

## **CHAPTER 6 PRELIMINARY DESIGN OF SEWERAGE SYSTEM**

## CHAPTER 7 ORGANIZATION STRUCTURE FOR PROJECT IMPLEMENTATION AND O&M OF SEWERAGE SYSTEM

### 7.1 Current Status of CWASA Organization

#### 7.1.1 Organogram 2020

The current organogram of Chattogram Water and Sewerage Authority (CWASA) was developed in 2020 as shown in Figure 7.1.1, which modified the Organogram 2016 that was developed with the assistance of the Japan International Cooperation Agency (JICA) technical cooperation project (PANI-2). Two Additional Chief Engineers (CEs), namely: 1 Additional CE (Water Supply (WS) and 1 Additional CE (Sewerage), were added under the current CE, but the Sewerage Circle and its departments under Additional CE (Sewerage) remains to be developed.

As of August 2022, the 520 positions (47%) among the total 1,119 positions that were approved in the Organogram 2020 are vacant, of which the breakdown according to the class of employees is shown in Table 7.1.1. The detailed breakdown of approved/ assigned/ vacant 1<sup>st</sup> class officers for each designation is shown in Table 7.1.2, where the key engineer's positions that will be technically involved in the project implementation and the management of operation and maintenance (O&M) of sewerage system are shown in red. There is considerable vacancy of 1<sup>st</sup> class officers, and particularly, the recruitment of SDE and AE should be done as early as possible, because higher officers should be filled up by promotion only.

The high rate of vacancy is due to the delay of recruitment and promotion. Regarding the delay of recruitment, the number of employees is not enough to handle the selection process of so many candidates who applied for the job advertisement of CWASA\*<sup>1</sup>. In addition to this, the grade, qualification, and promotion conditions were not defined in the CWASA Employees Service Regulations 2020 for 11 among 12 designations that were newly created in the Organogram 2020, and thus the promotion to or recruitment of the staff for these designations have not been implemented. Regarding the delay of promotion, most of the 1<sup>st</sup> class officers are nominated through promotion from lower positions or deputation from the central government, and thus, the delay of recruitment of lower grade officers leads to the vacancy of higher-grade officers.

**Table 7.1.1 Number of Approved/Assigned/Vacant Positions**

Class	Approved in Organogram 2020 (a)	Assigned as of August 2022 (b)	Vacant (c)=(a)-(b)	Share of Vacancy (d)=(c)/(a)
1 <sup>st</sup> Class Officer	126	51	75	60%
2 <sup>nd</sup> Class Staff	91	46	45	50%
3 <sup>rd</sup> Class Staff	442	261	181	41%

\*<sup>1</sup> A job circular was announced in February 2022 for 128 posts of 18 designations, which is still under the selection process as of March 2023. According to CWASA, the delay for more than one year is attributed to the temporary vacant period of DMD (Administration) and DMD (Finance) who are the key members of the CWASA Selection Board, and the decision to outsource the paper exam to external institutions, as well as the lack of employees to handle the selection process stated above. Besides, another selection is on-going for 18 Assistant Engineers (AEs) and 34 Sub-Assistant Engineers (SAEs).

