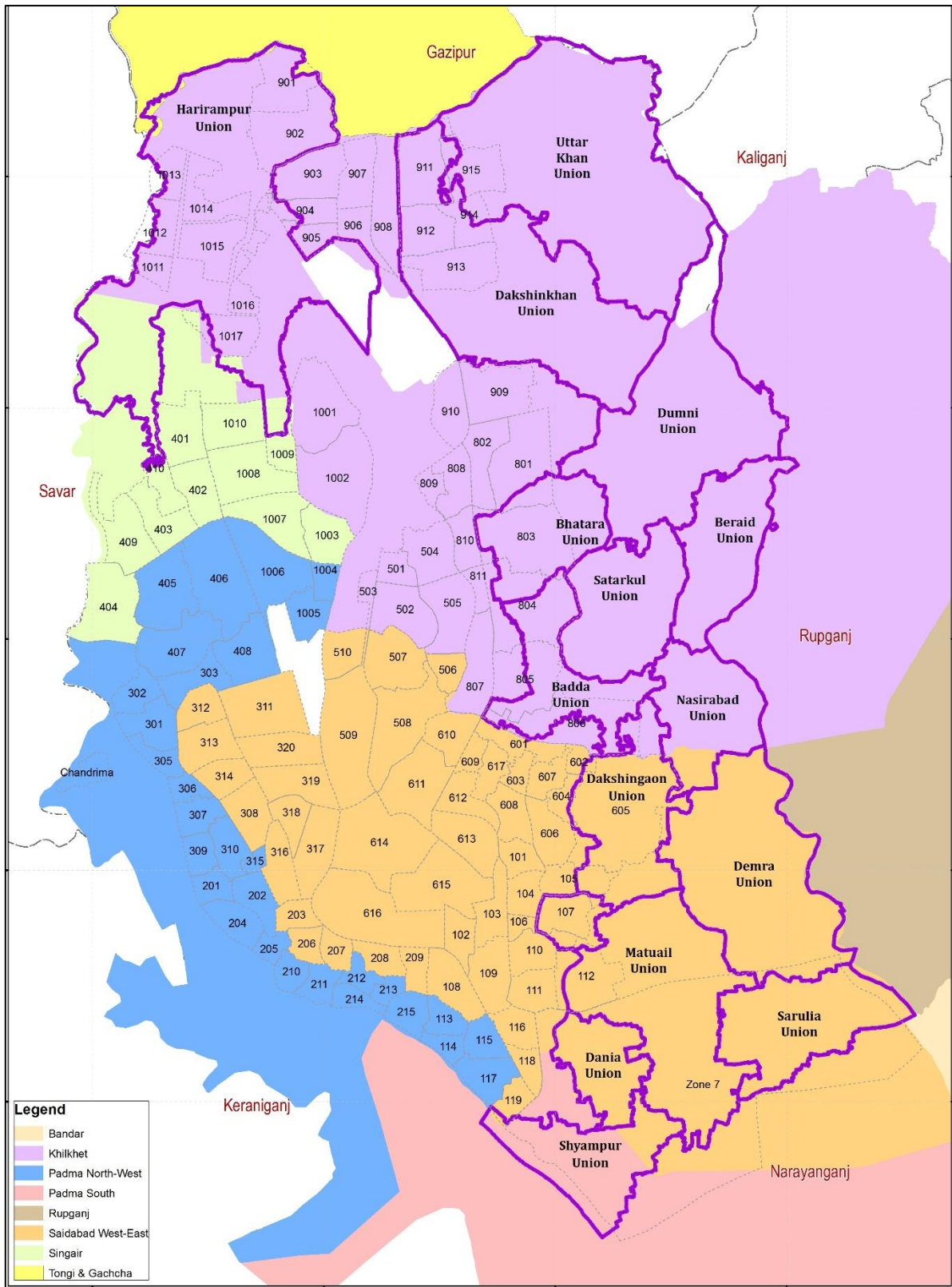


Figure 12: WSM sectors and the 16 Union Feasibility Study Area

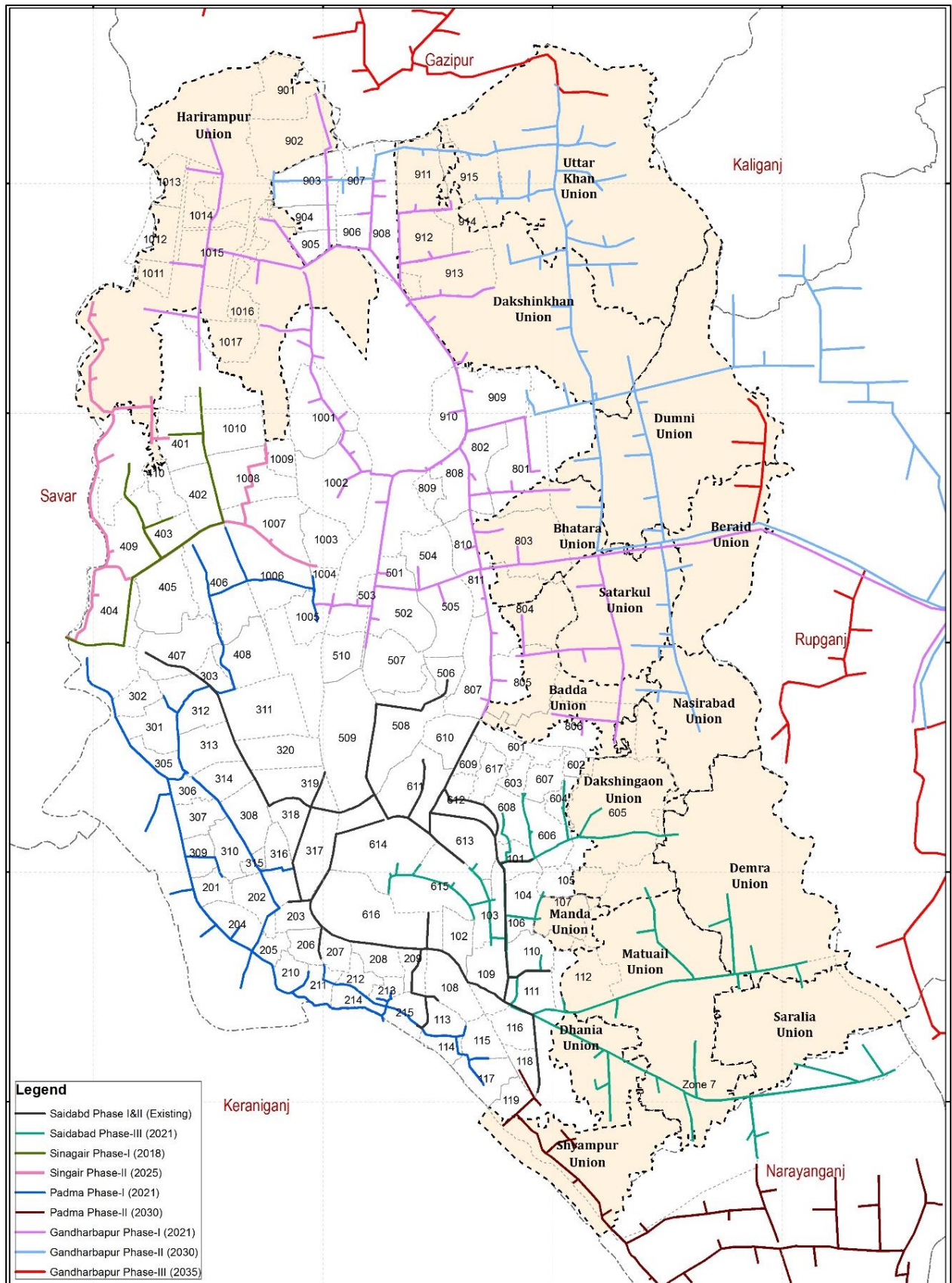


Figure 13: Layout of Transmission Mains and Extension in 16 Union Study Area

Table 18: DWSMP Sectors and SWTPs

DWSMP Sectors	Year	Surface Water Supply Source - SWTPs	Covered Area of 16 Union
Padma North-West	2020	Padma Phase-I	
	2025	Padma Phase-I	
	2030	Padma Phase-I	
	2035	Padma Phase-I	
Padma South	2020		Shyampur (part)
	2025		
	2030	Padma Phase-II	
	2035	Padma Phase-II	
Khilkhet	2020	Gandharbapur Phase-I	Harirampur (part), Uttarkhan, Dakshinkhan, Bhatara, Beraid, Badda, satarkul, Nasirabad (part), Dakshingaon (part)
	2025		
	2030	Gandharbapur Phase-I&II	
	2035	Gandharbapur Phase-I,II&III	
Saidabad West-East	2020	Saidabad Phase-I,II&III	Dakshingaon (part), Matulia, Manda, Sarulia, Dania, Demra, Shyampur (part)
	2025	Saidabad Phase-I,II&III	
	2030	Saidabad Phase-I,II&III	
	2035	Saidabad Phase-I,II&III	
Singair	2020	Singair Well Field Phase-I	Harirampur (part)
	2025	Singair Well Field Phase-I&II	
	2030	Singair Well Field Phase-I&II	
	2035	Singair Well Field Phase-I&II	
Rupganj	2020		
	2025		
	2030		
	2035	Gandharbapur Phase-III	
Bandar	2020		
	2025		
	2030		
	2035	Gandharbapur Phase-III	
Tongi & Gachcha	2011		
	2015		
	2020		
	2025		
	2035	Gandharbapur Phase-III	

In WSMP, nodal demand considered during design of transmission networks is shown in Table 19. From the table it is observed that, some unions will have more supply than the demand and some unions will have deficit of supply. However, this demand distribution can be updated by making some extension of transmission lines proposed in WSMP. Overall demand coverage by proposed transmission network to the area under current study is found as 91%. Rest of the demand will be supplemented by groundwater (local PTWs) in future.

Table 19: Demand Supply Balance for the Unions according to WSMP

Union	WSMP Nodal Demand								Total Demand, 2040 (MLD)	% of Demand Met from Transmission Main
	Gandharbapur Phase 1 (MLD)	Gandharbapur Phase 2 (MLD)	Gandharbapur Phase 3 (MLD)	Padma Phase 2 (MLD)	Saidabad Phase 3 (MLD)	Singair Phase 1 (MLD)	Singair Phase 2 (MLD)	Total (MLD)		
Harirampur	26.6					7.73	65	99.33	174.2	57%
Uttarkhan		122	8					130	114.2	114%
Dakshinkhan		95.5						95.5	89.8	106%
Badda		15						15	12.3	122%
Beriad		0	20					20	32.0	63%
Bhatara		17						17	18.1	94%
Satarkul		62.3						62.3	50.5	123%
Dumni		55	20					75	107.0	70%
Nasirabad		25						25	30.2	83%
Dakshingaon					13			13	10.9	119%
Demra					51			51	64.5	79%
Manda									2.7	0%
Sarulia					48			48	63.4	76%
Matuail					80			80	93.8	85%
Dania					32			32	49.3	65%
Shyampur				99				99	37.4	265%
Total	26.6	391.8	48.0	99.0	224.0	7.7	65.0	862.1	950.4	91%

Chapter 5: DMA Demarcation and Strategic Plan

5.1 General

It is a prime objective for an urban water distribution system to have a 24 hours pressurized water supply at consumer's end. In order to ensure the pressurized flow in 24/7 manner, reducing leakage at a reasonable extent in a water distribution system through better leakage management is necessary. Managing a water distribution system with a huge number of service connections is not an easy task in the context of system hydraulics. Whereas, it is convenient to manage an isolated part of a distribution system through District Metered Area (DMA) and relevant management concept.

DMA is a discrete area of a distribution system usually created by the closure of valves or complete disconnection of pipe work in which the quantities of water entering and leaving the area are metered. DMA concept is useful for water loss minimization in a system. With the help metered data the amount of water lost through leakage can be estimated and measures can be taken to reduce leakage.

In Dhaka, DMA concept has first been introduced through Dhaka Water Supply Sector Development Project (DWSSDP). For proper management, distribution system of seven MODS Zones was subdivided into 88 DMAs under the DWSSD project. Though Zones 1 and 2 are outside the contract of DWSSDP project, initial assessment for DMA has been made for these Zones also. Zones 1 and 2 were divided into 34 DMAs under this initial consideration. Moreover, in MODS Zone 7, 30 DMAs have been proposed under DWSNIP of DWASA out of them 7 DMAs will be implemented under DWSNIP. Furthermore, 7 new DMAs are being implemented in Uttara residential model town area (Uttara 3rd Phase) which is currently under MODS Zones 4 and 10. A summary of Zone wise DMAs is shown in Table 20.

Table 20: DMA in Different MODS Zones

MODS Zone	Zone Area (sq. km)	No. of DMA of Dhaka City	DMA Area (sq. km) of Dhaka city	No. of DMA under 16 Union	DMA Area (sq. km) Under 16 Union
Zone 01	28.25	19	15.05	3	3.6
Zone 02	12.93	15	8.05		
Zone 03	24.81	20	17.07		
Zone 04	26.26	14	14.98		
Zone 05	15.74	10	12.88		
Zone 06	27.91	17	22.93	1	4.5

MODS Zone	Zone Area (sq. km)	No. of DMA of Dhaka City	DMA Area (sq. km) of Dhaka city	No. of DMA under 16 Union	DMA Area (sq. km) Under 16 Union
Zone 07	30.25	7*	4.46	4	2.8
Zone 08	48.04	11	17.57	3	7.6
Zone 09	62.09	15	19.20	7	10.3
Zone 10	32.08	18**	20.10	7	6.3
Total	308.36	146	152.28	25	35.08

* According to recent design report of ICB 2.12 under DWSNIP of DWASA (7 DMAs will be implemented under DWSNIP)

** Including recently developed Uttara Apartment Project and Uttara 3rd Phase Area DMAs

According to Table 20, total 146 DMAs have been demarcated in DWASA service areas so far. Out of the demarcated DMAs, 48 nos. have already been implemented under DWSSDP. Moreover, implementation of 16 DMAs in MODS Zone 6 will be completed under DESWSP very soon. Rest of the DMAs will be implemented under different projects like DWSNIP and IWSP. It is to be noted that, out of the above mentioned 146 DMAs, 25 no. DMAs comprising an area of 35 sq. Km is within 16 union boundary. Zone-wise distribution of these 25 DMAs is also shown in above Table. A better illustration of implemented and proposed DMAs under different projects is shown in Map 2.

5.2 District Metered Area (DMA) Demarcation Criteria

DMA concept is used for reduction of water losses and maintaining a pressurized supply for 24 hours per day, thereby making the water supply operations financially self-sustaining. Once DMA implementation is successful, it will be able to determine the balance of water produced and billed. To manage a large area, it will be necessary to identify sub-areas where the water balance can also be determined. Such area will have consumer's consumption metered and the flows between sub-areas measured as well. This total inflow volume and consumption are recorded and the volume of unaccounted for water can thus be determined.

Performance data of all sub-areas will provide the required information on the performance of the MODS and at the same time will allow pin pointing any anomalies to be based on which and actions for rectification identified.

Normally, criteria to be considered during sectorization of water supply system into DMAs are:

- Geographic/demographic factors (e.g. urban or rural, industrial areas)
- Variation in ground elevation
- Water source (surface or ground) and water balance
- Size (number of properties)
- Hydraulic conditions (e.g. limitations of closing valves in the current network, and the need to maintain standards of service)

- Natural/hydraulic/manmade boundaries
- DMA – DMA interconnection points to be able to measure flows in both directions and to have pressure activated valves

5.3 Approach of DMA Demarcation in Study Area

In previous DWASA projects, DMA demarcation was finalized considering following criteria:

- Number of service connection between 1,000 to 2,000
- Hydraulic separation of the DMA
- At least one or more PTW within the DMA
- The groundwater extraction to meet the demand will take place within the DMAs

Most of the areas under the study currently have low population density. The road network is not fully developed in those areas. Moreover, some areas were found to have very low lying agricultural land. However, signboard of different real estate developers indicates that there will be rapid urbanization in those areas.

As most of the areas under study are underdeveloped so standard criteria (and also the practiced criteria in previous DWASA projects) for DMA demarcation is not applicable. The only basis for DMA demarcation could be Detailed Area Plan (DAP) for Dhaka city developed by RAJUK. But in DAP, alignment of only primary roads is available which could be considered as DMA boundaries. As the information of secondary and tertiary roads are not available so the alignment of future water distribution network cannot be finalized.

The areas under different housing development authorities may require water supply networks on priority basis. For instance, most of the areas under Bhatara, Dumni and Beraid unions have been land filled by different real estate developers like Bashundhara Group, Amin Mohammad Group, Eastern Housing, Swadesh Properties and many more. It is expected that, there will be a surge of population into these areas within next 5-10 years. Along with expansion of present development incentives such as road, drainage, water, electricity and telephone facilities will further facilitate growth. During DMA demarcation, these issues have also been considered. However, finalization of DMA boundaries in those areas will be done after discussion with private real estate developers about their future development plan.

5.4 DMAs in Study Area

Based on recent survey, discussion with stakeholders and DAP prepared by RAJUK, 42 nos. of DMA have been considered for implementation. Besides these DMAs, some areas with moderate population settlements have been considered for short term water supply. These areas

have been termed as Small Scale DMA and named according to the locality names. Map 3 showing DMAs and Small Scale DMAs considered for water supply system development. A brief summary of DMAs and localities (Small Scale DMAs) is provided in Table 21.

Table 21: Short Description of DMAs and Localities Considered for Water Supply

DMA ID	Description
DMA 120	<p>DMA 120 is located in eastern side of Manda Khal under Manda and Matuail unions. It is locally known as Green Model Town area and the area is developed by Amin Mohammad group. Its area is 1.02 sq. Km. As the area is newly developed, currently there is very low population settlement. There is an existing PTW inside this DMA which is supplying water to current inhabitants.</p> <p>Water demand for this DMA is estimated as 49 l/s and 125 l/s for the years 2025 and 2040 respectively. The existing PTW is sufficient to meet the present water demand. However, with population settlements the demand will rise higher and there will be requirement of additional water supply sources. According to Dhaka water Supply Master Plan (DWSMP), this area will be served from Saidabad SWTP (Phase III) which will be implemented by 2021. After implementation of the SWTP, surface water will be the primary source for water supply. However, to meet uncertainties one additional PTW is proposed for that area.</p> <p>From the existing and proposed road network it is found that, total length of distribution pipelines could be around 20 km.</p>
DMA 411	<p>DMA 411 is under MODS Zone 4 of DWASA. Its location is in the lower portion of Harirampur union under Pallabi Thana. It is surrounded by Rupnagar Khal in north and east, Botanical garden in south and the Beribadh road in west. The area of the DMA is 0.73 sq. Km. and major portion of the DMA is residential area developed by Eastern Housing Ltd.</p> <p>At present, there is existing water supply network with three PTWs as supply source. The calculated water demand of the DMA is 71 l/s for the year 2025 and for 2040 it is 97 l/s. Present water production from the existing PTWs is adequate to meet present water demand but might not be sufficient to meet the future water demand. However, there will be transmission line available from Singair Phase II which will be the primary source of water supply in the DMA.</p> <p>The existing distribution network consists of uPVC pipes which are not very old. So, rehabilitation of the existing network is not necessary. However, new pipelines needs to be proposed in addition to the existing network for full area coverage and for future demand fulfillment from the transmission line. Total length of distribution pipelines will be around 17 km.</p>
DMA 412	<p>DMA 411 is under MODS Zone 4 of DWASA. Its location is in the lower portion of Harirampur Union under Pallabi Thana. It is surrounded by Rupnagar khal in the south, Goranchahtbari retention pond on the north west, Mirpur Cantonment in the east. The area of the DMA is 0.92 square km. and major portion of the DMA is residential area developed by Eastern Housing Ltd. A small portion of local community (Alubdi village) is available there which occupies 11% of the total DMA area. At present, there is existing water supply network with two PTWs as supply source. The calculated water demand of the DMA is 104 l/s for the year 2025 and for 2040 it is 128 l/s. Present water production from the existing PTWs is adequate to meet present water demand but might not be sufficient to meet the future water demand. However, there will be transmission line available from Singair Phase II which will be the primary source of water supply in the DMA. Moreover, one additional PTW is proposed for that area to meet uncertainties in demand.</p> <p>The existing distribution network consists of uPVC pipes which are not very old. So, rehabilitation of the existing network is not necessary. However, new pipelines have been proposed in addition to the existing network for full area coverage and for future demand fulfillment from the transmission line. Total length of distribution pipelines will be around 23 km.</p>

DMA ID	Description
DMA 708	DMA 708 is under MODS Zone 7 of DWASA. It covers Shyampur and Pagla area. It is surrounded by Dhaka Narayanganj rail track in east side, Buriganga river in West side, Dhaka- Mawa Highway in North side. The area of the DMA is 2.54 square km and the area is mainly industrial with few commercial activities. Water demand for this DMA is estimated as 181 l/s and 238 l/s for the years 2025 and 2040 respectively. There is existing water networks with five existing PTWs as water source. Though present water production from the existing PTWs is adequate to meet present water demand but might not be sufficient to meet the future water demand. However, there will be transmission line available from Old Dhaka-Narayanganj Highway (Padma Phase-II by 2030, DWSMP) which will be the primary source of water supply in the DMA. Total length of distribution pipelines will be around 40 km.
DMA 709	DMA 709 is under MODS Zone 7 of DWASA. It covers the area including Nama Shyampur and Mohammadbag. The DMA is Surrounded by khal, Al-Amin Jame Mosque Road and Shahid Mukti Joddha Mukter Hossain road in North side, Dhaka – Narayanganj Rail track in West side, Pagla khal which is connected with Buriganga at Pagla point East side Internal Road of Pagla Sewerage Treatment Plant in South Side. The area of the DMA is 1.33 square km and the area is mostly residential. Water demand for this DMA is estimated as 146 l/s and 193 l/s for the years 2025 and 2040 respectively. There is existing water networks with two existing PTWs as water source. Two PTWs are insufficient to meet present water demand. However, there will be transmission line available from Old Dhaka-Narayanganj Highway (Padma Phase-II by 2030, DWSMP) which will be the primary source of water supply in the DMA. Total length of distribution pipelines will be around 28 km.
DMA 710	DMA 710 is under MODS Zone 7 of DWASA. This DMA includes Pagla Sewerage Treatment Plant and Rasulpur area. The area is surrounded by Dhaka – Narayanganj Rail track in West side Pagla khal which is connected with Buriganga at Pagla point in East side. The area of the DMA is 1.49 square km. Nearly half of the DMA area is occupied by Pagla STP. Other parts of the DMA consist of agricultural and residential area. Water demand for this DMA is estimated as 62 l/s and 98 l/s for the years 2025 and 2040 respectively. There is existing water networks with only one existing PTW as water source. One PTW is insufficient to meet the present demand of the DMA. However, a new PTW construction is ongoing in Pagla STP area. Moreover, there will be transmission line available from Old Dhaka-Narayanganj Highway (Padma Phase-II by 2030, DWSMP) which will be the primary source of water supply in the DMA. Total length of distribution pipelines will be around 19 km.
DMA 711	DMA 711 is under MODS Zone 7 of DWASA which covers Janatabag and Rayerbag area. The area is surrounded by Rayerbagh-Jurain Road North side, Zia Sarani Road in West side, Rayerbag Road in East side, Sahid Mukti Joddha Mukter Hossain road in South side. The area of the DMA is 0.73 square km and it is mostly residential area. Water demand for this DMA is estimated as 115 l/s and 127 l/s for the years 2025 and 2040 respectively. There is existing water networks with two existing PTWs as water source. However, there will be transmission line available from Zia Saroni Road (Saidabad Phase-III by 2021, DWSMP) which will be the primary source of water supply in the DMA. Total length of distribution pipelines will be around 25 km.
DMA 712	DMA 712 is under MODS Zone 7 of DWASA which covers Merajnagar and South Matuail area. The area is surrounded by Dhaka-Chattagram Highway in North side, Rayerbag Road in West side, Medical Road in East side, Pagla Khal in South side. The area of the DMA is 0.84 square km and it is mostly residential area. Water demand for this DMA is estimated as 80 l/s and 107 l/s for the years 2025 and 2040 respectively. There is existing water networks with three existing PTWs as water source. Three PTWs is sufficient to meet present demand but will be insufficient in future. However, there will be transmission line available from Khanka Road (Saidabad Phase-III by 2021, DWSMP) which will be the primary source of water supply in the DMA. Total length of distribution pipelines will be around 16 km.

DMA ID	Description
DMA 713	DMA 713 is under MODS Zone 7 of DWASA which covers Munshibag and Nischintapur area. The area is surrounded by Pagla Khal in North West side, Medical Road in East side, Pagla-Bhuigar Road in South side. The area of the DMA is 1.49 square km. The DMA is mainly Low-lying area with Residential use. Water demand for this DMA is estimated as 108 l/s and 175 l/s for the years 2025 and 2040 respectively. There is existing water networks with only one existing PTW as water source. One PTW is insufficient to meet the present demand of the DMA. However, there will be transmission line available along Medical Road (Saidabad Phase-III by 2021, DWSMP) and Pagla Bhuigar Road (Padma Phase-II by 2030, DWSMP) which will be the primary sources of water supply in the DMA. Total length of distribution pipelines will be around 26 km.
DMA 714	DMA 714 under MODS Zone 7 of DWASA which covers Partialy Bhuigar and Tanin Kunja area. The area is surrounded by Meraj Masjid Road and Gias Uddin Square in the North side, Dhaka-Narayanganj Highway in East side, Wayesh Karoni (Adarsha) Nagar in West side and Pagla-Bhuigar Road in South Side. The area of the DMA is 1.29 square km. The DMA is low-lying area and mostly Residential. There is indication of land development by real estate housing companies. Water demand for this DMA is estimated as 89 l/s and 149 l/s for the years 2025 and 2040 respectively. There is existing water networks with two existing PTWs as water source. However, there will be transmission line available from Dhaka Narayanganj Highway (Saidabad Phase-III by 2021, DWSMP) and Pagla Bhuigar Road (Padma Phase-II by 2030, DWSMP) which will be the primary sources of water supply in the DMA. Total length of distribution pipelines will be around 24 km.
DMA 715	DMA 715 is under MODS Zone 7 of DWASA which covers Saddam market and Tushardhara area. The area is surrounded by Dhaka-Chattagram Highway in North side, Dhaka-Narayanganj Highway in East side, Medical Road in West side, Meraj Masjid Road in South Side. The area of the DMA is 1.31 square km. The western part of the DMA is relatively low lying area. Existing land use pattern is mainly governed by residential area. Water demand for this DMA is estimated as 100 l/s and 151 l/s for the years 2025 and 2040 respectively. There is existing water networks with only one existing PTW as water source. One PTW is insufficient to meet the present demand of the DMA. However, there will be transmission line available from Dhaka Narayanganj Highway and Medical road (Saidabad Phase-III by 2021, DWSMP) which will be the primary source of water supply in the DMA. Total length of distribution pipelines will be around 27 km.
DMA 716	DMA 716 is under MODS Zone 7 of DWASA which covers the part of Matuail and north Rayerbag area. The DMA is surrounded by Dhaka-Chattagram Highway in South, Matuail College Road in East and Matuail Koborstan Road in North West. The area of the DMA is 0.75 square Km which is mainly residential area with high population density. Water demand for this DMA is estimated as 72 l/s and 93 l/s for the years 2025 and 2040 respectively. There is existing water networks with two existing PTWs as water source. There will be transmission line available along Dhaka Chattagram Highway (Saidabad Phase-III by 2021, DWSMP) which will be the primary source of water supply in the DMA. Total length of distribution pipelines will be around 18 km.
DMA 717	DMA 717 is under MODS Zone 7 of DWASA. It is within the Matuail area. The DMA is surrounded by Matuail School Road in north Side, Matuail Dakshinpara Road in west side, Momenbag Chowrasta Road in East side and Nimtola College Road in South side. The DMA is mainly residential area with high population density. The area of the DMA is 0.85 square Km. Water demand for this DMA is estimated as 74 l/s and 101 l/s for the years 2025 and 2040 respectively. There is existing water networks with two existing PTWs as water source. There will be transmission line available along Momenbag Chaurasta road (Saidabad Phase-III by 2021, DWSMP) which will be the primary source of water supply in the DMA. Total length of distribution pipelines will be around 23 km.
DMA 718	DMA 718 is under MODS Zone 7 of DWASA which covers mainly North Sonirakhra, Mridhabari, and west Matuail area. DND Khal is situated along the southern boundary of the DMA. This DMA is surrounded by Dhaka-Demra Highway in north Side, Matuail

DMA ID	Description
	Koborasthan Road in east side, Sonirakhra-Mridhabari Road in west side and Muktijoddha Rafiqul Islam Road in south Side. The area of the DMA is 0.69 square km. The area is mainly governed residential area with high population density. Water demand for this DMA is estimated as 84 l/s and 97 l/s for the years 2025 and 2040 respectively. There is existing water networks with two existing PTWs as water source. Present production from these PTWs is not sufficient to meet the present demand. However, there will be transmission line available along Sonirakhra-Mridhabari Road (Saidabad Phase-III by 2021, DWSMP) which will be the primary source of water supply in the DMA. Total length of distribution pipelines will be around 18 km.
DMA 719	DMA 719 is under MODS Zone 7 of DWASA covers mainly covers Konapara and partially Momenbag area. DND Khal is flowing along the northern boundary of the DMA. The DMA is surrounded by Dhaka-Demra Highway in north Side, Matuail school Road in south side, Momenbag Chowrasta Road in east side, Matuail Koborasthan Road in west side. The area of the DMA is 0.85 square km. The area is Mainly residential area with high population density. Water demand for this DMA is estimated as 71 l/s and 97 l/s for the years 2025 and 2040 respectively. There is existing water networks with two existing PTWs as water source. There will be transmission line available from Dhaka Demra Highway (Saidabad Phase-III by 2021, DWSMP) which will be the primary source of water supply in the DMA. Total length of distribution pipelines will be around 20 km.
DMA 720	DMA 720 is under MODS Zone 7 of DWASA mainly covers Konapara area. The DMA is surrounded by Dhaka-Demra Highway in north side, Borobhangha-Dogair-Konapara Road in south side, Basher Pool- Dogair Bazar Road in east side, Momenbag Chowrasta Road in west side. The area of the DMA is 0.63 square km. The DMA is mainly residential area with high population density. Water demand for this DMA is estimated as 53 l/s and 72 l/s for the years 2025 and 2040 respectively. There is existing water networks with only one existing PTW as water source. One PTW is insufficient to meet the present demand of the DMA. However, a new transmission line will be available along Dhaka Demra Highway (Saidabad Phase-III by 2021, DWSMP) which will be the primary source of water supply in the DMA. Total length of distribution pipelines will be around 17 km.
DMA 721	DMA 721 is under MODS Zone 7 of DWASA covers mainly Dogair and Hijoltola area. The area is surrounded by Farmer Mor-Dogair –Borobhangha Road in north side, Momenbag Chowrasta Road in west Side, Matuail-Dogair Dakshin Para-Sanarpara Road in south side and First World Road in east side. The area of the DMA is 1.26 square km. The DMA is mainly residential area with moderate population density. Water demand for this DMA is estimated as 113 l/s and 155 l/s for the years 2025 and 2040 respectively. Currently, the DMA has partial coverage with DWASA water supply network. There is no existing PTW within the DMA boundary. However, a new transmission line will be available along Proposed DAP road (Saidabad Phase-III by 2021, DWSMP) which will be the primary source of water supply in the DMA. Moreover, to supplement the surface water and to meet present water demand 3 PTWs have been proposed. Total length of distribution pipelines will be around 25 km.
DMA 722	DMA 722 is under MODS Zone 7 of DWASA covers mainly Muslim Nagar and Matuail Shohor Palli R/A. The DMA is surrounded by Matuail-Dogair Dakshin Para-Sanarpara Road in north side, Dhaka-Chattagram Highway in south side, Shaheed Milon Road in east side and Matuail College Road in west side. With an area of 1.38 square Km the DMA is mainly a residential area. A major portion of the area is low lying land. Water demand for this DMA is estimated as 115 l/s and 156 l/s for the years 2025 and 2040 respectively. The DMA has partial water supply network coverage by DWASA with only one PTW as water source. However, there will be surface water transmission line available along proposed DAP road (Saidabad Phase-III by 2021, DWSMP) which will be the primary source of water supply in the DMA. Moreover, to supplement the surface water and to meet present water demand 2 PTWs have been proposed. Total length of distribution pipelines will be around 24 km.

DMA ID	Description
DMA 723	DMA 723 is under MODS Zone 7 of DWASA covers mainly Shanarpar and Mouchak area. The area is surrounded by Dogair Dakshin Para-Shanarpar -Madaninagar Road in north and east side, Dhaka-Chattagram Highway in south side and Shaheed Milon Road in west side. With an area of 1.25 sq. km the DMA is mainly residential area. Around 50% of the area of the DMA is currently low lying land. Water demand for this DMA is estimated as 103 l/s and 151 l/s for the years 2025 and 2040 respectively. Currently, there is no existing water supply coverage from DWASA. So, people in this area use personal submersible pump to extract water from groundwater aquifer. However, there will be surface water transmission line available along Dhaka-Chattagram Highway and Madani Nagar Madrassa Road (Saidabad Phase-III by 2021, DWSMP) which will be the primary source of water supply in the DMA. To supplement the surface water and to meet present water demand 2 PTWs have been proposed. Total length of distribution pipelines will be around 22 km.
DMA 724	DMA 724 is under MODS Zone 7 of DWASA covers mainly Shanarpar, Bahir Tengra area. The DMA is surrounded by Borobhangha-Ranimahal Road in North side, Dogair Dakshin Para-Shanarpar - Madaninagar Road in south side, Hazi Rahamatulla School Road in east side and First World Road in west side. With an area of 1.17 sq. km the DMA is mainly residential area with moderate population density. Water demand for this DMA is estimated as 106 l/s and 146 l/s for the years 2025 and 2040 respectively. Currently, there is no existing water supply coverage from DWASA. So, people in this area use personal submersible pump to extract water from groundwater aquifer. However, there will be surface water transmission line available along Madani Nagar Madrassa Road (Saidabad Phase-III by 2021, DWSMP) which will be the primary source of water supply in the DMA. To supplement the surface water and to meet present water demand 2 PTWs have been proposed. Total length of distribution pipelines will be around 32 km.
DMA 725	DMA 725 is under MODS Zone 7 of DWASA covers mainly Basherpul, Ahmed Nagar area. The area is surrounded by Dhaka-Demra Highway in north side, Dogair Bazar- Boro Bhanga Road in south side, Dalia Bamoli-Boro Bhanga Road in east side and Basher Pul–Dogair Bazar Road in west side. With an area of 0.82 sq. km the DMA is mainly residential area with moderate population density. Water demand for this DMA is estimated as 66 l/s and 92 l/s for the years 2025 and 2040 respectively. Currently, the DMA has partial coverage with DWASA water supply network. There is only one PTW naming at Basherpul. No surface water transmission line is available at present. However, there will be surface water transmission line available along Proposed DAP road (Saidabad Phase-III by 2021, DWSMP) which will be the primary source of water supply in the DMA. Total length of distribution pipelines will be around 20 km.
DMA 726	DMA 726 is under MODS Zone 7 of DWASA covers mainly Bamoil, Borobhanga and partly Sarulia area. The area is surrounded by Dhaka-Demra Highway in north side, Dogair Bazar- Boro Bangha-Rani Mohal Road in south side, DND Khal in east side and Dalia Bamoli-Borobhanga Road in west side. With an area of 1.06 sq. km the DMA is mainly residential area with moderate population density. Water demand for this DMA is estimated as 88 l/s and 126 l/s for the years 2025 and 2040 respectively. Currently, there is no existing water supply coverage from DWASA. So, people in this area use personal submersible pump to extract water from groundwater aquifer. However, there will be transmission line available along Staff Quarter- Boro Bhanga Road (Saidabad Phase-III by 2021, DWSMP) which will be the primary source of water supply in the DMA. Moreover, to supplement the surface water and to meet present water demand 2 PTWs have been proposed. Total length of distribution pipelines will be around 30 km.
DMA 727	DMA 727 is under MODS Zone 7 of DWASA covers mainly Sarulia, Boxnagar, Nurbag and Shanarpar area. The DMA is surrounded by Ranimohol-Borobhanga Road in north side, Madani Nagar Madrassa Road and Dhaka-Chattagram Highway in south side, DND Khal in east side, Haji Rahmatullah School Road, Shanarpar Rowshan Ara College road in West Side. With an area of 1.62 sq. km this DMA is mainly residential area with moderate population density. Water demand for this DMA is estimated as 146 l/s and 206 l/s for the

DMA ID	Description
	years 2025 and 2040 respectively. Currently, there is no existing water supply coverage from DWASA. So, people in this area use personal submersible pump to extract water from groundwater aquifer. However, there will be surface water transmission line available along Demra-Chattagram road and Madani Nagar Madrassa road (Saidabad Phase-III by 2021, DWSMP) which will be the primary source of water supply in the DMA. Moreover, to supplement the surface water and to meet present water demand 3 PTWs have been proposed. Total length of distribution pipelines will be around 40 km.
DMA 728	DMA 728 is under MODS Zone 7 of DWASA covers mainly Shimrail, Ranimahal and Sarulia area. This DMA is isolated from other DMAs by DND Khal. The Shitalakhya river is flowing along the eastern boundary of the DMA. The DMA is surrounded by Dhaka-Demra Highway in north side, Dhaka-Chattagram Highway in south side. Area of the DMA is 2.08 sq. Km. The DMA is mostly Industrial area having residential settlement with moderate population density. Water demand for this DMA is estimated as 113 l/s and 161 l/s for the years 2025 and 2040 respectively. Currently, there is no existing water supply coverage from DWASA. So, people in this area use personal submersible pump to extract water from groundwater aquifer. However, there will be transmission line available along Dhaka-Chattagram Highway (Saidabad Phase-III by 2021, DWSMP), DWSMP) which will be the primary source of water supply in the DMA. Moreover, to supplement the surface water and to meet present water demand 2 PTWs have been proposed. Total length of distribution pipelines will be around 17 km.
DMA 729	DMA 729 is under MODS Zone 7 of DWASA partially covers Pagla, Shahi Bazar and Delpara Area. The area is surrounded by Pagla-Bhuigar Road in north side, Pagla Link Road in south side, Pagla Khal in west side and Delpara-Bhuigar Road in east side. With an area of 1.04 sq. km this DMA is mainly residential area with moderate population density. Water demand for this DMA is estimated as 72 l/s and 120 l/s for the years 2025 and 2040 respectively. The DMA has partial water supply coverage by DWASA network. There is no existing PTW within this DMA but some portion of this area is getting water from PTWs in adjacent DMAs. No surface water transmission line is available at present but soon will be available from Proposed DAP Proposed Road (Padma Phase-II by 2030, DWSMP). Moreover, to supplement the surface water and to meet present water demand 2 PTWs have been proposed. Total length of distribution pipelines will be around 28 km.
DMA 730	DMA 730 is under MODS Zone 7 of DWASA partially covers Bhuigar and Delpara Sarderbari area. The DMA is surrounded by Hazi Pande Ali Road in north side, Pagla Link Road in south side, Delpara-Bhuigar Road in west side and Dhaka Narayanganj Highway in east side. With an area of 1.01 sq. km this DMA is mostly residential area with moderate population density. Water demand for this DMA is estimated as 70 l/s and 117 l/s for the years 2025 and 2040 respectively. The DMA has partial water supply coverage by DWASA network. There is no existing PTW within this DMA but some portion of this area is getting water from PTWs in adjacent DMAs. No surface water transmission line is available at present but soon will be available from Proposed DAP Proposed Road (Padma Phase-II by 2030, DWSMP). Moreover, to supplement the surface water and to meet present water demand 1 PTW has been proposed. Total length of distribution pipelines will be around 22 km.
DMA 806 (Extension)	DMA 806 is newly developed residential area in Badda Union under MODS Zone 8 of DWASA. The DMA area is 2.80 sq. Km. The area is locally known as Jahrul Haque City (Aftabnagar) which is developed by Eastern Housing Ltd. Major portion of the area has newly developed water supply system under DWSSDP of DWASA. Around 40 km distribution pipelines have been installed in 2015. At present, there are two existing PTW in this area. Currently, groundwater is the only source of water supply. However, there will be transmission line available from Garndhabpur Phase II which will be the primary source of water supply in the DMA. Recently, the area of Jahurul Haque city has been extended further towards east. Moreover, some new roads and buildings have been constructed within the previously developed land.