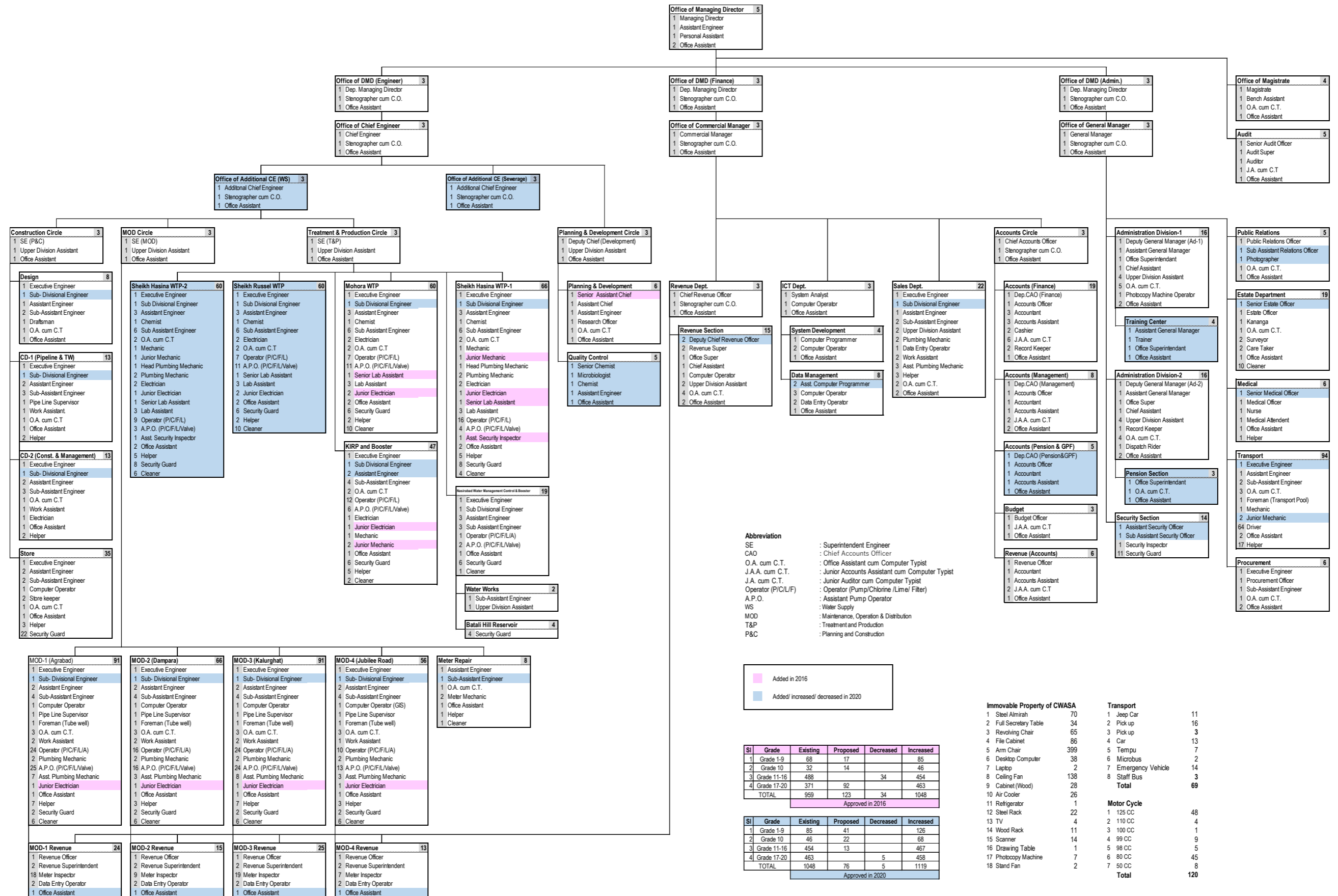
Class	Approved in Organogram 2020 (a)	Assigned as of August 2022 (b)	Vacant (c)=(a)-(b)	Share of Vacancy (d)=(c)/(a)
4 <sup>th</sup> Class Staff	460	241	219	48%
Sum	1,119	599	520	47%

Source: JICA Survey Team

**Table 7.1.2 Number of Approved/Assigned/Vacant 1<sup>st</sup> Class Officers as of August 2022**

No.	Designation	Salary Scale (Grade)	Approved	Assigned	Vacant
			Organogram 2020	as of Aug. 2022	Organogram 2020
1	Managing Director	-	1	1	0
2	Deputy Managing Director	-	3	2	1
3	Chief Engineer	3	1	1	0
4	Commercial Manager	3	1	1	0
5	Additional Chief Engineer	TBD	2	0	2
6	Secretary	4	1	1	0
7	Superintending Engineer	4	3	3	0
8	Deputy Chief (Development)	4	1	0	1
9	Chief Accounts Officer	4	1	0	1
10	Chief Revenue Officer (CRO)	5	1	0	1
11	System Analyst	5	1	1	0
12	Magistrate	6	1	0	1
13	Executive Engineer	6	17	10	7
14	Computer Programmer	6	1	1	0
15	Deputy Chief Accounts Officer	6	2	0	2
16	Deputy Chief Accounts Officer (Pension & GPF)	6	1	0	1
17	Deputy CRO	TBD	2	0	2
18	Deputy Secretary	6	2	0	2
19	Sub Divisional Engineer	TBD	14	0	14
20	Senior Assistant Chief	6	1	0	1
21	Senior Audit Officer	8	1	0	1
22	Senior Chemist	TBD	1	0	1
23	Senior Estate Officer	TBD	1	0	1
24	Senior Medical Officer	TBD	1	0	1
25	Assistant Secretary	9	3	2	1
26	Assistant Chief	9	1	1	0
27	Research Officer	9	1	0	1
28	Assistant Engineer	9	38	16	22
29	Microbiologist	TBD	1	0	1
30	Chemist	9	5	2	3
31	Accounts Officer (Finance/ (Management)	9	3	2	1
32	Revenue Officer (Billing/ Accounts)	9	5	3	2
33	Budget Officer	9	1	1	0
34	Medical Officer	9	1	1	0
35	Public Relation Officer	9	1	1	0
36	Procurement Officer	9	1	0	1
37	Estate Officer	9	1	1	0
38	Asst. Computer Programmer	9	2	0	2
39	Assistant Security Officer	TBD	1	0	1

Source: JICA Survey Team



Source: CWASA edited by the JICA Survey Team

Figure 7.1.1 Organogram 2020 of CWASA

### 7.1.2 Digitalization Status

The development status of software applications is shown in Table 7.1.3. Digitalization has been in progress in recent years by the initiative of the Information and Communications Technology (ICT) Department.

**Table 7.1.3 Development Status of Software Applications**

System	Main Functions	Development Status	Related Wing	Note
Billing	Shall send the data to server directly	Under development	Finance	Smart billing system will be tested as a pilot for 3,000 meters.
Online Payment Posting	Enables customers to refer to bills and proceed to on-line payment to the prescribed bank such as Robi, Bkash, and Grameen.	Available on-line in CWASA website	Finance	
Deep Tube Well	Customer can apply for license and renewal of deep tube wells.	In operation	Engineering	
NCMS (New Connection Management System)		In operation	Engineering	
Customer Complaint Tracking	Enables customers to post complaints and CWASA personnel to fix them and monitor the processing status.	In operation	Engineering	This is smoothly operating so no plan to update now.
HRMS (Human Resources Management System)	Only employee attendance management system has been in operation.	In operation	Admin.	The secretariat deals with this system.
Payroll Management	Bills regarding salary and other benefits like leave encashment, loan etc. are generated.	In operation	Finance, Admin.	
SMS-based Production Posting	Enables CWASA record and compile daily water production in WTPs and deep tube-wells.	In operation	Engineering	Design Division collects records and enters data in the CWASA Maintenance Management System. The total summary is sent to all concerned by SMS including the MD.
Meter Replacement	Enables customers to apply the replacement of meters and subsequently pay the meter installation fee.	In operation	Engineering & Finance	Only one meter mechanic is working in the meter replacement center.
Billing Comparison	Enables CWASA to do comparison of billed and collected amount of bills.	In operation	Finance	
Water Works	To distribute water by water bowser.	In operation	Engineering	Current procedure is time consuming, so an innovation committee of CWASA is working, especially to provide customers with online payment service.

System	Main Functions	Development Status	Related Wing	Note
Provident Fund	Calculation of pension fund.	Existing but not working	Finance, Admin.	
Tally	Financial accounting software.	In operation	Finance	<ul style="list-style-type: none"> <li>Managed by Finance Wing.</li> <li>Data disappears sometimes and if one data is entered more than once, the tally cannot notify the users.</li> </ul>
Store Inventory	Manages inventory of store and warehouse.	Under development	Engineering	Developed in 2021-2022; Under testing stage; Operation starts soon.
Inventory Management	Manages inventory of CWASA equipment.	Under development	Engineering	Under testing stage
e-Filing	Digitalization of the typical filing system is recommended by the government. CWASA has to visit <a href="http://www.nothi.gov.bd">www.nothi.gov.bd</a> and upload its document by entering the user ID, name, and password.	Central filing system is developed by the government.	Admin., Finance, Engineering	<ul style="list-style-type: none"> <li>Only a few documents are stored centrally.</li> <li>The website is slow.</li> <li>So far, CWASA wants to keep its traditional filing system with no plan of digitalizing the whole filing system until the government gives strict instruction.</li> </ul>

Source: JICA Survey Team

### 7.1.3 Training Program

International training programs in which CWASA employees have participated are shown in Table 7.1.4, where the programs specific to sewerage are shown in red. Most of the technical training programs have been on water supply topics and mainly targeted to higher class of employees (officers) of CWASA, Current CWASA staff have no practical experience with sewerage, at least not from their work with CWASA, and thus, comprehensive and intensive training programs should be arranged and implemented to both officers and lower class of employees (staffs) of CWASA.

**Table 7.1.4 International Training Opportunities from 2017 to 2021**

No.	Title of Training/ Workshop	Participant's Designation	Date and Duration	Place	Funding Authority
1	O&M of Sewerage System	XEN, MOD-1 XEN, Mohara WTP	Aug.-Sep. 2017 for 17 days	Japan	
2	Decision Tree Framework (DTF)	DPD, CWSISP XEN, CD-2	Apr. 2018 for 5 days	South Korea	World Bank
3	Training on Capacity Building Program for the Improvement of Water Security in Asia	XEN, Mohora WTP	Oct. 2018 for 9 days	South Korea	UNESCO International Centre for Water Security and Sustainable Management
4	Factory Inspection	DMD (A)	Oct.-Nov. 2018 for 8 days	Japan	KOLON-Kubota JV
5	Factory Inspection	SE and PD (KWSP-2)	Dec. 2018 for 10 days	South Korea	
6	Training on Transferrable Skills in Modern Water Supply & Sewerage Utility Management Practices	DMD (A) SE (P&C) and PD, CWSISP XEN	May.-Jun. 2019 for 10 days	Uganda	Utility Modernization Umbrella Consultancy Package of CWSISP
7	Training on Transferrable Skills in Modern Water	System Analyst SAE	Jul. 2019 for 11 days	Uganda	World Bank