DMA ID	Description
	<p>So extension of pipeline is required to provide water supply to the full area. The extended area is 0.63 sq. Km which makes total area of the DMA is around 3.43 sq. Km. The extended area will be supplemented with new pipeline keeping consistency with the previously laid pipelines.</p> <p>Estimated water demand for the extended area is 83 l/s for the design year 2040. There is no surface water transmission line available at present. However, there will be transmission line available from Garndhabpur Phase II which will be the primary source of water supply in the DMA. So, groundwater to be considered as the only source of water supply until Char Ghandharbapur Phase II is implemented. Considering demand supply gap there will be requirement of installation of three additional PTWs to meet the water demand. Length of extended road network with requirement of new pipelines is around 40 Km.</p>
DMA 812	<p>DMA 812 is newly developed residential area in Dumni Union under MODS Zone 8 of DWASA. Its location is in the south of Purbachal express way (300 feet road). It includes the newly developed area of Block H, J and K of Bashundhara R/A. Area of the DMA is 1.00 sq. Km.</p> <p>At present, there is low population settlement but construction of new buildings is taking place with a rapid pace. This DMA doesn't have any water distribution network. Estimated water demands of DMA 812 are 52 l/s and 132 l/s for the years 2025 and 2040 respectively. There will be transmission line available from Garndhabpur Phase II which will be the primary source of water supply in the DMA. However, to meet demands until surface water is available, two PTWs will require to be installed. From road network it can be initially said that the length of distribution pipelines will be around 20 km.</p>
DMA 813	<p>DMA 813 is newly developed residential area in Dumni Union under MODS Zone 8 of DWASA. Its location is in the south of Purbachal express way (300 feet road). It includes the newly developed area of Block J and K of Bashundhara R/A. Area of the DMA is 1.00 sq. Km.</p> <p>At present, there is very low population settlement but construction of new buildings is taking place with a rapid pace. This DMA doesn't have any water distribution network. Estimated water demands of DMA 813 are 48 l/s and 132 l/s for the years 2025 and 2040 respectively. There will be transmission line available from Garndhabpur Phase II which will be the primary source of water supply in the DMA. However, to meet demands until surface water is available, two PTWs will require to be installed. From road network it can be initially said that the length of distribution pipelines will be around 21 km.</p>
DMA 814	<p>DMA 814 is newly developed residential area in Dumni Union under MODS Zone 8 of DWASA. Its location is in the south of DMA 812. It includes the newly developed area of Block I, J and K of Bashundhara R/A. Area of the DMA is 0.80 sq. Km.</p> <p>At present, there is low population settlement but construction of new buildings is taking place with a rapid pace. This DMA doesn't have any water distribution network. Estimated water demands of DMA 814 are 49 l/s and 106 l/s for the years 2025 and 2040 respectively. There will be transmission line available from Garndhabpur Phase II which will be the primary source of water supply in the DMA. However, to meet demands until surface water is available, two PTWs will require to be installed. From road network it can be initially said that the length of distribution pipelines will be around 20 km.</p>
DMA 815	<p>DMA 814 is newly developed residential area in Dumni Union under MODS Zone 8 of DWASA. Its location is in the south of DMA 813. It includes the newly developed area of Block L and M of Bashundhara R/A. Area of the DMA is 1.05 sq. Km.</p> <p>At present, there is very low population settlement but construction of new buildings is taking place with a rapid pace. This DMA doesn't have any water distribution network. Estimated water demands of DMA 815 are 48 l/s and 139 l/s for the years 2025 and 2040 respectively. There will be transmission line available from Garndhabpur Phase II which will be the primary source of water supply in the DMA. However, to meet demands until surface water is available, two PTWs will require to be installed. From road network it can be initially said that the length of distribution pipelines will be around 20 km.</p>

DMA ID	Description
DMA 816	<p>DMA 816 is in Satarkul union under MODS Zone 8 of DWASA. This DMA is a newly developed area by United housing Ltd. It is bisected by the Madani Avenue (100 feet road). The area of the DMA is 1.44 sq. Km. and major portion of the DMA is residential area. Estimated water demands of DMA 816 are 52 l/s and 193 l/s for the years 2025 and 2040 respectively. There will be transmission line available from Garndhabpur Phase II which will be the primary source of water supply in the DMA. However, to meet demands until surface water is available, three PTWs will require to be installed. From road network it can be initially said that the length of distribution pipelines will be around 22 km..</p>
DMA 916	<p>This DMA is under the Zone 9 comprises with the area of Munda and Masterbari. Location of the DMA is in the Uttarkhan union in Uttara Thana surrounded by Tongi Khal in the north, Taltola Bhuiabari, Mainertek and Madarbari in south, Mausaid in east, and Chandbari in the west. The total area of the DMA is 1.80 square km. This DMA is occupied by only local community having unplanned road network.</p> <p>There is no existing water supply network in DMA 916. People in this area use submergible pump for fulfilling their daily water need. The calculated water demand of the DMA is 40 l/s for the year 2025 and for 2040 it is 152 l/s. There will be transmission line available from Gandharbpur Phase II which will be the primary water supply source in the DMA. To meet the water demand of the DMA until the transmission main is available for surface water supply, two PTWs have been proposed. Total length of the distribution pipeline will be around 19 Km.</p>
DMA 917	<p>This DMA is under the Zone 9 comprises with the area of Nowpara, Madarbari and Mainertek. Location of the DMA is in the Uttarkhan union in Uttara Thana surrounded by Masterbari in the north, Shah Kabir Mazar Road in south, Bashedbari and Koraihati in east, and Anurbag, Mollapara, Kazibari in the west. The total area of the DMA is 1.27 square km. This DMA is occupied by only local community having unplanned road network.</p> <p>There is no existing water supply network in DMA 917. People in this area use submergible pump for fulfilling their daily water need. The calculated water demand of the DMA is 28 l/s for the year 2025 and for 2040 it is 107 l/s.</p> <p>There will be transmission line available from Gandharbpur Phase II which will be the primary water supply source in the DMA. To meet the water demand of the DMA until the transmission main is available for surface water supply, one PTW has been proposed. Total length of the distribution pipeline will be around 18Km.</p>
DMA 918	<p>This DMA is under the Zone 9 comprises with the area of Nowpara and Madhyapara. Location of the DMA lies into the Uttarkhan and Dakshinkhan Union in Uttara Thana surrounded by Madarbari, Shah Kabir Majar Road in the north, Dobadia, Sonakhola in the south, Anurbag, Kazibari, Mollapara in the east, and Chamurkhan and Bearipari in the west. The total area of the DMA is 1.5 square Km. This DMA occupies community only with unplanned road network. The calculated water demand of the DMA is 44 l/s for the year 2025 and for 2040 it is 139 l/s.</p> <p>The DMA has partial water supply lines in south-western part. There are two DWASA installed PTWs which are current source of water supply. However, there will be transmission line available from Gandharbpur Phase II which will be the primary water supply source in the DMA. Total length of the distribution pipeline will be around 24 Km.</p>
DMA 919	<p>This DMA is under the Zone 9 comprises with the area of Sonakhola, Dobadia and Naddapara. Location of the DMA lies into the Uttarkhan and Dakshinkhan union in Uttara Thana surrounded by Nowpara, Anurbag, Chamurkhan, Madhyapara in the north, Asian City in the south, Pakija Road in the east, and Airport Dakkhinkhan Road, Anisubag and Amtola in the west. The total area of the DMA is 1.16 square Km. The calculated water demand of the DMA is 34 l/s for the year 2025 and for 2040 it is 108 l/s.</p> <p>The DMA has partial water supply lines in western part. There is only one existing PTW which are current source of water supply. However, there will be transmission line available from Gandharbpur Phase II which will be the primary water supply source in the DMA in future. Total length of the distribution pipeline will be around 14 Km.</p>

DMA ID	Description
DMA 920	<p>This DMA is under the Zone 9 in Dakshinkhan Union, Uttara Thana. This DMA comprises the Civil Aviation Authority of Bangladesh (CAAB) colony and major portion of newly developed Ashiyan City. The DMA is surrounded by Airport-Dakshinkhan Road in the north, Khilkhet in the south, Holan in the east, and Dhaka Maymansing Highway in the west. The total area of the DMA is 3.41 square Km. The calculated water demand of the DMA is 96 l/s for the year 2025 and for 2040 it is 336 l/s.</p> <p>The DMA has existing water supply network with three PTWs as water supply source. There will be transmission line available from Gandharbpur Phase II which will be the primary water supply source in the DMA in future.</p>
DMA 1018	<p>DMA 1018 is under MODS Zone 10 of DWASA. Its location is in the southern boundary of Harirampur Union. This DMA consists of Mirpur DOHS area in the north, Mirpur Ceramic Industry in the south and western part, PWD staff Quarters in the southeastern part and some other low lying area. It is surrounded by Uttara Residential Model town in the north, Mirpur Ceramic Road in the south, Dhaka Cantonment in the west and Shagufta Housing and Baunia in the east.</p> <p>Mirpur DOHS area has newly developed water supply system with five existing PTWs. Area of Mirpur DOHS is 0.67 square km and currently there is no deficit of water. The remaining area of the DMA is 0.78 square Km and a major portion is currently occupied by Mirpur ceramic industry. There is one existing PTW in south eastern side of the DMA which is currently supplying water Duip Nagar area (DMA 1010).</p> <p>Estimated water demand of the DMA is 84 l/s for the year 2025 and for 2040 it is 142 l/s. The portion of Mirpur DOHS has around 17 Km water lines of uPVC pipe. As the network is recently developed so, no replacement of pipelines is required. The Other portion of the DMA is not connected with Mirpur DOHS water network. So, new pipelines is required in those area.</p> <p>At present groundwater from existing PTWs is the only source of water supply in the DMA. However, there will be transmission line available from Singair Phase I which will be the primary water supply source in near future. Length of the distribution pipeline required for the area which is not connected with Mirpur DOHS will be around 4 Km.</p>
DMA 1019	<p>DMA 1019 is under MODS Zone 10 of DWASA. Its location is in the south-western part of Harirampur union boundary. This DMA consists of newly developed Shagufta Housing area, Bihari Camp and other low lying areas in the south eastern part. It is surrounded by Bawnia in the north eastern side Mirpur DOHS in the north western side, Bauniabadh slum (DMA 1009) in the south, Dhaka Cantonment in the east and Duip Nagar (DMA 1010) in the west. Total area of the DMA is 0.95 square Km out of which 0.5 square Km is Shagufta Housing area. The south western portion of the DMA consists a low income community named Bihari Camp and in the east of the Bihari camp there is low lying area.</p> <p>Sagufta housing area has partial coverage of DWASA water supply from an existing PTW. In the Bihari camp area there are two submersible pumps installed by Bangladesh Army with the help from NGOs. There is no water network inside Bihari Camp area and people collects their daily water from the tube well premise.</p> <p>Estimated water demand of the DMA is 63 l/s for the year 2025 and for 2040 it is 104 l/s. There will be transmission line available from Singair Phase II which will be the primary water supply source in the DMA. However, one additional PTW will be required to meet water demand until Singair Phase II is available. Total length of the distribution pipeline will be around 12 Km.</p>
DMA 1020	<p>DMA 1020 is under MODS Zone 10 of DWASA. Its location is in the western side of Hazrat Shah Jalal international airport under Harirampur union. This DMA comprises with the area of Bawnia and portion of Uttara sector 17. It is surrounded by Uttara Residential Model town and Priyanka City in the north, Shagufta Housing and Dhaka Cantonment in the south. The total area of the DMA is 3.43 square km.</p> <p>The northern portion of the DMA is currently served from adjacent areas (i.e. from Ahalia) where there is existing DWASA water network. The rest Portion of the DMA doesn't have</p>

DMA ID	Description
	<p>any planned water supply system and people fulfill their water needs from production of personal submergible pumps.</p> <p>A significant portion of the DMA is currently low lying land. However, land development is ongoing and the area is expected to be populated in near future. The calculated water demand of the DMA is 169 l/s for the year 2025 and for 2040 it is 463 l/s. There will be transmission line available from Gandharbpur Phase I which will be the primary water supply source in the DMA. However, to meet current demand and to supplement the future demand four nos. of PTW will be required. Length of the distribution pipeline will be around 25 km.</p>
DMA 1021	<p>DMA 1021 is under MODS Zone 10 of DWASA. Its location is in the northern portion of Harirampur Union. This DMA comprises with the area of Noyanagar and Dhour. It is surrounded by Shonarga Jonopod Road in north, Uttora 3rd Phase in south and south-west, and Mirpur Road in the west and Noyanagar road, Ranavola, Bamnertek, Phulbaria in the east. The total area of the DMA is 2.54 square km.</p> <p>A significant portion of the DMA is currently low lying land. However, land development is ongoing and the area is expected to be populated in near future. The calculated water demand of the DMA is 179 l/s for the year 2025 and for 2040 it is 387 l/s.</p> <p>Currently, this DMA is doesn't have any planned water supply system and people fulfill their water needs from production of personal submergible pumps. There will be transmission line available from Singairr Phase II and Gandharbpur Phase I which will be the primary water supply source in the DMA. However, to meet current demand and to supplement the future demand three nos. of PTW will be required. Length of the distribution pipeline will be around 22 km.</p>
DMA 1022	<p>This DMA comprises with the Uttaron Housing and Dhour area under MODS Zone 10. Location of the DMA is in the northern portion of Harirampur union under Uttara thana. The total area of the DMA is 1.15 square km in which Uttaron housing comprises 0.40 square km and the rest area is locality. This DMA is surrounded by Mirpur highway road in the west and Abdullahpur highway road in the north, Rajbari in east and Noanogor in the south. Turag river is flowing along the northern and eastern boundary of the DMA.</p> <p>At present the area is not moderately dense. There is no population settlement in the newly developed Uttaron Housing area. However, it is expected to have population growth in near future. The calculated water demand of the DMA is 77 l/s for the year 2025 and for 2040 it is 179 l/s.</p> <p>Currently, this DMA is doesn't have any existing water supply network. Inhabitants fulfill their water demand from production of personal submergible pumps. However, there will be transmission line available from Singair Phase II and/or Gandharbpur Phase I which will be the primary water supply source in the DMA. To meet the current demand and to supplement future demand two nos. of PTW will be required. Length of the distribution pipeline will be around 17 Km.</p>

5.5 Other Areas Considered for Immediate Implementation

Most of the areas under study are currently underdeveloped and road network in those areas is not well defined. Some areas have been found to have moderate population settlements but DMA implementation will not be possible because of undefined road networks, unplanned settlements. Moreover, major portion of these area is currently low lying agricultural land. These areas have been termed as 'Scattered Localities' in the report. Water supply system development in localities has been considered for intermediate purpose (up to year 2030) only.

DMA will be implemented once there is more population settlement with defined road network. For design purpose of water distribution networks, only major (or primary) roads have been considered for pipe laying. House connections will be provided from the distribution pipelines upon application from customers.

Table 22 provides a summary of locality areas (Small Scale DMAs) to be considered for immediate implementation. For better illustration please refer Map 3.

Table 22: Scattered Localities (Small Scale DMAs) Considered for Immediate Water Supply System Development

Locality	Description
Small Scale DMA 101 (Amulia-Demra)	Amulia is under Demra Union. Its location is in the north of Dhaka Demra Highway and in the western side of Demra Staff quarter Road. This area contains Amulia Model Town where there is recent land development done by Amin Mohammad group. Currently there is no population settlement in the Amulia Model town area but there are some scattered population settlement around the model town area. People living in this locality currently dependent on private submersible pumps for daily water needs. Moreover, there are some community PTWs found during the reconnaissance. The estimated demand for this localities along with Amulia Model Town area is 80 l/s for the year 2030. Total length of water distribution lines will be around 18 Km out of which around 9 Km will be in Amulia Model town Area.
Small Scale DMA 102 (Demra)	Population settlement had been observed in the along the Dhaka Demra Highway (north side of DND canal). There are also some small real estate developed projects like Concord housing. Extension of the area is from Mridha Bari Bus stop in west to Staff Quarter bus stop in east. There is one existing PTW which is supplying water to the southern part of DND canal (MODS Zone 7 of DWASA). Calculated water demand for this area is 40 l/s for 2030. As the area is not fully developed so pipeline along the major road will be considered in hydraulic design. Total length of pipelines will be around 14 Km.
Small Scale DMA 103 (Staff Quarter-Demra)	This area consists of Demra staff quarter, Demra Bazar and Naraibag area. Balu River is flowing along the eastern boundary of this locality. Water in the staff quarter area is currently served from two PTWs installed by the Jute mill authority. Whereas, the Naraibag and Demra Bazar area is supplied with water from locally installed community PTWs. Estimated water demand for this locality is 37 l/s and the length of distribution pipelines will be around 22 Km.
Small Scale DMA 104 (Manda)	This locality is along the eastern side of the Manda Khal and southern side of Norai Khal. The areas includes in this locality are Gauranagar, Nagdarpar, Shekher Jaiga and Manikdia of Khilgaon Thana. The road network in this locality is undeveloped. People depends on community submersible pumps for daily water needs. Calculated water demand for this locality is 64 l/s for the year 2030. Total length of distribution pipelines will be around 13 Km.
Small Scale DMA 801 (Satarkul)	This area mainly consists of Satarkul Bazar area along with the surrounding area of Satarkul union. Satarkul Khal is flowing along the western boundary of the locality. Estimated water demand for this locality is 10 l/s for 2030. The length of distribution pipelines will be around 4 Km.
Small Scale DMA 802 (Beraid)	Beraid locality is situated in the southern side of Madani Avenue and western side of Balu River. Currently people in this area depend on private pumps for water supply. Estimated water demand for this locality is 13 l/s for the year 2030. The length of distribution pipelines will be around 5 Km.

Locality	Description
Small Scale DMA 803 (Dumni)	Dumni locality is situated in the southern side of Purbachal express way and western side of Balu River. Currently people in this area depend on private pumps for water supply. Estimated water demand for this locality is 28 l/s for the year 2030. The length of distribution pipelines will be around 13 Km.
Small Scale DMA 901 (Barua-Dakshinkhan)	Barua locality is under Dakshinkhan union. Population settlements in this locality is mainly in the both side of Holan-Naddapara-Barua road and other secondary roads. Ashiyan City is being developed in Naddapara area. Most of the areas in this locality is low lying land. Estimated water demand for the year 2030 is 88 l/s. The length of distribution pipelines will be around 14 Km
Small Scale DMA 902 (Uttarkhan)	Small portion of Uttarkhan Union (north western part) has existing water supply network developed by DWASA. There is moderate population settlements in those area. Water supply system development in those developed portion has been considered to be implemented by DMA concept. But, major portion of Uttarkhan is currently undeveloped and there are some scattered population settlements where DMA implementation is not possible. So, these scattered localities are considered to have a combined water supply system. Localities considered under this system are Mausaid, Mainertek, Uttarkhan, Poradia, Kanckura, Chamurkhan and Bhatira. Currently people in this area depend on private pumps for water supply. Estimated water demand for this locality is 282 l/s for the year 2030. The length of distribution pipelines will be around 58 Km.

5.6 Strategic Plan for Water supply System Development in the Study Area

In Dhaka Water Supply Master Plan (DWSMP) report, it has been planned that the commanding area of DWASA under DNCC and DSCC will be covered by the year 2035. Planning for water supply coverage within Dhaka City Corporation has been categorized into the short-term plan and the medium-term plan. Moreover, areas outside Dhaka City Corporation have been considered for the Long term plan. As the current study area is within the city corporation area therefore, the water supply strategy for the study area has been developed keeping consistent with the short-term and medium-term plan of water supply master plan. Map 4 illustrates the areas under short-term and medium-term plan.

5.6.1 Short-term Plan

Areas to be covered with water supply network by the year 2025 are considered in short-term plan. Areas under short-term plan comprises of the DMAs under current study and some localities having moderate population settlements. Water supply coverage of these areas will be localized water supply system, incorporating supply sources and the corresponding necessary pipelines.

The total number of DMAs considered in short-term plan are 42. Moreover, 9 Small-scale DMAs having moderate population settlements have been included in short-term plan. Population settlements localities are scattered and still expanding. So, only major (or primary) pipelines have been considered for design with design year 2030. Once these areas are fully

developed with planned road network, implementation of DMAs in those areas could be possible upon further study. Details of DMAs and Small Scale DMAs (localities) considered for short-term plan is provided in Table 23 and Table 24. It is to be mentioned that, in MODS Zone 7 of DWASA, 30 DMAs were planned to be implemented under Dhaka Water Supply Network Improvement Project (DWSNIP). Location of these DMAs are within Dhanua, Sarulia, Shyampur and Matuail Union and some extended areas (Kutubpur Union). Later it has been decided that, only 7 DMAs will be implemented under ICB 02.12 of DWSNIP. So, the remaining 23 DMAs are incorporated into the current study. The list of 42 DMAs considered in the short-term plan and their future primary source of water supply (as per DWSMP) is summarized in Table 23.

Table 23: District Metered Areas Considered in the Short-term Plan with and Primary Source of Water Supply

DWASA MODS Zone	Nos. of DMA	Identity of the DMAs	Sector Name according to DWSMP
1	1	120	Saidabad West-East
4	2	411, 412	Singair
7	23	708 to 730	Saidabad West-East
8	5	812 to 816, 806(extension)	Khilkhet
9	4	916 to 920	Khilkhet
10	5	1018 to 1022	Khilkhet, Singair

In order to meet the water demand of this period of time, water to be supplied from the sources of Singair phase I & II, Saidabad SWTP Phase-III and Gandharbapur Phase- I.

Table 24: Surface/Ground Water Transmission Lines Available for Water Supply in the Short-term Plan

Year	Source of Supply	Amount of Supply (MLD)	Sector Name according to DWSMP
2019	Singair Well Field Phase-I	8	Singair
2025	Singair Well Field Phase-II	50	Singair
2021	Gandharbapur SWTP Phase-I	277	Khilkhet
2021	Saidabad SWTP Phase-III	183	Saidabad West-East

In the short-term plan, DMAs to be implemented within the year 2025 are considered based on the available water sources mentioned in the water supply master plan report. For instance, MODS Zone 1, 4, 7 and 10 will be mostly covered by transmission lines from surface water and groundwater sources by the year 2025. So, most of the areas of these zones under current study are included in short-term plan. Moreover, areas expected to have rapid population settlements (i.e. areas to be developed by real estate housing authorities and areas adjacent to main city) are also included in short-term plan albeit there is no provision for surface water/

groundwater transmission lines by 2030. It has been done because of immediate need of water supply in those areas. During the interim period (2025-2030), groundwater (PTWs) will be only water source of water supply for those areas. After the implementation of transmission lines, the distribution system will be connected with the available transmission lines through necessary arrangements and surface water will be the primary source of water supply.

Transmission lines from Singair phase-I is planned to cover Mirpur DOHS area of Harirampur Union. Baunia and major portion of MODS Zone 10 under Harirampur Union will be covered by transmission lines from Gardharbapur phase-I. Shagufta Housing and Eastern Housing is planned to be covered by Singair Phase-II. Whereas, water is planned to be supplied by Gandharbapur phase-I and Singair phase-II to the Dhour and Noanagar areas of Harirampur Union considering future supply provisions. Areas of Matuail Union, Sarulia Union, and Dania Union will be covered by transmission lines from Saidabad phase-III.

All these aforementioned areas having surface/ground water supply coverage from transmission lines by the year 2025 have been included in the short-term plan. Coverage areas of short-term plan is illustrated in Figure 14.

Table 25 illustrates a vivid description of water balance in different DMAs under short-term plan for the year 2025. It is observed that for DMAs in MODS Zone 1, 4 and 7 will have surplus water which can be distributed to the adjacent deficit DMAs. Overall, 86% of 2025 demand could be met from the outer sources like Ghandrabapur Phase I, Sayedabad Phase III and Singair Phase I.

Table 25: Water Balance in Different DMAs for the Year 2025

MODS Zone	No. of DMA	DMA Area (sq. Km)	Water Demand (MLD)	Water Supply Provision in WSMP (MLD)	% of Water Supply Coverage	GW requirement (MLD)	Remarks
1	1	1.02	4	15	354%	0	Provision for more Supply than the Demand. However, the supply can be redistributed in the areas as per demand.
4	2	1.67	15	20	132%	0	
7	23	27.48	192	211	110%	0	
8	6	8.75	50	0*	0%	50	Water Supply to be supplemented by GW Source
9	5	9.14	21	0*	0%	21	
10	5	9.59	49	34	69%	15	
Total	42	57.65	332	280	84%	86	

*DMAs of MODS Zone 8 and 9 will be supplied from Gandharbapur Phase III SWTP and according to WSMP transmission lines will be available by 2030.

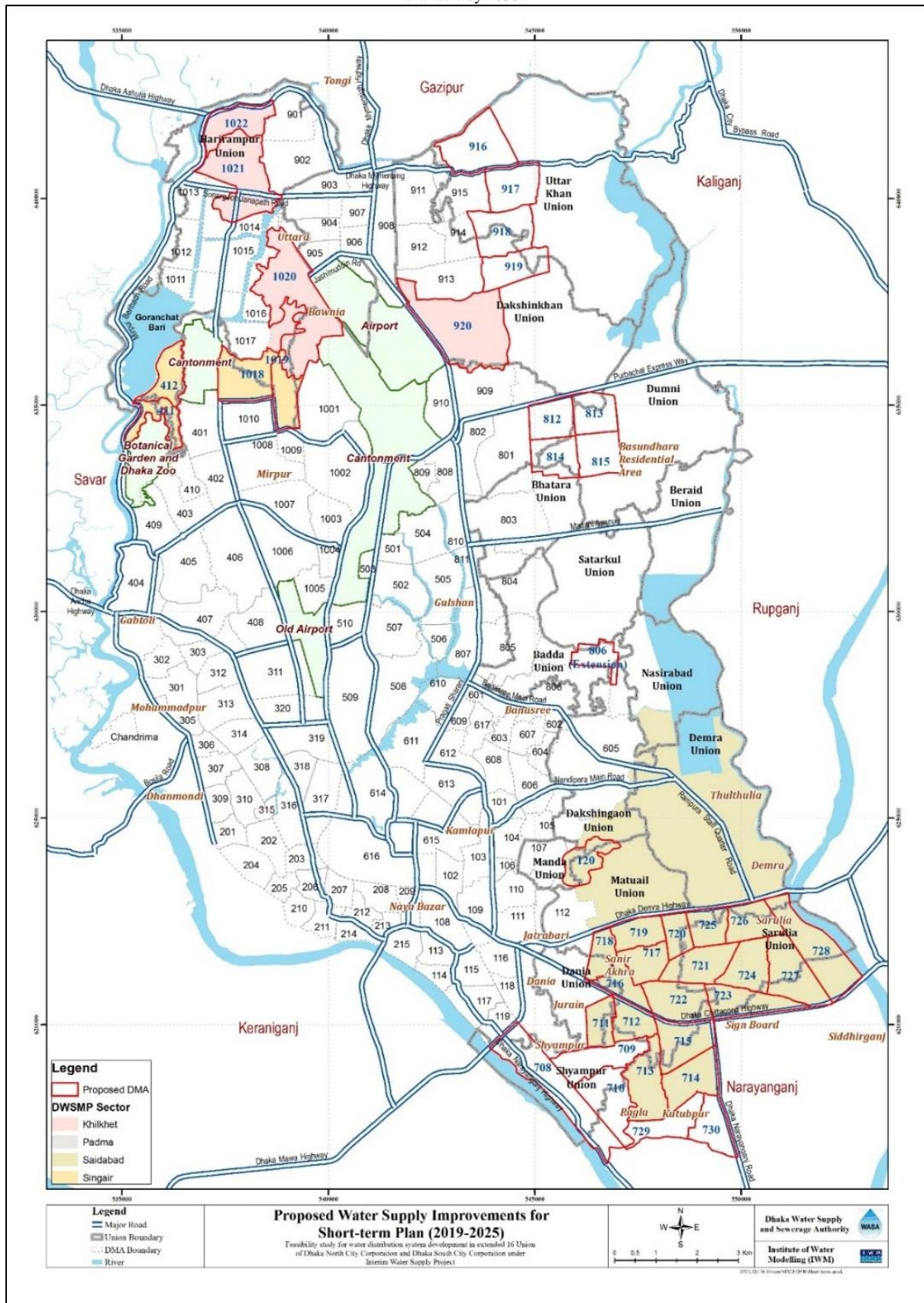


Figure 14: Water Supply Coverage in 16 Union by 2025

By the year 2030, other major sources like Ghandharbapur Phase II, Padma Phase II and Singair II will be implemented. Table 26 shows the water balance in different DMAs considered in short-term plan for the year 2040. The table indicates there is provision for meeting 72% of 2040 water demand from the transmission lines coming from outer sources. Remaining percentage of water requirement will be supplemented from localized groundwater sources (i.e. PTWs).

Table 26: Water Balance in different DMAs for the year 2040

MODS Zone	No. of DMA	DMA Area (sq. Km)	Water Demand (MLD)	Water Supply Provision in WSMP (MLD)	% of Water Supply Coverage	GW requirement (MLD)	Remarks
1	1	1.02	11	15	139%	0	Provision for more Supply than the Demand. However, the supply can be redistributed in the areas as per demand.
4	2	1.67	19	20	103%	0	
7	23	27.48	271	192	71%	79	Water Supply to be supplemented by GW Source
8	6	8.75	100	82	82%	18	
9	5	9.14	73	76	104%	0	Balanced from SW Sources
10	5	9.59	110	34	31%	76	Water Supply to be supplemented by GW Source
Total	42	57.65	584	419	72%	173	

5.6.2 Medium-term Plan

A major portion of areas under current study is currently underdeveloped without having population settlements. Water supply system development in those areas is not feasible currently because of undeveloped road network and very low number of consumers. However, these areas are expected to be developed in near future. Moreover, according to Dhaka Water Supply Master Plan (DWSMP) report, whole area under Dhaka City Corporation (DNCC and DSCC) will be covered by transmission lines from major sources (surface water and ground water) by the year 2030. A summary of major sources to be implemented after 2025 is provided in Table 27.

Table 27: Sources of Supply in the Mid Term Plan

Year	Source of Supply	Amount of Supply (MLD)	Sector Name
2025	Singair Well Field Phase-II	150	Singair
2030	Padma SWTP Phase-II	450	Padma South
2030	Gandharbapur SWTP Phase-II	500	Khilkhet
2035	Gandharbapur Phase-III	500	Khilkhet, Rupganj, Bandar, Tongi & Gachcha

Areas which are not considered in short-term plan will be consider under the medium-term plan. The medium-term plan will be implemented after 2025. The areas under medium-term plan are Localities and these areas have been identified as MDP area 101, 801, 802, 901, and 1001 based on location of the area (please refer Map 4).

Figure 15 shows expected water supply coverage of DWASA by 2030. A brief summary of water balance in those areas is provided in Table 28. From the table it is observed that, around 90% of the 2040 demand can be met from outer sources. Remaining water requirement will be met from locally installed groundwater sources. However, details survey and study will be required before implementation of water supply network in those areas.

Table 28: Water Balance in different DMAs for the year 2040 with respect to Medium-term Plan

MODS Zone	No. of DMA	Area (sq. Km)	Water Demand (MLD)	Water Supply Provision in WSMP (MLD)	% of Water Supply Coverage	GW requirement (MLD)	Remarks
1	MDP 101	12.15	114	43	38%	70.5	The Water Supply can be redistributed to the areas as per requirement
4	MDP 601	3.62	27	21	77%	6.1	
8	MDP 801	4.04	7	30	411%	0	
	MDP 802	7.98	32	37	117%	0	
	MDP 803	7.07	116	47	41%	68.6	
	MDP 804	4.07	58	40	70%	17.4	
9	MDP 901	21.25	39	150	383%	0	
10	MDP 1001	0.51	19	0	0%	19.1	
Total		60.69	411	368	90%	182	



Figure 15: Water Supply Coverage in 16 Union by 2040

Chapter 6: Survey and Investigation

6.1 General

Assessments were made for all the river systems surrounding Dhaka city in terms of water availability and quality during the Resource Assessment Study (IWM, 2006). Based on the resource assessment study, surface water sources were finalized in Water Supply Master Plan. This study will also use the same data on surface water assessment utilized during the preparation of water supply master plan.

On the other hand, for groundwater assessment, evaluation of both quantitative and qualitative parameters of the aquifer system of the study location and its adjoining area will be carried out. Test tube well will be installed for long term aquifer test at two sites, located within the project boundary in search of suitable aquifer layer. Results of the long term aquifer test will be used for groundwater source investigation.

6.2 Topographic Survey

A major portion of the study area does not have well developed road network. So, topographic survey has been conducted in some selected primary roads. Map 5 showing the roads where topographic survey had been conducted. Detailed methodology of topographic survey is as follow:

RTK-GPS Survey

Reference Bench Mark

Survey of Bangladesh has a number of Geodetic Bench Mark in and around the project area (Dhaka City). These BM Pillars had been used as reference for conducting the RTK Survey.

Establishment of Base Station

A base station was established at IWM office at Mohakhali by static survey from the Reference benchmark. The survey had been conducted keeping 2 dual frequency RTK-GPS receiver simultaneously at the reference station and proposed base station location. The data were processed by using post processing software supplied from the manufacturer (GNSS Solution). IWM office building at Mohakhali is an ideal location for setting up base station as the location is obstruction free and the distance of survey area is within 50km. Ashtech ProFlex 500 dual frequency GPS receiver with GLONASS option is ideal as a base station which was used as

base receiver. The receiver is capable of logging raw GPS data and simultaneously transmitting RTCM correction message using Radio Link or GSM Technology.

RTK-GPS Setup for Field

Ashtech ProMark 200 dual frequency RTK-GPS had been used as rover system. Ashtech GNSS RTK-GPS system is specially designed for the similar type of works. It uses Fast Survey Software for configuration of the equipment as well as monitoring GPS condition and recording data. The survey can be done in either of the 2 procedure mentioned below depending on the accuracy level achieved in the field:

- a) Real time survey using RTCM Correction message received from the base station through GSM/GPRS Technology. It is expected that the fixed solution will be achieved if the site condition is favorable. In this case, the point locations at RTK-Fix conditions is recorded in the specified format by the Surveyor as well as logging the point in the GPS. No post processing is required in this method.
- b) The raw GPS data is logged in the field using stop and go kinematic technique. In this method, GPS observations are taken on desired points without stopping data logging in the rover. In each occupation, GPS observations are logged for around 10 to 15 minutes (as recommended by the manufacturer). The data are required to be post processed offline by GNSS Solution (version 3.60) in the office.

Total Station Survey

Total station survey was conducted at places where it was not be possible to conduct RTK-GPS survey with desired accuracy. In such case, total station had been used to supplement RTK-GPS Survey. Known points derived from RTK-Survey was used as control point for Total Station orientation.

Conventional Level Survey

Auto levels had been used to check sample points surveyed by RTK-GPS Survey. This will be done to ensure the quality of GPS Survey works.

Co-ordinate System

The survey output will be given in Bangladesh Transverse Mercator (BTM) Projection system. The parameter are:

Conversion Parameter from WGS-84 Ellipsoid to Local Ellipsoid (Everest 1830)

Everest-1830 ellipsoid

Semi-major axis $a = 6,377,276.34518$ m

Semi-minor axis $b = 6,356,075.41511$ m

Inverse flattening $1/f = 300.8017$

Datum Transformation Parameters

Method	:	Seven Parameters
Rotation X	:	0
Rotation Y	:	0
Rotation Z	:	0
Translation X	:	-283.729 m
Translation Y	:	-735.942 m
Translation Z	:	-261.143 m
Scale	:	0 ppm

Projection Parameter

Projection method	:	Transverse Mercator
Latitude of origin	:	0° N
Central meridian	:	90° E
False Northing	:	-2,000,000 m
False Easting	:	500,000 m
Scale factor	:	0.9996

6.3 Hydrogeological Investigation

Groundwater investigation has been conducted for resource assessment which includes evaluation of both quantitative and qualitative parameters of the aquifer system. Under this study, assessment is carried out for target aquifer systems in the study area and its adjoining areas. Detail investigation is required for the suitable aquifer system. Hydrogeological field investigation has been carried out for generating further data and assessment of total aquifer system on the following aspects:

- Lithological characterization and delineation of aquifer geometry.
- Assessment of groundwater level situation.
- Assessment of aquifer characteristic and properties.
- Water quality assessment
- Assessment of groundwater resource availability

Observation well/ Exploratory well

Test tube well has been installed at two sites. One site is at Kawla of Dakshinkhan Union and other is at Smritidhara of Dania Union. These test tube well is installed in search of suitable aquifer layer. For carrying out proper assessment sufficient primary long-term data are required for all relevant parameters. These two wells will be converted to monitoring wells for observing groundwater level situation.

Production Tubewell

The general dimensions of the production well and the fixture materials are 400mm X 200mm dia. The standard of upper well casing (UWC) / pump housing pipe (PHP) will be of uPVC E-grade, lower well casing (LWC), bail plug, reducing cone will be of uPVC E-grade pipe. The well screen is of 304 Stainless Steel and V shaped continuous slot and with adequate structural strength to withstand the vertical and horizontal loading from installation and development, as well as lateral subsurface pressure during subsequent operation up to a depth of 250m -350m. The production well has been constructed using reverse circulation /direct circulation methods of construction. Samples have been collected at 1.5 m (5 feet) intervals or at any change of lithology along the total length of bore hole. Minimum 500 gm representative sample from each type of formation material have been collected for further analyses for gravel pack design. During the execution of works starting from drilling, well assembly design, well components installation, gravel shrouding, preliminary washing, washing with dispersant, hydraulic jetting, development, step draw down test, aquifer test, verticality test and well disinfection should have to carry out in one continuous operation.

Development stabilizes the sand aquifer around the screen of a well so that the well produces sand free water. It increases the porosity and permeability of the aquifer to the well. A fundamental objective in the development operation is to create reversal of flow direction through the screen opening to the formation particles adjacent to the screen. Development of the well has been carried out by following method – operating the pump at 50% of design capacity of well for 3 hours after completion of the gravel packing, by pumping compressed air in the well through a combined airline and educator pipe with a pressure of minimum 450 PSI or as required. The well screen slots, shrouded gravel and the wall of the drilled hole may require washing with Sodium Hexa-meta-phosphate solution or any other approved dispersant. Following the use of dispersant and chlorine solution into the well for 24 hours, high velocity water jetting should be carried out for developing the well at a rate of about 100 m/second

velocity with minimum 450 psi pressure horizontally from four opposite nozzles. Development by over pumping means, pumping the well at a higher rate than the rate of pumping of the well is put into service. Over-pumping will consist of step pumping at increasing rates from 75% - 150% of design capacity of the tube well. The minimum operation was for three hours at each state or as required.