No.	Title of Training/ Workshop	Participant's Designation	Date and Duration	Place	Funding Authority
	Supply & Sewerage Utility Management Practices				
8	Training on Transferrable Skills in Modern Water Supply & Sewerage Utility Management Practices	Deputy Chief Accounts Officer Accounts Officer AS-1 Revenue Officer	Jul. 2019 for 10 days	Uganda	World Bank
9	Factory Inspection	SE (A.C.) AE, Sales	Feb. 2019 for 9 days including transit	Turkey	M/S PEPCO Bangladesh
10	Strengthening Government through Capacity Development of the BCS Cadre Officials	DS and DMD	Mar. 2019 for 20 days	Australia	Bangladesh Government
11	Workshop	XEN (A.C.), MOD-3 Revenue Officer-1, Revenue Billing	Jun. 2019 for 2 days including transit	Spain	Global Water Operators Partnership
12	NRW Management (Leakage Control)	AE, CD-2	Jul.-Aug. 2019 for 38 days including transit	Japan	JICA
13	Factory Inspection	MD SE (MOD)	Jul. 2019 for 10 days	UK and USA	KOLON-Kubota JV
14	Factory Inspection	DMF (F) Sheikh Hasina WTP	Aug. 2019 for 8 days	China	China Geo-Engineering
15	Physical Inspection and Performance Test	AE, Bhandaljury WS Project AE, MOD-2	Oct. 2019 for 7days	Japan	M/S Yokogawa Solution
16	Factory Inspection	CE CRO	Oct. 2019 for 9 days	Turkey	M/S China Geo- Engineering
17	Factory Inspection	DMD (A), (F) & (E) PD, Bhandaljury WS Project	Nov. 2019 for 10 days	South Korea and China	Teayoung Engineering & Construction Company Ltd.
18	Workshop on Global Green Business Partnership- 2019	PD, PESSCM-1	Dec. 2019 for 5 days	South Korea	Korea Environmental Industry and Technology Institute (KEITI)
19	3rd Capacity Building Program for Improvement of Water Security in Asia	AE, Sheikh Rasel WTP	Nov. 2019 for 10 days	South Korea	The International Centre for Water Security and Sustainable Management
20	Training on NRW Management, Asset Management, Customer Service, Billing, Collection and GIS/IOT	XEN, MOD-1 XEN, CD-2 Computer Programmer Accounts Officer (Management) Revenue Officer-1, Revenue Billing AE, MOD-3	Mar. 2020 for 6 days	India	Waterlinks, SUEZ India
21	Issue Focused Training Course on "On Site Wastewater Treatment System"	AE-MOD-1	Jan.-Feb. 2021 for 26 days	Japan/ Online	JICA
22		XEN, CD-2	Oct. 2021 for 15 days	Japan/ Online	JICA

Source: JICA Survey Team

### 7.1.4 Overviewed Results of Previous Studies

The results of the research on the willingness to pay of citizens conducted in 2017 and the SWOT analysis of CWASA conducted in 2022 were overviewed, as the reference information for the problems analysis described in Sub-section 7.4.3.

#### (1) Willingness to Pay of Citizens

In the Sanitation Masterplan (MP), the willingness to pay of citizens was investigated for getting connection to the sewerage system and sewerage service. On average, 42% of surveyed households are able and willing to pay for the connection to the sewerage system. Most of these surveyed households are also willing to pay BDT 10,000-20,000 for sewerage connection in addition to internal plumbing, and they also said that they would prefer a contractor hired by CWASA to do the plumbing work. Moreover, most the surveyed households indicated that they are able and willing to pay less than BDT 350 per month for sewerage services.

Besides, as mentioned in Sub-section 2.4.1, the collection rate of water tariff from FY 2014/15 to FY 2021/22 varies from 83.4% to 99.6%, with the average being 92.6%, which is comparatively high.

#### (2) SWOT Analysis

In the Project Preparation Study for the Chattogram Metropolitan Sewerage Project for North Kattoli Catchment (hereinafter “F/S for Catchment-5”), a strength, weakness, opportunity, and threat (SWOT) analysis was conducted as shown in Table 7.1.5. Among the weaknesses and threats listed in this table, those that the JICA Survey Team has identified to be strengthened in the medium term, i.e., before starting the operation of sewerage system in Catchment-1 presumably in 2026, are indicated **in red**.

**Table 7.1.5 SWOT of CWASA’s Overall Performance in Sewerage Activities**

Strengths	Weaknesses
<ul style="list-style-type: none"> <li>• Strong leadership from the PIU team.</li> <li>• CWASA MP providing volumes and infrastructure projections up to 2065.</li> <li>• A combination of senior management and junior staff, which contribute to organizational stability and dynamism.</li> <li>• Internal knowledge on water operations can be leveraged for sewerage (GIS, water quality monitoring, customer management, etc.) and support functions are already in place (human resources (HR), finance, etc.)</li> <li>• Relatively good revenue collection performance.</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of strategic orientation and management (outdated 5-year rolling business plan).</li> <li>• <b>Inadequate organizational structure that needs rationalization and clarity to support performance improvement.</b></li> <li>• <b>Low level of digitalization, absence of integrated information management systems.</b></li> <li>• <b>Poor internal knowledge on sewerage.</b></li> <li>• Poor formalization of operational practices, processes, and procedures.</li> <li>• <b>Absence of industry-standard operational digital tools: GIS, Computerized Maintenance Management System (CMMS), SCADA, etc.</b></li> <li>• No culture of asset management.</li> <li>• <b>Poor HR management and staff capacity building - Low emphasis on training, talent retention, etc.</b></li> </ul>
Opportunities	Threats
<ul style="list-style-type: none"> <li>• Government support and funding for sewerage infrastructure development.</li> <li>• Donor-funding and international technical support.</li> </ul>	<ul style="list-style-type: none"> <li>• The city’s rapid growth (and in particular, slums) may challenge projections and infrastructure dimensions.</li> <li>• <b>Unclear mandate on FSM (CCC/CWASA).</b></li> </ul>



<ul style="list-style-type: none"> <li>• High demand for sewerage services within the CWASA service area and willingness to pay.</li> <li>• Legal framework enabling the billing of a contribution to sewerage infrastructure even if the customer does not connect.</li> <li>• Availability of CWASA/CCC land for sewerage treatment facilities.</li> </ul>	<ul style="list-style-type: none"> <li>• The population’s low average salary and customers’ capacity to pay will be a limiting factor in the sewerage tariff setup.</li> <li>• Dense urban city setup: density, difficult access to land, road narrowness (complicating construction works and FSM operations).</li> <li>• Climate change exacerbating exposure to extreme events.</li> <li>• Local manpower generally inexperienced in sewerage management and the growth of the private sector will lead to competition for skilled staff.</li> <li>• Poor population awareness on sanitation and hygiene issues (Population’s inherited habit of discharging wastewater and sewage into the khals to be drained away from the neighborhoods).</li> </ul>
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Source: Draft Final Report of F/S for Catchment-5 (July 2022), edited by the JICA Survey Team

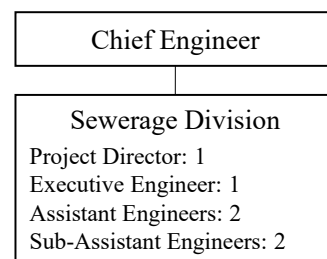
## 7.2 Organization Structure for Project Implementation

### 7.2.1 Organization Structure in Designing and Construction of Sewerage Works

#### (1) Organization Structure Proposed in MP

The organization structure at the initial stage of the design and construction of the sewerage system was proposed in the MP as shown in Figure 7.2.1.

It was assumed that CWASA would start the design and construction of sewerage works in a small-scale sewage collection catchment with one sewerage treatment plant, which was the most feasible and appropriate approach to introduce CWASA to the sewerage sector and assist in building up internal sewerage knowledge and capacity.



Source: MP

**Figure 7.2.1 Organization Structure Proposed in MP in the Design and Construction Phase**

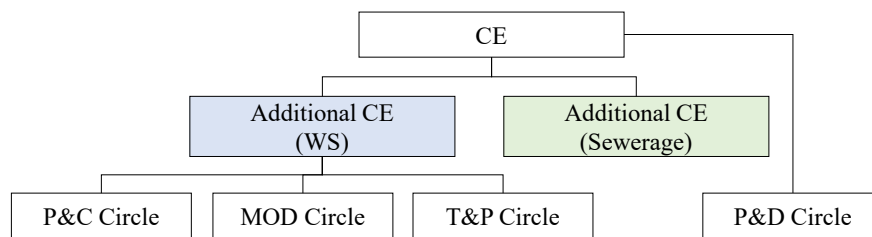
Based on this assumption, the Sewerage Division was planned to be established under the direct control of the Chief Engineer (CE), consisting of six staff and to be headed by a Project Director (P/D). The staff will assist the P/D in monitoring the design and construction supervision activities, including the selection of design and supervision consultant before preparing the tender documents and evaluating bidders. In close cooperation with the selected design and supervision consultants, this will help them gain practical knowledge about sewerage design and construction.

#### (2) Organization Structure of Organogram 2020

As stated in 7.1.1, a new designation ‘Additional CE’ was created in the Organogram 2020 and Additional CE (WS) and Additional CE (Sewerage) are under CE as shown in Figure 7.2.2. However, no subordinate departments are set up under Additional CE (Sewerage), with only two assistants under him/her, i.e., a Stenographer cum Computer Operator and an Office Assistant, and thus organization for designing and construction of sewerage works has not been explicitly shown in the organogram. As of October 2022, these designations of two Additional CEs and their assistants are still vacant.