A step draw-down test has been carried out at 75%, 100%, 125%, and 150% of the design well capacity. At each test rate pumping was continued for 120 minutes and be increased to the next rate without stopping the pump. At the end of the test, water level recovery was measured for at least 24 hours from the end of pumping. Following step draw down test, a constant discharge test at the design rated well capacity was excavated. As part of the final constant discharge pumping test of the well the sand content of the discharge was measured. The test was considered satisfactory when the sand content in the test is less than 5 (five) mg/l by volume.

The annular space between the housing pipe and the bore hole above the gravel was filled with paddled clay. The remaining 5m up to ground level will be filled with cement grout with 2:2 (cement: sand) proportion. The sanitary seal has been done after completion of the well development and pump testing.

Disinfecting of the tube well has been carried using dry, loose Calcium Hypochlorite powder (minimum 65% chlorine present)

Aquifer Test

Two long term aquifer tests have been carried out in the newly constructed production wells for the hydrogeological investigation. The test was carried out for minimum 72 (seventy-two) hours continuous pumping and necessary time for recovery test.

One long term aquifer test was performed in each of the selected location. Test was carried out for collection of hydraulic properties about the vertical and horizontal hydraulic conductivity, transmissivity, storage coefficient and specific yield including other aquifer characteristics of the study area. The aquifer test site was provided by DWASA.

In order to ascertain the zone of influence and to measure the draw down, observation wells was installed at designated distance from the production well in accordance with production well design at different depths.

The test was conducted in 2 phases i.e., constant rate pumping test and recovery test. The constant rate-pumping test was continued uninterrupted for a period of 72 (seventy-two) hours.

During constant rate pumping test production well's discharge was maintained at its rated discharge.

Water Quality test

For quality analysis, groundwater sample was collected and the following parameters were tested in BUET laboratory:

- Iron
- Manganese
- Chloride
- Arsenic
- pH

Details of test results and description about the hydrogeological investigation is available in Volume 3: Hydrogeological Investigation report.

6.4 Geotechnical Investigation

Soil samples from several locations within the study area have been collected and investigated in lab. The lab test result is used in environmental impact assessment. The result is also helpful for decision making during pipeline installation and pump house construction.

6.5 Household Survey

To pursue social impact assessment, household survey had been conducted by consultant. In the household survey a standard questionnaire covering household income, occupation, gender issues, and ethnic and minority issues was used. Moreover, current water supply conditions like availability of tap in houses, per capita consumption and people's willingness to have a new water supply system were assessed based data found from household survey. Details of household survey is available in social survey report submitted as annex to Interim report.

6.6 Environmental survey

An environmental reconnaissance of the project site, including location of the proposed pumping station as well as areas along the alignment of the proposed water supply line with its social settings have been visited in order to observe the overall setting of the pre-project condition. In the environmental baseline survey, the pre-project socio-economic and environmental conditions of areas in and around the project site, against which possible impacts of the proposed project have been delineated and analyzed. The potential impacts on various socio-economic & environmental parameters with respect to project activities have been

identified. Both qualitative and quantitative impact assessments have been carried out. These assessments were made based on standard methodologies using the collected field data and applying results of the mathematical modelling studies, where appropriate. Details of environmental survey is available in ESIA report.

Chapter 7: Hydraulic Design of Water Distribution Networks

7.1 General

Hydraulic model has been developed to distribute water in the DMAs and scattered localities. In doing so, new pipe network and junction has been created. Demand has been allocated in more realistic way and source has been finalized based on WSMP. After simulating the model, the pipe sizing and number of PTWs required have been decided. The alignment of the primary and secondary distribution pipeline will comply with Dhaka Water Supply Sector Development Project (DWSSDP). The alignment will be reviewed and updated by considering following steps:

- Conducting topographical survey of road, water body, embankments and infrastructures (bridge, culvert etc.)
- Keeping compliance with Dhaka Water Supply Master Plan (WSMP)
- Finalizing alignment of the primary and secondary distribution networks based on the survey conducted and the investigation accordingly.

7.2 Design Philosophy

The aim of network system design is to prepare a lay-out for primary & secondary distribution system. Basic design principles are:

- Guarantee continuous delivery of a sufficient quantity of safe drinking water to the consumers with adequate pressure
- Be economically and financially viable, ensuring sufficient income for the upkeep and extension of the system

These principles can be considered as the first priority for the design of the system. The second priority is that the system:

- Have sufficient spare capacity to operate in an emergency situation (power failure, pipe bursts, fires)
- Have a sufficient degree of “flexibility”
- The capacity of the major components of a distribution system is generally such that the component will perform satisfactory for existing water demand.

7.3 Design Consideration

While designing the water supply system following considerations have been adopted for the project:

- To distribute safe potable water produced from Water Sources (PTWs and SWTPs)
- Ensure efficient distribution of water to the different DMAs under the study
- Ensure minimum head in the distribution networks to maintain adequate pressure at consumer's end
- Easy operation and maintenance of primary and secondary distribution networks
- Minimize imported operation and maintenance items
- Maximize local labor during construction and operation
- Use local materials wherever possible and provide adequate flexibility

7.3 Design Assumptions

Assumptions to be applied during design are:

- Groundwater will be the only water source for present scenarios. That means the network model will be simulated with PTWs as water source for current condition.
- Standard Pump Curves have been used for PTWs with capacity of 1.5 cusec, stage-3 or discharge of about 42 L/sec at discharge pressure 15-20 m for the design year 2040.
- Surface water will be considered as future source. The layout of surface water transmission lines will be followed during selection of Surface Water Injection Points (SWIP).
- Node elevation is assumed to be 1 m below the road surface, which is as calculated from the electronic DEM data as (PWD – 1.0m)
- Hazen Williams co-efficient (C) for the network will be considered 110 for all HDPE pipes and 130 for uPVC pipes (please refer article 7.4.1 for justification).

7.4 Design Parameters

7.4.1 Roughness and Minor Loss Parameters

The standard Hazen-William Coefficient (C) for HDPE and uPVC pipe is 130 and 150 respectively for new and smoother pipes. Generally, it is considered new pipe has a smooth internal surface and maintains its flow capability over time. Hazen Williams's factor remains same, even after years of use. Nevertheless, the aging effect on the roughness might get come along, so this fact should be taken into consideration. The losses in the pipes comes not just

from the friction between water and internal wall but also on local points along the pipe network such as tees, elbows, valves and etc. These losses are called minor losses. Minor losses have not been counted within model but their effect has been incorporated in final value for Hazen - William's coefficient C. In this stage it's not possible to calculate exact value for coefficient C, because the exact value can only be estimated by calibrating the model using observed data on the field. These observed data now doesn't exist, thus an approximate value of Hazen Williams co-efficient has been used. In the modelling of primary and secondary water distribution pipes Hazen Williams C value has been considered as 110 for HDPE pipes and 130 for uPVC pipes considering the pipe friction with the inclusion of all sort of minor losses are possible. For the purpose of modeling in this regard, a sensitivity analysis has been carried. The model has been executed for various values for C as the sensitivity test are shown in Sensitivity Analysis Section.

7.4.2 Pipe Material

To minimize traffic disturbance and public life hazards, trenchless technology is widely practiced nowadays. DWASA has implemented most of its DMAs by using the trenchless technology in addition to open trench method. The introduction of trenchless technologies required the use of HDPE pipe. During design of DMAs under current study, HDPE is considered as pipe material. However, extension pipelines in areas with newly installed existing uPVC water lines (i.e. in Aftabnagar and Pallabi Eastern Housing area and Mirpur DOHS) was designed considering uPVC pipes.

7.4.3 Pipe Diameter

Accurate internal Diameter of different sizes of HDPE Pipe PE 100 (PN 10) SDR 17, ISO 4427-2: 2007(E) used in the model, which is presented in Table 29.

Table 29: HDPE PE 100 (PN 10) Internal Diameter in mm

HDPE pipes dimensions						
Nominal outside Diameter	Mean outside Diameter	Maximum out of roundness (mm)		Nominal wall thickness (mm)		Internal Diameter (mm)
				SDR 17 (S 8)		
				PE 100 (PN 10)		
DN	dia, min	dia, max		e_{min}	e_{max}	
75	75	75.5	1.6	4.5	5.1	65.4
110	110	110.7	2.2	6.6	7.4	96
160	160	161	3.2	9.5	10.6	139.9
200	200	201.2	4	11.9	13.2	174.9
250	250	251.5	5	14.8	16.4	218.8
315	315	316.9	11.1	18.7	20.7	275.6

HDPE pipes dimensions						
Nominal outside Diameter	Mean outside Diameter	Maximum out of roundness (mm)		Nominal wall thickness (mm)		Internal Diameter (mm)
				SDR 17 (S 8)		
				PE 100 (PN 10)		
DN	dia, min	dia, max		e_{min}	e_{max}	
355	355	357.2	12.5	21.1	23.4	310.5
400	400	402.4	14	23.7	26.2	350.1
450	450	452.7	15.6	26.7	29.5	393.8

For uPVC pipes, internal diameter used in design is presented in Table 30.

Table 30: uPVC internal Diameter

Nominal Diameter (mm)	Internal Diameter (mm)
100	101.6
150	147.6
200	184.6
250	230.8
300	290.8

7.4 Design Criteria

Design criteria for the water distribution networks have been adopted from DWSSD project.

There will be two main hydraulic criteria:

- Minimum pressure in the network will be 1 bar (10 m of H₂O) and
- Head loss gradient in a pipe should not be greater than 5m/Km. However, for some larger diameter pipes of smaller length- considerations for cost were given preference over head loss criteria. To ensure that criterion the design velocities for different diameter pipes will be as in Table 31.

Table 31: Velocity Criteria for Water Distribution Pipes

Pipe Diameter (mm)	Design Velocity (m/s)
100	up to 0.5
150	up to 0.5
200	up to 0.5
250	0.5-1.0
300	0.5-1.0
≥400	0.5 – 1.5

7.5 Hydraulic Model Development

Hydraulic model has been developed based on survey data and estimated water demand. Design assumptions have been considered during model simulation. Surface water supply sources have been finalized keeping compliance with Water Supply Master Plan. Surface water injection points (SWIP) have been represented as PRV in the model. Nodal pressure in the

system depends on available pressure in surface water transmission line and PRV setting. Moreover, number of PTWs have been estimated based on water demand and provision for surface water sources. Pump capacity is considered as 1.5 cusec. A standard 2 cusec pump can provide 42 l/s flow with around 75 m head. To overcome the possible risks and uncertainties and ensure improvement of the integrated behavior of system, Inter-DMA Connections with meter chamber were considered. This meter chamber was designed to allow water flow in both directions maintaining the required upstream pressure with the help of Pressure Sustaining Valve (PSV).

The Bentley WaterGEMS modelling tool which has been used for the current study is widely used program for designing water networks. That software is based on the widely used EPANET software engine. Similar program was also used in other DWASA projects like DWSSDP, DESWSP and IWSP. Moreover, for mapping purposes ESRI ArcGIS 10.3 has been used. Integration of WaterGEMS with ArcGIS has made the modelling more user friendly. Step by step procedure of model simulation is provided in Figure 16.

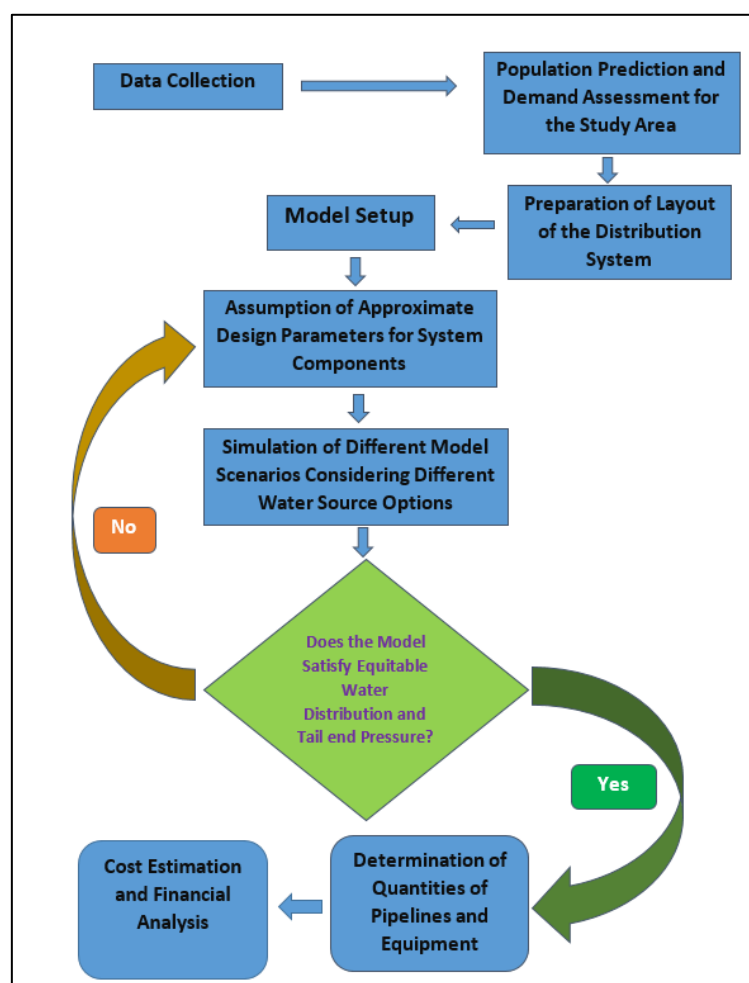


Figure 16: Work Flow Diagram for Hydraulic Modelling

Quantities of Pipelines, PTWs, Gate Valves, Chambers and other equipment have been finalized based on outline model design. Based on the quantities found from the model design, cost is estimated for development options.

Economic and financial viability of the project is determined by: comparing cost with other DWASA pipeline projects; comparing project costs with projected DWASA revenue stream, i.e. estimating project costs as % of estimated revenue.

7.6 Outline Design of DMAs and Localities

7.6.1 Layout of the Network

Layout of existing road network is the primary basis for layout of proposed pipe network considered in design. GIS shapefiles of existing road network have been traced from recent satellite image and field survey. Layout of proposed roads has been drawn from recent DAP of RAJUK. Moreover, areas where land is developed by real estate housing authorities, project layout plan has been collected from respective authorities. The pipe network layout in those areas were finalized from the project layout plans.

7.6.2 Nodal Elevation

The nodal elevation have been extracted from recent survey data and RAJUK DEM. The elevation was extracted automatically from DEM by WaterGEMS software.

7.6.3 Demand Distribution

DMA wise water demand has been estimated for the design year. Total demand of an area needs to be distributed among the nodes of distribution network. Demands can be allocated to the nodes using various methods. Many methods are based on observed data, such as billing meters, known flows in certain points of the network, by land use or by population settled. Since all of this data are not available, other method that compile geometry of network will be used. One of these is "proportional distribution by area". This method divides the lump-sum flow among the service polygons based upon one of two attributes of the service polygons-the area (in this case a total area). The greater the percentage of the lump-sum area that a service polygon contains, the greater the percentage of total flow that will be assigned to that service polygon. Each service polygon has an associated demand node, and the flow that is calculated for each service polygon is assigned to this demand node. A portion of created Thiessen polygons is shown in Figure 17.

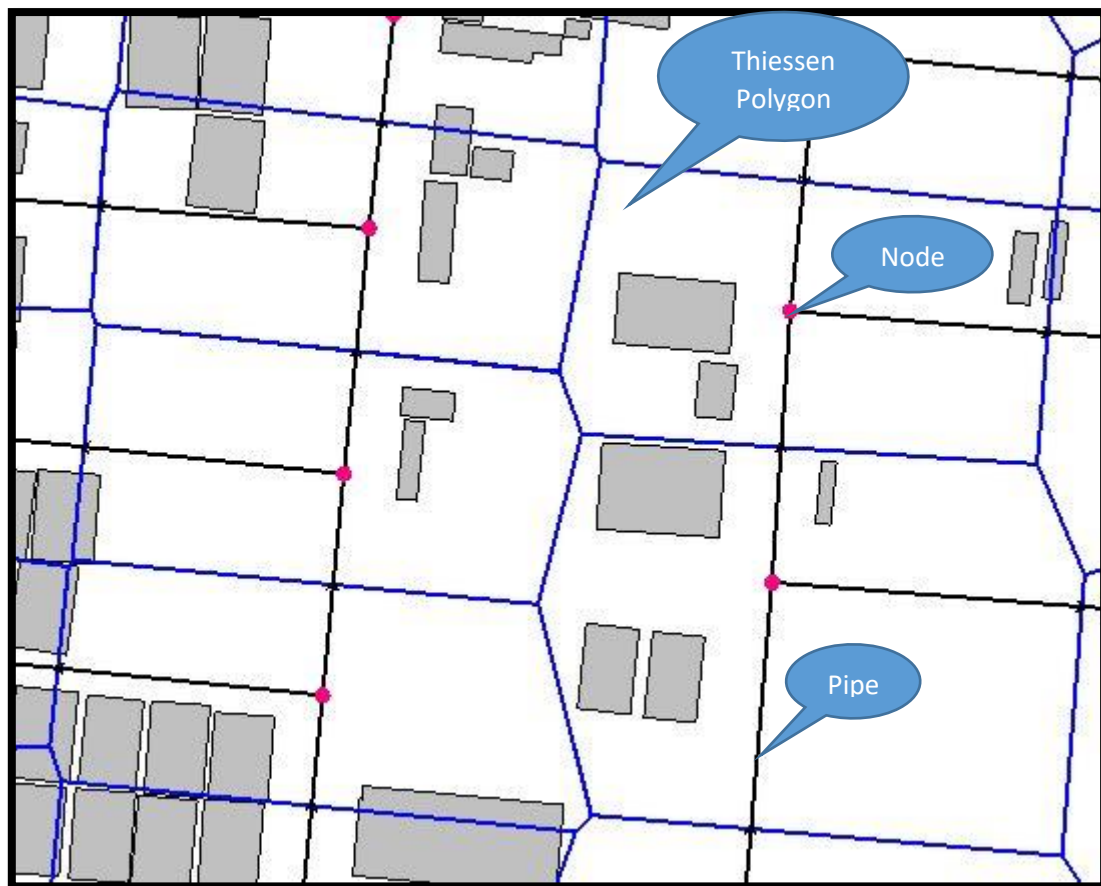
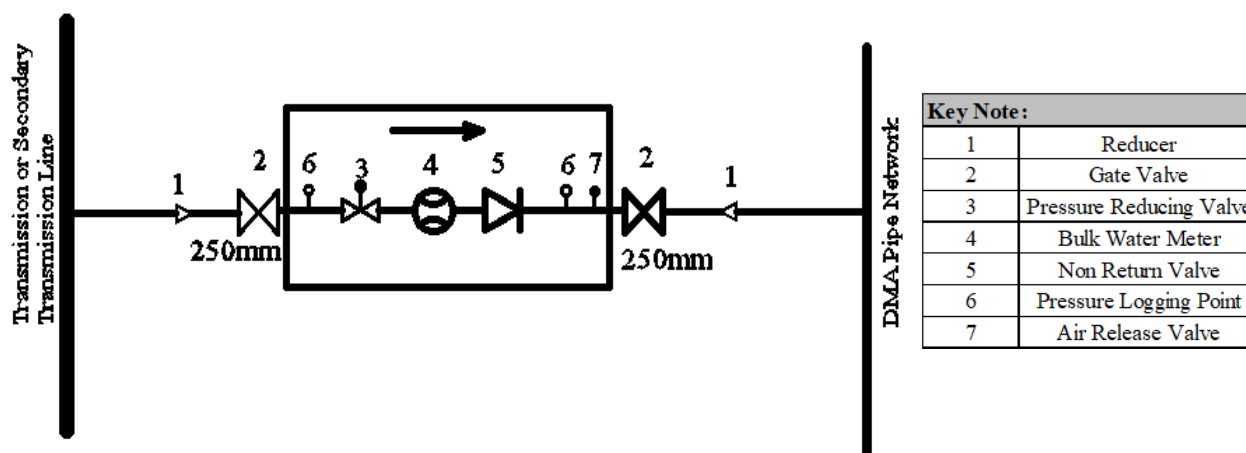


Figure 17: Thiessen Polygon for Respective Nodes

7.6.4 Water Source Selection

Surface water source in a DMA has been selected keeping compliance with water supply master plan of Dhaka city. Number of surface water injection points for a DMA depends on total water required for that DMA. The surface water inlets will be drilled in transmission line and will be connected with distribution lines through an interconnection chamber. However, if it is not possible to make direct inlet from the transmission line, a parallel secondary transmission pipeline will require to be installed to draw water from main transmission line. In that case, the surface water inlets will be drilled from that secondary parallel transmission line. An interconnection chamber will typically consist of a Pressure Reducing Valve (PRV), a Bulk Water Meter (BWM) and two Gate Valves (GV). PRV will allow the water to enter in a DMA with a certain reduced pressure from the transmission line. Typical plan of a Surface Water Inlet Chamber is shown in Figure 18. In model surface water inlets have been represented a PRV. Pressure setting in PRV will depend on minimum service pressure required in a DMA. In general, equipment sizes are determined considering the head loss at BWM below

0.5 m; and the total head loss at interconnection chamber for unidirectional flow nearly 1 m. However, exceptions may occur at some special cases.



** All valves and equipment in the SWIP Chamber are 250 mm in size

Figure 18: Typical Plan of Surface Water Inlet Chamber

To overcome the possible risks and uncertainties and ensure improvement of the integrated behavior of system, inter-DMA Connections with meter chamber were considered. This meter chamber will allow water flow in both directions maintaining the required upstream pressure with the help of Pressure Sustaining Valve (PSV).

Ground water is considered as present water supply source in design. Number of PTWs required in a DMA is calculated considering pump capacity as 1.5 cusec and assuming major percentage of the demand to be supplied from transmission lines in future. However, there are exceptions and the estimation is done by case by case consideration. A summary about the water supply sources in 42 DMAs is shown in Table 32.

Table 32: Estimated Water Demand and Sources Considered in Hydraulic Modelling of DMAs

DMA ID	Area (Sq. Km)	Water Demand, 2025 l/s	Water Demand, 2040 l/s	No. of PTW			Chamber	
				Existing	Proposed	Total	SWIP	Inter DMA
120	1.02	49	125	1	1	2	2	0
411	0.74	71	97	3	0	3	2	1
412	0.93	104	128	2	1	3	2	0
708	2.54	181	238	5	0	5	2	0
709	1.33	146	193	2	1	3	2	1
710	1.49	62	98	1	1	2	1	1
711	0.73	115	127	2	1	3	1	1
712	0.84	80	107	3	1	4	1	1
713	1.49	108	175	1	1	2	2	1

DMA ID	Area (Sq. Km)	Water Demand, 2025 l/s	Water Demand, 2040 l/s	No. of PTW			Chamber	
				Existing	Proposed	Total	SWIP	Inter DMA
714	1.29	89	149	2	0	2	2	1
715	1.31	100	151	1	1	2	2	0
716	0.75	72	93	2	0	2	1	1
717	0.85	74	101	2	1	3	1	1
718	0.69	84	97	3	0	3	1	1
719	0.85	71	97	2	0	2	1	1
720	0.63	53	72	1	0	1	1	1
721	1.26	113	155	0	3	3	2	0
722	1.38	115	156	1	2	3	2	0
723	1.25	103	151	0	2	2	2	0
724	1.17	106	146	0	2	2	2	0
725	0.82	66	92	1	0	1	1	1
726	1.06	88	126	0	2	2	2	1
727	1.62	146	216	0	3	3	2	0
728	2.08	113	161	0	2	2	2	0
729	1.04	72	120	0	2	2	1	1
730	1.01	70	117	0	1	1	1	1
806	3.43	331	456	2	3	5	5	0
812	0.99	52	132	0	2	2	2	1
813	1.00	48	132	0	2	2	2	1
814	0.80	49	106	0	2	2	2	1
815	1.05	48	139	0	2	2	2	1
816	1.48	52	193	0	3	3	2	1
916	1.80	40	152	0	2	2	2	1
917	1.27	28	107	0	1	1	1	2
918	1.50	44	139	2	0	2	2	2
919	1.16	34	108	1	0	1	2	2
920	3.41	96	336	3	0	3	4	0
1018	1.52	84	142	6	0	6	3	1
1019	0.95	63	104	1	1	2	2	0
1020	3.43	169	463	0	4	4	5	1
1021	2.54	179	387	0	3	3	4	1
1022	1.15	77	179	0	2	2	2	1
Sub Total	57.65	3,845	6,763	50	55	105	83	32

Moreover, scattered localities were considered in outline design for providing water supply. These have been identified by analyzing recent satellite images and from reconnaissance survey. The areas currently identified as “Small-Scale DMAs” are not reliable for long term planning, but in future, there might be extension of these type of areas. So, the population projection, water demand and layout of the network will need to be updated during design and implementation phase of water supply network development in those areas. Even though pipe network in these areas have been designed with groundwater source only to meet the demand of 2030, provisions have also been kept for Surface Water Injection Points (SWIP) in those

scattered localities for water distribution network. 9 surface water inlet points are proposed along with ground water sources in all the nine small-scale DMAs. Water demand and proposed sources for small-scale DMAs is shown in Table 33.

Table 33: Estimated Water Demand and Sources Considered in Hydraulic Modelling of Localities (Small-scale DMAs)

Small-scale DMAs (Locality)	Area (Sq. Km)	Water Demand, 2025 l/s	Water Demand, 2030 l/s	No. of PTW		
				Existing	Proposed	Tot al
Small-scale DMA101 (Amulia-Demra)	2.39	14	80	0	2	2
Small-scale DMA 901 (Barua-Dakshinkhan)	6.03	60	88	0	2	2
Small-scale DMA 802 (Beraid)	2.52	10	13	0	1	1
Small-scale DMA 102 (Demra)	3.36	25	40	1	0	1
Small-scale DMA 803 (Dumni)	5.57	19	28	0	1	1
Small-scale DMA 104 (Manda)	1.61	42	64	0	1	1
Small-scale DMA 801 (Satarkul)	3.43	6	10	0	1	1
Small-scale DMA 103 (Staff Quarter-Demra)	2.01	23	37	0	1	1
Small-scale DMA 902 (Uttarkhan)	13.68	188	282	0	7	7
Sub Total	40.61	388	583	1	16	17

7.8.5 Pipe Sizing and Design Outputs

Distribution Network Model has been prepared & analyzed for SW, GW and Conjunctive use scenario. Networks pipe sizing have been done for specific hydraulic criteria and improved by giving several trials.

During pipe sizing, peak factor in demand is considered as 1.25. However, due to high level of uncertainties in population projection of “Housing Development Areas” (like in Bashundhara Housing, EHL Pallabi and Aftabnagar, United Housing etc.), pipe sizing in those areas have been done considering a higher peak factor (say 1.5) in demand. The pipe sizing is finalized after some sensitivity analysis in the network. Sensitivity analysis consists of increase in peak demand, pump shut off (in conjunctive scenario) and change in pipe roughness.

7.8.6 Inventory of the 42 DMAs and 9 Small-scale DMAs

Pipe Network Inventory

Total length of water distribution pipelines that has been considered in 42 DMAs and 9 Small-scale DMAs under current study are approx. 897 km and approx. 158 km respectively. In addition to this, the reticulation and secondary transmission main have been considered around 400 km to facilitate house connection and connection with the transmission main. Reticulation pipes will be provided in tertiary roads and in parallel to higher diameter pipes.

The locality areas (Small-scale DMAs) are currently underdeveloped. Further study will be required once road network and population settlements in those areas undergoes development process.

Summary of pipelines of different diameters from model design are summarized in the following Table 34 and Table 35.

Table 34: DMA-wise Distribution Pipe Length

DMA	Pipe Length (m)						Total Length (m)
	110 mm	160 mm	200 mm	250 mm	315 mm	400 mm	
120	12,660	1,020	3,260	1,160	1,200	-	19,300
411	1,340	900	320	900	-	-	3,460
412	2,100	-	40	460	140	-	2,740
708	19,150	7,300	7,600	3,300	2,250	500	40,100
709	12,850	4,800	5,850	2,300	1,200	550	27,550
710	9,550	2,800	1,700	3,550	1,000	50	18,650
711	12,150	5,600	4,150	1,750	650	350	24,650
712	6,450	1,600	4,450	1,800	900	200	15,400
713	11,350	7,150	3,100	2,350	500	1,300	25,750
714	9,150	7,400	4,600	1,800	500	650	24,100
715	11,000	6,800	4,250	2,600	1,950	400	27,000
716	6,150	7,200	2,900	550	900	50	17,750
717	9,100	7,550	4,000	750	650	400	22,450
718	7,100	4,050	4,550	850	350	350	17,250
719	8,400	7,450	1,850	1,000	700	300	19,700
720	7,950	4,950	2,600	450	300	400	16,650
721	8,250	8,350	3,800	2,200	1,700	400	24,700
722	6,800	9,400	3,050	2,750	800	650	23,450
723	7,150	6,700	4,950	1,250	1,050	800	21,900
724	12,150	11,350	4,150	2,750	1,000	250	31,650
725	7,100	7,950	2,600	850	550	50	19,100
726	12,050	11,100	3,700	2,250	600	150	29,850
727	15,200	16,000	3,500	2,250	1,800	750	39,500
728	3,400	3,100	2,450	3,800	1,750	1,750	16,250
729	10,350	10,850	3,100	2,200	700	250	27,450
730	7,500	9,400	2,050	1,250	800	550	21,550
806 (Extension)	18,760	13,320	6,540	240	480	-	39,340

DMA	Pipe Length (m)						Total Length (m)
	110 mm	160 mm	200 mm	250 mm	315 mm	400 mm	
812	11,460	2,620	3,140	1,680	840	-	19,740
813	14,360	1,600	2,160	1,500	1,620	-	21,240
814	13,120	3,560	1,040	1,520	680	-	19,920
815	9,820	3,100	2,140	3,160	1,480	-	19,700
816	6,380	7,480	4,140	2,700	1,200	-	21,900
916	5,640	5,340	4,020	2,620	1,180	460	19,260
917	7,600	2,680	5,780	1,000	1,100	-	18,160
918	9,940	3,920	5,300	2,860	1,640	-	23,660
919	5,720	2,420	3,660	1,800	160	-	13,760
920	6,960	6,220	2,780	3,240	4,420	-	23,620
1018	540	2,160	720	540	540	-	4,500
1019	6,860	500	980	1,560	1,860	-	11,760
1020	6,300	6,980	2,960	2,160	6,220	-	24,620
1021	2,080	5,120	4,280	5,840	3,920	-	21,240
1022	7,140	2,760	3,240	2,620	1,100	-	16,860
Total	369,080	240,550	141,450	82,160	52,380	11,560	897,180

Table 35: Distribution Pipe Length in 9 Localities (Small-scale DMAs)

Locality	Pipe Length (m)						Total Length (m)
	110 mm	160 mm	200 mm	250 mm	315 mm	400 mm	
Small-scale DMA101 (Amulia-Demra)	9,720	3,700	820	2,200	1,420	-	17,860
Small-scale DMA 901 (Barua-Dakshinkhan)	4,960	5,020	880	2,800	-	-	13,660
Small-scale DMA 802 (Beraid)	3,280	-	740	720	-	-	4,740
Small-scale DMA 102 (Demra)	6,740	1,560	940	1,920	2,780	-	13,940
Small-scale DMA 803 (Dumni)	5,320	4,700	660	1,700	520	-	12,900
Small-scale DMA 104 (Manda)	6,900	2,920	1,820	980	-	-	12,620
Small-scale DMA 801 (Satarkul)	1,380	920	1,260	-	-	-	3,560
Small-scale DMA 103 (Staff Quarter-Demra)	10,260	4,560	1,860	4,400	480	-	21,560
Small-scale DMA 902 (Uttarkhan)	30,720	10,940	2,060	13,820	-	-	57,540
Total	79,280	34,320	11,040	28,540	5,200	-	158,380

Valve Inventory

Total 6,199 numbers of gate valves have been considered for 42 DMAs and 9 Small-scale DMAs. Where, 5,765 numbers of gate valves from 100mm to 400mm dia. have also been considered in the water network. In addition to this, total 184 numbers of 250mm dia. gate valves will be required for 92 SWIP chambers and 64 numbers of 150mm dia. gate valves will be required for 32 numbers of inter-DMAs. Furthermore, 186 numbers of gate valves (112

numbers of 100mm dia. and 74 numbers of 150mm dia.) will be required for 186 numbers of washout options along with 186 numbers of Air Release Valve (ARV).

Quantitative summary of valves in the network and chambers within 42 DMAs and 9 Small-scale DMAs under current study are listed in **Table 36**.

Table 36: Summary of Valves within 42 DMAs and 9 Small-scale DMAs

Summary of Valves								
Valve Type	Dia meter (mm)							Total
	50	100	150	200	250	300	400	
Gate Valve (Network)	-	1,786	1,385	944	978	518	154	5,765
Gate Valve (SWIP + Inter DMA)	-	-	64	-	184	-	-	248
Gate Valve (Washout)	-	112	74					186
Air Release Valve	-	186						186

BWM Chamber and Equipment Inventory

To ensure the surface water provision into the 42 DMAs total 92 numbers of surface water injection points (SWIPs) have been considered in the model analysis. Where, 83 SWIPs have been considered for 42 DMAs (details has been shown in Article 7.8.4) and 9 SWIPs have been considered for 9 Small-scale DMAs. In addition to this, total 32 numbers of inter-DMA chambers have also been included in the design.

A total of 147 bulk water meters are considered (64 numbers of 150 mm dia and 83 numbers of 250 mm dia). Moreover, 64 numbers of Pressure Sustaining Valve (PSV) (150 mm dia) and 83 numbers of Pressure Reducing Valve (PRV) (250 mm dia) will also be required along with total 147 numbers of Non-Return Valve (NRV) (64 numbers of 150mm dia and 83 numbers of 250 mm dia). For 9 Small-scale DMAs, 9 PRVs, 9 NRVs and 9 BWMs are considered (all 250mm dia).

The equipment quantity for the no. of Surface Water Inlet Point (SWIP) chambers & Inter DMA chamber have been listed in the following **Table 37 and Table 38**.

Table 37: Summary of Chamber Equipment within 42 DMAs

SWIP & Inter DMA	Diameter (mm)		Total Nos.
	150	250	
Chambers items			
Bulk Water Meter (BWM)	64	83	147
Gate Valve	64	166	230
NRV	64	83	147
PSV	64	-	64
PRV	-	83	83

Table 38: Summary of Chamber Equipment within 9 Small-scale DMAs

SWIP	Diameter (mm)
Chambers items	250
Bulk Water Meter (BWM)	9
Gate Valve	18
NRV	9
PRV	9

House Connection Inventory

The total 63,910 numbers of house connections have been estimated in this project for 42 DMAs and 9 Small-scale DMA areas.

The inventory of house connection has been listed in the following **Table 39**.

Table 39: Summary of House Connection (HC)

DMAs	HCs Considered in this Project
23 DMAs (DMA 708-730)	47,650
19 DMAs (DMA 102-1022)	14,510
9 Small-scale DMAs	1,750
Total	63,910

Chapter 8: Instrumentation & Controls, Artificial Recharge and Water Quality Improvements

8.1 Instrumentation & Controls

This section defines the general requirements of the instrumentation elements and the control system to be installed at the Production Tube Wells (PTWs).

The integrated control system for Production Tube Wells (PTWs) and District Metered Area (DMA) shall be based on the use of Programmable Logic Controllers (PLCs). The various modes of controls shall be (i) Auto, (ii) Semi-automatic and (iii) Manual.

The optimal operation of the system shall be achieved by well-coordinated application of

- a) Hydraulic monitoring and control
- b) Process monitoring and control
- c) Equipment monitoring and control
- d) Emergency responses
- e) Minimizing energy, chemical and labor costs

The following control systems shall be based on the use of Programmable Logic Controllers (PLCs):

- a) Water transmission system at PTWs
- b) Chlorine feed system / Water quality monitoring and control system
- c) Power receiving and distribution system

Note: The PLC software and control system hardware shall be designed to allow an upgrade to fully automatic control in the future, but the control system for Phase 1 shall be configured to allow semi-automatic or manual control only.

Semi-automatic control shall be defined as an automatic control sequence that must be manually initiated to start.

There shall a Local PC based supervisory control and data acquisition (SCADA) system with its control center in the Main Control Room in Administration Building. Remote monitoring and limited remote operation capabilities shall be provided from this local SCADA system. This local SCADA system shall be configured to interface with a Master SCADA system serving the water supply network.

In the event of failure of the automatic sequencing or by operator choice, it shall be possible to revert to manual operation of each item of Plant independent of the PLC functions, based on the hard wiring of essential relays, measurements and control switches as specified in the

respective unit's Functional Design Specifications (FDS) for operation and control of the individual units.

8.1.1 Control Systems

The control systems shall be designed for the fully automatic operation of the following systems:

- a) Production Tube Wells (PTWs)
- b) Chlorine Feed System
- c) Each Electrical Substation and Generators

The fully automatic control systems referred to in the above paragraphs shall be configured for semi-automatic operation (manual initiation of the automatic sequence) in this project.

The control systems shall be designed to recover fully to a normal operational state on restoration of power, following a power failure, without manual intervention. This requirement includes recovery from a High Voltage Panels (electrical supplied panel) failure as well as the control system power failure (i.e. this requirement refers to a real failure of power to the control system, as would be experienced if the control system UPS were not functioning)

In the event of a power failure, from the local utility's supply, or a failure of the semi-automatic controls, systems operating in the semi-automatic shall not be restarted automatically, but their failure condition shall be alarmed to signal the need for a manual restart.

The field instrumentation shall also form an integral part of the control system and shall be configured by a system integrator.

8.1.2 Design Requirements of Instrumentation and Control System

Basic Design Features

Instrumentation, control, automation Human-Machine Interfaces (HMIs) and SCADA system shall be designed, manufactured and installed to achieve the following basic requirements:

- a) To maintain the highest standards of availability, reliability and accuracy and to give clear warnings of any deterioration in performance.
- b) To suit the abilities of the staff who will use the systems and service the systems
- c) To measure, indicate process, store and control the relevant parameters, as specified.
- d) To give clear warnings of dangerous and other abnormal conditions and to initiate plant safety procedures, shutdowns and corrective measures as specified to assure the safety of Operations and Maintenance (O&M) personnel and PTWs and to store and collect the data, as required.
- e) To derive, present and utilize, as required, such additional data as required to facilitate:
 - i. The most efficient operation of the plant
 - ii. The routine maintenance of the plant

General Requirements

The Instrumentation and Control systems shall be designed, manufactured, installed and tested by an experienced system integrator to ensure high standards of operational reliability.

Instruments mounted in the field and in panels shall be suitable for continuous operation. All electronic components shall be adequately rated and their circuits shall be designed so that a change in component characteristics shall not affect plant operation.

All Instrumentation and Control (I&C) equipment shall be new, of proven design, of a reputed make, and shall be suitable for continuous operation. Unless otherwise specified, all instruments shall be specifically designed for the hot humid conditions prevalent in Dhaka city. The outdoor equipment shall be designed to withstand tropical rain and temperature variation from 0°C to +60°C. Wherever necessary, exhaust fan, dust and waterproof cabinets shall be provided. Instruments offered shall be complete with all the necessary mounting accessories. The control equipment installed inside the control rooms shall be designed to function at 45°C and the instruments in sheltered places outside the control room shall be rated for 60°C.