For reference, the main functions of the circles: Planning and Construction (P&C), Maintenance, Operation, and Distribution (MOD), Treatment and Production (T&P), and Planning and Development (P&D) are as follows:

- P&C Circle: to supervise the construction of pipes, pumps, and other structures (except project works), archive design and as-built drawings, and manage procured equipment and materials.
- MOD Circle: to manage existing four MOD offices (district service stations), which are to operate and maintain pipelines, service reservoirs, booster pumps, deep tube wells, valves and bulk water meters, and customer connections and to receive and manage customer queries, applications, and complaints (meter reading and billing function is still to be established and delegated from the Revenue Section of HQs).
- T&P Circle: to operate and maintain water intake facilities, water treatment plants, main reservoirs, pumping stations, laboratories, and water tankers.
- P&D Circle: to communicate and coordinate with related various institutions on the development, preparation, and monitoring of projects (as was mentioned in Section 7.2):



Abbreviations:  
P&C: Planning and Construction  
MOD: Maintenance, Operation, and Distribution  
T&P: Treatment and Production  
P&D: Planning and Development

Source: JICA Survey Team based on the Organogram 2020

**Figure 7.2.2 Organization Structure of Additional CEs in Organogram 2020**

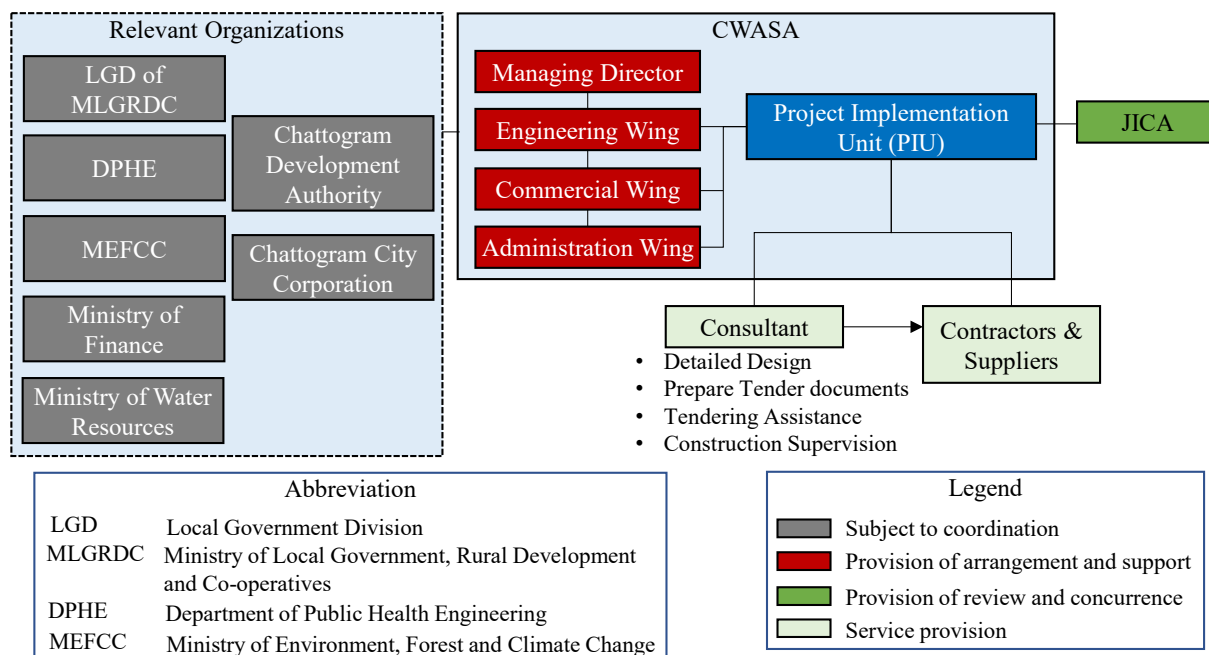
## 7.2.2 Establishment of Project Implementation Unit

### (1) Standard Project Implementation Structure of CWASA

CWASA has set up a project implementation unit (PIU) as a temporary cross-cutting unit for the implementation of a large-scale construction project. Since the construction of sewerage works takes a long time to finish, it is favorable to establish a permanent organization structure to manage the design and construction of sewerage works. However, it needs several experienced staffs and their expertise for its establishment, and thus, it is the provisional but practical approach to establish a PIU to manage and supervise the design and construction on each respective project basis, including the implementation of the Project.

The standard structure of CWASA for the project implementation is shown in Figure 7.2.3. The PIU takes the initiative in project implementation and its supervision. The consultant is presumed to be engaged in detailed design, preparation of specifications and contract documents, tendering assistance,

construction supervision, and facilitation to implement the Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP) in compliance with the “Guidelines for the Employment of Consultants under Japanese ODA Loans” published in April 2012.



Source: JICA Survey Team

**Figure 7.2.3 Standard Project Implementation Structure of CWASA**

## (2) Project Implementation Unit in Similar Projects

### 1) Karnaphuli Water Supply Project (Phase 2) (KWSP-2)

The members of the PIU for KWSP-2 are shown in Table 7.2.1. A total of 26 employees were assigned, among which 20 were contractual (non-permanent) employees, namely, 5 Assistant Engineers (AE), 12 Sub-Assistant Engineers (SAE), 1 Accountant, and 2 Office Assistants cum Computer Typists. Among the 22 engineers, 12 were civil engineers, 3 were mechanical engineers, and 7 were electrical engineers.

The experience of the PIU members in KWSP-2 should be utilized in the implementation of the Project, considering the similar methodology of project management, albeit the difference of water supply (WS) and sewerage. Thus, it is recommended to shift these members to the PIUs for on-going and upcoming sewerage projects including catchment-2 and 4, after the completion of KWSP-2, i.e., after pre-commissioning and before commissioning, which is expected to be at the end of June 2023. As for the absorption of contractual employees of KWSP-2 as permanent employees, this issue has been already discussed in the CWASA board meeting and is under the approval process. However, it should be noted that the Supreme Court of Bangladesh has recently issued an order, which clarified that the regularization of the services of the employees of development projects and their inclusion into the revenue budget is prohibited unless statutory requirements have been fulfilled\*<sup>2</sup>.

\*<sup>2</sup> “Don’t ask govt to absorb contractual staffers SC orders all courts about regularization of project employees”, 10 May,

**Table 7.2.1 Members of PIU for KWSP-2**

	Designation	Number				Specialty
		Permanent		Contract (Full-time)	Sum	
		Full-time	Acting			
1	Chief Engineer (P/D)	-	1	-	1	M:1
2	Superintending Engineer (Deputy P/D)	1	-	-	1	M:1
3	Executive Engineer	-	2	-	2	C:1, E:1
4	Assistant Engineer	-	1	5	6	C:5, E:1
5	Sub-Assistant Engineer (SAE)	-	-	12	12	C:6, M:1, E:5
6	Accountant	-	-	1	1	
7	Office Assistant cum Computer Typist	-	-	3	3	
Total		1	4	21	26	

Source: CWASA

Note: C: Civil; M: Mechanical; E: Electrical

## 2) Project for Establishment of Sewerage System in Chattogram Metropolitan (PESSCM-1) (Package-W1)

The Package-W1 of PESSCM-1 consists of the design, construction, supply, installation, testing, and commissioning of 100,000 m<sup>3</sup>/d sewage treatment plant (STP); 300 m<sup>3</sup>/d fecal sludge treatment facility; and sewerage network for north-middle Haliashahar and adjoining areas on a turnkey basis.

The members of the PIU for PESSCM-1 as of August 2022 are shown in Table 7.2.2. A total of 17 personnel are assigned, among which 11 personnel are contractual (non-permanent) employees, namely, 1 AE, 6 SAE, 1 Computer Operator, 1 Driver, and 2 Office Assistants. Among the 13 engineers, civil engineers are 4, while mechanical engineers and electrical engineers are 4 and 5, respectively. To date, only Package-W1 has been started and is still at the detailed design stage. Thus, after the commencement of the construction work of Package-W1 and the start of other packages (W2 and W3), more engineers may be needed.

**Table 7.2.2 Members of PIU for PESSCM-1**

	Designation	Number				Specialty
		Permanent		Contract (Full-time)	Sum	
		Full-time	Acting			
1	Superintending Engineer (P/D)	-	1	-	1	E:1
2	Executive Engineer (Deputy P/D)	1	-	-	1	M:1
3	Assistant Engineer	1	1	1	3	M:1, E:2
4	Sub-Assistant Engineer	-	2	6	8	C:4, M:2, E:2
5	Computer Operator	-	-	1	1	
6	Driver	-	-	1	1	
7	Office Assistant	-	-	2	2	
Total		2	4	11	17	

Source: CWASA

Note: C: Civil; M: Mechanical; E: Electrical

## (3) Proposed PIU Structure for the Project

2022, The Daily Star, <https://www.thedailystar.net/news/bangladesh/news/regularisation-project-employees-it-not-right-3020106>. The CWASA Board once decided that the contractual AEs and SAEs in the PIU of KWSP-2 would be allowed to shift to permanent employees if they pass the viva voce exam but has changed this decision to include both paper exam and viva voce exam based on the direction of the LGD. Similar decision will be made for the other contract employees of KWSP-2 and other projects according to CWASA.

The proposed PIU structure for the Project in the phase of detailed design (including land acquisition) and tendering of contractors, as well as construction is shown in Figure 7.2.4 & Table 7.2.3 and Figure 7.2.5 & Table 7.2.4, respectively.