Instruments shall be having the following basic design attributes:

- a) Electronic instruments shall utilize solid state electronic components, integrated circuits, microprocessors, etc., which shall be of proven design.
- b) For transmitting instruments, the output signal shall be a 4~20mA DC linear signal in a two (2) or four (4) wire system.
- c) Unless otherwise stated, overall accuracy of all measurement systems shall be $\pm 1\%$ of measured value, and repeatability shall be $\pm 0.5\%$.
- d) The performance of all instruments shall be unaffected for a $\pm 10\%$ variation in power supply voltage and a $\pm 5\%$ variation in frequency, occurring simultaneously.
- e) After a power failure, when the local utility's power supply resumes, the instruments and associated equipment shall start working automatically.
- f) The instruments shall be designed to permit maximum interchange ability of parts and ease of access during inspection and maintenance.
- g) Unless otherwise stated, field mounted electrical and electronic instruments shall be weatherproof protected for ingress to IP 65 standard.
- h) The instruments shall be designed to work at the extremes of the ambient conditions of temperature, humidity, and chlorine contamination that may prevail. The instruments shall be protected against corrosion.
- i) All wetted parts of sensors shall be made out of non-corrosive materials capable of operating with the chlorine content in the fluid being measured at 5 ppm.
- j) Lockable enclosures shall be provided for the field mounted instrument.
- k) All field instruments and panel-mounted instruments shall have tag plates permanently attached to them.
- l) For all instruments (transmitting analogue signals) installed in the field, Surge Protection Devices (SPDs) shall be provided at both ends of the connecting cable for the protection against static discharges, lightning and electromagnetic interference.
- m) Pressure transmitters shall be provided with a two (2) valve manifold and a test port, so that in-situ calibration can be performed.
- n) Two wire transmitters shall be provided with on-line test terminals.

- o) The ranges of all instruments shall be suitable for their specific application in the process, plus an allowance for an additional 25% of scale.
- p) Instruments of similar type shall be of same make by a single manufacturer to simplify the inventory of spares, and for the standardization of maintenance and training.
- q) The local SCADA system shall be housed in an air conditioned, dust free Control Room.
- r) Local manual controls shall be located adjacent to the equipment for which they are associated, to facilitate operation, maintenance and troubleshooting.

All RTU's equipment essential for the continuous operation of the plant shall be provided with at least one (1) installed standby (i.e., PLC's CPU, power, and communication module Redundancy).

Erection Requirements

Locally mounted instruments shall be installed on appropriately sized rigid supports, designed to transmit minimum vibrations. The instruments shall be installed away from hot objects.

Instruments shall be protected against physical damage or liquid splashing by providing metallic or fiberglass enclosures or canopies.

All transmitters and transducers shall be installed nearest to the sensing point and at a place convenient to access for maintenance. Field instruments (i.e. the instruments mounted outside of a control panel) shall be mounted at a convenient height of approximately 1.5 m above grade or finished floor level.

While installing an instrument, provision shall be made to carry out in-situ calibration.

Instrumentation cables shall be separated from electrical cables. The instrumentation cables from the field mounted instruments shall be terminated on the control panel without any joints. Double compression glands shall be used for sealing the cable in field instruments and in the instrument control panel.

A non-corrosive metallic tag number plate shall be provided for each instrument.

8.1.3 System Architecture

The main control room located in the Zonal Office Buildings shall provide the primary operator interface with the Remote Terminal Unit (RTU : PLC based) systems and other field instrumentation for real time data acquisition and control functions. The main control room monitors all Production Tube Wells. It shall provide the following functions:

- a) Status information of process equipment, automatic sequencing and primary elements.
- b) Plant-wide alarm reporting
- c) Limited supervisory control of plant processes
- d) Printing operational reports and graph
- e) Real time trending of process variables

The unit control station consists of a PC with monitor, keyboard & printers. All plant operations are through keyboard & monitor. The SCADA Server maintains I/O & control database for the system and coordination of all system functions.

Area Control Stations (at each RTUs)

RTUs shall be installed in and configured to interface with the 4 important areas:

- a) Production tube Wells (Water Pump Station): 72 Location
- b) Each Electrical Substation
- c) Remote Access (Future)
- d) District Metered Area.

All field devices shall be connected to their respective RTUs through I/O modules. RTUs shall be interconnected on dual redundant data highway lines and wireless network.

Real time control of all field devices such as pumps, valves etc. shall be achieved through RTUs for implementation of interlocks, safety startups and shutdown.

Monitoring and control is possible locally through the RTU's panel view in case of SCADA failure.

Operator Workstations

An operator workstation / terminal shall be provided at each area control station. This terminal shall be connected directly to the RTU liable to only control functions of the concerned area.

Local Control Panels

Local control panel is provided in the form of direct manual operation at the field via conventional push buttons, selector switches, etc. mounted near the ancillaries. The local control is independent of the PLC, even if they share the same control panel, so that plant can be operated manually if the PLC fails.

Quality Assurance

- A. All equipment shall be suitable for installation and continuous services in the ambient conditions at the job site.
- B. All equipment of a similar type shall be supplied from a single manufacturer to ensure common spares, operations and maintenance procedures.
- C. All hardware and software proposed shall have been successfully proven in a similar water application for a period of at least two (2) years and be from established and reputable suppliers.

8.1.4 SCADA System

SCADA System Design

The SCADA system shall be provided with open system standards, windows based supervisory, control and data acquisition software and shall support industry standard protocols for third party interfacing required in future for connectivity to the master SCADA system. The software package chosen shall be a market leader and have a proven record of use within the water supply industry for similar applications.

The PC based SCADA system shall provide the following facilities and functions:

- A. Provide color graphic screen representation for each zonal office and process system.

- B. Display the status of PTWs in a graphical and tabular format (i.e. running, stopped, fault etc.)
- C. Display analog values on the appropriate graphic screen (display shall change color when in fault conditions or when data is suspect)
- D. Display status and values at other downstream PTWs as required.
- E. Annunciate alarm associated with the area of zonal office concerned including details of the time the alarm occurred and the time it was acknowledge.
- F. Provide facilities for the operator to:
 - 1) Display and adjust process set points
 - 2) Select process control modes
 - 3) Provide all other facilities required for operation on the plant
 - 4) Acknowledge alarms
 - 5) View a journal of unacknowledged alarms
 - 6) View a journal of the last 200 alarm acknowledged and unacknowledged
 - 7) Provide real time and historic trending of local analogue values
 - 8) Issue commands for start-stop operation of major equipment (where authorization has been given)
 - 9) Issue commands for opening or closing of motorized valves
- G. Provide data archiving of all local analogue values.
- H. Prepare daily, weekly and monthly reports (providing details of daily, weekly and monthly throughputs against the number of running hours and power usage, chemical consumption, etc.)
- I. Display a total running hours log of major equipment items.
- J. Power monitoring using various analog and digital inputs provided from the each of HV, LV switchgear as noted in the I/O list:
- K. Security systems shall be provided to prevent unauthorized adjustment of process set points and unauthorized control of major equipment items.
- L. On-line data monitoring and control.
- M. Provide a database for both real time and historical data management.
- N. Allow safety tagging and interlocking operations.
- O. Allow PLC program uploading and downloading.

Master Station/Central System – Hardware

A. Computer

The system shall support hardware and software interconnectivity to other networks in accordance with the ISO Open System Interconnect (OSI) reference model.

Engineer terminals and plant Operator Station (OS) shall be RISC based and shall be similar throughout.

B. Redundancy

The SCADA shall be supplied with dual redundant servers and suitable proven software to ensure high system availability and to prevent loss of service or data.

C. Visual Display Unit (VDU)

All visual display units shall be 525 mm colour LCD screens, capable of displaying information in alphanumeric, bar histogram, graphical and mimic diagram formats. Monitors shall simultaneously display a minimum of 256 colours from a palette of 16 million colours and be non - interlaced, low radiation, flat screen with no discernible flicker. Display of characters shall be legible and stable on a shadow mask tube, having a resolution of not less than 1600 x 1200 pixels and a refresh rate of not less than 50Hz. The units shall include all the necessary picture controls to adjust the sharpness, contrast and position of the image.

D. Keyboard

The master station keyboards shall be of the standard QWERTY pattern, separate from the VDU, low profile and have non-reflecting surfaces and keys of low intensity to reduce unwanted reflections.

E. Alarm Printer

This printer shall be used for logging of system wide events and alarms shall comply with the following:

Printer type	: Impact Dot Matrix Continuous Feed
Print speed	: 160 characters per second
Paper feed	: Adjustable width tractor feed mechanism
Paper width	: 18 to 38 cm fan fold
Print pitch	: 10 or 12 cpi
Print width	: 132 characters at 10 cpi
Character set	: Full ASCII
Noise level	: < 55 dBA
LAN port	: IEEE 802.3 Ethernet LAN Standards

F. Colour Printer

This printer shall be used to produce colour screen dumps and reports and shall have a sufficiently sized buffer memory such that system performance will not be degraded when the colour printer is operational and comply with the following:

Printer type	: Color Laser Jet type
Print speed	: 80 characters per second (text).
Print speed	: 12 ppm full colour graphics.
Colours	: Compatible with VDU graphics.
Paper feed	: A3 and A4 with auto sheet feeder mechanism and

minimum 50 sheets per tray.

Paper width	: A4/A3.
Resolution	: 1200 DPI.
RAM	: 256 Mbyte
LAN port	: IEEE 802.3 Ethernet LAN Standards

G. Report Printer

Printer type	: Laser Jet type
Print Speed	: 30 pages per minute
Paper feed	: A4/A3 with auto sheet feeder mechanism and minimum 250 sheet paper tray
Resolution	: 1200 DPI
Character set	: Full ASCII.
RAM	: 512 Mbyte
LAN port	: IEEE 802.3 Ethernet LAN Standards

H. Audible Alarm

An audible alarm shall be provided which is initiated by any fault condition arising and silenced on operator acceptance of all fault conditions. An alarm mute function shall be provided to silence the audible alarm without accepting any fault conditions. It shall be possible in the engineer's mode to enable/disable this audible alarm.

I. Data Storage

A hard disk historical data system with removable optical or disk media for archive and backup shall be provided.

The historical data system shall store all alarms with the time of occurrence for one month and the daily average, total, maximum and minimum with time of occurrences for all analogues connected to the system, in addition to their value at the set logging intervals. All events shall be archived in a first in first out buffer for a period of one month.

A high speed back up device with DVD media and automatic back-up system shall be provided for each server, suitable for backing up the whole system on a weekly basis. Archiving shall be fully automatic with non-archived data being overwritten.

Data selected for archive shall be written to removable media which shall be sized to support at least one month's worth of archive data.

J. Un-interruptible Power Supply (UPS) System

There will be a UPS system with sufficient capacity to maintain power to the supplied equipment, its peripherals and process critical instrumentation on a mains power failure for a minimum period of one (1) hour.

In the event of power failure, the master central system shall be supported by the uninterruptible power supplies specified.

The central system equipment shall be programmed to degrade gracefully once UPS power is exhausted or execute a shutdown routine after a pre-set time from the original mains failure.

The UPS systems shall be monitored and a fault in the UPS system shall be accorded the highest priority status.

The FDS shall detail modes of failure and process shutdowns and itemize signals to be supported by UPS.

Power distribution from the UPS in the control room area shall be via floor plate mounted sockets, the design of which will be such as to prevent inadvertent connections of non-system hardware, for example cleaning equipment.

Central System Software Functions

A. General

All necessary equipment will be included for supplying complete software packages to enable the plant to operate as stated in this specification. Provision must be made for the adding of further software tasks as and when required. All software functions shall be user friendly with instruction and messages to aid the operator.

The computers shall utilize a real time multi-tasking and networked operating system with a proven track record in real time distributed process control applications.

It is a requirement that the system be supported by on line configuration and editing of all mimic displays and database.

The system shall be capable of supporting the allocation of plant to zones and these zones may be allocated for the attention of particular OS.

Each Operator Station (OS) and Engineers Terminal shall be a high-performance RISC system with disk storage for all local area and frequently used graphics displays. High resolution, multi-screen graphics, (minimum 1600 x 1200 pixels 256 colour) is required. Operational mimics and other graphics shall be presented in an industry standard GUI format. A minimum of four active windows should be displayable concurrently. Both text and graphics shall re-size automatically to accommodate changes made to the size of a window. Operator interface shall be via low profile minimum 102 key keyboard with associated mouse or track ball pointing device. The system shall be designed to minimize the operator's use of the keyboard. All major functions shall be accessible on-screen through use of the mouse or track ball.

An OS (or Operator Workstation) shall be provided for each process area control center and be connected to the plant data highway. Functionality shall be identical to that of the Main Control Room OS allowing full access to all system functions at the authorized access level. Operator system entry for each area will be Password coded with different levels of entry depending on the level of authority of the operator. Development and Systems level entry passwords will be provided for the Main Control Room (MCR) and Engineer workstations. Each action taken by any operator at any level of entry, or, at any operator

terminal shall be log file recorded, and time and date stamped. Log in and out time and dates will be printed on the control room event logging printer.

VDU mimics will display dynamic colour details of flow rates and pressures, pump status, well levels, alarms, treatment dosing rates, electrical power supplies and other general treatment and plant status conditions. Commands via the operator terminals, will operate in a Graphic User Interface (GUI) working environment using a mouse or track ball pointing device, all requests and commands shall be via icons, whether menu linked or linked to plant control actions. A permanent dynamic alarm banner shall be displayed at the bottom or top of each operator screen. Each control action will be routed through a series of confirmation routines.

The complete system database shall be available to each operator terminal offering pre-configured reports per process area. These reports shall be available for printing in graph or tabular format; dynamic trend displays shall also be available for all analogue flow, level and pressure values. Custom, as well as pre-configured reports and trends shall be available to a higher level of entry. A colour A4 size screen dump printer shall be provided for graph and trend prints.

An operator help utility shall be provided offering help linked to the particular action being carried out by the operator at that time. At least one help screen per screen page shall be available. This facility shall be pre-configured with an option for updating by operators via a password entry. Typical information available shall consist of guides of actions to take under particular plant conditions, general process information and help in operating the telemetry system itself.

B. Display Facilities

The displays shall be user configurable, with the user being able to construct any desired symbol for display. Any display shall appear (excluding historical recall) within 3 seconds of selection and the displayed data shall be updated from the database as information is recovered from the Input Output Processors (IOPs). Alarms shall typically appear within three (3) seconds of being received into the central system database.

The initial application software shall provide for the display pages listed below and any pages necessary for the system to function as a complete entity.

- 1) Mimic displays
- 2) Alphanumeric configuration pages for the complete I/O and IOP's
- 3) Graphic displays
- 4) Trend displays
- 5) Alarm summary tables with date and time
- 6) Alert summary with date and time
- 7) Event logs of past seventy-two (72) hours with date and time
- 8) Tabular display of data
- 9) Inset windows showing analogue trends may be mixed with mimic displays. In such a display the main mimic and inset trend shall all be live with automatic display updates

10) Pan and zoom facility with automatic de-cluttering on zoom out

Indexing of information and menus shall be presented in the form of active windows on the screen while the mimics etc. are still available for view.

No display or function shall affect the logging / monitoring of data. It shall be possible for the master station terminal and auxiliary terminals to perform different tasks within the displays simultaneously.

The system shall support full Pan and Zoom graphic display facilities.

C. Plant Control

The system shall support a high security plant control facility. This should be password based and work on a select, check-back and execute philosophy of operation.

D. Data Archiving

Continuous process (analog) data, digital event states, alarms and operator actions shall be archived to a removable read/write optical disk system. The archive media shall be sized to store logged analogue data, at a maximum sample rate of 15 minutes, for a period of 15 months. Data recording shall be on dual media. The archive system shall generate an alarm when a file is 90% full.

Analogues will be stored at a rate selected by the operator in the range 1 minute to 1 hour. The operator shall have the facility to select the way in which an analogue is stored, the system will provide any combination of the following:

- 1) Instantaneous value
- 2) Average value
- 3) Maximum value
- 4) Minimum value
- 5) Not stored

Maximum, minimum and average values shall be calculated over a period set by the operator in the range 15 minutes to 24 hours, the default shall be 1 hour.

The logging of new data and reception of alarms must be carried out at the same time as the operator is viewing archived data. Any alarms received must be displayed as an overlay on the visual display unit.

E. Data Archiving

Continuous process (analog) data, digital event states, alarms and operator actions shall be archived to a removable read/write disk system. The archive media shall be sized to store logged analogue data, at a maximum sample rate of 15 minutes, for a period of 15 months. Data recording shall be on dual media. The archive system shall generate an alarm when a file is 90 percent full.

F. Mimic Displays

All the mimics to provide total detailed coverage of the monitoring and control of plant as detailed in this specification. It is expected that display modifications will be required in

the future and therefore the ability to change the displays without programming skills is essential.

Instrumentation shall be displayed using ISO standard symbols. For mimic configuration it shall be possible to call up a library of standard symbols representing items (e.g., pumps, valves) and add new symbols to the library. Building mimics shall be simple and be achieved by using a mouse or tracker ball pointing device. The mimic displays shall consist of the following pages:

- 1) A general diagram covering the whole of the system on a single screen with key data.
- 2) A general block diagram for each site or area of site showing the plant displayed on a series of single screens with key data.
- 3) Mimic of the plant and instrumentation connected to each IOPs displayed on as many screens as necessary.

G. Tabular Representation of Data

It shall be possible to put any data into a tabular format, with the data entered in row or columns. The user shall be able to add headings to any of the rows or columns and store the table as a blank for later use.

H. Trend Displays

It shall be possible to plot dynamically updated real time data and archived data on a line graph to represent analogue or digital information. Each graph shall be capable of displaying 4 plots overlaid on a graph of different colours and line texture. By the graph there shall be a key relating each colour to its function. The horizontal axis shall be time based and user selectable in minutes, hours, days, weeks, etc. together with a start time.

The vertical axis shall be scaled in units to suit the individual readings and be displayed in the colour of the selected reading. To avoid cluttering the vertical axis scale shall be changed by selecting the individual display. The vertical axis shall be automatically scaled for each selected point between limits entered by the user.

The display of the data shall also be available in tabular form.

I. Manually Entered Data

Some data will need to be entered into the system manually via the keyboard. This data will fall into three types.

- 1) Constants which will be changed infrequently. This data may have time and date associated with it e.g., unit cost of power.
- 2) Variables which will mainly be the results of laboratory testing. This data will need to have a time and date entered manually with the data.
- 3) Maintenance related comments.

J. Manually Corrected Data

The system shall allow an operator to manually correct false data via the keyboard. This data shall include a marker to enable modifications to be highlighted.

K. Reports

There shall be a real time spread sheet facility supplied and installed in the master station. The users shall be able to transfer data from either the archive system or live data to the spread sheet. The user shall be able to produce daily, weekly, monthly and annual reports using any data and a mixture of formats (tables, graphs, summaries, spread sheets). Typical reports would be:

- 1) Power consumption and costs
- 2) Effluent quality
- 3) Total flows
- 4) Failures of each PTW.
- 5) Maintenance schedules

It shall be possible to configure and store blank templates for later use, facilities for editing stored templates shall be provided.

L. Input Tables

Each Input shall have a table covering every characteristic of the input. This data shall be automatically sent to the appropriate locations when the user has completed entering or modifying data into the table. It is essential to compile all input tables as indicated in the input/output schedules, plus any other I/O to enable the complete and optimum monitoring and control of the plant. The user shall be able to modify, amend or create new tables. It is essential to ensure all possible characteristics are included in the table including the following:

- 1) Point identity
- 2) Point description
- 3) Point type
- 4) Point state
- 5) Point range
- 6) Point units
- 7) Status, Alarm and Priority levels
- 8) Alarm set-points : High, Low, Out of Range High/Low
- 9) Log interval : Time between logs
- 10) Log type : Average, Total, etc.
- 11) Log in IOP : For communications failures

M. Output Tables

Each output shall have a table covering every characteristic of the output. This data shall be automatically sent to the appropriate locations when the user has completed entering or modifying data into the table. It is essential to compile all output tables as indicated in the Input / Output schedules, plus any other I/O to enable the complete and optimum monitoring and control of the plant. The user shall be able to modify, amend or create new tables. It is essential to ensure all possible characteristics are included in the table including the following:

- 1) Point identity
- 2) Point description
- 3) Point type
- 4) Point state
- 5) Point range
- 6) Point units

N. Profiling

From an average, typical or manually entered plot it shall be possible to set an exception profile whereby readings within an upper and lower level are acceptable. The user may select for the system to alarm if the reading is outside the profile and / or highlight such exceptions as part of a report and so reduce the need to examine all data to ensure acceptability. The number of exceptions shall be logged.

O. Data Manipulation

It shall be possible to perform simple mathematical functions on any data, including the following functions:

- 1) Addition
- 2) Subtraction
- 3) Multiplication
- 4) Division
- 5) Square root

It shall be possible to log, display or use in a control loop the resultant data.

P. Database Query Facilities

The system shall support the use of database relationships and wild card characters to provide database query facilities. It shall be possible to easily configure queries and save them for future use.

Q. Downloading IOP Configuration

It shall be possible to download configuration to the IOP's from the Engineers Terminal. This facility shall be in addition to any local programming of the IOP.

R. Diagnostics

The system shall have on-line diagnostic facilities to report system faults as they occur. A set of off-line diagnostic routines shall be supplied for more extensive fault diagnosis.

S. Access Levels

The functions available on the system shall be fully flexible so as to allow users access levels to be customized by the System Operator to suit individual user requirements.

Access to management and engineering levels shall be restricted by user selectable passwords or key-switch. The security systems shall be based on a set of privileges which may be granted or denied to individual users by the System Operator.

T. Control Loop and Sequence Programming

The method of programming will depend upon the systems requirements. However, the following standards shall be followed:

- 1) All programs shall be written such that they lend themselves easily to alterations and additions.
- 2) Good programming practice shall be followed using structured programming techniques. All programs shall be tidy in format and logical to follow, and shall be accompanied by flow diagrams. Programs should be extensively annotated with comments and be self-documenting.
- 3) The system shall be supplied with programs that use a high level language for the master station.

U. Program - Documentation

As part of the requirements of this specification full documentation is required as below:

- 1) Software user manuals
- 2) Database point allocation table.
- 3) Complete program listing, flow charts for all sequences and control routines.
- 4) Application software source code.
- 5) End user license agreements.

V. Relational database

W. Maintenance management

X. Management information system and administrative LAN

IOP - Software

The IOP shall be capable of processing locally input plant information before broadcasting it on the data highway to reduce transmission overheads.

Total internal scan time interval for all inputs and outputs in an IOP shall not exceed 100ms.

There shall be two pairs of alarm settings for each analogue input, one an alarm warning of a possible fault, the other warning that the input is outside a valid range of readings.

The IOPs shall have sophisticated in built control facilities to permit control loop configuration using simple building blocks. These blocks shall sequence control, three term control and other control routine components as required by the Specification. The IOP shall be capable of routine signal processing including integration, summation, subtraction and totalization of one or more inputs. Control loops shall incorporate deviation and rate of change alarms, bump-less transfer facility, set point and output high and low limits.

The IOP shall be capable of executing sequential control logic. Programming of sequential control shall be by means of vendor supplied high level function block language or ladder diagram format as a part of an integrated package.

The IOP's shall have standalone capability, able to continue monitoring plant and executing control loops if the communication link to the master station fails. In the event of such a failure the IOP shall log all alarms and required analogues until all the total memory is filled. When the communication link is restored the IOP will automatically upload the logged data to the data archiving system.

The IOP's shall have a watchdog function and full self-diagnostics capable of detecting and reporting faults to the master station and displayed locally.

Data Communications Links

A. Communication Standards

Transmission of data shall conform to a recognized CCITT standard. The data transfer system shall be self-monitoring such that any equipment or line failure shall be displayed at both ends.

B. Site Data Highway

All IOPs, Operator Stations (or Workstations) and Control Room hardware shall be linked by a redundant data highway to transfer data between the master station and IOP. Both links shall transmit all communications at all times. Neither link shall be dormant. The system shall continuously monitor the performance of both links and output an alarm on detection of an abnormal condition.

C. Leased or Private Cable

The system shall have the ability to use leased or private cables to transfer data between the SCADA and the off-site IOP. The modems used shall be of a type approved by the telecommunications authority.

Inputs/Outputs (I/O) Processor

A. All process I/O and plant interface boards shall comply with the following:

- 1) Plant wiring termination's shall accommodate up to 0.9 mm diameter conductors, terminals shall be of the test disconnect type to permit ease of signal isolation and loop monitoring for commissioning and maintenance purposes.
- 2) Hot (powered) replacement of input/output boards shall be possible without special tools.
- 3) Provision to power two wire loop powered transmitters.
 - a) Digital Inputs
 - b) All digital inputs shall be optically isolated.

All alarm and state indications shall be from dry contacts or 60VDC wet contacts. An isolated +24VDC supply shall be provided to source the Optic Isolated inputs when connected to dry contacts, adequate filter circuits and software de-bounce techniques will be necessary. Contact operation shall be as follows:

Alarms in the healthy condition the contacts shall be closed with the relay coil energized; in the alarm condition the contacts shall be opened with the relay de-energized.

States contacts shall be open with relay coil de-energized in the off (logic '0') condition, and closed in the on (logic '1') condition.

Two bit digital one contact shall close when the plant is in one state and a second contact shall close when the plant is in the opposite state.

B. Analogue Inputs

Independently configured channels in the range 4~20mA, 1~5VDC, 0~1VDC, 0~5 VDC, 0~10VDC or +/-10VDC. All analogues shall be screened and segregated from other cables. The signal ground shall be separate from the system ground. Input impedance shall be greater than 1 M Ω . Analog to Digital Converter (ADC) conversion at ten times per second shall be 12 bit, system accuracy + 0.2 percent of span.

C. Digital Outputs

All digital outputs shall be optically isolated.

All control circuits shall operate from a 24VDC supply. The contact will be normally open and energized to close when an action is initiated. Outputs shall be either open-collector or volt-free contacts as follows:

- Open collector: 100 mA at 35 VDC
- Contact : 2A at 60VDC or 120VA (resistive)
0.5A at 60VDC or 120VA (inductive).

D. Analogue Outputs

In general all analogue outputs shall be 4~20mA or 1~5VDC, selectable, and drive a maximum loop impedance of 600 ohms. The signal ground shall be separate from the system ground. Digital to Analog Converter (DAC) conversion shall be 10bit, system accuracy +0.2 percent of span.

E. RTD Input

Capable of receiving 10-ohm Copper or 100-ohm Platinum Resistance Temperature Devices (RTD) directly without external transmitter. Conditioned signal must be capable of being directly accessed by the on board IOP controller without external intervention.

F. Thermocouple Input

Capable of receiving type E, J, K, input directly without an external transmitter. Linearization shall be performed at the IOP without external intervention.

G. Pulse Input

Capable of receiving a zero based pulse or rectangular wave or sinusoidal wave form with amplitude of 4~6 or 21.6~27 volts and rate of 0 to 5000 pulses per second for totalizing, frequency counting and period determination.

Power Supply Requirements

Operating and protection power supplies

All power supplies shall conform to the followings:

- 1) Be comprised of standard available units.
- 2) Be fitted with adequate input/output fuse protection.
- 3) Power supplies to be fitted if applicable with short circuit protection and current limiting facilities.
- 4) All power supplies to be selected such that they are de-rated to allow for future expansion to improve the reliability, and help increase the MTBF of the units. With all the expansion described in this specification the loading on the power supplies shall not exceed 75 percent of their total capacity.

Environment Conditions

A. Temperature and Humidity Range

The equipment shall be installed in an environment having a temperature range of 10°C to 50°C and a relative humidity of 10 to 100 percent (non-condensing).

It is essential to use, where required, fans, heaters, and air conditioning units to maintain a correct working temperature for his equipment.

All parts of the equipment shall be constructed of materials or treated to prevent the formation of mould, fungus or any corrosion over the temperature and relative humidity ranges specified.

B. EMI / RFI Noise Immunity

The plant to be provided shall be adequately protected against interference from the use of the radio transmitters, at any point external to the equipment housings, and no malfunction of the plant shall result from this cause.

C. Generated Interference

It is essential to ensure that the SCADA, instrumentation and communications equipment conforms to relevant standards for noise emissions.

8.1.5 Field Instrument

General Description

- A. This part specifies the panel mounted and miscellaneous instruments and equipment to perform the required functions in conjunction with information and equipment specified in other Parts of the Specifications.
- B. It is essential to ensure that the panel instruments and equipment supplied under this Part are compatible with the primary elements and equipment specified under other Sections of these specifications, and that the signal transmission methods are compatible.
- C. Enclosures of front of panel mounted instruments shall be of uniform design and color scheme wherever possible. Front of enclosure colors shall be compatible with panel colors and subject to final approval by the Employer. Normally, compatible standard colors of the manufacturer shall be acceptable.

Products

General

- A. Instrumentation and control equipment furnished shall be manufactured by a Company regularly and currently engaged in the design and manufacture of similar equipment. All equipment furnished shall be new and of the most recent design.
- B. All equipment shall be designed for ease of maintenance and repair, and access to critical Parts shall not require major dismantling. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.
- C. Materials and installation shall comply with the requirements of the current editions of referenced electrical codes and standards, and the codes and standards referred to shall be used for establishing the minimum quality of the materials and equipment supplied and installed. All equipment of the same type shall be products of the same manufacturer.
- D. Manufacturers shall test and calibrate each input/output to operate within specified limits calibration and compliance certificates provided by the manufacturer, shall be authenticated by the manufacturer and submitted to the employer.

Analog Analyzer

- A. General : Analyzer shall be provided as required for process monitoring and control as follows:
 - 1) Suitable for 220VAC or 24VDC power source
 - 2) Control panel rate NEMA 4X(IP65 or IP66) with stainless steel construction equipped with LED or LCD indication of measured value
 - 3) Compatible with service temperature, pressure, humidity, and atmosphere
 - 4) Produce 4~20mA analog signal, that is linear to measured parameter
 - 5) A sunshield shall be provided for control panel located outdoors
 - 6) Calibration : All instrumentation shall be factory-calibrated and calibrated by a qualified manufacturer's representative in the field
 - 7) Rate for Class I, Division I or Class I, Division 2 for explosive atmospheres per NFPA 820
- B. Residual chlorine : Shall be provided as required to sample chlorine residual as appropriate for controlling chlorine residual and shall be :
 - 1) Amperometric or colorimetric type for measuring total chlorine or free residual chlorine as needed for the process
 - 2) Designed for 30 days of continuous, unattended operation
 - 3) Performance requirements:
 - a) Measuring range : 0 to 5mg/L free or total residual, as required
 - b) Accuracy : ± 5 percent of reading or ± 0.035 mg/L
 - c) Repeatable : ± 5 percent or 0.005mg/L
 - 4) See Field Instrument Equipment List
- C. pH Analyzers : Shall be provided to measure pH and shall be:

- 1) Potentiometric measurement probe type
 - 2) Automatic temperature compensation required
 - 3) Performance requirements:
 - a) Measuring range : 0 to 14 pH units, as required
 - b) Accuracy : ± 0.01 pH
 - c) Stability : ± 0.01 pH/month
 - d) Repeatability : ± 0.01 pH
 - 4) See Field Instrument Equipment List
- D. Turbidity Analyzers : Shall be provided for process monitoring and control as need and shall be:
- 1) Incandescent or LED type suitable for continuous monitoring
 - 2) Equipped with NEMA 4X operator interface that provides data logging up to 30 days and transfer capability to SCADA
 - 3) Performance requirements:
 - a) Measuring range : Low Range 0 to 10 NTU, High Range 0 to 100 NTU
 - b) Accuracy
 - i. ± 2 percent of reading or ± 0.020 NTU (whichever is greater) from 0 to 40 NTU
 - ii. ± 5 percent of reading from 40 to 100 NTU
 - c) Resolution : 0.001 NTU
 - d) Repeatability : Better than ± 1.0 percent of reading or ± 0.002 NTU, whichever is greater
 - e) Response time
 - i. Initial response in 1 minute
 - ii. 15 seconds with internal bubble trap.
 - 4) See Field Instrument Equipment List

Pressure Measurement

- A. General : Pressure measurement shall be provided as needed to monitor and control process equipment and piping in accordance with this section
- B. Pressure Indicating Transmitters shall be:
 - 1) Designed such that process fluid is isolated from the sensing elements
 - 2) Produce 4~20mA analog signal that is linear to measured parameter
 - 3) Equipment with transmitter that have:
 - a) Self-diagnostics and electronically adjustable span, zero, and damping
 - b) Integral temperature compensation
 - c) Over-range protection to maximum line pressure
 - d) Type 316 stainless steel mounting bracket

- e) LCD digital indicator in unit of kg/cm²G
- 4) Performance requirements:
 - a) Measuring range : Suitable for measurement over the specified pressure range
 - b) Reference accuracy : Plus or minus 0.075 percent of calibrated span, including effects of hysteresis, nonlinearity, and repeatability
 - c) Total performance accuracy : Plus or minus 0.30 percent of calibrate span, including reference accuracy effects, static pressure, and ambient temperature effects
 - d) Stability : Plus or minus 0.15 percent of upper range limit over five years
 - e) Type 316 stainless steel mounting bracket
 - f) LCD digital indicator in unit of kg/cm²G
- 5) See Filed Instrument Equipment List

Temperature measurement

- A. General : Temperature measurement shall be provided as needed to monitor water temperature as well as for control of process equipment and piping in accordance with this section
- B. Resistance Temperature Detector / Transmitter shall be:
 - 1) 100-ohm, 3-wire or 4-wire, hermetically sealed, platinum type
 - 2) Temperature Detector with Integral transmitter
 - 3) Sensor housing shall be 316 stainless steel
 - 4) Produce 4~20mA analog signal that is linear to measured parameter
 - 5) Performance requirements:
 - a) Measuring range : Suitable for measurement over the specified temperature range
 - b) Accuracy : ± 0.2 percent of adjustable range span
 - c) LCD or LED digital indicator in unit of centigrade($^{\circ}$ C)
 - 6) See Filed Instrument Equipment List

Surge Protector Devices (SPD or Ar)

Two (2) Surge Protection Devices (SPDs) shall be provided for each signal loop and power loop for field instruments located outdoors. One SPD shall be provided in the field near each transmitter and the other shall be mounted in the control panel. The SPDs shall be suitable for withstanding the surge arising out of high energy static discharges and lightning strikes and shall protect the instrument from any damage.

SPDs shall provide three (3) stages of protection through a quick acting semiconductor like tranzorb, zener diodes, varistors and an automatic disconnect and reset circuit. The SPDs shall be passive units and shall require no power for operation. During the occurrence of a surge the SPD shall clamp on the allowable voltage and pass the excess voltage to the ground.

The SPDs shall be of self-resetting type to minimize the down time of the measurement loop. The SPDs shall have a weatherproof casing and shall be suitable for field or back of panel

mounting. There shall be total isolation between the input, output and ground terminals. Each SPD shall have a minimum surge rating of capacitance following:

- A. Main Power Line : 100kA(8x80 μ s)/mode
- B. Instrument Power Line : 20kA(8x20 μ s)/mode
- C. Signal (4~20mA) : 10kA(8x20 μ s)/mode
- D. Communication Line : 10kA(8x20 μ s)/mode

Power Supply Unit (PWS)

The power supply unit shall be designed to stabilize DC power for instruments and to be installed in the auxiliary relay panels or monitor and control panels. The output voltage setting accuracy shall be $\pm 1\%$.

The unit shall be designed to short circuit and have an over current protection device with low-voltage alarm device.

Power supply unit shall have a rating of 150% of required power.

Distributor (DX)

The distributor shall supply power to two-wire transmitters, receiving units and convert a 4 to 20 mA DC signal to a 1 to 5 VDC output signal. Isolation between input/output and distributor power supply shall be provided.

The accuracy shall be $\pm 0.2\%$ of full scale.

The distributor shall have as spares, at least 120% of the required units.

The distributor shall be provided and installed in the auxiliary relay panel or monitor and control panels.

Signal Isolator (Si)

The signal isolator shall be provided as required to ensure system compatibility and shall be either field-mounted or back-of-panel.

Each signal isolator for input/output signals and signal/power supply shall be completely isolated.

Uninterruptible Power Supply (UPS)

General

- A. This specification sets out the requirement of the UPS system. The work comprises the supply and installation of all services, equipment, components, accessories and fittings required for the operation of the UPS system.
- B. An uninterruptible Power Supply (UPS) shall be provided to power communications, RTUs, Field Instruments, and critical instruments only, UPS shall be evaluated for emergency exhaust system associated with chemical feed systems.
- C. Each panel furnished with a Programmable Logic Controller (PLC) shall have one UPS. The UPS shall be true double conversion, on-line unit with total harmonic distortion of less than 2.5 percent.

- D. The UPS shall comply with IEEE Standard 519 with the point of common coupling defined as the panel board feeding the UPS and be designed to provide battery backup power for a minimum of one (1) hour under full load.
- E. UPS shall have discrete output to the RTUs indicating "UPS on battery power" and "UPS low power."
- F. See SCADA System Equipment List

Quality Assurance

- A. The equipment to be furnished shall be new and shall be a standard product of a manufacturer experienced in the design, fabrication and construction of UPS systems. The manufacturer shall demonstrate to the Engineer from operating installations of equal or larger capacity utilizing equipment such as herein, that all the features and appurtenances of the equipment will operate satisfactorily for the purposes intended. All equipment furnished under this Section shall be demonstrated to the satisfaction of the Engineer that the quality is acceptable.
- B. The Tenderer shall submit a list of customers to whom this equipment has been supplied, with dates and value of contract.

Battery Power Supplies

- A. Battery power supplies shall be suitable for operation with the battery system and voltage specified. The battery charger assembly shall be solid state constant potential incorporating a Self-protecting current limiting feature for protection against low battery voltage short circuit or reverse polarity connection to the batteries.
- B. The charger shall have controls for:
 - 1) On/Off
 - 2) Float/boost charge and indication of:
 - 3) Automatic high-rate charge
 - 4) Rectifier failure
 - 5) High DC voltage
 - 6) Low DC voltage
 - 7) Battery voltage
 - 8) Output current.
- C. Volt-free contacts shall be provided for remote signaling of common alarm.
- D. The charger shall incorporate an automatic high-rate charge circuit to be initiated manually or by operation of the rectifier current limit for a period of time. This shall automatically bring the battery system, over a site adjustable time period, to float charge level.
- E. Batteries shall be nickel cadmium sealed pocket type designed, constructed and tested in accordance with IEC 623.
- F. Batteries shall be contained within translucent impact resistant flame retardant polypropylene cases. They shall be designed for low maintenance and shall have a life in service of at least 20 years.
- G. The batteries shall be suitable for use on switchgear and circuit protection applications.

- H. Batteries shall be housed within the battery charger enclosure or within a separate battery enclosure. The cells shall be arranged in tiers to enable a rapid visual check of electrolyte level and access for maintenance. Terminals shall be shrouded to prevent accidental contact. The battery enclosure shall be corrosion resistant and ventilated to prevent the build-up of gases.
- I. The battery installation shall be supplied complete with all tools etc necessary for the safe and efficient maintenance of the batteries.
- J. Warning notices shall be provided for wall mounting to warn of the presence of charge gases.

Un-interruptible Power Supply

- A. The UPS shall be floor mounted, self-contained and metal clad and shall be suitable for supplying a non-linear load. It shall be possible to open the enclosure front door when the unit is in use without exposing any live contact to touch.
- B. The UPS shall be an on-line type incorporating a six pulse rectifier and pulse width modulation inverter technology with microprocessor control. It shall incorporate a static bypass switch which shall operate in the event of UPS failure, overload or manual initiation in order to transfer the output supply to mains without disturbance to the output supply. The UPS shall incorporate a DC under voltage trip circuit to electronically trip the UPS output in order to protect the batteries.
- C. The noise level of the unit shall not exceed 60dB(A) at 1 m from the UPS cabinet.
- D. The output of the inverter shall be a sine wave having less than 2 percent THD for linear loads and less than 4 percent for 50 percent nonlinear load. It shall be suitable for load power factors 0.7 lag to 0.9 load.
- E. The unit shall have a dynamic response such that a 100 percent step load causes an output voltage transient of less than ± 4 percent with a recovery time of less than 4 ms.
- F. For three phase output units the output voltage shall not vary by more than ± 1 percent for an unbalance of 10 percent.
- G. The load crest factor shall not be less than 3:1.
- H. The efficiency at full load and 0.8 power factor shall be greater than 88 percent.
- I. The unit shall incorporate a monitoring and diagnostics system to provide an audible alarm to provide warnings and fault indication.
- J. The following parameters shall be monitored:
 - 1) Inverter output voltage
 - 2) Battery voltage
 - 3) Static bypass voltage
 - 4) Output current
 - 5) Inverter output frequency
 - 6) Available battery bridging time at rated load
 - 7) Available battery bridging time depending on actual load
- K. Indicators to indicate:
 - 1) UPS status

2) UPS alarm conditions

- L. It shall be possible for operations and maintenance personnel to determine the cause of UPS failure by viewing a fault annunciation display or by interrogation of a 'user friendly' integral keypad and display unit.
- M. The UPS shall have an emergency power off facility. This shall be operable both locally and remotely. A 24VDC emergency shut-down relay shall be provided to accept the remote shut down signal.
- N. The UPS shall be required to be manually reset after operation of the emergency shutdown.
- O. The UPS shall provide a volt free contact output to indicate:
 - 1) Warning, i.e. low battery capacity
 - 2) Fault
 - 3) Static bypass in use
- P. The UPS shall have an overload capacity of 150 percent for 30 seconds and shall be protected in the event of a short circuit of the output.
- Q. The radio interference level shall be equal to or better than suppression degree 'N' as defined in VDE0875.
- R. The batteries shall be housed, either within the UPS enclosure or within a separate matching battery cubicle suitable for location adjacent to the UPS.
- S. The batteries shall be of the maintenance free sealed for life lead acid type.
- T. Batteries shall be contained within translucent impact resistant flame retardant polypropylene cases. They shall be designed for low maintenance and shall have a life in service of at least ten (10) years.
- U. The cells shall be arranged in tiers to enable a rapid visual check of electrolyte levels and access for maintenance. Terminals shall be shrouded to prevent accidental contact. The battery enclosure shall be corrosion resistant and ventilated to prevent the buildup of gases.
- V. The battery installation shall be supplied complete with all tools etc. necessary for the safe and efficient maintenance of the batteries.
- W. Warning notices shall be provided for wall mounting to warn of the presence of charge gases.
- X. The battery supply to the UPS shall be via a fused load break switch disconnected circuit breaker.
- Y. The battery recharge time to 90 percent of full charge shall be approximately ten times the discharge time at full load.

AC Power Supplies

- A. AC stabilized power supplies shall be based on the Ferro-Resonant, Saturable reactor transformer principle. They shall provide a regulated and filtered voltage power supply.
- B. They shall be maintenance free and have a short circuit current limit of 2 times rated current.
- C. Output voltage regulation shall be better than ± 1 percent for steady state and ± 3 percent for transient input voltage variation of ± 15 percent. Harmonic distortion shall not exceed 3 percent.

- D. A change of supply frequency of one percent shall not produce a voltage change in excess of 1.5 percent.

DC Power Supplies

- A. The power supplies will operate from 220VAC, and produce a 24VDC output voltage at full load current.

Voltage regulation : 0.02 percent for ± 10 percent mains voltage variation

Load regulations : 0.3 percent from zero to full load conditions

Ripple at full load : <1 mV rms

Noise : <5 mV to 10 MHz.

- B. The power supply shall incorporate an overvoltage protection circuit, the components of which shall be independent of the voltage regulating circuit.
- C. The protection circuit shall operate within 50ms of an overvoltage occurring, and shall cause rupturing of the mains input or output fuses.
- D. Automatic reset of the overvoltage protection circuit is not permitted.
- E. For a 24VDC power supply, the overvoltage tripping setting shall be 28V.

Execution

Testing

- A. All equipment shall be tested both at the manufacturer's works and on site.
- B. Test certificates or type test certificates shall be provided for all devices.

8.2 Artificial Recharge

According to the "Establishment of Groundwater Monitoring system in Dhaka City for Aquifer System and DWASA Production Wells", groundwater level of these areas has declining at a rate of 1.63 to 3.05 m/year at Upper DupiTila Aquifer and 1.65 to 3.41 m/ year at Lower DupiTila Aquifer in the northern part of the city. In the Southern part of the city have groundwater declining rate of 0.53 to 1.83 m/year for Upper DupiTila Aquifer and 0.65 to 1.59 m/year for Lower DupiTila Aquifer system. To reduce the groundwater declining situation, DWASA has started to construct artificial recharge unit and divert the roof top rainwater to the aquifer under gravitational force.

Scope for artificial recharge from rainwater has already been carried out by DWASA with the technical support of IWM. In 2010, it has been performed at 2 locations and then, in the period of 2015 to 2018, it has been completed in 10 locations at Upper DupiTila aquifer. A prototype design for Artificial recharge unit has been established for DWASA¹.

¹Final Report (2018) Study on Artificial Recharge to Aquifer by Rainwater Harvesting from Building Roof-Tops in Dhaka City; DWASA-IWM, Annex 2.

The components of artificial recharge include recharge pit, filter bed, recharge well, gate valve arrangement, drop pipe connection with roof top, connection of collection network from roof top with flow control arrangement of the system etc. The design components and the component wise cost have been mentioned in details¹.

It is evident from the study that Upper Dupi Tila Aquifer system have potential for artificial recharge from harvested roof top rainwater. Artificial recharge will have a good contribution to reduce the groundwater declining rate as well it will solve the urban flood or storm water drainage congestion problem.

The current study proposing for implementation of 20 numbers of artificial recharge system during the project period and kept probation for increasing the recharge system number in future to reduce the current water level declining rate or at least not to increase further due to implementation of new 71 production tubewell.

It is expected that implementation of rainwater harvesting, and recharge well will bring following benefits to the city:

- Recharge ground water and restore groundwater level and environment
- Preserve and enhance surface water bodies in urban areas.
- Augment supplemental groundwater to city water supply system.
- Divert excess rainfall runoff to aquifer and thereby mitigate urban floods – and drainage congestion.
- Mitigate impact of climate changes in the urban environment.

8.3 Water Quality Improvements (IRP)

In some cases, pollutions in the form of coliforms, harmful metals, and pesticides in both surface and ground water sources in Bangladesh is a general problem. Proper water treatment procedure is normally used to overcome this type of water quality problem. Iron contamination in ground water is another cause of water pollution in Bangladesh. Bangladesh has established drinking water standards of 0.3 to 1.0 mg/L for Iron according to Environmental Conservation Rules, 1997. The Iron content in most of areas of Dhaka city is within the specified limit. Some areas within Dhaka city are found to exceed the limit by larger ratios (for example, in Mirpur areas, Iron concentration has been found as 2 mg/L). To ensure groundwater quality in 16 unions areas, a provision of 71 new IRPs have been considered.

Final Report (2018) Study on Artificial Recharge to Aquifer by Rainwater Harvesting from Building Roof-Tops in Dhaka City; DWASA-IWM, Annex 2.

Working Principle

Effective removal of iron consists of 3 processes: i) Aeration ii) Filtration iii) Backwash and Rinse. Iron occurs naturally in water in soluble form as the ferrous iron (Fe^{2+} or $\text{Fe}(\text{OH})^+$) or complexed form like the ferric iron (Fe^{3+} or $\text{Fe}(\text{OH})_3$). The process through which iron is removed from water is known as Oxidation Filtration that involves the oxidation of the soluble forms of iron (Fe) to their soluble forms and then removal by filtration. This is achieved by raising the pH of water using alkaline materials like NaOH. Under such conditions soluble ferrous iron is oxidized to ferric iron which subsequently forms a precipitate of insoluble iron hydroxide which is removed by filtration. The oxidant chemically oxidizes the iron and kills iron bacteria after that filter removes the iron particles. After the filtration process the accumulated suspended iron particles will have to be removed from the ferrous free unit by sending the water through reverse direction. In reverse direction, the water with sufficient pressure agitates the filter media and takes out all the iron particles through the drain port. Once the backwash is completed, the agitated media is allowed to settle by gently passing the water through the filter media. To ensure sufficient pressure in the IRP chambers, sufficient capacity of booster pump may need to install before the oxidation chamber.

The main components of a 150 m³/hour capacity water treatment plant (IRP) consists of the followings:

1. Oxidation Chamber (OC): Consists of compressor with media, internal distribution system, valves and front pipe network.
2. Iron Removal Filter (IRF): Consists of media (sand and gravel)
3. Activated Carbon Filter (ACF): Consists of pressure vessel and initial charge of media (Gravel, pebble, coarse silex, fine silex, Anthracite).

A schematic diagram of an IRP of 150 m³/hour capacity is shown in Figure 19.

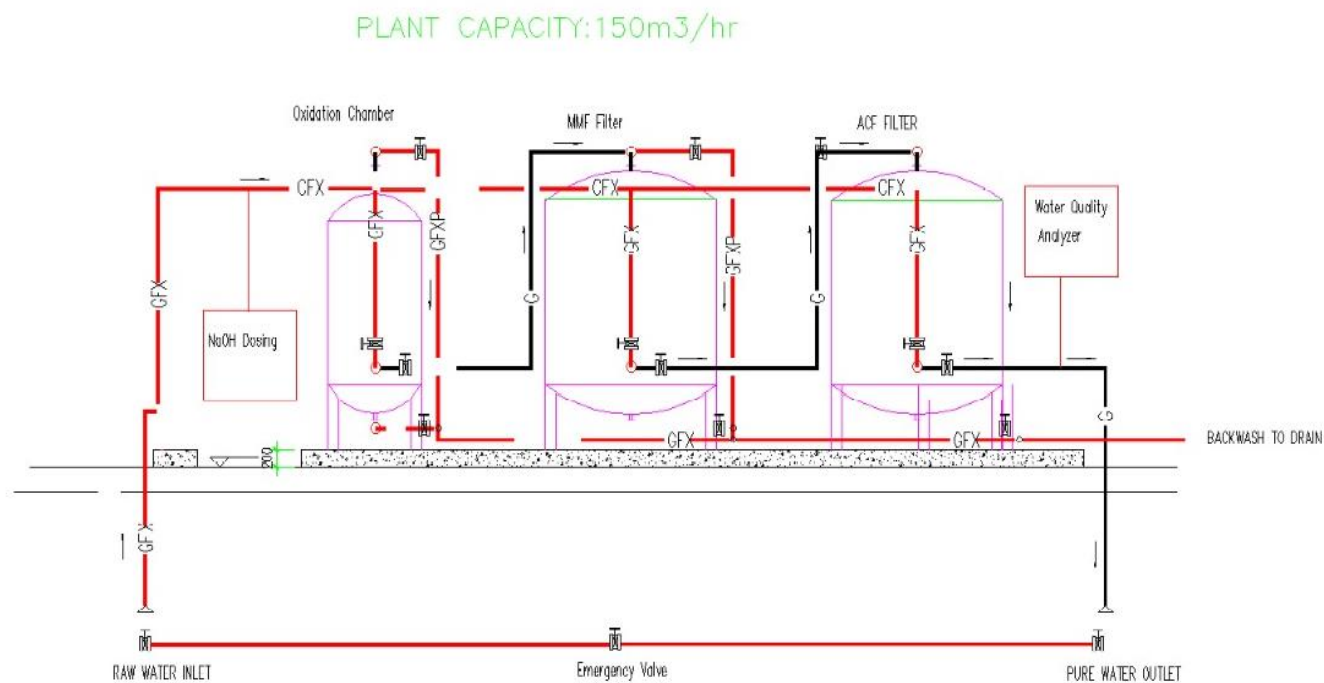


Fig 19: Schematic Diagram of an IRP of 150 m³/hour capacity

Chapter 10: Stakeholders Discussion

Regular meetings and discussions have been arranged with DWASA officials to discuss the project progress and other project related issues. Moreover, several meetings with DWASA MODS Zone were held for better understanding of the existing water supply situation and future plan of MODS Zone. Information for areas to be considered for immediate water supply system development, areas having existing water supply system but with water crisis were identified and visited. Monthly production data of existing PTWs have been collected from MODS Zones.



Figure 20: Meeting with DWASA Officials

Several meeting with real estate housing authorities within the study area have been conducted. The consultants have collected the layout plan and other data required for finalizing the layout of distribution network in the housing areas. Some of the major housing authorities contacted are:

- Bashundhara Group
- Haji M.A Gafur Land Developers

- Eastern Housing Ltd
- ABM Properties Ltd
- Ashiyan Land Developers
- United Group
- Uttaran Properties Ltd
- Sagufta Group
- Rupayan group
- Swadesh Properties Ltd

10.1 Key Informants Interviews (KII)

A total of five Key Informants Interview (KII) sessions were organized within proposed area with DWASA officials, DESCO & DPDC, Titas Gas Transmission & Distribution Company Limited, Department of Environment (DoE) and City Corporation officials. Most of the participants express their opinions regarding the proposed project based on their experiences. They have also informed that their services yet to be provided in some parts of 16 union areas. However, their organizations are also taking actions for providing the services to the remaining areas of 16 unions. Summary of the opinions where they have their services are given below

Opinions obtained from Dhaka Electric Supply Company Ltd. (DESCO) & Dhaka Power Distribution Company Ltd. (DPDC):

DESCO & DPDC authority think that they may have to face some problems during construction phase of the subproject interventions. There are some underground electric line and some low height electric line within the subproject area. Without proper safety measures any kind of accident may occur during pipe laying works & valve chamber construction works. Their advices are as follows:

- During detail design, DWASA design team shall discuss with DESCO & DPDC officials and during design, DWASA design team shall avoid electric line as much as possible.
- During construction works, sometimes power shut down may be required, DWASA will inform DESCO & DPDC local zonal office 5 to 7 days before the work.
- If any electric pole replacement is required, it's better to find out these electric poles during detail design. DESCO & DPDC must be informed minimum 3 months before. Electric pole replacement time will depend on availability of electric pole and DWASA will pay for the replacement work as per DESCO & DPDC electric pole replacement rate.
- During trench cutting works and earthworks for valve chambers, proper sheet piling and slope protection shall be followed by DWASA contractor.



Figure 21: Key Informants Interview (KII) with Engr. Mohammad Shafiqul Islam, Executive Engineer, DESCO, Dhaka, participated in KII sessions

Opinions from Titas Gas Transmission & Distribution Company Limited (TGTDCCL)

- During detail design DWASA design team shall discuss with TGTDCCL pipeline team to collect information about gas transmission & distribution line and during design DWASA design team shall avoid gas lines as much as possible.
- Gas lines should be identified before using ground penetration rudder (one kind of scanner to identify utility line under road surface). DWASA contractor will make sufficient trial holes to identify gas line under road surface before starting pipe laying works.



Figure 22: Key Informants Interview (KII) with Deputy General Manager, Titas Gas Transmission and Distribution Company Ltd.

Opinions came from Dhaka City Corporation

Dhaka City Corporation is very much worried about DWASA' road cutting activities during pipe laying works. The DWASA design team discussed about different issues and summary of the interview is illustrated below

- DWASA will inform City Corporation before construction works of the subproject interventions. If there is any need of road cutting, DWASA will pay City Corporation for road repairing works & after pipe laying City Corporation will repair the roads.
- After pipe laying works every trench shall be filled with fine sand and compaction work must be done properly. Pipe trench within paved road can't be filled with excavated soil.
- If DWASA, in advance, inform the City Corporation about their planning for pipe laying, the City Corporation will be able to prepare their proper road construction planning accordingly.
- The City Corporation authority prefers winter season for road cutting & pipe laying works.
- The engaged contractors of DWASA shall use steel plane sheet for the protection of trenches during pipe laying & chamber construction works within busy roads. After backfilling work of pipe trenches, the same steel sheets will be used to cover pipe trenches and City Corporation will repair the road as early as soon as possible.
- In some cases, the engaged DWASA contractors keep construction materials & equipment within road (experiences from their previous projects). The City Corporation people requested not to repeat the same in the upcoming project interventions. If required DWASA contractor may use City Corporation vacant land to store their construction materials and equipment.



Figure 23: Key Informants Interview (KII) Engr. Saidur Rahaman, Executive Engineer, Zone 3, DNCC

Opinions from Department of Environment

EIA team discussed with DoE official about the proposed project and the Environmental Assessment Report preparation works. Summary of the discussion is illustrated below

- During report preparation EIA team must follow the TOR, which is provided by DoE
- Proper mitigation measures of probable problems and proper monitoring plan should provide within EIA report
- Within monitoring plan, the Environmental parameters shall be specified (air, water, noise etc). DoE prefer 3- or 4-times monitoring (Every year).
- Proper Stockpile (Store for Materials) have to be arranged before starting the construction work
- Proper traffic management plan should be provided.
- Proper safeguard cost is to be provided within EIA report & this cost has to be incorporated within the bidding document.



Figure 24: Key Informants Interview (KII) with Dr. Md Sohrab Ali, Director, Department of Environment, Dhaka

Opinions given by Dhaka Water Supply and Sewage Authority (DWASA)

- DWASA is the host of this proposed project, and will be involved with construction and operation issues of this water supply project.
- DWASA will be involved with material, manpower, equipment, procurement etc. issues for this project
- Contractor's background will be checked rigorously with proper judgment before selection.

- The pipeline work will be done within existing right of way, there will be of no disturbance related to the transfer of temporary dwellers.
- During detail design and construction work of the project DWASA will communicate with DESCO, DPDC, City Corporation, Titas Gas about utility transfer (if required) and road cutting activities during detail design & construction stage
- During construction work periodic monitoring report will be submitted to DoE regularly
- DWASA will incorporate Environmental Safeguard cost within bidding document

10.2 Observations

The newly included 16 unions of DNCC and DSCC has total area of 178.75 sq. Km. All the utility services required for the city dwellers in these areas must be developed simultaneously and in an integrated way. Before development of water supply system, planning and execution for road network, solid waste disposal system, drainage network, electric supply line, telephone line etc. should be developed simultaneously. In the contrary, unplanned haphazard development of localities will occur as was happened in the unplanned old Dhaka City as well as in some newly developed area of the city. As such all the development activities of the utility services necessary for the city dwellers need to be executed simultaneously. Necessary funds to be earmarked and executed as soon as possible. Development of only water supply system will invite similar problems as are existing in future.

Chapter 11: Environmental and Social Impact Assessment

11.1 General

The Environmental study team of IWM has investigated the study area and studied the present environmental status of the area and they also found the probable impacts due to the implementation of the subproject interventions and mitigation measures and the study team also formulated the environmental management plan, the environmental monitoring plan, the environmental safeguard cost to be incorporated in the bidding document. This chapter provides an outline of activities undertaken during ESIA study. However, details are available in ESIA report provided as annex to this report.

11.2 Legislation, Regulation and Policy Consideration

Legislative basis for the Environmental and Social Impact Assessment (EIA) in Bangladesh are the Environmental Conservation Act 1995 (ECA '95) and the Environmental Conservation Rules 1997 (ECR '97). The different activities associated with the Department of Environment (DoE) associated with different categories of project such as Green, Orange-A, Orange-B and Red. The other associated national and international environmental conventions are also triggered during the study and those are National Environmental Policy, 1992, protection of the country against natural disasters; etc. were followed. Other Legislations followed are, The workman's Compensation Act of 1923, the Forest act of 1927, National Fisheries Policy, 1996, Acquisition and Requisition of Immovable Property Ordinance, 1982, Rio Declaration, Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Ramsar (1971) etc. were followed.

11.3 The Project area

The area of 16 union are already within the boundary of MODS Zone 1, 4, 6, 7, 8, 9 and 10. Dania, Shyampur, Sarulia and part of Matuail union are under MODS Zone 7; Manda and part of Matuail, Demra, Dakshingaon union are within MODS Zone 1; Part of Dakshingaon, Nasirabad and Demra union are within MODS Zone 6; Bhatara, Badda, Satarkul, Beraid and part of Dumni and Nasirabad union are within MODS Zone 8; Uttarkhan, Dakshinkhan and Harirampur (part) are within MODS Zone 9; Part of Harirampur is within MODS Zone 10 and another part is within MODS Zone 4. DWASA has service coverage in parts of some of the union like Harirampur, Dakshinkhan, Uttarkhan, Bhatara, Badda, Dakshingaon, Manda,

Matuail, Dania and Shyampur. Most of the remaining areas are currently dependent on private production tube wells. Moreover, community pumps were observed in some areas of Demra and Nasirabad union. The major activities and issues during the construction phase of the proposed 16 union water supply project are (i) Installation of production well (ii) Construction of pump houses (iii) Installation of pipeline (iv) Construction of valves chambers.

11.4 Baseline Environment in the Project area

As part of the Environmental and Social Impact Assessment (ESIA) of water distribution development project in extended new 16 union of Dhaka north & south city corporation under Dhaka WASA, an environmental baseline survey was carried out in project location. The specific objectives of the baseline study were to gather information on the existing physical environment, biological-ecological environment and socio-economic environment; to gather and assess peoples' perception on different aspects of the proposed project in and around the project area. The baseline survey report provides a detailed description of the existing conditions of physical, biological as well as socio-economic environment of the project area. As a part of the baseline survey, different physical features were identified and documented. Relevant data on climate, geology and soils, air quality, noise level, and water quality were assessed. Ecological information in and around the project areas were collected through field research and through consultation. Ecologically Critical Area, Protected Area, National Park, Game Reserve and Wildlife Sanctuary were also searched during the field investigation.

11.5 Socio-Economic Environment of the Project Area

As a part of the ESIA, an assessment of the baseline of socio-economic conditions / attributes of the areas surrounding the proposed project site was investigated. The socio-economic baseline scenario describes the socio-economic characteristics of project area on the basis of primary and secondary data. The socio-economic characteristics include administrative area, demographic, household size, education, occupation, housing, employment opportunity, health, housing, access to water and sanitation status, etc. along with the willingness to pay for the supply water.

11.6 Evaluation of anticipated Environmental Impacts

As a part of the Environmental Impact Assessment (EIA), environmental impacts of the specific project activities on different ecological, physico-chemical and human interest related parameters, both during the construction phase and the operation phase, have been identified and assessed. The environmental impacts of the specific project activities listed above have

been assessed separately for preconstruction, construction and operational phases of the project, with special emphasis on the issues that could generate significant adverse impacts, such as:(i) impacts on physic-chemical environment (air quality, noise level and water), (ii) Ecological impacts (impact on flora and fauna), and (iii) Possible disruption to traffic during the construction phase. This Chapter provides an assessment of the potential environmental impacts specially focusing on these issues and the mitigation measures of the proposed project, during preconstruction, construction and operation phases of the project.

11.7 Analysis of Alternatives

The purpose of this section is to examine feasible alternatives to the project and highlight the benefits of and general rationale for the proposed project that need to be considered against any potential environmental cost. The general principle involved in identifying option(s) to the proposed development is to ensure that the option chosen, which indeed may be the ‘non-development’ option, would result in optimal social, environmental and capital. “No-action” Alternative and Design Alternative were duly considered.

11.8 Environmental and Social Management Plan

Environmental and Social Management and Mitigation Plan summarizes the preventive and mitigation measures during pre-construction/design period, construction phase and operation period.

Table 48: Environmental and Social Management /Mitigation Plan (ESMP)

Environmental Impact	Severity of Impacts	Mitigation Measures
During Pre-Construction Phase		
Legal requirement	Without clearance from DOE, project work may hampered	Environmental Clearance Certificate from DOE before implementation of the project intervention.
Project information	Disclosure of project information before construction	Project authority shall inform local authorities and stakeholders who are the beneficiaries as well as the project affected person.
Land acquisition	Land may be required for the production tube well installation	Obtain land acquisition prior to the commencement of any such construction works.
Environmental clause in the contract	Absence of environmental clause within contract documents will cause problem during implementation	Incorporate environmental clauses in bid and contract document

Environmental Impact	Severity of Impacts	Mitigation Measures
Local conflicts of interest	There may be some conflicts of interest during engagement of laborers during implementation	Local laborers should get priority during engagement of laborers, other than the skill workers required for the subproject
Specific management plan	Hazard at work places and ambient environmental quality is to be ensured	Prior to start of works, Environmental Management plan with proper dust control, noise control, spill management, waste management, traffic management, occupational health and safety, emergency response plan shall be in place:
Start of site works	If there is any social conflict, that should be resolved before works	Establish a Grievance Redress Mechanism (GRM) shall be in the place
Construction vehicles and machinery	Hazard at work places and ambient	Trial run of contractor's vehicles and machinery to confirm effectiveness and controlled noise level etc.
During Construction Phase		
Training for engineers and contractors	Problem may be there without training, of engineers/workers	Provide training on environmental and social safeguard issues to the stakeholders
Transportation	Materials carrying vehicles may damage environment around including physical and social institutions.	Prior starting works, local people should be informed properly, including maintaining timing for carrying construction materials and proper traffic signs shall be there. Proper protection for the pedestrians, school going childrens shall be there.
Work Camps	Absence of proper labor camp will create problems during construction.	The labour-camp will be at the near place of construction, proper waste management for the work camps, proper cooking arrangement, water supply, waste bins, lighting etc. shall be in place
Air Pollution	Moderate: Impacts on air quality during the construction, emission of CO ₂ and NO _X due to combustion of diesel from construction vehicles, diesel generator sets, production well drilling equipment etc.	Exhaust emissions from vehicles and equipment will comply with standards, road surfaces, excavation and construction sites will be water-sprayed regularly, proper silencer to the vehicles/generators, construction material to be kept covered during carrying and stock piling, proper vehicle speed to be maintained etc.
Water Pollution	Pile driving for pump houses, , pile slurry, domestic waste from worker's camp, etc. may damage the environment around	All wastes, slurry, waste water from camp etc. shall be managed properly.
Ground water	The ground water sources may be affected from wastes/ to be generated anyway	Proper management of waste water, spill oil etc. shall be controlled properly

Environmental Impact	Severity of Impacts	Mitigation Measures
Soil Contamination	Surrounding soil may get contaminated from handling of construction materials, slurry, fuel, lubricants, paints etc	Fuel and lubricant storage area will be paved, proper efforts will be to avoid and minimize the solid and liquid wastes generation.
Waste	Moderate: Generation of construction sludge and domestic waste	Segregate organic and inorganic waste at sources and management of wastes properly including recycling with reusable waste
Noise	Increasing noise level during construction works may disturb around.	Timing of construction activities, proper transportation of the construction materials and noisy construction work have to be carried during the scheduled times. Setting muffler or silenser to noise creating machines to be ensured.
Arrangement of stockpile	Proper stock piling is essential during construction period.	Stock piles will have to provide near the construction area with proper fenced to minimize the spreading of dust from air blowing.
Earthwork	Slope, erosion and dust blowing, during earth work	Care to be taken during any excavation work and proper slope protection will have to be provided
Dust	Dust is generated during vehicle movement and excavation works	Construction materials should be carried by the covered vehicle and water spraying in every day, during construction period
Accident	Traffic accident may occur during carrying materials and during excavation works.	Health and Safety Management Plan, accident control and management, proper fencing around worksite etc are to be maintained.
Occupational Health and Safety	Construction workers may be affected for the lack of proper personal protection equipment	Proper personal protection equipment with first aid box shall be in place.
Children's' right	Child workers may be engaged	Regular monitoring of sites shall be done to protect child laborers.
Social Conflict	Project-related traffic and construction activities may cause social conflicts around	Orientation and training will be provided to the contractors, supervisors and workers, on health, safety and environment including sexual diseases control (as of BOQ),
Gender and Vulnerability	Differences in wages may be there for the male and female workers	Proper wage distribution mechanism shall be in place
Impacts of Labor Influx	Conflicts may occur between local and outside laborers, and problems may occur due to outside laborers with the local community	Local people should be employed for the construction works to the maximum extent to control labor influx.
During Operation Phase		

Environmental Impact	Severity of Impacts	Mitigation Measures
Noise	During operation, faulty pump & generator create noise.	During operation, noise from the pumps will be controlled properly.
Waste Water Management	Improper maintenance of waste and grey water handling causes environmental hazards around	People have to use septic tank and sock wells for their household latrines and urineries, proper on-site sanitation, sewerage and storm water drainage system shall be in place
Project management conflicts during maintenance of pipeline and PTWs	May cause accident and conflicts	WASA authority shall manage the maintenance system of pipelines and PTWs as they will collect the supply water charges from the households.

Table 49: Environmental and Social Monitoring Plan

Environmental impact	Means of Monitoring
Pre-construction phase	
Environmental clearance	Verify compliance with the conditions attached to the ECC by DOE
Land acquisition	Confirm the scale of land acquisition, checking compliances of the required land acquisition with the RPF and checking the compensations are completed
Local Conflicts	Confirm that all information about this project are disclosed to local peoples
Labour Shade	Confirm proper place for labour camp and checking that the shades are constructed properly with proper facility
Proper stockpile	Confirm proper place for stockpile
Construction phase	
Air quality	Confirm to minimize dust through spraying water and confirm the change in air quality in the vicinity of the proposed areas every six months
Water quality	Check whether earthworks are undertaken in the dry season, checking the hemical materials and other construction materials are treated properly
Soil erosion	Check the soil protection measures, soil compaction and minimization of vegetation and egular maintenance of the protection measures
Noise and vibration	Checking the construction works are in the daytime and checking the the noise level in the vicinity of the proposed sites every six months
Wastes	Check the construction sites are cleaned and with garbage bins and waste disposal sites are installed properly and waste management works are done properly.
Ecosystem	Check whether conservation measures, such as minimization of vegetation clearance and re-vegetation, are properly undertaken
Regional hydrology and drainage	Check whether construction materials are properly stored to avoid disturbance with proper drainage facilities of surrounding areas.

Environmental impact	Means of Monitoring
Living and livelihoods	Check whether there are people who may lose income sources due to the activities, check the people are informed properly and people are sufficiently informed.
Safety and health	Check whether potential safety hazards and health issues are explained to construction workers and proper safety measures are taken with proper PPE and aid box.
Labour Standards	Checking child labor force and wages of the laborers are in place.
Unexpected impacts	Check whether impacts which have not been considered are caused by the construction works
Post-construction phase	
Environmental Monitoring	Undertake a periodic environmental monitoring on air quality, water quality, noise level, sediments, 6 months after the completion of construction of the works.
Soil erosion	Check the backfilling of trench and road surface and repair when required
Living and Livelihoods	Confirm the perceptions of PAPs on the project construction works
Land acquisition	Confirm the perceptions of PAPs on the water supply improvement Check whether PAPs have any complaint
Safety and health	Check whether safety measures and safety signs are installed properly.
Operation and maintenance	Check whether the production wells and pipelines are working properly

Institutional arrangement for environmental management system: The DWASA, as the executing agency, is responsible for the environmental and social considerations. The Engineers of the DWASA bears the responsibility for environmental and social issues through implementing the BOQ which is enriched with environmental and social safeguard compliances.

Grievance redress mechanism: A grievance can be defined as an actual or perceived problem that might give grounds for complaint. As a general policy, the implementing agency will work proactively towards arising and minimizing grievances through the implementation of impact mitigation measures and community liaison activities that anticipate and address potential issues before they become grievances.

Cost of Environmental Safeguard: In the preconstruction phase, the labor camps are to be constructed with proper cooking arrangement, and with proper waste management system. Adequate supply of potable water for ensuring and sanitation and waste management facilities are to be ensured. Providing First Aid Box with sufficient gauge, bandage, medicines and personal protection equipment. Arrangement of stockpile and materials stocking arrangement

is to be ensured. Providing personal protection equipment (PPE); 300 pairs-hand gloves, 300 pairs-gumboot, 300-approne, 300-eye protecting glass, 300-Helmets etc. During the construction works, the air quality will be tested, dust pollution is to be minimized, noise level shall be maintained and dust pollution is to be minimized through spraying water daily. Surface Water quality and ground water monitoring activities will be in place. Waste management is to be ensured. Noise and vibration will be measured in specified locations. Ecosystem (Flora and Fauna) shall be monitored and Accidents events (if any) are to be managed properly. During the Operation phase, air quality, water quality, noise level, works safety, accident control etc. are to be maintained along with the tree plantation after construction works completed.

11.9 Stakeholder/ Public Consultation

Public consultation has been ensured to know their views about the project, the subproject components, willingness to payment to WASA for the supply water etc. including waste water management and maintenance of the water supply system during operation.

11.10 Emergency response Plan and Disaster Impact Assessment

Disaster can occur due to subsidence, accidents, earthquake, natural disasters occur during construction and proper plan of actions are indicated in the ESIA report.

11.11 Conclusions and Recommendations

The overall objectives of the ESIA were to identify potential significant impacts, both positive and negative, during construction and operation phases of the proposed project, and to recommend mitigation measures to avoid or reduce adverse environmental and social impacts and to enhance positive impacts. Environmental impacts of the specific project activities on different physicochemical, ecological, and socio-economic parameters during the construction phase and in operation phase, have been identified and evaluated. Mitigation and abatement measures have been suggested and an environmental management plan (EMP) has been developed. It has been found that most of the adverse impacts during construction phase could be minimized or even removed if appropriate mitigation measures are adopted as suggested in the EMP. However, a monitoring program needs to be put in place. The Recommendation has been made to implement the project activities.

Chapter 12: Project Implementation and Operation

12.1 Project Implementation Plan

12.1.1 The Executing Agency

Dhaka WASA under the Ministry of Local Government, Rural Development and Cooperatives (Local Government Division) will be the Executing Agency of the project, responsible for the overall technical supervision and execution of the project. A Project Implementation Unit (PIU) headed by a Project Director (PD) will be set up in DWASA. The staffing of the PIU will include expertise in project management, water supply engineering, installation and finance. The PIU will also incorporate all consultancy services under the project including liaison and discussion with the consultants of the other projects of water supply of DWASA.

12.1.2 Implementation Arrangement

The overall coordination, monitoring and guidance on the policy aspects related to the project will be provided by chairperson of the concerned implementation agency i.e DWASA. An inter-ministerial Project Implementation Committee (PIC), chaired by Managing Director, Dhaka WASA will be set up. Its membership will include the Representative from the Planning Wing of the concerned Ministry/Division, Representative from the Development Wing of the Concerned Ministry/Division, Representative from the Concerned Wing/Sector- Division of the Planning Commission, Representative from the Programming Division of the Planning Commission, Representative of NEC-ECNEC & Coordination Wing of the Planning Division, Representative from the Concerned Sector of IMED, Representative from Finance Division, Representative from Department of Environment (DoE), Project Director of Dhaka WASA, Representative from Department of Water Resources Engineering of BUET, Concerned Desk Officer of the Implementing Agency.

Terms of Reference of the PIC will be given as follows:

- To give necessary assistance or suggestion for implementing project activities.
- If any problem arise during project implementation then to give necessary decision to solve the problem.
- The committee will meet at least one in every three months.
- The committee may co-opt members, if necessary.

DWASA will setup a Project Implementation Unit (PIU) headed by a Project Director (PD). The PD will be in charge exclusively with its project execution and will have no other duty with DWASA. The PD supported by the PIU will be directly responsible for overall project implementation, monitoring, supervision, under the guidance of the Deputy Managing Director (RP&D) and will report to the Managing Director. The PIU shall be responsible to process international/ local tenders, issue of work orders for respective packages and the consultants will assist PIU during evaluation of tenders, selection of contractors and suppliers. The PIU will be responsible for day to day management of the project including but not limited to the following:

- Prepare overall Project Implementation Plan (PIP)
- Provide overall construction supervision works of the project components
- Initiate tendering and executing contracts
- Monitor and supervise all project management activities
- Organize monitoring and evaluation activities
- Prepare Project Progress Report (PPR) and Project Completion Report (PCR)
- Ensure full compliance with resettlement, environmental and other safe guard issues and policies.
- The PIU will be assisted by the consultants for design supervision and construction supervision.
- PIU will continue the O&M of the project up to defect liability period and then PIU will hand over the operation and maintenance of the project to the Executive Engineer, O&M Division for proper operation and maintenance of the Project. A proposed organizational structure of operation and maintenance of the project has been given in given in **Figure 27**.

Other responsibilities of the Project Director are handing over site to the contractor. Any dispute arises in the sites for instances, land dispute, access road and the route of the distribution main will be solved by the PD without any delay with the assistance of PIU.

A proposed organizational structure for Project Implementation unit (PIU) has been given in **Figure 25**.

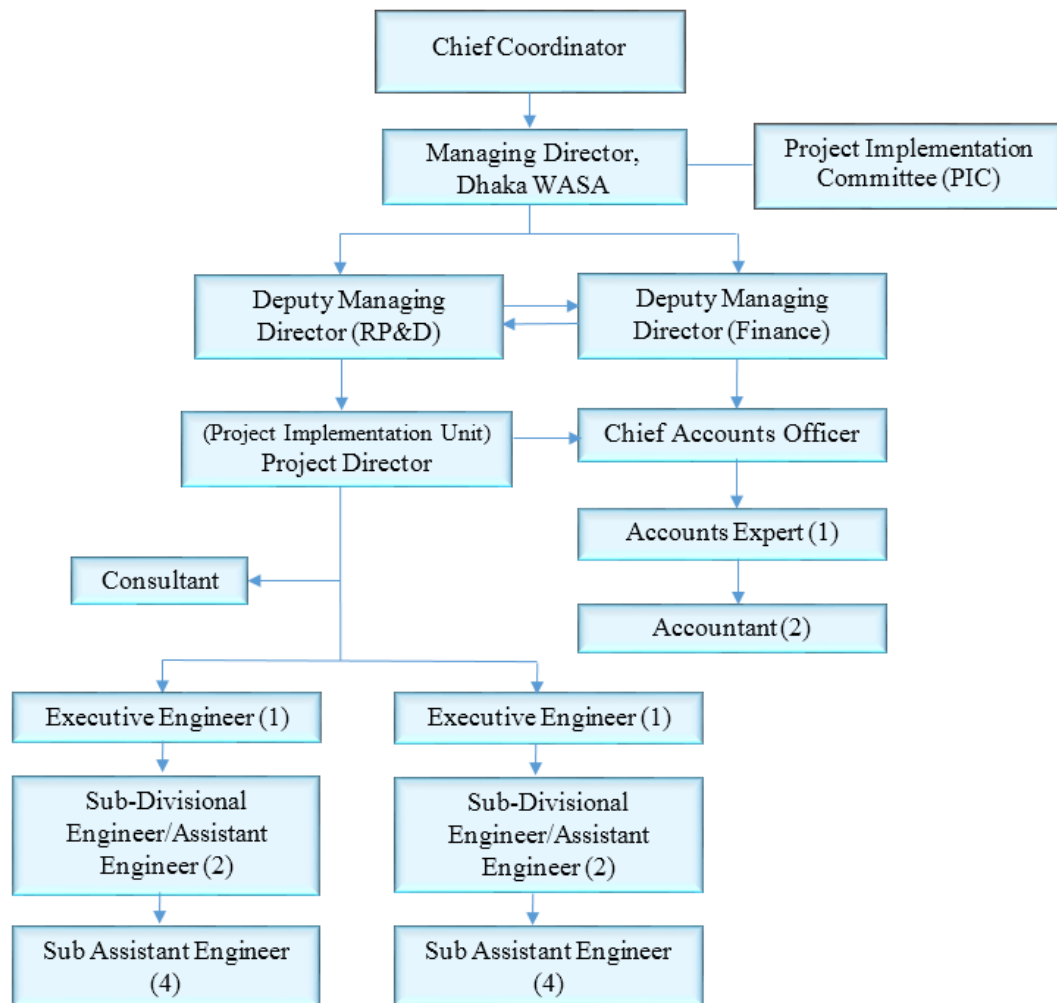


Figure 25: Proposed Organizational Structure for Project Implementation Unit (PIU)

12.2 Proposed Organogram for the Operation of Water Distribution System

DWASA will setup a Unit for operation and maintenance (O&M) of Water Distribution System and Water Pumps by an Executive Engineer. The O&M unit will be responsible for

- a) Procurement of chemicals (chlorine), operation and maintenance of water pumps
- b) Operation and maintenance of distribution network
- c) Providing service connection to the consumers
- d) Receive complains and provide emergency services

Proposed Organizational Structure for O&M unit of the overall water supply system is shown in Figure 27

12.2.1 Staff Position and Duties

A proposed organogram for the Operation and Maintenance of the Water Distribution System has been established in Figure 27. The water distribution system will be operated under an executive engineer. He will be sole responsible for operation and maintenance (O&M) of the water distribution system.

Executive engineer will be assisted by following officers and staffs for O&M and procurement of chemicals, use and preservation of the chemicals. The pumps will be operated 24 hours basis and according the staffs will be engaged in operation & maintenance of the pumps. The proposed supporting officers & staffs are given below:

- a. Executive Engineer
- b. Sub-Divisional Engineer
- c. Assistant Engineer
- d. Sub-Assistant Engineer
- e. Higher Division Assistant
- f. Cashier
- g. Office cum Data Entry Operator
- h. Wireless Operator
- i. Store Keeper
- j. Pipe Line Inspector
- k. Pipe line Mechanics
- l. Assistant Pipe Line Mechanics

- m. Pump Operator
- n. Assistant Pump Operator
- o. Driver
- p. MLSS

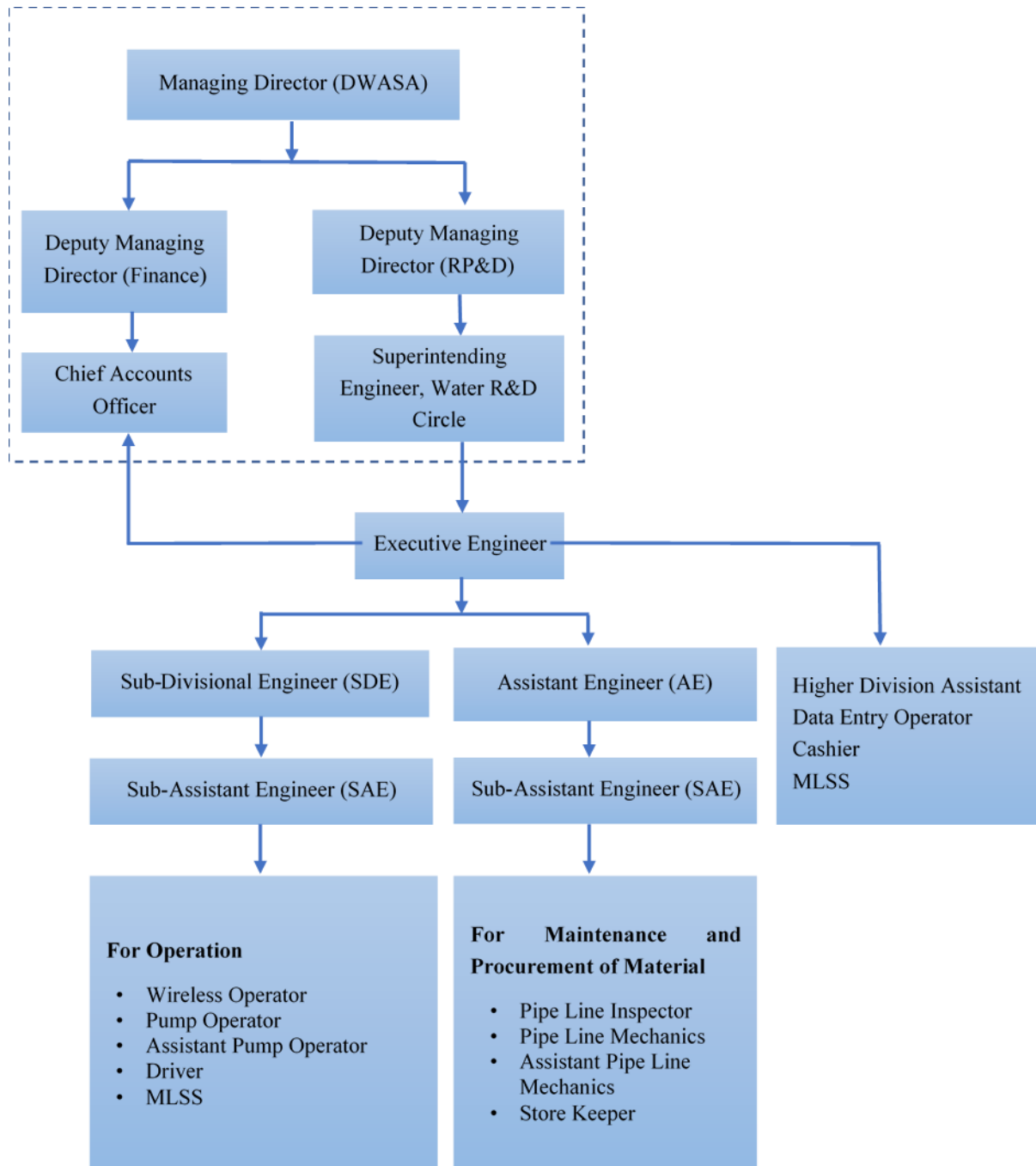


Figure 27: Proposed Organogram for O&M Unit of Water Supply System

Duty of the Sub Divisional Engineer and Assistant Engineer are to engage the staffs & operators in different activities of the water distribution system. Operator and maintenance

staffs will be engaged in such a way that the pumps will be in operation on 24 hours' basis. The schedule of the O&M staffs will be prepared in such a way so that each and every staff will be on duty at least for 8 hours. At each PTW, at least 3 operators will be necessary. Considering the above facts, O&M staffs have been estimated. The overall responsibility of O&M of the water distribution system including procurement of chemicals will be the Executive Engineer. Other supporting staffs will be responsible for assisting their seniors.

Chapter 13: Findings and Recommendations

Following are the overall findings. Feasibility level cost has also been included to get an idea of the cost of the project facilities DWASA to negotiate with the prospective development partner on financing of the project.

13.1 Findings

- Large portion of 16 unions area do not have household settlements yet. In some places scattered localities were found. In most of these localities, private pumps are the source for meeting water needs. Moreover, some areas are supplied from community pumps installed by local people. In some areas, there are existing water supply network installed by DWASA. For instance, a significant portion of Harirampur, Uttarakhan, Dakshinkhan, Bhatara, Badda, Dakshingaon, Manda, Matuail, Dania and Shyampur unions have existing DWASA water lines.
- Water supply system in some areas under 16 unions boundary have already been implemented under other DWASA projects. For instance, water supply network in Uttara apartment project area and Uttara 3rd phase project area of Harirampur union, western part of Bhatara, Badda and Dakshingaon unions have already been installed under DWSSDP, DESWSP and IWSP of DWASA. These areas are not included under current study.
- Waterlines in western parts of Uttarkhan, Dakshinkhan, Manda, Dania and Shyampur unions will be installed under DWSNIP of DWASA. These areas are also excluded from current study.
- The planning horizon for the current study is 2040. Water demand for the study area will be around 950 MLD in 2040. For the study area, provision of water supply from transmission lines considered in DWSMP is around 860 MLD which indicates around 90% of the demand can be met from the planned transmission lines. The rest 10% of the demand will be supplemented by groundwater from locally installed PTWs.
- As a major portion of the study area does not have population settlements, it will not be possible to construct water networks in whole area. Around 50% of the study area is considered for immediate implementation of water supply system.
- 42 nos. of DMA has been considered in the study area. Total water demand in the DMAs is estimated as 330 MLD in 2025 and 585 MLD for 2040.

- Areas with scattered population settlements are also considered for immediate water supply system development. But DMA implementation in those areas is not possible in current situation because of low number of service connections and undeveloped road networks. Only primary water lines have been considered during design in these ‘Scattered localities’.
- On hydraulic design, surface water has been considered as primary source and groundwater as supplementary source. Total 71 nos. of PTW will be required to supplement the surface water in DMAs and ‘Scattered localities’.
- Total length of water distribution pipelines in DMAs and localities were found as around 1,055 km. However, if reticulation lines are included then the total length of pipelines will be around 1,455 Km.
- Total length of secondary transmission mains to be laid is around 16 Km.
- Total cost for project implementation is estimated around BDT 16639.5 Million. Cost includes installation of pipelines on DMA and Small-scale DMA basis, and PTWs, Variable Frequency Drive (VFD), Instrumentation & Control, SCADA, Artificial Recharge Unit and Iron Removal Plant, road restoration charge for pipe installation, consultancy charge, land acquisition cost and contingency.

13.2 Recommendations

- The implementation of the total project shall be implemented phase-wise as illustrated in Map 4. DMAs and scattered localities considered in design are recommended to implement by 2025 and the rest of the areas to be implemented by 2030.
- Installation of PTWs in the service areas to be done phase-wise depending on the development facilities and population settlements in the service areas.
- The secondary transmission lines to be constructed in parallel to the primary transmission lines or as extended lines to the primary transmission lines. These secondary transmission lines will receive water from the distribution nodes of primary transmission lines and water in the DMAs will be supplied from secondary transmission lines through surface water injection points (SWIP).
- The city corporation may be requested to ensure planned development of the area as far as possible. Inter-organizational coordination among the stakeholder organizations (i.e. RAJUK, DNCC, DSCC, DWASA, PDB, DESCO, DPDC, GTCL etc.) responsible for development in the area is required.

- For smooth implementation of project, road restoration during pipeline installation process might be done by DWASA instead of DNCC or DSCC. This will reduce project implementation time.
- Due to considerable increase in the water supply service area, the existing nos. of MODS Zone may be increased and intra-zonal adjustment may be done for better operation and maintenance in service area.

Annex 1

Terms of Reference (ToR)

Water Distribution System Development in Extended Dhaka North City Corporation and Dhaka South City Corporation Areas



Terms of Reference

August 2017

1. Introduction

Dhaka Water Supply and Sewerage Authority (DWASA) is entrusted with the responsibility to supply piped potable water to dwellers of Dhaka City and its adjacent area. Presently, water supply coverage includes around 60% of Dhaka and Narayanganj city. The areas, which are left out, are mostly in the eastern Dhaka and at the outskirts of the city area. These areas were outside the jurisdictions of Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC). In May 2016, the government decided to incorporate 16 more unions into the two city corporations of Dhaka. The decision was taken at the meeting of the National Implementation Committee for Administrative Reforms (NICAR) held at the Secretariat with Prime Minister Sheikh Hasina in the chair. The LGRD Ministry placed the proposal. Following the NICAR's approval of inclusion of the new unions, an area of 178.75 sq. km would be added to the two city corporations -- 114.58 square kilometres to the DNCC and 64.17 square kilometres to the DSCC.

As per the decision, Beraid, Badda, Bhatara, Satarkul, Horirampur, Uttarkhan, Dakkhinkhan and Dumni unions would be included in the DNCC while DSCC would get Shyampur, Matuail, Demra, Dania, Sarulia, Dakkhingaon, Nasirabad and Manda unions.

DWASA has service coverage in some of these unions but not all. LGRD Ministry directed DWASA to extend their service to areas where it is not available. This would be a major initiative on part of DWASA which needs careful planning and execution. In this context, a full-scale Feasibility Study including Environmental and Social Impact Assessment (ESIA) is required.

The feasibility and ESIA study should take into consideration the existing situation of water supply, future plans of expansion as per DWASA water supply master plan, assessment of source of water supply, present and future water demand, economic and financial analysis and environmental and social impact assessment of different options including estimated cost of implementation.

2. Objective

The main objective of the study is to carry out a feasibility study of the project aiming at extending sustainable water supply to 16 unions recently included with Dhaka North City Corporation (DNCC) and Dhaka South City Corporation (DSCC) considering all relevant technical, social, environmental, economic and institutional aspects.

The specific objectives are as follows:

1. To study different options for a sustainable supply system in 16 unions recently included to Dhaka North & South City Corporations.

2. To harmonize the ADB funded Dhaka Water Supply Sector Development Project (DWSSDP) project with the proposed project in 16 unions. The study should outline District Metered Areas (DMA) in the 16 unions similar to the concept used in the DWSSDP.
3. To prepare a cost estimates of development options.
4. To evaluate financial viability of the proposed improvements.
5. To conduct detail ESIA and institutional assessment.

3. Scope of Work

3.1.1 Collection of all secondary data and reports which includes but not limited to the followings:

- a. Interim Water Supply Project of DWASA (2016-17)
- b. DWASA Water Supply Master Plan (2014)
- c. Feasibility Study of Saidabad Water Treatment Plant Project Phase III (2014)
- d. Transmission & Distribution system from Char Gandharbapur WTP
- e. Dhaka Sewerage Master Plan and Sanitation Strategy (2013)
- f. Population census data 2011
- g. Topographic and GIS data from DWSSDP and other relevant projects (2010-16)
- h. Resource Assessment and Monitoring of Water Supply Sources for Dhaka City (2007)

3.1.2 Primary data acquisition

- a. Conduct land level survey along alignments of proposed transmission and distribution water supply pipelines.
- b. Socio-economic baseline survey
- c. Environmental baseline survey

3.1.3 Prediction of population and water demand for the next 30 years in the 16 unions

3.1.4 Reviewing the water supply master plan and mapping of alignments of proposed transmission and distribution water supply pipelines and their Right of Way (ROW) based on survey information

3.1.5 Identification of outline of DMAs for the 16 unions and harmonizing with the proposed water supply sectors recommended in the water supply master plan and with the existing and proposed DMAs in the Dhaka city under the ADB funded DWSSDP

3.1.6 Hydrogeological investigation in the study area which include:

- a. Observation well (37 mm dia up to 300m depth) to monitor the Groundwater table fluctuation & to identify the radius of influence

- b. Production wells will be installed at the sites selected by the Consultant. These production wells will be used for long term aquifer test to calculate the specific capacity, well loss including determination of storage coefficient.
 - c. Analysis of Groundwater quality & recommend possible treatment
 - d. Groundwater resource assessment shall be performed by the Consultants based on data to be obtained from aquifer tests, lithologs, groundwater level monitoring data, water quality analysis etc.
- 3.1.7 Assessing the connectivity with water supply sectors and supply sources as recommended in the water supply master plan.
 - 3.1.8 Preparing outline design of distribution system based on mathematical models to be developed using survey data
 - 3.1.9 Estimating cost based on outline design for different project components such as PTW, distribution network, equipment & chamber etc.
 - 3.1.10 Economic and financial analysis for the project based on cost estimate for implementation and future operation & maintenance.
 - 3.1.11 Conducting ESIA study
 - a. *Environmental Reconnaissance of the Project Site*

Environmental reconnaissance of the project area, including alignment of transmission and distribution network, injection points to observe the overall setting of the pre-project condition.
 - b. *Environmental Baseline Study*

A detailed environmental baseline study of the entire project area as per requirements. The main objective of the baseline study is to assess the pre-project socio-economic and environmental conditions of project area, against which possible impacts of the proposed project will be analyzed.
 - c. *Identification and Analysis of Possible Impacts*

Assessment of potential impacts on various socio-economic and environmental parameters with respect to project activities. Both qualitative and quantitative impact assessments will be made. Identification of impacts based on the following:

 - Location of Project Components
 - Construction Phase
 - Operational Phase
 - Design inadequacy and /or failure due to natural disaster or non-acceptance by the citizens, etc.

d. Design of Mitigation Measures

To offset adverse impacts on the socio-economic and environmental condition due to the project, mitigation measures would be suggested depending on impact characteristics. Methods of rectifying the impact by repairing, rehabilitating, resettling or restoring the affected socio-economic & environmental settlements will also be included here.

e. Preparation of Environmental Management Plan (EMP)

f. Environmental Monitoring

An environmental monitoring program will be developed which will include:

- Monitoring location
- Parameters to be monitored
- Frequency of monitoring
- Resources required.

4. Duration of the Study

The Consultants shall complete the study in 8 (eight) months effective from the date of signing of the contract agreement.

5. Reporting Requirements

- Inception Report – after one month of contract signing
- Interim Report – after three months of contract signing
- Draft Final Report – after Six months of contract signing
- ESIA report - after Seven months of contract signing
- Final Report – after Eight months of contract signing

6. Consultant's Key Professional

This Terms of Reference (ToR) provides an indicative staffing list for the Consultant. The Consultant may propose alternative staffing and skill mix in order to carry out its roles and responsibilities efficiently. Key members of the indicative staffing and person-months for the consultant's team are as follows.

Key personnel	Nos.	MM
Team Leader	1	6.0
Water Supply Engineer	1	6.0
Hydraulic Modeler	2	16.0
Hydrogeologist	1	4.0
EIA Expert	1	4.0
Sociologist	1	2.0
Economic and Financial Specialist	1	3.0
Survey Specialist	1	3.0
GIS/ AutoCAD Specialist	1	4.0

Key personnel	Nos.	MM
Sub-total		48.0
Non-Key Experts		
Junior Engineer	2	16.0
Junior Hydrogeologist	2	12.0
Draftsman	1	4.0
Surveyor	1	4.0
Sub-total		36.0
Total		84.0

7. Payment Schedule

The payment shall be made according to the following schedule:

- Twenty (20%) percent of the lump-sum contract price shall be paid upon submission of the Inception Report.
- Twenty-Five (25%) percent of the lump-sum contract price shall be paid upon submission of the Interim Report.
- Thirty (30%) percent of the lump-sum contract price shall be paid upon submission of the Draft Final Report.
- Ten (10%) percent of the lump-sum contract price shall be paid upon submission of the Environmental and Social Impact Assessment (ESIA) Report.
- Fifteen (15%) percent of the lump-sum contract price shall be paid upon submission of the Final Report.

8. Team Composition

The consultant shall ensure that a team of experts and professionals with necessary education, skill and experience is engaged for all tasks in the assignment. A summary of the minimum team requirements for the assignment and indicative level of effort is given below. The team aligning with the consultant shall be responsible to fulfil the requirement of the employer as mentioned in the scope of works. Indicative professional staff months to be required for the assignment are as follows:

Position	Qualification and experience	Job description	Staff man month
Key Expert			
Team Leader	Minimum Masters Degree or equivalent in Civil Engineering/ Water Resources Engineering/ Sanitary Engineering. He/ She should have at least 15 years experience in water resources/ urban water supply management and sanitation. Practical experience as Team Leader for minimum 2 similar assignments. Previous experience in coordinating water resources assessment and management studies will be preferred.	<ul style="list-style-type: none"> • Full responsibility for all aspects of activity planning, liaison and reporting; • Prepare project plan, schedules and time frame work for the preparation of reports; • Attend meetings as and when required; • Responsible for quality control of output of the study; • Contribute and review the reports and give suggestions for improvement. 	6

Position	Qualification and experience	Job description	Staff man month
Water Supply Engineer	Minimum Masters Degree or equivalent in Civil Engineering/ Water Resources Engineering. He/ She should have at least 15 years' experience in water resources/ urban water supply management and sanitation. Practical experience in water supply and sanitary engineering projects.	<ul style="list-style-type: none"> • Carry out hydraulic analyses using model output; • Plan and designing distribution mains; • Specify and design distribution mains and components • Contribute in reporting and supervise draftsman. 	6
Hydraulic Modeler	Minimum Masters Degree in Civil Engineer/Environmental Engineering/ Water Resources Engineering. He/ She should have at least 5 yrs. working experience. Practical experience as Hydraulic Modeler for minimum 3 similar assignments. Should have good computer knowledge, report writing and communication skills.	<ul style="list-style-type: none"> • Prepare project plan, schedules and time frame work for the preparation of model; • Analysis of the model and preparation of the report; • Assist water supply engineer and draftsman; 	16
Hydro-geologist	M.Sc. in Geology/ Hydrogeology having 20 yrs. of working experience in the field of hydrogeology. He/she should have at least 15 years' experience in hydrogeological investigation, groundwater resource assessment, data analyses, groundwater hydraulics and groundwater monitoring system groundwater management including isotope study and artificial recharge to aquifer from harvested rainwater, production well design and	<ul style="list-style-type: none"> • Formulate specification of hydrogeological field investigation and survey. • Prepare geological maps, hydrogeological map, groundwater maps etc. • Analysis of borelog data and aquifer test data to define hydrogeological situation of the study area and to define aquifer properties, assessment of groundwater resources. • Updating hydro stratigraphic system of Dhaka. • Contribute in report writing 	4

Position	Qualification and experience	Job description	Staff man month
	construction supervision. He /she should have experience on working with groundwater modelling team.		
EIA Expert	Minimum Masters degree in Civil Engineering/ Environmental Engineering. He/ She should have at least 10 years' experience in EIA studies, Environmental Management. Previous experience in coordinating sanitation management studies will be preferred.	<ul style="list-style-type: none"> • Conduct environmental study and prepare EIA; • Indicate whether potentially adverse environmental effects are significant or whether mitigation measures can be adopted to reduce or eliminate these adverse effects. • Provide recommendations on proposed project sites, • resource demand, waste production and regulation, policies and guidelines for implementation. 	4
Sociologist	Minimum Masters degree in related discipline with minimum 15 years working experience in the relevant discipline. Experienced in SIA studies, resettlement projects.	<ul style="list-style-type: none"> • He has to design and plan needs assessment and SIA surveys of communities in the project area; • To identify future probable social negative impacts of the project and social imbalance; • Arrange interaction meeting with different stakeholders; Contribute in the report. 	2
Economic and Financial Specialist	Minimum Master degree in economics with at least 15 years working experience in economic and financial analyses and evaluation of different option plans including experience in working field related with sociology, social welfare or related discipline.	<ul style="list-style-type: none"> • He has to identify all costs and benefits of different option plans; • Collect all related information for carrying out economical and financial analyses; • Carry out economical and financial analyses for the proposed investment; • Conduct necessary socio-economic survey and demographic assessments; 	3
Survey Specialist	Minimum B.Sc. in civil engineering. He/she should have at least 10 years of	<ul style="list-style-type: none"> • Supervision and quality control of the field survey and 	3

Position	Qualification and experience	Job description	Staff man month
	working experience in related field. Should have at least 5 years experience in organizing field survey, data collection and processing using the modern satellite-based survey equipment. He/She should have adequate experience in supporting mathematical modelling team.	data collection activities; <ul style="list-style-type: none"> • Guide and monitor the preparation / production of drawings, maps and reports; • Interaction with DWASA officials in the matters of survey and data collection specification and quality control; • Contribute in reporting. 	
GIS /AutoCAD Specialist	Minimum of Bachelor degree on Civil Engineering / Water Resources Engineering / Urban and Rural Planning / Hydrology or Masters degree in Geography. Minimum 5 years experience in working with GIS. He/She should have adequate experience in pre and post processing of data required for model application and result interpretation.	<ul style="list-style-type: none"> • Prepare ArcGIS based geo-referenced maps of the project area; • Prepare maps of water supply improvement projects; • Prepare maps and presentation materials for reporting and discussion meeting; 	4
Non-Key Experts			
Junior Engineer	B.Sc. Civil or Environmental Engineer with at least 2 yrs working experience in water supply and related projects.	<ul style="list-style-type: none"> • Carry out hydraulic modelling activities; • Assist in plan and designing distribution mains; • Assist in design distribution mains and components 	16
Junior Hydro geologist	M.Sc. in Geology/ Hydrogeology having 5 yrs of working experience in field of hydrogeology. He/she should have at least 5 years' experience in hydrogeological investigation, data analyses, and groundwater hydraulics. He/she should have experience of supervising	<ul style="list-style-type: none"> • Supervise the hydrogeological field investigations and perform necessary analysis of litholog data. • Support to prepare geological maps, aquifer map, groundwater maps etc. • Support to analysis of borelog data and aquifer test 	12

Position	Qualification and experience	Job description	Staff man month
	hydrogeological field investigation works in the field.	data to define hydrogeological situation of the study area and to define aquifer properties. • Contribute in report writing	
Drafts man	Diploma in Engineer with at least 5 yrs working experience in water supply and related projects.	Prepare maps of water supply improvement projects; Prepare maps plan and profile sheets for outline design, • maps etc	4
Surveyor	Diploma in survey with at least 2 yrs working experience in water supply and other municipal projects.	Field survey and data collection activities for topographic data; Guide and monitor the preparation / production of drawings, maps and reports;	4

9. Responsibility of the client

For carrying out the assignment successfully within the stipulated period DWASA will provide the following support:

- Communicating with all stakeholder offices in the study area to provide all support to the consultant in order to make the study a success
- Providing all data and information in possession with DWASA offices
- Assisting the consultant to collect all associated data and information in possession with various GoB offices
- Providing necessary assistance in connection with field activities such as primary data collection, setting up field offices etc., to the consultants
- Assigning a responsible officer to supervise the activities of the consultant

The consultants shall have regular meetings with the DWASA professional staff to discuss technical and contract management issues. Any unresolved technical or otherwise should be taken up with the responsible officer of the client and shall provide the available data, as per its own system.

a) Legal Documents

DWASA will provide all necessary assistance in seeking permission or requesting through application to different agencies to supply data and to provide support to the consultants for their work.

DWASA will provide, if required, the staffs of Consultant ID cards or any form of legal document to visit to the required sites.

b) Timely Approval of Deliverables

For successful completion of the assignment in stipulated time frame the Client shall promptly review and put their comments/suggestions (if any) and approve the documents/deliverables in time.

10. Responsibility of the consultant

- The consultant shall assure sufficient support staffs including mid-level and junior engineers, logistics, office equipment and other necessary support on their own cost to deliver the services in an effective manner.
- The consultant shall carry out the services as detailed in the “Scope of Work” in the best interest of DWASA for the successful realization of the assignment with reasonable care, skill and diligence with sound technical, administrative and financial practices and shall be responsible to DWASA for discharging responsibilities.
- The consultant will provide the required human resources.
- The consultant shall abide by existing rules and regulations of Dhaka City Corporations, Rajdhani Unnayan Kartripokhya, Dept. of Environment and other stakeholder agencies. The recommendation of these agencies may be adopted wherever relevant and necessary.
- The consultant shall submit a detailed work schedule in inception report and follow it ardently.
- The consultant shall occupy office accommodation at IWM office in New DOHS, Mohakhali Dhaka.
- The consultants shall mobilize their team at a date agreed upon in the contract.
- The consultant will prepare reports in English and submit them to DWASA. They are responsible for incorporating the comments of DWASA, if there is any, in the report.
- The consultant will arrange workshop/seminar after submission of Inception Report and Draft Final Report.

Annex 2

Mouza wise Land Acquisition Rate



ডেমরা সাব-রেজিস্ট্রার অফিসের মৌজা ওয়ারী শ্রেণীভিত্তিক ব্যক্তি মালিকানাধীন জমির প্রতি শতকের সর্ব নিম্ন বাজার মূল্য তালিকা
(সম্পত্তি বাজার মূল্য নির্ধারণ বিধিমালা-২০১০ মোতাবেক ২০১১-২০১৮ সনে কার্যকরনার্থে প্রস্তুতকৃত)

ক্র. নং	মৌজার নাম	জিটি জমি	বাড়ী জমি	নাগ জমি	ডোবা জমি	পুকুর	চালা	পতিত	বোরো	মতব্য
৩৪	রাজারবাগ	৯,৪৮,৯০০/-	২৫,৬১,৫০০/-	৭,৯০,৩০০/-	১০,৬৩,২০০/-	৬,৬৭,৫০০/-	*৯,৩৫,১০০/-	৫,৩০,৮০০/-	৬,৪০,২০০/-	
৩৫	ব্রাহ্মনচিরন (মুগদা/খাম্বাবাড়ী)	১৪,৩১,৯৫৩/-	১৬,৭০,৩০০/-	৭,১৬,৫৮২/-	৮,৩১,২১৬/-	৩,০৩,৫০০/-	*৩,৮০,৪০০/-	*৩,৮০,৪০০/-	*২,০২,৮০০/-	
৩৬	উত্তর ব্রাহ্মনচিরন	*৮,৯৪,৭০০/-	৩৯,৬২,৮০০/-	*৬,২০,৪০০/-	*৬,০২,০০০/-	*৬,০০,৪০০/-	*৬,৪০,০০০/-	*৬,৪০,০০০/-	*৬,২০,৪০০/-	
৩৭	পূর্ব ব্রাহ্মনচিরন	*৯,৮০,৩০০/-	১৪,৯৯,৬০০/-	৫,৩১,০০০/-	৭,৯২,৬০০/-	১,৮১,৮১৮/-	*৩,৬০,৪০০/-	*৩,৬৪,৪০০/-	*২,১০,৮০০/-	
৩৮	দারুপদাও ✓	৪,৮১,৩০০/-	৭,৩৯,১০০/-	৩,২৬,০০০/-	৪,৭২,৩০০/-	১,৮২,০০০/-	৪,৫৭,৮০০/-	১,২৪,৫০০/-	২,৭৯,২০০/-	
৩৯	মাতা ✓	১০,৩৫,৫০০/-	৯,৮৯,৬০০/-	৪,৫০,৯০০/-	৪,৭৩,৬০০/-	৯,৭৫,৭০০/-	*২,১৬,৪০০/-	৩,৮০,৫০০/-	৪,৬৮,১০০/-	

প্রত্যয়ন করা যাইতেছে যে, "সম্পত্তির সর্ব নিম্ন বাজার মূল্য নির্ধারণ বিধিমালা; ২০১০" মোতাবেক ডেমরা সাব রেজিস্ট্রার কার্যালয়ে ১শা জানুয়ারী/২০১৫ ইং তারিখ হইতে ৩১শে অক্টোবর/২০১৬ ইং তারিখ পর্যন্ত রেজিস্ট্রীকৃত নাম বিক্রয় কবলা দলিল সমূহ খনড়া রেজিস্ট্রারে গিপিবদ্ধ করতঃ যথাযথ নিয়ম অনুসরণক্রমে অত্র মৌজাওয়ারী শ্রেণীভিত্তিক জমির হুড়াগড় গড় মূল্য তালিকা প্রস্তুত করা হইয়াছে। শাসনিক নিয়ম অনুসরণ ক্রমে অত্র তালিকায় "শমনা" বর্জন করা হইয়াছে। যে সকল মৌজার ২০১৫ ও ২০১৬ ইং সনে কোন সাক কবলা দলিল রেজিস্ট্রী করা হয় নাই, সে সকল মৌজায় * চিহ্ন এবং সে সকল মৌজা সমন্বয় করা হইয়াছে সে সকল মৌজায় ** চিহ্ন দিয়া ২০১৫ সনের বাজার মূল্য বিধি মোতাবেক অত্র তালিকায় অন্তর্ভুক্ত করা হইয়াছে। ঢাকা জেলার অধীন ডেমরা সাব রেজিস্ট্রার কার্যালয়ে ২০১৭-২০১৮ সনে কার্যকরনার্থে অত্র হুড়াগড় গড় মূল্য তালিকা "সম্পত্তির বাজার মূল্য নির্ধারণ কমিটি, ডেমরা, ঢাকা" কর্তৃক সর্ব সন্মতিক্রমে অনুমোদন করা হইল।

স্বঃ:
 ডি. পি.
 প্রত্নকারক

নং ৪৫
 হুগনাকারক

অশাহুল ইসলাম
 সাব-রেজিস্ট্রার
 ডেমরা, ঢাকা
 ও সদস্য সচিব
 বাজার মূল্য নির্ধারণ কমিটি, ঢাকা।

মোঃ সেলিম হাওলাদার
 সাব-রেজিস্ট্রার
 মিরপুর, ঢাকা
 ও সদস্য
 বাজার মূল্য নির্ধারণ কমিটি, ঢাকা।

ধীপক কুমার সরকার
 জেলা-রেজিস্ট্রার, ঢাকা
 ও সভাপতি
 বাজার মূল্য নির্ধারণ কমিটি, ঢাকা।

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
সাব-রেজিস্ট্রার এর কার্যালয়, উত্তরা, ঢাকা



সম্পত্তির সর্বনিম্ন বাজার মূল্য নির্ধারণ বিধিমালা ২০১০ এর সংশোধন ৫ অনুসারে প্রস্তুতকৃত ০১/০১/২০১৫ ইং হইতে ৩১/১০/২০১৬ ইং পর্যন্ত রেজিস্ট্রিকৃত সাফ কবলা দলিলা সমূহের মূল্যের উপর মৌজা ওয়ারী শ্রেণী ভিত্তিক প্রতি অমুতাংশ জমি বাজার মূল্যের তালিকা ২০১৭-২০১৮ সনের জন্য প্রযোজ্য :-

ক্রঃ নং	মৌজার নাম	মে.এল নং	থানা	বাড়ী	জিটি	চাল/পাতিত সাইল	নাল	বোর	ভোবা	পুকুর
০১	আব্দুল্লাহ	১০	উত্তরা	৩১৮০৫**	৩১৭০১**	২২৯২**	২৪৮৫**	.....	৩২৬৭**	১২৪৮**
০২	আল	১৮	উত্তরখান	১০৩০৫**	৭৮৭৮**	৬৫৮৭**	৬৬৮৪**	.....	৩০৬৫**	২৩৬৭**
০৩	আনাছরা	২৭	উত্তরখান	৩৭১২	৪১১৫	৩৪৮০	১৭৭১	২৬৮৫	৬০৬*	৬০৬*
০৪	উত্তরখান	১৯	উত্তরখান	৮৬২৮	৭০৬০	৫৪০০	৩০১২	২৩৬২	৩২০৪	৩২৭২
০৫	উজানপুর	২১	উত্তরখান	৪৬৭৪	২২২৬	২৭০৭	১৪২৫	৯৫১	১২১২	৫১৮*
০৬	কাফুকা	২৮	উত্তরখান	৭০৭০	৫০১৮	৩৪০০	৩৭৬২	.....	৮৪২*	৮৭২
০৭	গোবিন্দপুর	২৫	উত্তরখান	৫২৮২	৪৬০০	২৪৫২	১৮৭০	১৬৮১	৪৫০	৯৮০
০৮	চামুদখান	২৬	উত্তরখান	৪৭৯৭	৩৬৬৯	৩০২৭	২২৭৯	৪২২	১১৫৬*	১১৫৬*
০৯	দোয়াখান	২৭	উত্তরখান	৩০২২	৩২০৫	২৫৬১	১২৪০	৭৫৪	২০৩*	২০৩*
১০	নিজর আল্লাহ	১১	উত্তরখান	৮২৫**	৪৯৩**	৪৩০**	১৪৬২**	.....	৩৭৪**	৩৭৪**
১১	নিজর	২০	উত্তরখান	৪৫৩৭	৪৭৪৭	২৪১২	১৫৭৮	৬৯২	৭৫৮*	৭৫৮*
১২	নগাপিয়া	২৯	উত্তরখান	৪০০৪	৩৬৭৯	৩১৫২	২০০১	১৩৮৬	৪১০*	৪১০*
১৩	নগাপিয়া (স্টেট)	৩০	উত্তরখান	৪০০০	৩৭৬৫	৩০৯৪*	১২০৮*	.....	২৪২	২০৮*
১৪	ফারদাখান	১৪	উত্তরা	১১৮০২**	১১৬৮০**	৮৫০১**	৫২১০**	.....	৩০৫৭**	২২৬৬**
১৫	বাহলপুর	১২	উত্তর/হুমাশ	৬৬২৮**	৭৫৮৪**	৪৪৯৬**	২৭৭৩**	৬৪১৭**	২২০৫**	৩৫৭২**
১৬	হাজরা	৩০	উত্তরখান	৪০১৬	৩০৪৯	১৭৭২	৬৮৯	৬০৯	২৯৪	২৭৭
১৭	আহুদিয়া	৩২	উত্তরখান	২৩৫৭	১৮৭৯	৩০৯৮*	১৭৪১	১২২২	২৪০	২০৮*
১৮	মাইসাইদ	২০	উত্তরখান	৩৬১২	২৭৯৫	২৮৯৬	৩০৯৮	২৮১৮	১৮২২	১১০১
১৯	মৌসাইদ	১৭	উত্তরখান	৬৭৯৪**	৮২৬১**	৮৬৫১**	৪৭৫৩**	৮২৬**	৮১৮**	৮১৮**
২০	আনাফোলা	০৮	উত্তর/হুমাশ	১৫৩৪৩**	১০৯৪০**	৮০৫২**	৭৭৪২**	৩৯০৬**	৩৬৩৩**	৩৪৮৫**
২১	মানবাতি	৩১	উত্তরখান	১৭১৮	১৫৬০	৬৪৪*	৮৮৯	৭০৪	৫০০	৪৯২*

বি.সি. ২০১৫-২০১৬ সনে কোন দলিল রেজিস্ট্রি না হওয়ায় পূর্ব বছরের বাজার মূল্য (*) চিহ্নিত ঘান্না বহাল রাখা হইয়াছে। একাধিক অধিক্ষেত্রাধীন মৌজার সমন্বয়ের মাধ্যমে নির্ধারিত বাজার মূল্য (**) চিহ্নিত করে দেখানো হইলো।

মোহাম্মদ নিজামুর রহমান
সাব-রেজিস্ট্রার, উত্তরা, ঢাকা
সদস্য সচিব
বাজার মূল্য নির্ধারণ কমিটি।

মোহাম্মদ খালেদ
সাব-রেজিস্ট্রার, বিলাপাতি, ঢাকা।
সদস্য
বাজার মূল্য নির্ধারণ কমিটি।

শ্রীশঙ্কর কুমার সরকার
জেলা রেজিস্ট্রার, ঢাকা
সভাপতি
বাজার মূল্য নির্ধারণ কমিটি।

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
 সার্ব-রেজিস্ট্রার কার্যালয়, বাজা, ৪৪৬ রেজিস্ট্রেশন কমপ্লেক্স, তেজগাঁও শি/এ, ঢাকা-১২০১
 স্বাক্ষর মূল্য নির্ধারণ বিধিমালা ২০১০ইং (এস.আর.ও ৩০১-আইন/২০১২, তারিখ-২৬/০৯/২০১২ প্রিঃ দ্বারা সংশোধিত) অনুযায়ী স্বাক্ষরিত
 মৌজা ওয়ারী শ্রেণীভিত্তিক প্রতি অঞ্চলস্বত্ব সন্নিবিষ্ট স্বাক্ষর মূল্য তালিকা ০১ যা জানুয়ারী ২০১৭ ইংতে ৩১শে ডিসেম্বর ২০১৬ ইং সনের মধ্যে প্রস্তুত।



ক্রম নং	বন্দা	মৌজার নাম	স্ব.এস.নং পিটি নম্বর	বাড়ী	কিচি	চালা/পাতিত/সাইল	বোর	তোবা	পূত্র	
১১	সাহা	জোয়ার সাহা	০৩	*২৬১৪৯	**৪৯৭৬১	*৪৫৭০	**৭৫৯৯	*৭৯০৮	*৫৪৪৬	*৬১৯০
২১		কাসিমদিয়া	০৭	৫২৯৬	৮০৭০	৪০২৪	২২০২	২০৬৭	৫০৩	*৩২৩
৩১		হোট বেরাইন	২৫	৫১৪১	১০৭৬	৫৫৮	৩৪৯৬	১৭৫৪	*১০২	*১০২
৪১		বড় বেরাইন	০৯	৮৬৪০	৮০৮৭	৫৪৭১	১৩৮৭	২৫৮৩	১৮০৯	*৯৭৯
৫১		পূর্ব হারদেয়া	১০	৪১৭৭	৪৪৮৬	*২৫১	৯৭৮	১১৮৬	৩১৪	*৩১১
৬১		পশ্চিম হারদেয়া	১২	*১০২৪	১০১৩	*৪৫৩	১২৫৩	১৩০৪	*১৫০	*১৫০
৭১		দিতর আগ্রাইন	১১	*৪২৫	**৪৯০	*৪৩০	**১৪৬২	-	*৩৭৪	*৩৭৪
৮১		সাকারখুল	১৩	৪৮৮৬	৪৮৪১	২৯২৩	১৬৪৭	১২২৪	৫০৬	৯২৩
৯১		সুকিডোলা	১৪	১৬৭৫৯	১৬১৩৪	১৫৬৯৬	৬০০৫	৩৫৭৫	৫৯৩১	৪০৮০
১০১		হাজা ১-১০০০ দাগ পর্যন্ত	২২	১৭৭৯২	২২৮৪৫	৯৮৮৪	৫৫৪৪	----	৪০৭৭	*৩২৮৩
		হাজা ১০০১ দাগ হইতে ১৫৫	২২	১৫৫৭৫	২১৫৭০	৮০৯৩	৬২৪৮	২৯৩৯	৭২১৪	৭১৯০
১১১	ভাটারা	ভাটারা ১-৭০০ দাগ পর্যন্ত	১৫	২০৬৫৫	১১৬৮০	৯৫৩৮	৭০৭৮	৫৭৫৮	৩০৫৮	*১৯৯২
		ভাটারা ৭০১ দাগ হইতে ১৫৭	১৫	১৮২৮৬	১৭৩৮০	৯০৭১	৬৯১৯	৩৬০০	২৩৪৭	৩০২২
১২১	বিগেজত	কুম্বী	০৬	৫০৯৯	৯১৩১	৫০০৫	৪৯১২	১৫৫১	৫৬৫	*৪৮০
১৩১		পাতিয়া	০৫	৪৩৮৩	৪১৭১	৭৫০৭	২০৯৯	৯২৩	৪৮০১	২২৩৫
১৪১		ডেলনা	০২	২১৪৯	*১৪৪১	৩৭০২	৫০৯	৮৮৩	*২৮০	-----
১৫১		ডেলনা	০৩	*৪৬২	২৫০০	৪৫০	১৪৭৪	৯৭৪	*১৩৪	-----
১৬১		বরুয়া	০১	৯০৬৭	৮০২৩	৪৫৮০	২০৪৩	১৪৪৯	১৯৮২	*১১৫৮
১৭১		মধুদ	০৪	১০৩৪৩	৪৭৭৫৭	৪৩৩৭৬	৫৫৬৯	৭০২	৩৩৪	*৩৩৪

০৪১ ১শা জানুয়ারী ২০১৭ইং হইতে ৩১শে অক্টোবর ২০১৬ইং সনে যে সময় শ্রেণীর মালিক রেজিস্ট্রার হার দায়, পূর্ববর্তী স্বাক্ষরের স্বাক্ষর মূল্য বহল হইয়া এক তারকা চিহ্ন (*) দ্বারা দেখানো হইল। জোয়ার সাহা ও দিতর আগ্রাইন মৌজাধর সমন্বিত স্বাক্ষর মূল্য নির্ধারণ কমিটি কর্তৃক প্রস্তুত ও এতদধিক স্বাক্ষর মূল্য নির্ধারণ সন ২০১৩ইং সনে নির্ধারিত স্বাক্ষর মূল্য দুই তারকা চিহ্ন (**) দ্বারা চিহ্নিত করে প্রেরণ করা গিয়া। ভাটারা ও হাজা মৌজার মূল্য শি.এস ও এস.এ মালিকের ভিত্তিতে নির্ধারিত হইবে।

স্বাক্ষর
 সার্ব-রেজিস্ট্রার কার্যালয়
 বাজা, ঢাকা

উপস্বাক্ষর
 আওগ্যাস হোসেন
 মোহতার
 সার্ব-রেজিস্ট্রার অফিস,
 বাজা, ঢাকা।

স্বাক্ষর
 সার্ব-রেজিস্ট্রার কার্যালয়
 বাজা, ঢাকা
 সদস্য সচিব
 স্বাক্ষর মূল্য নির্ধারণ কমিটি
 বাজা সার্ব-রেজিস্ট্রার অফিস, ঢাকা।

স্বাক্ষর
 সার্ব-রেজিস্ট্রার কার্যালয়
 বাজা, ঢাকা
 সদস্য
 স্বাক্ষর মূল্য নির্ধারণ কমিটি।

স্বাক্ষর
 স্বাক্ষর মূল্য নির্ধারণ কমিটি
 বাজা সার্ব-রেজিস্ট্রার কার্যালয়,
 বাজা, ঢাকা
 সভাপতি



ডেমরা সাব-রেজিস্ট্রি অফিসের মৌজা ওয়ারী শ্রেণীভিত্তিক ব্যক্তি মালিকানাধীন জমির প্রতি সূত্রের সর্বমোট বাজার মূল্য তালিকা
(সম্পত্তি বাজার মূল্য নির্ধারণ বিধিমালা-২০১০ মোতাবেক ২০১৭-২০১৮ সনের বার্ষিক হিসাব প্রস্তুতকৃত)

ক্রঃ নং	জে, এল নং	মৌজার নাম	ভিটি জুমি	বাড়ী জুমি	নাল জমি	ডোবা জমি	পুকুর	মন্তব্য
১২	৩২	ডগার	৭,৩৯,৩৩৪/-	৮,১৪,২৪৫/-	৩,৩৯,৪৩৪/-	৮৯,৫৯৬/-	৭৫,৮৬৫/-	
১৩	১৪	ডেমরা	**৪,৭০,৫৮৮/-	৩,৫৫,৫৬৮/-	**২,৮৩,৩৩৩/	**৪০,০০০/	**৪০,০০০/-	বিলাপাও, সূত্রাপুর ও শ্যামপুর অফিসের সাথে সমন্বয় করে প্রস্তুত করা হয়েছে।
১৪	২৪	দয়াপুর (যাত্রাবাড়ী, সিটি এলাকা)	**৯,০০,০০০/-	১৬,৯০,২৯২/-	** ২,০৮,৯৫৫/	২,৪৩,২৪৩/-	** ১,৮৪,৬০০/	
১৫	৩৪	দেইল্যা	২,২৮,৩৪৩/-	৪,১৯,৬৯০/-	২,৮৮,৩৯৯/-	৪১,৬০৫/-	৩৭,১৪৩/-	
১৬	১৯	ধার্মিকপাড়া/দামড়িপাড়া	১,৫২,৮৬৬/-	১,২০,০৩৮/-	১,০৫,৫২৮/-	৪০,৭৯৯/-	৩৮,৮৫৮/-	
১৭	১৬	নড়াইবাগ	২,০৮,৮৮৭/-	৪,৯৩,৮৪৭/-	২,৩০,৭৬৭/-	৫৯,০৮১/-	২,৪৮,০০০/-	
১৮	১০	পূর্ব দুর্গাপুর	**৫৩,০৬১/-	৬৯,০৩৬/-	৭৬,৮০০/-	৮৯,৩৩০/-	২৪,৩৩৩/-	
১৯	০৭	পশ্চিম দুর্গাপুর	**৪,৬৭,৩৩৩/-	**৬,০০,০০০/	৩,৩৯,৮০০/-	৩,৩৬,০০০/-	**৩,২০,০০০/	
২০	১৭	পাইটি	২,২৯,২১২/-	২,৮১,৬০৩/-	২,২৭,১১০/-	৩৩,৬২৩/-	৩৮,৪৭০/-	
২১	৩১	পাড়া ডগার (ডেমরা থানা)	৭,২৪,২৯৭/-	১১,৫৫,১৪২/-	৪,৬২,৮২৬/-	৮৯,০৯২/-	৬৯,০৮৯/-	
২২	৩১	পাড়া ডগার (যাত্রাবাড়ী থানা)	৬,৩৪,০২১/-	১০,০৮,৭৭২/-	২,৭৪,০৯৯/-	১,০৪,৬৭৮/-	১,৪৭,৩১৯/-	
২৩	৩৩	বামৈল	৩,৪৩,৩৩৩/-	৬,৮৫,৩৫৮/-	৫,৩৯,১৭৯/-	১,০৫,৭৮২/-	**৫১,৪৫০/-	

মোঃ মিস্তাফিজুল হক
সিনিয়র ইঞ্জিনিয়ার
সহকারক

মোঃ মিস্তাফিজুল হক
সিনিয়র ইঞ্জিনিয়ার
সহকারক

আব্দুল হক ইসলাম
সাব-রেজিস্ট্রার
ডেমরা, ঢাকা
ও সদস্য সচিব
বাজার মূল্য নির্ধারণ কমিটি, ঢাকা।

মোঃ সৌগত হাওলাদার
সাব-রেজিস্ট্রার
মিরপুর, ঢাকা
ও সদস্য
বাজার মূল্য নির্ধারণ কমিটি, ঢাকা।

শ্রীপক কুমার সরকার
জেলা-রেজিস্ট্রার, ঢাকা
ও সভাপতি
বাজার মূল্য নির্ধারণ কমিটি, ঢাকা।

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
সাব-রেজিস্ট্রার এর কার্যালয়, মিরপুর, ঢাকা



এস.আর.ও নং ১২০-আইন/২০১০ এর সম্পত্তির সর্বনিম্ন বাজার মূল্য নির্ধারণ বিধিমালা ২০১০ এবং এস.আর.ও নং ৩৩১-আইন/২০১২ সম্পত্তির সর্বনিম্ন বাজার মূল্য নির্ধারণ বিধিমালা ২০১০ এর সংশোধনী এর বিধি ৫ অনুসারে প্রস্তুতকৃত ১লা জানুয়ারী ২০১৫ হইতে ৩১শে অক্টোবর ২০১৬ পর্যন্ত রেজিস্ট্রিকৃত সাফ কবলা দলিল সমূহের মূল্যের উপর মৌজা ওয়ারী শ্রেণী ভিত্তিক প্রতি শতাংশ জমির বাজার মূল্যের উপর নির্ভর করে ২০১৮ ইং সনের জন্য প্রযোজ্য :-

ক্রমিক নং	মৌজা	জে.এল.নং	থানা	হাজিগিং	বাড়ী	জিটি	চালা/পতিত	নাল	বোরো	ডোবা	পুকুর
০১	আনন্দনগর	১১	দারুস সালাম		৯,৯৭,৮০৮	*১০,০০,০০০	*২,২০,০০০	*৯৯,৬৮৬	*৯৮,৮১৪	১,১৬,৭৬৬	*৬৯,৭২০
০২	বোজারবাগ	০৭	দারুস সালাম	৪,৫৩,১৭৫	৫,৯৯,০৯৬	৩,৭০,০০০	৩,৪৪,৪৪৫	১,৩৩,৩৩৪	*১,২১,২১৪	*৮৪,৬৭৬	*৮৪,৬৭৬
০৩	গড়ানচটবাড়ী	০৪	শাহআলী	-----	১৫,৬৮,৫৬৪	৬,৯৪,৩৫০	৪,৩৮,২৬৬	২,৩৯,৫৪৬	১,৩৯,৫০৭	১,৪০,৬৬১	*৭৪,৩৬০
০৪	ছেতিদিঘাড়া	০৪	দারুস সালাম		৮,৪১,৯২৬	*৫,৫০,০০০	*৩,০০,০০০	*১,৫০,০০০	১,২২,৬২১	১,১৫,৩১০	৯১,৭৪৪
০৫	ছেতিসায়েক	৯৬	দারুস সালাম	-----	১,৬১,৪৭৯	*১,৬০,০০০	*১,০০,০০০	*৮৩,৩৩৪	*৮২,১০৪	*৭৬,০০০	*৭৬,০০০
০৬	ছহরাদাবাদ	০৫	দারুস সালাম	*৯,৫২,৭২৮	১৩,৩০,১৪৩	৫,৭২,৫৪৯	৪,৬২,০০৭	৩,০০,০০০	১,৩০,৮৫৪	১,৮৬,৬৫৯	*১,২৪,০০০
০৭	নবাবেরবাগ	০২	শাহআলী	-----	৭,২৩,৯২৩	৯,২৩,১৫৬	*২,২৮,৫৭২	১,০০,০০০	*৯৩,৫০০	*৯০,০০০	*৯০,০০০
০৮	নন্দেরবাগ	১৩	দারুস সালাম	৪,৭৫,০০০	৪,৭২,০৯৭	*২,৮৮,০৯৬	*২,৩০,৭৭০	*১,২১,৩৬৪	*১,১৪,৭৬০	*১,১২,৫২৯	*১,১২,০০০
০৯	পূর্বকান্দার	০৬	দারুস সালাম		১৩,০০,৬২৭	১২,৪০,৮০৯	২,৯০,৪৫৭	২,১৬,২১৭	*১,৬৭,০২০	১,১৬,৬২২	*১,০৪,০০০
১০	পশ্চিম কান্দার	০৯	দারুস সালাম	-----	১০,৩৬,৮৯৫	*৪,৬৫,৭২৬	*২,২৩,৩০১	৩,৭১,৬৮২	*১,৬১,৬১৬	১,৮৩,৯৩১	*৮০,০০০
১১	পাইকপাড়া	১৬	মিরপুর দারুস সালাম	৯,১৮,৫৩৬	১১,৫৬,০৫৫	১১,৭১,৮৭৭	১২,৩৬,৫৪৫	৪,৫৩,৩৬১	১,৯৪,৯৮৬	২,২৯,৮৯১	*১,৬৯,৪৯২
১২	বড়সায়েক	১৫	দারুস সালাম	-----	১৪,৩৮,৩৫২	১০,৫৮,৬৮২	৩,০৫,৫৭৯	৩,৬১,২৪৫	*১,৫০,২৪৬	*১,৩০,০০০	*১,৪১,৮৪৪
১৩	কমুশাড়া	০৮	দারুস সালাম		৫,৯৪,৯০১	৭,৪০,৬২২	৫,০৬,০০০	*২,৪৮,০০০	২,৯৪,৬৩৮	*১,৫৪,৫৪৬	*১,৫৪,০০০
১৪	বিশিল	০৩	দারুস সালাম শাহআলী	১৮,৭৯,৩৫১	১০,৪১,৫৪৪	১৫,৫৬,১২১	৪,৮৫,০০০	৩,১১,৩০৩	৬,১৬,১৫৩	১,৩০,৪৩৬	*১,১৩,৩৩২
১৫	মিরপুর	১২	দারুস সালাম	*৬,২৫,০০০	৭,৯৬,৭৬১	*৯,৯৮,৮৭৮	৫,৫৬,৯০৩	২,৯৭,৭০৭	১,৬৩,৩৯৩	২,১৩,৭৫০	৯৩,৯৯৯
১৬	সেনপাড়াপর্বতা	১৭	মিরপুর	১৯,৯২,৩০০	১৫,১৩,৭০০	৯,৮৬,৮০০	১৭,৯৪,২০০	৫,১০,০০০	২,৭০,৪০০	২,৮৬,৮০০	*২,৮২,৮০০
১৭	হরিরামপুর	১০	দারুস সালাম		৬,৫৬,৪৪৮	*৫,২৫,৬৪২	*২,৪১,০০০	*১,৫০,০০০	*১,৪৫,৪৫৬	১,৮৯,৭৯০	১,৪০,২৭৫

**** ১লা জানুয়ারী ২০১৫ হইতে ৩১শে অক্টোবর ২০১৬ পর্যন্ত যে সকল মৌজার যে সকল শ্রেণীর কোন সম্পত্তি ক্রয় বা বিক্রয় হয় নাই অথবা একটি দলিল রেজিস্ট্রি হইয়াছে উক্ত মৌজার ঐ সকল শ্রেণীর পূর্ববর্তী বৎসরের নিখারিত বাজার মূল্যই পরবর্তী বৎসরের বাজার মূল্য হিসাবে কার্যকর থাকিবে। যাহ বাজার মূল্য তাগিকার * চিহ্ন দ্বারা দেখানো হইল।

সহকারী, সাব-রেজিস্ট্রার অফিস, মিরপুর, ঢাকা

(মোঃ সোহাগ হুতনাদাত)
সাব-রেজিস্ট্রার, মিরপুর, ঢাকা
সদস্য সচিব, বাজার মূল্য নির্ধারণ কমিটি

(আশরাফুল ইসলাম)
সাব-রেজিস্ট্রার, ডেমরা, ঢাকা
সদস্য, বাজার মূল্য নির্ধারণ কমিটি

(দীপক কুমার সরকার)
জেলা রেজিস্ট্রার, ঢাকা
সভাপতি, বাজার মূল্য নির্ধারণ কমিটি

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
সাব-রেজিস্ট্রার এর কার্যালয়, গুলশান



গুলশান সাব-রেজিস্ট্রি অফিসের অধিক্ষেত্রের অধীন মৌজা সমূহের শ্রেণী ভিত্তিক প্রতি অযুতাংশ জমির সর্ব নিম্ন মূল্য নির্ধারণের প্রস্তাবিত তালিকা, যাহা ২০১৭ ও ২০১৮ খ্রিঃ এর জন্য প্রযোজ্য।

ক্রমিক নং	মৌজার নাম	খানার নাম	বাড়ী	ভিটি	চালা	পতিত	নাল	বোর	ডোবা	পুকুর
০১	আব্দুল্লাহপুর	দক্ষিণখান	৩১,৮০৫/-**	৩১,৭০১/-**	৯,২৯২/-**	---	৯,৮৮৫/-**	---	৩,২৬৭/-**	১,২৪৮/-**
০২।	আনুল	দক্ষিণখান	১০,৩৩৫/-**	৭৮৭৮/-**	৬,৫৮৭/-**	৬,৫৮৭/-**	৬,৬৮৮/-*	---	৩,০৬৫/-**	২,৯৬৭/-**
০৩।	কড়াইল	গুলশান	২৩৪৪/-*	২,৩১০/-*	২,৩০৪/-*	--	১,০১৮/-**	১,০১৮/-*	৬৩২/-*	---
০৪।	জোয়ার সাহারা	ক্যান্টনমেন্ট	২৬,১৪৯/-**	৪৯,৭৬১/-**	৯,৫৭৩/-**	৯,৫৭৩/-**	৭,৫৯৯/-**	৭,৯৩৮/-**	৫,৪৪৬/-**	৬,১৯০/-**
০৫।	তেজগাঁও শি/এ	গুলশান*	৩৪,০৪৮/-**	৫১,৬০০/-**	১৫,১৫২/-**	১৫,১৫৬/-**	৪,৩১৫/-	---	১৭,১০০/-**	---
০৬।	দক্ষিণখান	দক্ষিণখান	১৫,৪৭৯/-	১০,৯৭৯/-	১৩,৩২৬/-	৬,৮৩২/-*	৪,৪২০/-**	২,৭৯৯/-	৩,৪০১/-	২,৫৮০/-
০৭।	ধামালাকোট	গুলশান ও ক্যান্টনমেন্ট	২২,৩৩৮/-**	৮,৮৯১/-**	৪,০৪২/-**	৪,০৪২/-**	৫,২০০/-**	৩,২৪২/-**	৫৩৪/-**	---
০৮।	পুরাকৈর	দক্ষিণখান	১৪,১১৮/-	৯,৩৫৭/-	৬,৫৪৯/-	৬,৫২০/-	৬,৮৯৫/-	---	৪,৩১২/-	৩,৩৯৪/-
০৯।	ফারখাদাবাদ	দক্ষিণখান	১১,৮০২/-**	১১,৬৮৩/-**	৮,৫০১/-**	৮,৫০১/-**	৫,২১০/-**	---	৩,০৫৭/-**	২,২৬৬/-**
১০।	বরুয়া	দক্ষিণখান	৯,০৭৬/-**	৮,৩০১/-**	৪,৫৮০/-**	--	২,০৪৩/-**	১,৪৪৯/-**	১,৯৮২/-**	১,১৫৮/-**
১১।	ভোলাসামাইর	গুলশান	১৭,৫৫৩/-*	৫,৬১৩/-	৭,৫১৫/-*	--	৫,৬১২/-*	১,৯৬৫/-*	১,৮২৮/-*	--
১২।	মহাখালী	গুলশান	৫৭,৬৭২/-**	৩৬,২৫৫/-**	১৬,৪৫৫/-**	--	৯,৬৫৯/-**	৮,৮০৫/-**	৩,৪৩৪/-**	--
১৩।	মৌশাইর	দক্ষিণখান	৬,৭৯৪/-**	৮,২৬১/-**	৮,৬৫১/-**	--	৪,৭৫৩/-**	৮২৬/-**	৮১৮/-**	৮১৮/-**
১৪।	গালাদরাই	ক্যান্টনমেন্ট ও বনানী	২৬,১২৯/-**	১৫,৭৯০/-**	১৫,৪০০/-**	১৫,৪০০/-**	৯,৭০০/-**	৭,৯৭২/-**	৩,৭৬১/-**	---

* বাজার মূল্য সমূহ পূর্ববর্তী বৎসরের মূল্য বহাল আছে।

** একাধিক অধিক্ষেত্রাধীন হওয়ায় সমন্বয়ের মাধ্যমে নির্ধারিত বাজার মূল্য।

৩

<p>প্রস্তুতকারক</p> <p>(মোঃ মিয়াব উদ্দিন)</p> <p>সহকারী</p> <p>সাব-রেজিস্ট্রি অফিস গুলশান, ঢাকা।</p>	<p>তুলনাকারক</p> <p>(মোঃ মফিজুল হক)</p> <p>সহকারী</p> <p>সাব-রেজিস্ট্রি অফিস গুলশান, ঢাকা</p>	<p>(মোঃ কামাল হোসেন খান)</p> <p>সাব-রেজিস্ট্রার, গুলশান, ঢাকা</p> <p>ও সদস্য সচিব</p> <p>সম্পত্তি বাজার মূল্য নির্ধারণ কমিটি, ঢাকা</p>	<p>(শহিদুল হাসান)</p> <p>সাব-রেজিস্ট্রার, সূত্রাপুর, ঢাকা</p> <p>ও সদস্য</p> <p>সম্পত্তি বাজার মূল্য নির্ধারণ কমিটি, ঢাকা</p>	<p>(দ্বীপক কুমার সরকার)</p> <p>জেলা রেজিস্ট্রার, ঢাকা</p> <p>ও সভাপতি</p> <p>সম্পত্তি বাজার মূল্য নির্ধারণ কমিটি, ঢাকা</p>
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শ্যামপুর সাব-রেজিস্ট্রী অফিসের মৌজা ওয়ারী শ্রেণীভিত্তিক জমির প্রতি শতকের পরিমিত বাজার মূল্য তালিকা
(সম্পত্তি বাজার মূল্য নির্ধারণ বিধিমালা-২০১০ মোতাবেক ২০১৭ সনে কার্যকর করা হয়েছে)



ক্র. নং	মৌজার নাম	ভিটি জমি	বাড়ী জমি	নাশ জমি	ডোবা জমি	পুকুর	বাণিজ্যিক	মন্তব্য
১	আইলবহর	৫,০০,০০০/-	৬,৭৪৮৮৩/-	**২,৬১০৬৬/-	৯৭১৩৩/-	**৭১৮২৪		* তারকা চিহ্নিত মূল্য গত বছরের মূল্য বহাল রাখা হইয়াছে।
০২	কদমতলী ✓	৭,১৮,৭৭৭/-	৮০৯৮২৭/-	৪,৩১,৪৩৩/-	১,৩৪,০০১/-	**২,০০,০০০/-		** তারকা চিহ্নিত মূল্য যে মৌজা একের অধিক সাব রেজিস্ট্রীর অফিসের আওতাভুক্ত হওয়ার সকল অফিসের মূল্য সমন্বয় রাখা হইয়াছে।
৩	জুর ইন (কদমতলী থানা)	৬,৯২,৯৩৫/-	৯,০২৬৮২/-	৪,৭০,১০৭/-	২,৯০,৯৭৭/-	২,২৪,৬৮২/-		
৪	দনিয়া ✓	১০,১২,৫০০/-	১৩,৮৩,৫১৭/-	৯,০৮,০২৪/-	২,৪০,৬৫৯/-	৩,৪২,১১৩/-		
৫	শ্যামপুর ✓	৮,৬০,১২৫/-	১০,১৮,৫১৪/-	৩,৫৭,১৮৩/-	১,৫৪,১৭৪/-	১,০২,২৩৭/-		
৬	গোড়ারিয়া	*৯,৮৮,৮৮৯	১৪,৬৮,৭৪৮/-	*৬,৭৮,২৫০/-	২,৪৯,৮৯৯/-	২,৩১,১১১/-		
৭।	দয়ামাধ গোড়ারিয়া সিটি এলাকা	**৯,০০,০০০/-	১৬,৯০,২৯২/-	**২,০৮,৯৫৫/-	২,৪৩,২৪৩/-	**১,৮৪,৬০০/-		
৮।	ওয়ারী	২০,০০,০০০/-	৩২,৮৯,৬০০/-	৪,৩৬,৯০০/-	২,০৬,১০০/-	**২,০৩,৬০০/-		
৯।	সুফাপুর	৯,৪৪,৪০০/-	১৪,৯৮,২০০/-	৪,২২,৬০০/-	৭,৮৮,৯০০/-	৩,৮০,৬০০/-	২০,০৮,৬০০	

বিহীন ২০১৫-২০১৬ সনের যে সমস্ত শ্রেণীর দলিল রেজিস্ট্রী হয় নাই তাহা পূর্ববর্তী বৎসরের বাজার মূল্য বহাল রাখিয়া তাহার চিহ্ন (*) দ্বারা দেখানো হইল এবং ** দ্বারা সমন্বয় দেখানো হইল।

স্বাক্ষরিত করকঃ
মোঃ ইমতিয়াজ আলম
সহকারী
সাব-রেজিস্ট্রীর শ্যামপুর, ঢাকা

স্বাক্ষরিত করকঃ
মোঃ মতিউর রহমান
মোহরার
সাব-রেজিস্ট্রীর শ্যামপুর, ঢাকা

স্বাক্ষরিত করকঃ
শেখ ফারুক আলম
সাব-রেজিস্ট্রীর শ্যামপুর, ঢাকা
সদস্য সচিব বাজার মূল্য নির্ধারণ কমিটি, ঢাকা।

স্বাক্ষরিত করকঃ
আশ্রাফুল হুসাইন
সাব-রেজিস্ট্রীর ডেমরা, ঢাকা
সদস্য সচিব বাজার মূল্য নির্ধারণ কমিটি, ঢাকা।

স্বাক্ষরিত করকঃ
বীপক কুমার সরকার
জেলা-রেজিস্ট্রীর, ঢাকা
সভাপতি বাজার মূল্য নির্ধারণ কমিটি, ঢাকা।

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
সাব-রেজিস্ট্রারের কার্যালয়, বিলাপাও.
সব রেজিস্ট্রার কার্যালয় বিলাপাও এর আওতাধীন বৌদ্ধ সংখ্যক ২০১৭ ইং সনের জন্য প্রযোজ্য হওয়া উচিত নির্দেশিত কামার মূল্য তালিকা।
(সেপা সিস্টেম কর্পোরেশনের আওতাধীন)

ক্রমিক নং	সেবার নাম	প্রতি অমু বাকী	প্রতি অমু বিটি	প্রতি অমু চাপা	প্রতি অমু দাল	প্রতি অমু পুরিত	প্রতি অমু ঘের	প্রতি অমু মোসা	প্রতি অমু পুনা	প্রতি অমু বাতি	মন্তব্য
০১	মেসারিয়া	১১৬০৬	১৪২১৯**	৩৪৮৪**	৩৯০৪	৪৪৩৭**	৫০৯৩**	৫৪৭৫	২৯৪০*	---	* তারকা
০২	হাকার ঘাস	২০৬১০	২৪৮৯	৯০৫*	৭৯০০	৫০০৮	৬৪০২	১০৬০২	৬৬৭৫	---	চিহ্নিত মূল্য
০৩	শেফাল	১১৫৭৯	১০৬৭০	১২৯৭৫*	৫৮৪০	৩৮১৯*	৩০১০	৫৮২১	২০৬৯	---	সর্ব বহুর
০৪	শর সিঁচাও	২০৫৭৫	১২৭০১	৮০৮২*	৬৯২৬*	৫২৯৪*	৩৫৫৬*	৬৩৮৯	১৭৭০*	১০৭৩৪*	মূল্য বৃদ্ধি
০৫	লাকির শর সিঁচাও	২৫০৭৮	১২০৬২	৪২১১*	২৪৭৬*	৩৮৮০*	২৪৩৮*	১৬১৬*	৩১৬০*	১০৮০৯*	সর্ব
০৬	কান	১৭৮৫	১৬৭৭২	৫৮৭*	৫৭০৪*	৫০৯৯*	৩০২৬*	৫৬৮২	২৮৩৭*	---	সর্ব
০৭	শুকিন কান	১৬১২৭	৬৬৭৬	৮০৯২	৯০৭২	৩৪০৫	৩১৫২*	১১১৮২	১০৯৯*	৩৪০৩*	* তারকা
০৮	লাকির কান	১৪৭০৩	১৪০১৯	৫৮০৫*	১৬৬৫	৩৮০৪*	২০২৮*	৮৩১২*	৩০০৫	---	চিহ্নিত মূল্য
০৯	লাকির কান সিঁচাও	১৮৪৭	৬৪০০*	৬২০৫*	৬২০৫*	৬৪০০*	৬২০৫*	৬০২*	৬০০৫*	৫৫৩৮*	সর্ব
১০	সর্ব বহুর কান	১৬১৮	৯১০০	৩৬০৪*	৫৩১০	৩৬৪৪*	২৩৮*	৫৮২৬*	১৮১	---	সর্ব
ইতিমধ্যে পরিচালিত											
১১	শুকিন	৯৫১	৭৫০৮	৩০৪৪	৩০৭২	১১৫২*	৯০০	১৬৫১	৩০৫৯	---	সর্ব
১২	শর সিঁচাও	১৮১০	৬৮৫০	১৬৯	৩৬৬২	১০০৫*	১৬২২	১৪১২	১০৪৪	---	সর্ব
১৩	শুকিন	৫৮০	৪০০*	১১৫*	১৭৮	১১৫২*	৬৮*	৮*	৫*	---	সর্ব
১৪	লাকির সিঁচাও	৭১১	৪১১০	৪৭৮	৩৮০	১৬৫	১৮*	৫*	১*	---	সর্ব
১৫	শুকিন	১৮১০	১০০০৫	২১৬৫*	৪১০৯	৩১০৫	৪৬১১	৪১০৬	৯৮*	---	সর্ব
১৬	শুকিন	২৫৯৯	১১০৫	১৪৫*	১০৪১	৯১*	১১০	১৬	১৬*	---	সর্ব
১৭	শুকিন	১৫৬০	৮৬	---	২৬১৫	---	---	১১০	১১০	---	সর্ব
১৮	শুকিন	৩০১১	৩৬০০	১১০৬	১০৪০	---	১৫১*	১৬*	৩০*	---	সর্ব
১৯	শুকিন	২৮০০	১১৫	---	১১৬৫	---	---	৩৬	১৬*	---	সর্ব
২০	শুকিন	১১০	৩৬০*	---	৬৮	---	---	৮০	৬০	৩৬	সর্ব
২১	শুকিন	১০০৫*	৩৬৭০*	---	৩৬৮৮	---	---	৩৬০	৩১০*	---	সর্ব
২২	শুকিন	১৮৬	২৬৮*	---	১০৮৭	---	---	১০৬৬	৯৬	---	সর্ব
২৩	শুকিন	৩৪২	৮০১৮	---	১০১৪	---	---	৩৬৬	৩৬৬	---	সর্ব
২৪	শুকিন	৩২৭	১২৫৪০	---	৩১৪৬	২৮০১	১১১২	৯০০	---	---	সর্ব

২০১৭-১৮ সালে এই সর্ব রেজিস্ট্রার কার্যালয় বিলাপাও এর আওতাধীন বৌদ্ধ সংখ্যক ২০১৭ ইং সনের জন্য প্রযোজ্য হওয়া উচিত নির্দেশিত কামার মূল্য তালিকা।

১২/১৩/১৪/১৫/১৬/১৭/১৮/১৯/২০/২১/২২/২৩/২৪/২৫/২৬/২৭/২৮/২৯/৩০/৩১/৩২/৩৩/৩৪/৩৫/৩৬/৩৭/৩৮/৩৯/৪০/৪১/৪২/৪৩/৪৪/৪৫/৪৬/৪৭/৪৮/৪৯/৫০/৫১/৫২/৫৩/৫৪/৫৫/৫৬/৫৭/৫৮/৫৯/৬০/৬১/৬২/৬৩/৬৪/৬৫/৬৬/৬৭/৬৮/৬৯/৭০/৭১/৭২/৭৩/৭৪/৭৫/৭৬/৭৭/৭৮/৭৯/৮০/৮১/৮২/৮৩/৮৪/৮৫/৮৬/৮৭/৮৮/৮৯/৯০/৯১/৯২/৯৩/৯৪/৯৫/৯৬/৯৭/৯৮/৯৯/১০০/১০১/১০২/১০৩/১০৪/১০৫/১০৬/১০৭/১০৮/১০৯/১১০/১১১/১১২/১১৩/১১৪/১১৫/১১৬/১১৭/১১৮/১১৯/১২০/১২১/১২২/১২৩/১২৪/১২৫/১২৬/১২৭/১২৮/১২৯/১৩০/১৩১/১৩২/১৩৩/১৩৪/১৩৫/১৩৬/১৩৭/১৩৮/১৩৯/১৪০/১৪১/১৪২/১৪৩/১৪৪/১৪৫/১৪৬/১৪৭/১৪৮/১৪৯/১৫০/১৫১/১৫২/১৫৩/১৫৪/১৫৫/১৫৬/১৫৭/১৫৮/১৫৯/১৬০/১৬১/১৬২/১৬৩/১৬৪/১৬৫/১৬৬/১৬৭/১৬৮/১৬৯/১৭০/১৭১/১৭২/১৭৩/১৭৪/১৭৫/১৭৬/১৭৭/১৭৮/১৭৯/১৮০/১৮১/১৮২/১৮৩/১৮৪/১৮৫/১৮৬/১৮৭/১৮৮/১৮৯/১৯০/১৯১/১৯২/১৯৩/১৯৪/১৯৫/১৯৬/১৯৭/১৯৮/১৯৯/২০০/২০১/২০২/২০৩/২০৪/২০৫/২০৬/২০৭/২০৮/২০৯/২১০/২১১/২১২/২১৩/২১৪/২১৫/২১৬/২১৭/২১৮/২১৯/২২০/২২১/২২২/২২৩/২২৪/২২৫/২২৬/২২৭/২২৮/২২৯/২৩০/২৩১/২৩২/২৩৩/২৩৪/২৩৫/২৩৬/২৩৭/২৩৮/২৩৯/২৪০/২৪১/২৪২/২৪৩/২৪৪/২৪৫/২৪৬/২৪৭/২৪৮/২৪৯/২৫০/২৫১/২৫২/২৫৩/২৫৪/২৫৫/২৫৬/২৫৭/২৫৮/২৫৯/২৬০/২৬১/২৬২/২৬৩/২৬৪/২৬৫/২৬৬/২৬৭/২৬৮/২৬৯/২৭০/২৭১/২৭২/২৭৩/২৭৪/২৭৫/২৭৬/২৭৭/২৭৮/২৭৯/২৮০/২৮১/২৮২/২৮৩/২৮৪/২৮৫/২৮৬/২৮৭/২৮৮/২৮৯/২৯০/২৯১/২৯২/২৯৩/২৯৪/২৯৫/২৯৬/২৯৭/২৯৮/২৯৯/৩০০/৩০১/৩০২/৩০৩/৩০৪/৩০৫/৩০৬/৩০৭/৩০৮/৩০৯/৩১০/৩১১/৩১২/৩১৩/৩১৪/৩১৫/৩১৬/৩১৭/৩১৮/৩১৯/৩২০/৩২১/৩২২/৩২৩/৩২৪/৩২৫/৩২৬/৩২৭/৩২৮/৩২৯/৩৩০/৩৩১/৩৩২/৩৩৩/৩৩৪/৩৩৫/৩৩৬/৩৩৭/৩৩৮/৩৩৯/৩৪০/৩৪১/৩৪২/৩৪৩/৩৪৪/৩৪৫/৩৪৬/৩৪৭/৩৪৮/৩৪৯/৩৫০/৩৫১/৩৫২/৩৫৩/৩৫৪/৩৫৫/৩৫৬/৩৫৭/৩৫৮/৩৫৯/৩৬০/৩৬১/৩৬২/৩৬৩/৩৬৪/৩৬৫/৩৬৬/৩৬৭/৩৬৮/৩৬৯/৩৭০/৩৭১/৩৭২/৩৭৩/৩৭৪/৩৭৫/৩৭৬/৩৭৭/৩৭৮/৩৭৯/৩৮০/৩৮১/৩৮২/৩৮৩/৩৮৪/৩৮৫/৩৮৬/৩৮৭/৩৮৮/৩৮৯/৩৯০/৩৯১/৩৯২/৩৯৩/৩৯৪/৩৯৫/৩৯৬/৩৯৭/৩৯৮/৩৯৯/৪০০/৪০১/৪০২/৪০৩/৪০৪/৪০৫/৪০৬/৪০৭/৪০৮/৪০৯/৪১০/৪১১/৪১২/৪১৩/৪১৪/৪১৫/৪১৬/৪১৭/৪১৮/৪১৯/৪২০/৪২১/৪২২/৪২৩/৪২৪/৪২৫/৪২৬/৪২৭/৪২৮/৪২৯/৪৩০/৪৩১/৪৩২/৪৩৩/৪৩৪/৪৩৫/৪৩৬/৪৩৭/৪৩৮/৪৩৯/৪৪০/৪৪১/৪৪২/৪৪৩/৪৪৪/৪৪৫/৪৪৬/৪৪৭/৪৪৮/৪৪৯/৪৫০/৪৫১/৪৫২/৪৫৩/৪৫৪/৪৫৫/৪৫৬/৪৫৭/৪৫৮/৪৫৯/৪৬০/৪৬১/৪৬২/৪৬৩/৪৬৪/৪৬৫/৪৬৬/৪৬৭/৪৬৮/৪৬৯/৪৭০/৪৭১/৪৭২/৪৭৩/৪৭৪/৪৭৫/৪৭৬/৪৭৭/৪৭৮/৪৭৯/৪৮০/৪৮১/৪৮২/৪৮৩/৪৮৪/৪৮৫/৪৮৬/৪৮৭/৪৮৮/৪৮৯/৪৯০/৪৯১/৪৯২/৪৯৩/৪৯৪/৪৯৫/৪৯৬/৪৯৭/৪৯৮/৪৯৯/৫০০/৫০১/৫০২/৫০৩/৫০৪/৫০৫/৫০৬/৫০৭/৫০৮/৫০৯/৫১০/৫১১/৫১২/৫১৩/৫১৪/৫১৫/৫১৬/৫১৭/৫১৮/৫১৯/৫২০/৫২১/৫২২/৫২৩/৫২৪/৫২৫/৫২৬/৫২৭/৫২৮/৫২৯/৫৩০/৫৩১/৫৩২/৫৩৩/৫৩৪/৫৩৫/৫৩৬/৫৩৭/৫৩৮/৫৩৯/৫৪০/৫৪১/৫৪২/৫৪৩/৫৪৪/৫৪৫/৫৪৬/৫৪৭/৫৪৮/৫৪৯/৫৫০/৫৫১/৫৫২/৫৫৩/৫৫৪/৫৫৫/৫৫৬/৫৫৭/৫৫৮/৫৫৯/৫৬০/৫৬১/৫৬২/৫৬৩/৫৬৪/৫৬৫/৫৬৬/৫৬৭/৫৬৮/৫৬৯/৫৭০/৫৭১/৫৭২/৫৭৩/৫৭৪/৫৭৫/৫৭৬/৫৭৭/৫৭৮/৫৭৯/৫৮০/৫৮১/৫৮২/৫৮৩/৫৮৪/৫৮৫/৫৮৬/৫৮৭/৫৮৮/৫৮৯/৫৯০/৫৯১/৫৯২/৫৯৩/৫৯৪/৫৯৫/৫৯৬/৫৯৭/৫৯৮/৫৯৯/৬০০/৬০১/৬০২/৬০৩/৬০৪/৬০৫/৬০৬/৬০৭/৬০৮/৬০৯/৬১০/৬১১/৬১২/৬১৩/৬১৪/৬১৫/৬১৬/৬১৭/৬১৮/৬১৯/৬২০/৬২১/৬২২/৬২৩/৬২৪/৬২৫/৬২৬/৬২৭/৬২৮/৬২৯/৬৩০/৬৩১/৬৩২/৬৩৩/৬৩৪/৬৩৫/৬৩৬/৬৩৭/৬৩৮/৬৩৯/৬৪০/৬৪১/৬৪২/৬৪৩/৬৪৪/৬৪৫/৬৪৬/৬৪৭/৬৪৮/৬৪৯/৬৫০/৬৫১/৬৫২/৬৫৩/৬৫৪/৬৫৫/৬৫৬/৬৫৭/৬৫৮/৬৫৯/৬৬০/৬৬১/৬৬২/৬৬৩/৬৬৪/৬৬৫/৬৬৬/৬৬৭/৬৬৮/৬৬৯/৬৭০/৬৭১/৬৭২/৬৭৩/৬৭৪/৬৭৫/৬৭৬/৬৭৭/৬৭৮/৬৭৯/৬৮০/৬৮১/৬৮২/৬৮৩/৬৮৪/৬৮৫/৬৮৬/৬৮৭/৬৮৮/৬৮৯/৬৯০/৬৯১/৬৯২/৬৯৩/৬৯৪/৬৯৫/৬৯৬/৬৯৭/৬৯৮/৬৯৯/৭০০/৭০১/৭০২/৭০৩/৭০৪/৭০৫/৭০৬/৭০৭/৭০৮/৭০৯/৭১০/৭১১/৭১২/৭১৩/৭১৪/৭১৫/৭১৬/৭১৭/৭১৮/৭১৯/৭২০/৭২১/৭২২/৭২৩/৭২৪/৭২৫/৭২৬/৭২৭/৭২৮/৭২৯/৭৩০/৭৩১/৭৩২/৭৩৩/৭৩৪/৭৩৫/৭৩৬/৭৩৭/৭৩৮/৭৩৯/৭৪০/৭৪১/৭৪২/৭৪৩/৭৪৪/৭৪৫/৭৪৬/৭৪৭/৭৪৮/৭৪৯/৭৫০/৭৫১/৭৫২/৭৫৩/৭৫৪/৭৫৫/৭৫৬/৭৫৭/৭৫৮/৭৫৯/৭৬০/৭৬১/৭৬২/৭৬৩/৭৬৪/৭৬৫/৭৬৬/৭৬৭/৭৬৮/৭৬৯/৭৭০/৭৭১/৭৭২/৭৭৩/৭৭৪/৭৭৫/৭৭৬/৭৭৭/৭৭৮/৭৭৯/৭৮০/৭৮১/৭৮২/৭৮৩/৭৮৪/৭৮৫/৭৮৬/৭৮৭/৭৮৮/৭৮৯/৭৯০/৭৯১/৭৯২/৭৯৩/৭৯৪/৭৯৫/৭৯৬/৭৯৭/৭৯৮/৭৯৯/৮০০/৮০১/৮০২/৮০৩/৮০৪/৮০৫/৮০৬/৮০৭/৮০৮/৮০৯/৮১০/৮১১/৮১২/৮১৩/৮১৪/৮১৫/৮১৬/৮১৭/৮১৮/৮১৯/৮২০/৮২১/৮২২/৮২৩/৮২৪/৮২৫/৮২৬/৮২৭/৮২৮/৮২৯/৮৩০/৮৩১/৮৩২/৮৩৩/৮৩৪/৮৩৫/৮৩৬/৮৩৭/৮৩৮/৮৩৯/৮৪০/৮৪১/৮৪২/৮৪৩/৮৪৪/৮৪৫/৮৪৬/৮৪৭/৮৪৮/৮৪৯/৮৫০/৮৫১/৮৫২/৮৫৩/৮৫৪/৮৫৫/৮৫৬/৮৫৭/৮৫৮/৮৫৯/৮৬০/৮৬১/৮৬২/৮৬৩/৮৬৪/৮৬৫/৮৬৬/৮৬৭/৮৬৮/৮৬৯/৮৭০/৮৭১/৮৭২/৮৭৩/৮৭৪/৮৭৫/৮৭৬/৮৭৭/৮৭৮/৮৭৯/৮৮০/৮৮১/৮৮২/৮৮৩/৮৮৪/৮৮৫/৮৮৬/৮৮৭/৮৮৮/৮৮৯/৮৯০/৮৯১/৮৯২/৮৯৩/৮৯৪/৮৯৫/৮৯৬/৮৯৭/৮৯৮/৮৯৯/৯০০/৯০১/৯০২/৯০৩/৯০৪/৯০৫/৯০৬/৯০৭/৯০৮/৯০৯/৯১০/৯১১/৯১২/৯১৩/৯১৪/৯১৫/৯১৬/৯১৭/৯১৮/৯১৯/৯২০/৯২১/৯২২/৯২৩/৯২৪/৯২৫/৯২৬/৯২৭/৯২৮/৯২৯/৯৩০/৯৩১/৯৩২/৯৩৩/৯৩৪/৯৩৫/৯৩৬/৯৩৭/৯৩৮/৯৩৯/৯৪০/৯৪১/৯৪২/৯৪৩/৯৪৪/৯৪৫/৯৪৬/৯৪৭/৯৪৮/৯৪৯/৯৫০/৯৫১/৯৫২/৯৫৩/৯৫৪/৯৫৫/৯৫৬/৯৫৭/৯৫৮/৯৫৯/৯৬০/৯৬১/৯৬২/৯৬৩/৯৬৪/৯৬৫/৯৬৬/৯৬৭/৯৬৮/৯৬৯/৯৭০/৯৭১/৯৭২/৯৭৩/৯৭৪/৯৭৫/৯৭৬/৯৭৭/৯৭৮/৯৭৯/৯৮০/৯৮১/৯৮২/৯৮৩/৯৮৪/৯৮৫/৯৮৬/৯৮৭/৯৮৮/৯৮৯/৯৯০/৯৯১/৯৯২/৯৯৩/৯৯৪/৯৯৫/৯৯৬/৯৯৭/৯৯৮/৯৯৯/১০০০

সর্ব রেজিস্ট্রার কার্যালয় বিলাপাও, ঢাকা ও সদস্য কামার মূল্য নির্ধারণ কমিটি

সর্ব রেজিস্ট্রার কার্যালয় বিলাপাও, ঢাকা ও সদস্য কামার মূল্য নির্ধারণ কমিটি

সর্ব রেজিস্ট্রার কার্যালয় বিলাপাও, ঢাকা ও সদস্য কামার মূল্য নির্ধারণ কমিটি



ডেমরা সাব-রেজিস্ট্রি অফিসের মৌজা ওয়ারী শ্রেণীভিত্তিক ব্যক্তি মালিকানাধীন জমির প্রতি শতকের সর্ব নিম্ন বাজার মূল্য তালিকা
(সম্পত্তি বাজার মূল্য নির্ধারণ বিধিমালা-২০১০ মোতাবেক ২০১৭-২০১৮ সালে কার্যকরনার্থে প্রস্তুতকৃত)

ক্র: নং	জে,এল নং	মৌজার নাম	ভিটি জমি	বাড়ী জমি	নাশ জমি	ডোবা জমি	পুকুর	মন্তব্য
২৪	০৯	বালুখীপুর	১,২৫,৫০০/-	২,৮০,০২১/-	১,২৬,৪০০/-	৩৬,৫১৭/-	৮৭,৫০০/-	বিলাপাও, সূত্রপুর ও গামপুর অফিসের নথি সমন্বয় করে প্রস্তুত করা হয়েছে।
২৫	২১	ব্রাহ্মনচিরণ (যাত্রাবাড়ী, সিটি এলাকা)	১৪,৩১,৯৫৩/-	১৬,৭০,৩০০/-	৭,১৬,৫৮২/-	৮,৩১,২১৬/-	৩,০৩,৫০০/-	
২৬	২০	মাতুলমাইল-১ (ডেমরা থানা)	১৪,৭০,৯৫৭/-	৯,৭৭,৪১৬/-	৪,৯৩,২৫৭/-	১,২৪,৩১২/-	৩,৩০,১৭৪/-	
২৭	২০	মাতুলমাইল-১ (যাত্রাবাড়ী থানা)	৭,১০,৫৪১/-	৯,১৪,৭০২/-	৪,৫৫,৮৫১/-	২,২৭,৮৫৮/-	৮,০৯,৩০৮/-	
২৮	২০	মাতুলমাইল-২ (ডেমরা থানা)	**১০,০৬,৬১৪/-	১২,৬৫,৮২২/-	২,৫৪,২১৬/-	৮৮,৮৬৬/-	*৫৪,৬১২/-	
২৯	২০	মাতুলমাইল-২ (যাত্রাবাড়ী থানা)	১৩,০০,৩০৪/-	১৫,৩৫,১৬৩/-	৩,০৭,০২৬/-	১,০৪,৭৫৪/-	১,৭৭,২০৬/-	
৩০	১২	মেন্দীপুর	৪৬,৪০৪/-	৪৫,০০০/-	৪৫,০০০/-	**১৭,৬০০/-	*১৭,৬৬৭/-	
৩১	২০	যাত্রাবাড়ী (সিটি এলাকা)	১৩,৯৬,৯১৮/-	১৪,৪৮,১০৫/-	৫,৯২,০০৬/-	২,৯২,৯৪২/-	২,১৬,৯৮৬/-	
৩২	১৮	শূন্য	৪,২০,২৯০/-	১,৭৫,২৯৮/-	১,২৪,৩৫৫/-	১,২১,৭২৪/-	৮৮,৭৫৭/-	
৩৩	৩৬	সারুলিয়া	৭,৬৭,৭৭২/-	৭,৯২,৮১৪/-	৪,১৫,৮৮৪/-	২,৫৬,১৮৯/-	৪,৬২,৭২৪/-	

ডেপুটি কমিশনার
সি.মি. কামরুজ্জামান
প্রস্তুতকারক

সহকারী
সহকারী
তৃণনাকারক

অশাহুজ্জামান
সাব-রেজিস্ট্রার
ডেমরা, ঢাকা
ও সদস্য সচিব
বাজার মূল্য নির্ধারণ কমিটি, ঢাকা।

মোঃ সেলিম হাওশাদার
সাব-রেজিস্ট্রার
মিরপুর, ঢাকা
ও সদস্য
বাজার মূল্য নির্ধারণ কমিটি, ঢাকা।

দ্বীপক কুমার সরকার
জেলা-রেজিস্ট্রার, ঢাকা
ও সভাপতি
বাজার মূল্য নির্ধারণ কমিটি, ঢাকা।

Annex 3

Road Restoration Charges

রেজিস্টার্ড নং ডি এ-১

বাংলাদেশ



গেজেট

অতিরিক্ত সংখ্যা
কর্তৃপক্ষ কর্তৃক প্রকাশিত

বৃহস্পতিবার, সেপ্টেম্বর ৮, ২০২২

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
স্থানীয় সরকার, পল্লী উন্নয়ন ও সমবায় মন্ত্রণালয়
স্থানীয় সরকার বিভাগ
সিটি কর্পোরেশন-১ শাখা
প্রজ্ঞাপন

তারিখ : ২১ ভাদ্র ১৪২৯/০৫ সেপ্টেম্বর ২০২২

নং ৪৬.০০.০০০০.০৭০.২২.০০১.১৮-১০৪৩—স্থানীয় সরকার বিভাগ প্রণীত 'ঢাকা মহানগরীর সড়ক খনন নীতিমালা, ২০১৯' এর আলোকে অর্থ বিভাগের ২২-০৮-২০২২ তারিখের ০৭.০০.০০০০.১৫৫.১৪.০০১.২০-৫২০নং স্মারকের পরিপ্রেক্ষিতে সরকার ঢাকা দক্ষিণ ও ঢাকা উত্তর সিটি কর্পোরেশন অধিক্ষেত্রে 'সড়ক খনন ক্ষতিপূরণ ফি' নিম্নবর্ণিতরূপে নির্ধারণ করিল :

উন্মুক্ত খনন এবং এইচডিডি খনন ক্ষতিপূরণ ফি :

(ক) উন্মুক্ত খনন ক্ষতিপূরণ ফি :

ক্রমিক	রাস্তার প্রকৃতি	ব্যক্তিগত খনন	প্রস্তাবিত রাস্তা খনন ফি (প্রতি বর্গ মিটার)	
		গভীরতা ১.৫০ মিঃ পর্যন্ত	সংস্থা	
১	২	৩	গভীরতা ১.৫০ মিঃ পর্যন্ত	গভীরতা ১.৫০ মিঃ এর অধিক
১।	কাঁচা রাস্তা	৪৮২.০০	৪৮২.০০	৪৮২.০০
২।	ব্রিক পেভমেন্ট (২০০ মিঃ মিঃ)	১৭৯২.০০	১৭৯২.০০	২০৩৩.০০
৩।	বিটুমিনাস রাস্তা (প্রাইমারী রোড)	৭৮৭১.০০	৭৮৭১.০০	৯৬১৯.০০
৪।	বিটুমিনাস রাস্তা	৬৩১২.০০	৬৩১২.০০	৭৬৮০.০০
৫।	সি সি রাস্তা	৪৯৪৬.০০	৪৯৪৬.০০	৬১৫১.০০

(১৫১২৫)

মূল্য : টাকা ৮.০০

১৫১২৬ বাংলাদেশ গেজেট, অতিরিক্ত, সেপ্টেম্বর ৮, ২০২২

১	২	৩	৪	৫
৬।	আরসিসি রাস্তা	৬৭০৪.০০	৬৭০৪.০০	৭৯৩০.০০
৭।	সি সি ফুটপাথ	৩০২১.০০	৩০২১.০০	৩৩৮৪.০০
৮।	এনস্লেভ সিসি টাইল (ফুটপাথ)	৪৩৫৬.০০	৪৩৫৬.০০	৪৯৬৮.০০
৯।	ইউনিব্রক পেভারস (ফুটপাথ)	৩৯২৮.০০	৩৯২৮.০০	৪৫৪৫.০০

(খ) এইচডিডি Horizontal Direction Drilling (with casing) পদ্ধতিতে সড়ক খননের ক্ষতিপূরণ ফি :

১। ১৫০ মিমিঃ (৬") পর্যন্ত ডায়া রাস্তা বোরিং ফি, টাকা/মিটার

ক্রমিক	রাস্তার প্রকৃতি	প্রস্তাবিত রাস্তা বোরিং ৬ ইঞ্চির চেয়ে কম ব্যাসের জন্য (প্রতি মিঃ)	
		গভীরতা ১.৫০ মিঃ এর কম পর্যন্ত (উন্মুক্ত পদ্ধতিতে খনন রেট×১০%)	গভীরতা ১.৫০ মিঃ এর অধিক (উন্মুক্ত পদ্ধতিতে খনন রেট×৫%)
১	২	৩	৪
১।	কাঁচা রাস্তা	৪৮.২	২৪.১
২।	ব্রিক পেভমেন্ট (২০০ মিঃ মিঃ)	১৭৯.২	৮৯.৬
৩।	বিটুমিনাস রাস্তা (প্রাইমারী রোড)	৭৮৭.১	৩৯৩.৫৫
৪।	বিটুমিনাস রাস্তা	৬৩১.২	৩১৫.৬
৫।	সি সি রাস্তা	৪৯৪.৬	২৪৭.৩
৬।	আরসিসি রাস্তা	৬৭০.৪	৩৩৫.২
৭।	সি সি ফুটপাথ	৩০২.১	১৫১.০৫
৮।	এনস্লেভ সিসি টাইল (ফুটপাথ)	৪৩৫.৬	২১৭.৮
৯।	ইউনিব্রক পেভারস (ফুটপাথ)	৩৯২.৮	১৯৬.৪

২। ১৫০ মিমিঃ (৬") এর অধিক ৩০০ মিমিঃ (১২") পর্যন্ত ডায়া রাস্তা বোরিং ফি, টাকা/মিটার

ক্রমিক নং	রাস্তার প্রকৃতি	প্রস্তাবিত রাস্তা বোরিং ৬ ইঞ্চির থেকে ১২ ইঞ্চির কম ব্যাসের জন্য (প্রতি মিঃ)	
		গভীরতা ১.৫০ মিঃ এর কম পর্যন্ত (উন্মুক্ত পদ্ধতিতে খনন রেট×১৩%)	গভীরতা ১.৫০ মিঃ এর অধিক (উন্মুক্ত পদ্ধতিতে খনন রেট×৭%)
১	২	৩	৪
১।	কাঁচা রাস্তা	৬২.৬৬	৩৩.৭৪
২।	ব্রিক পেভমেন্ট (২০০ মিঃ মিঃ)	২৩২.৯৬	১২৫.৪৪
৩।	বিটুমিনাস রাস্তা (প্রাইমারী রোড)	১০২৩.২৩	৫১০.৯৭
৪।	বিটুমিনাস রাস্তা	৮২০.৫৬	৪১০.২৮
৫।	সি সি রাস্তা	৬৪২.৯৮	৩২১.৪৯
৬।	আরসিসি রাস্তা	৮৭১.৫২	৪৩৬.২৮
৭।	সি সি ফুটপাথ	৩৯২.৭৩	১৯৬.৩৬
৮।	এনস্লেভ সিসি টাইল (ফুটপাথ)	৫৬৬.২৮	২৭৪.৯৬
৯।	ইউনিব্রক পেভারস (ফুটপাথ)	৫১০.৬৪	২৫৬.৯৬

বাংলাদেশ গেজেট, অতিরিক্ত, সেপ্টেম্বর ৮, ২০২২

১৫১২৭

৩। ৩০০ মিলিমিটার (১২") এর অধিক ডায়ামিটার বোরিং ফি, টাকা/মিটার

ক্রমিক নং	রাস্তার প্রকৃতি	রাস্তা বোরিং ১২ ইঞ্চি থেকে ১৮ ইঞ্চি ব্যাসের জন্য (প্রতি মিঃ)	
		গভীরতা ১.৫০ মিঃ এর কম পর্যন্ত (উন্মুক্ত পদ্ধতিতে বনন রেট×১৭%)	গভীরতা ১.৫০ মিঃ এর অধিক (উন্মুক্ত পদ্ধতিতে বনন রেট×৯%)
১	২	৩	৪
১।	কাঁচা রাস্তা	৮১.৯৪	৪৩.৩৮
২।	ব্রিক পেভমেন্ট (২০০ মিঃ মিঃ)	৩০৪.৬৪	১৬১.২৮
৩।	বিটুমিনাস রাস্তা (প্রাইমারী রোড)	১৩৩৮.০৭	৭০৮.৩৯
৪।	বিটুমিনাস রাস্তা	১০৭৩.০৪	৫৬৮.০৮
৫।	সি সি রাস্তা	৮৪০.৮২	৪৪৫.১৪
৬।	আরসিসি রাস্তা	১১৩৯.৬৮	৬০৩.৩৬
৭।	সি সি ফুটপাথ	৫১৩.৫৭	২৭১.৮৯
৮।	এনগ্রোড সি সি টাইল (ফুটপাথ)	৭৪০.৫২	৩৯২.০৪
৯।	ইউনিট্রক পেভারস (ফুটপাথ)	৬৬৭.৭৬	৩৫৩.৫২

(গ) এইচডিডি Horizontal Direction Drilling (without casing) পদ্ধতিতে সড়ক
খননের ক্ষতিপূরণ ফি :

১। ১৫০ মিলিমিটার (৬") পর্যন্ত ডায়ামিটার বোরিং ফি, টাকা/মিটার

ক্রমিক নং	রাস্তার প্রকৃতি	প্রস্তাবিত রাস্তা বোরিং ৬ ইঞ্চির চেয়ে কম ব্যাসের জন্য (প্রতি মিঃ)	
		গভীরতা ১.৫০ মিঃ এর কম পর্যন্ত (উন্মুক্ত পদ্ধতিতে বনন রেট×১৩%)	গভীরতা ১.৫০ মিঃ এর অধিক (উন্মুক্ত পদ্ধতিতে বনন রেট×৭%)
১	২	৩	৪
১।	কাঁচা রাস্তা	৬২.৬৬	৩৩.৭৪
২।	ব্রিক পেভমেন্ট (২০০ মিঃ মিঃ)	২৩২.৯৬	১২৫.৪৪
৩।	বিটুমিনাস রাস্তা (প্রাইমারী রোড)	১০২৩.২৩	৫৫০.৯৭
৪।	বিটুমিনাস রাস্তা	৮২০.৫৬	৪৪১.৮৪
৫।	সি সি রাস্তা	৬৪২.৯৮	৩৪৬.২২
৬।	আরসিসি রাস্তা	৮৭৯.১৯	৪৭৩.৪১
৭।	সি সি ফুটপাথ	৩৯২.৭৩	২১১.৪৭
৮।	এনগ্রোড সি সি টাইল (ফুটপাথ)	৫৬৬.২৮	৩০৪.৯২
৯।	ইউনিট্রক পেভারস (ফুটপাথ)	৫১০.৬৪	২৭৪.৯৬

১৫১২৮

বাংলাদেশ গেজেট, অতিরিক্ত, সেপ্টেম্বর ৮, ২০২২

২। ১৫০ মিমিমি (৬") এর অধিক ৩০০ মিমিমি (১২") পর্যন্ত ডায়া রাস্তা বোরিং ফি, টাকা/মিটার

ক্রমিক নং	রাস্তার প্রকৃতি	প্রস্তাবিত রাস্তা বোরিং ৬ ইঞ্চি থেকে ১২ ইঞ্চির কম ব্যাসের জন্য (প্রতি মিঃ)	
		গভীরতা ১.৫০ মিঃ এর কম পর্যন্ত (উন্নুক্ত পদ্ধতিতে খনন রেট×১৬%)	গভীরতা ১.৫০ মিঃ এর অধিক (উন্নুক্ত পদ্ধতিতে খনন রেট×১৯%)
১	২	৩	৪
১।	কাঁচা রাস্তা	৭৭.১২	৪৩.৩৮
২।	ব্রিক পেভমেন্ট (২০০ মিমি মিমি)	২৮৬.৭২	১৬১.২৮
৩।	বিটুমিনাস রাস্তা (প্রাইমারী রোড)	১২৫৯.৩৬	৭০৮.৩৯
৪।	বিটুমিনাস রাস্তা	১০০৯.৯২	৫৬৮.০৮
৫।	সি সি রাস্তা	৭৯১.৩৬	৪৪৫.১৪
৬।	আরসিসি রাস্তা	১০৮২.০৮	৬০৮.৬৭
৭।	সি সি ফুটপাথ	৪৮৩.৩৬	২৭১.৮৯
৮।	এনহোড সিসি টাইল (ফুটপাথ)	৬৯৬.৯৬	৩৯২.০৪
৯।	ইউনিরক পেভারস (ফুটপাথ)	৬২৮.৪৮	৩৫৩.৫২

৩। ৩০০ মিমিমি (১২") এর অধিক ডায়া রাস্তা বোরিং ফি, টাকা/মিটার

ক্রমিক নং	রাস্তার প্রকৃতি	রাস্তা বোরিং ১২ ইঞ্চি থেকে ১৮ ইঞ্চি ব্যাসের জন্য (প্রতি মিঃ)	
		গভীরতা ১.৫০ মিঃ এর কম পর্যন্ত (উন্নুক্ত পদ্ধতিতে খনন রেট×২১%)	গভীরতা ১.৫০ মিঃ এর অধিক (উন্নুক্ত পদ্ধতিতে খনন রেট×১১%)
১	২	৩	৪
১।	কাঁচা রাস্তা	১০১.২২	৫৩.০২
২।	ব্রিক পেভমেন্ট (২০০ মিমি মিমি)	৩৭৬.৩২	১৯৭.১২
৩।	বিটুমিনাস রাস্তা (প্রাইমারী রোড)	১৬৫২.৯১	৮৬৫.৮১
৪।	বিটুমিনাস রাস্তা	১৩২৫.৬৬	৬৯৪.৩২
৫।	সি সি রাস্তা	১০৩৮.৫২	৫৪৪.০৬
৬।	আরসিসি রাস্তা	১৪২০.২৩	৭৪৩.৯৩
৭।	সি সি ফুটপাথ	৬৩৪.৪১	৩৩২.৩১
৮।	এনহোড সিসি টাইল (ফুটপাথ)	৯১৪.৭৬	৪৭৯.১৬
৯।	ইউনিরক পেভারস (ফুটপাথ)	৮২৪.৮৮	৪৩২.০৮

০২। বর্ধিত সড়ক খনন ক্ষতিপূরণ ফি অবিলম্বে কার্যকর হইবে।

রাষ্ট্রপতির আদেশক্রমে

মোহাম্মদ শামসুল ইসলাম

উপসচিব।

মোহাম্মদ ইসমাঈল হোসেন, উপপরিচালক (উপসচিব), বাংলাদেশ সরকারী মুদ্রণালয়, তেজগাঁও, ঢাকা কর্তৃক মুদ্রিত।
হাছিনা বেগম, উপপরিচালক (উপসচিব), বাংলাদেশ ফরম ও প্রকাশনা অফিস, তেজগাঁও,
ঢাকা কর্তৃক প্রকাশিত। website: www.bgpress.gov.bd

Annex 4

Cost Breakdown of HDPE Pipe (Supply and Installation Cost)

Item No.	Description of Items	Unit	Installation Cost in BDT	Material Cost in BDT
1.1	HDPE Pipe (PN10) (ISO 4427-2:2007): Open Cut Method			
a)	75 mm	Rm	904	367
b)	110 mm	Rm	939	783
c)	160 mm	Rm	1,002	1,634
d)	200 mm	Rm	1,124	2,553
e)	250 mm	Rm	1,228	3,965
f)	315 mm	Rm	1,263	6,303
g)	400 mm	Rm	1,707	10,164
1.2	HDPE Pipe (PN10) (ISO 4427-2:2007): Horizontal Direction Drilling (HDD)			
a)	75 mm	Rm	639	367
b)	110 mm	Rm	656	783
c)	160 mm	Rm	705	1,634
d)	200 mm	Rm	923	2,553
e)	250 mm	Rm	1,179	3,965
f)	315 mm	Rm	1,233	6,303
g)	400 mm	Rm	1,817	10,164

Annex 5

Land Acquisition Cost Estimation

PTW ID	Union Name	DMA ID	No. of PTWs	Mauza Name	Bhiti Land Rate (in Tk.)	Total Area of PTWs Covered per Union (decimal)	3 times the Govt. Rate including Additional Charges (per decimal in Tk.)	Total Cost (in Tk.)
1	Matuail	722	7	Matuail	1,470,957	40.1744	4,508,483	25,875,087
2		715		Matuail	1,470,957		4,508,483	25,875,087
3		722		Matuail	1,470,957		4,508,483	25,875,087
4		721		Para Dagar	724,297		2,219,970	12,740,854
5		120		Matuail	1,470,957		4,508,483	25,875,087
6		712		Matuail	1,470,957		4,508,483	25,875,087
7		717		Para Dagar	724,297		2,219,970	12,740,854
8	Shyampur	709	6	Kadamtali	718,777	34.4352	2,203,052	12,643,753
9		710		Kadamtali	718,777		2,203,052	12,643,753
10		713		Deul Para	860,125		2,636,283	15,130,156
11		729		Deul Para	860,125		2,636,283	15,130,156
12		729		Bhuigar	860,125		2,636,283	15,130,156
13		730		Deul Para	860,125		2,636,283	15,130,156

PTW ID	Union Name	DMA ID	No. of PTWs	Mauza Name	Bhiti Land Rate (in Tk.)	Total Area of PTWs Covered per Union (decimal)	3 times the Govt. Rate including Additional Charges (per decimal in Tk.)	Total Cost (in Tk.)
14	Sarulia	727	11	Shimrail	767,772	63.1312	2,353,221	13,505,607
15		724		Saralia	767,772		2,353,221	13,505,607
16		724		Dagar	739,334		2,266,059	13,005,364
17		728		Saralia	767,772		2,353,221	13,505,607
18		728		Shimrail	767,772		2,353,221	13,505,607
19		721		Dagar	739,334		2,266,059	13,005,364
20		721		Dagar	739,334		2,266,059	13,005,364
21		723		Dagar	739,334		2,266,059	13,005,364
22		723		Dagar	739,334		2,266,059	13,005,364
23		727		Saralia	767,772		2,353,221	13,505,607
24		727		Khorda Ghoshpara	767,772		2,353,221	13,505,607
25	Dumni	814	10	Joar Sahara	49,761	57.392	152,517	875,328

PTW ID	Union Name	DMA ID	No. of PTWs	Mauza Name	Bhiti Land Rate (in Tk.)	Total Area of PTWs Covered per Union (decimal)	3 times the Govt. Rate including Additional Charges (per decimal in Tk.)	Total Cost (in Tk.)
26		814		Joar Sahara	49,761		152,517	875,328
27		815		Bara Kanthaldia	8,070		24,735	141,957
28		815		Bara Kanthaldia	8,070		24,735	141,957
29		813		Bara Kanthaldia	8,070		24,735	141,957
30		813		Dumni	9,131		27,987	160,620
31		812		Joar Sahara	49,761		152,517	875,328
32		812		Joar Sahara	49,761		152,517	875,328
33		816		Bara Kanthaldia	8,070		24,735	141,957
34		Small-scale DMA 803		Dumni	9,131		27,987	160,620
35		Satarkul		816	3		Satarkul	4,841	17.2176	14,838	85,156
36	816		Satarkul	4,841		14,838	85,156	

PTW ID	Union Name	DMA ID	No. of PTWs	Mauza Name	Bhiti Land Rate (in Tk.)	Total Area of PTWs Covered per Union (decimal)	3 times the Govt. Rate including Additional Charges (per decimal in Tk.)	Total Cost (in Tk.)
37		Small-scale DMA 801		Satarkul	4,841		14,838	85,156
38	Dania	711	1	Dhania	1,012,500	5.7392	3,103,313	17,810,531
39	Demra	726	6	Ghop Dakshin	470,588	34.4352	1,442,352	8,277,948
40		726		Deilla	228,343		699,871	4,016,701
41		Small-scale DMA 103		Kamar Ghop	470,588		1,442,352	8,277,948
42		Small-scale DMA 102		Sunna	420,290		1,288,189	7,393,173
43		Small-scale DMA 101		Amolia	8,018		24,575	141,042
44		Small-scale DMA 104		Amolia	8,018		24,575	141,042

PTW ID	Union Name	DMA ID	No. of PTWs	Mauza Name	Bhiti Land Rate (in Tk.)	Total Area of PTWs Covered per Union (decimal)	3 times the Govt. Rate including Additional Charges (per decimal in Tk.)	Total Cost (in Tk.)
45	Badda	806	2	Meradia	14,519	11.4784	44,501	255,399
46		806		Badda	22,845		70,020	401,858
47	Dakshingaon	806	1	Nondipara	7,459	5.7392	22,862	131,209
48	Dakshinkhan	Small-scale DMA 901	2	Barua	8,023	11.4784	24,590	141,130
49		Small-scale DMA 901		Dakshinkhan	10,979		33,651	193,128
50	Uttarkhan	917	10	Uttar Khan	7,063	57.392	21,648	124,243
51		916		Uttar Khan	7,063		21,648	124,243
52		916		Uttar Khan	7,063		21,648	124,243
53		Small-scale DMA 902		Uttar Khan	7,063		21,648	124,243

PTW ID	Union Name	DMA ID	No. of PTWs	Mauza Name	Bhiti Land Rate (in Tk.)	Total Area of PTWs Covered per Union (decimal)	3 times the Govt. Rate including Additional Charges (per decimal in Tk.)	Total Cost (in Tk.)
54		Small-scale DMA 902		Uttar Khan	7,063		21,648	124,243
55		Small-scale DMA 902		Uttar Khan	7,063		21,648	124,243
56		Small-scale DMA 902		Chamor Khan	3,669		11,245	64,540
57		Small-scale DMA 902		Gobindapur	4,630		14,191	81,445
58		Small-scale DMA 902		Mousaid	2,795		8,567	49,166
59		Small-scale DMA 902		Uttar Khan	7,063		21,648	124,243

PTW ID	Union Name	DMA ID	No. of PTWs	Mauza Name	Bhiti Land Rate (in Tk.)	Total Area of PTWs Covered per Union (decimal)	3 times the Govt. Rate including Additional Charges (per decimal in Tk.)	Total Cost (in Tk.)
60	Beraid	Small-scale DMA 802	1	Bara Beraid	8,087	5.7392	24,787	142,256
61	Harirampur	1021	11	Dhaur	525,642	63.1312	1,611,093	9,246,383
62		1021		Diabari	525,642		1,611,093	9,246,383
63		1021		Diabari	525,642		1,611,093	9,246,383
64		1022		Dhaur	525,642		1,611,093	9,246,383
65		1022		Dhaur	525,642		1,611,093	9,246,383
66		1020		Baunia	525,642		1,611,093	9,246,383
67		1020		Baunia	525,642		1,611,093	9,246,383
68		412		Digun	525,642		1,611,093	9,246,383
69		1019		Baunia	525,642		1,611,093	9,246,383
70		1020		Baunia	525,642		1,611,093	9,246,383
71		1020		Baunia	525,642		1,611,093	9,246,383

PTW ID	Union Name	DMA ID	No. of PTWs	Mauza Name	Bhiti Land Rate (in Tk.)	Total Area of PTWs Covered per Union (decimal)	3 times the Govt. Rate including Additional Charges (per decimal in Tk.)	Total Cost (in Tk.)
Land Acquisition for Production Tubewells								541,470,014

Land Acquisition for O&M Offices

PTW ID	Union Name	MODS Zone	Bhiti Land Rate (in Tk.) / Decimal	Total Area required for each MODS Zone (decimal)	3 times the Govt. Rate including Additional Charges (per decimal in Tk.)	Total Cost (in Tk.)
1	Matuail	12	1,470,957	33.06	4,508,483	149,040,767
35	Badda	13	22,845	33.06	70,020	2,314,708
48	Dakshinkhan	14	10,979	33.06	33,651	1,112,418
Total Land Acquisition for O&M Offices						152,467,893

Total Land Acquisition for O&M Offices and Production Tubewells						693,937,907
Total Land Acquisition for O&M Offices and Production Tubewells with consider 6% inflation of 5 years						928,645,457

Annex 6

Breakdown of

Road Restoration Charges

Table: Breakdown of Road Restoration Charges

Pipe Diameter (mm)	Open Trench					HDD		
	Trench Width (m)	1-meter Trench Area	Total Pipe Length for OT in meter	Avg Rate/Sq. Km	Road Restoration Charge for OT in Tk.	Total Pipe Length for HDD in meter	Avg Rate/m	Road Restoration Charge for HDD in Tk.
75	0.28	0.28	83,544	6,505	149,460,112	20,886	710.2	14,832,402
110	0.41	0.41	589,040		1,571,107,810	147,260		104,578,162
160	0.46	0.46	211,568		633,118,721	52,892		37,561,783
200	0.50	0.50	121,120		393,970,052	30,280		21,503,645
250	0.55	0.55	91,760		328,317,051	22,940		16,291,070
315	0.62	0.62	47,752		191,048,673	11,938		8,477,890
355	0.66	0.66	-		-	-		-
400	0.70	0.70	20,208		92,023,494	3,812		2,707,130
Sum			1,164,992		3,359,045,911	290,008		205,952,081
Total RRC for Pipe Installation					3,564,997,993			
RRC for HC Pit					598,699,166			
RRC (Grand Total)					4,163,697,158	Or Approx. 4163.7 million BDT		

Table: Rate Consideration for Open Trench

Rate Consideration for Open Trench			
Road Type	Rate/sqm in Tk.	% Considered	Rate/sqm in Tk.
Bituminous Road (Primary)	7871	25%	1968
Bituminous Road	6312	40%	2525
RCC Road	6704	25%	1676
CC Road	4946	5%	247
Brick Pavement	1792	5%	90
Katcha Road	482	0%	0
Average		100%	6505

Table: Rate Consideration for HDD

Rate Consideration for HDD			
Road Type	Rate/sqm in Tk.	% Considered	Rate/sqm in Tk.
Bituminous Road (Primary)	787.1	50%	393.6
Bituminous Road	631.2	25%	157.8
RCC Road	670.4	20%	134.1
CC Road	494.6	5%	24.7
Brick Pavement	179.2	0%	0.0
Katcha Road	48.2	0%	0.0
Average		100%	710.2

Annex 7

Breakdown of

71 PTW Installation

Breakdown of Each PTW Installation		
SL No.	Item Description	Rate in Million BDT
1	PTW Installation	11.000
2	Land Development	0.300
3	Pump House	0.600
4	Joist	0.300
5	Boundary Wall	0.700
6	Substation and Electric Demand Node	2.000
7	Delivery	0.700
8	Flow Meter	2.000
9	Chlorination Set	0.800
10	Pump	1.600
11	Column Pipe	0.400
12	Cable	0.500
Total		20.900

Breakdown of Artificial Recharge Unit

SL No.	Description	Amount (Million BDT)
1	Injection Well Construction and Complete Development	1.4
2	Construction of Recharge Pit	0.25
3	Construction of Rainwater Collection and Delivery Pipe Network	0.35
Grand Total		2.0