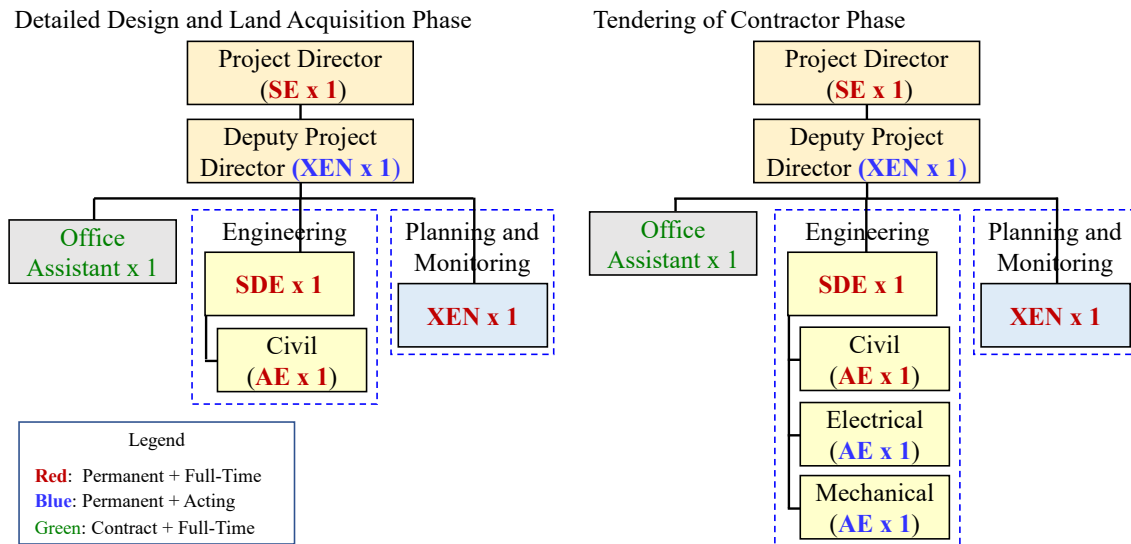
The key positions, namely, the P/D, the Deputy P/D, the Financial Specialist, the Engineers (except the Site Engineers), and the Planning and Monitoring Engineer are to be assigned to permanent officers of CWASA, namely, Superintending Engineer (SE), Executive Engineer (XEN), Sub-Divisional Engineer (SDE), AE, and Accountant.

Regarding the Civil Engineer and the Site Engineer (Civil), civil engineering is the key specialization for the construction of STPs, pumping stations, trunk and branch sewers, and house connections, thus, one permanent and full-time AE and three permanent and acting SAEs are to be assigned to the Civil Engineer and the Site Engineer (Civil) positions respectively, so that their experience in the PIU will be utilized in the upcoming other sewerage projects (catchments 3, 5, and 6) as well as in the subsequent construction of branch sewers and house connections. The remaining number of Site Engineers (Civil) is to be assigned to one contracted AE and nine contracted SAE, but the number of the Site Engineers (Civil) is expected to be adjusted according to the contract packaging and the segmentation of construction areas of the sewer network.

For the mechanical engineering, one permanent and acting AE and one contracted SAE are planned to be assigned to the Mechanical Engineer and the Site Engineer (Mechanical), respectively, considering the temporary nature of mechanical construction work. Likewise for the electrical engineering, one permanent and acting AE and one contracted SAE are planned to be assigned to the Electrical Engineer and the Site Engineer (Electrical), respectively, considering the temporary nature of electrical construction work. Regarding the environmental and social considerations, one XEN to be assigned to the Planning and Monitoring Engineer will be engaged in the task on full-time basis.

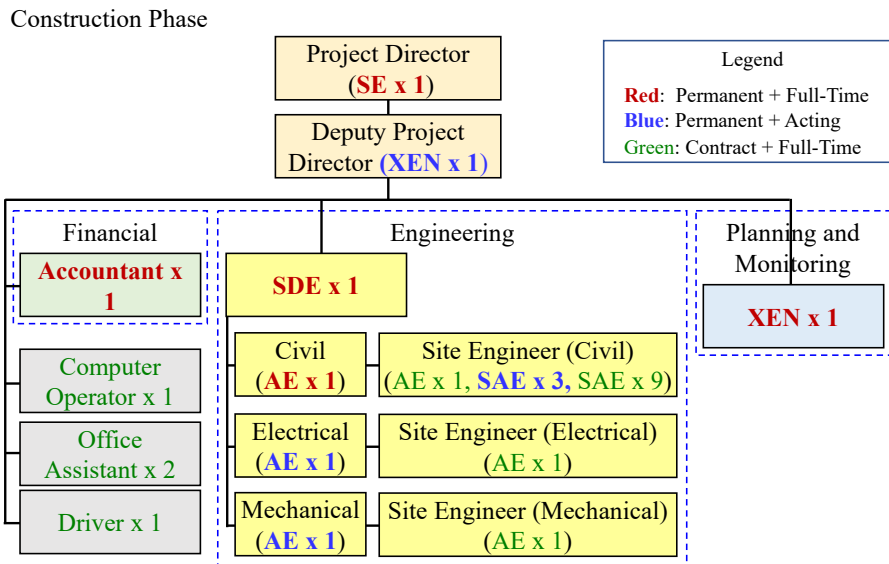
To establish the structure of PIU for the Project, CWASA has implemented the following measures:

- Three XENs have been assigned to the Deputy P/D, the Head of Engineering, and the Planning and Monitoring (of which one is currently an AE and assigned to the XEN as an acting charge and would be an SDE when promoted), and two AEs (full-time, Civil) and one SAE (part-time, mechanical) have also been assigned.
- As stated in the footnote in the previous sub-section, the CWASA Board has decided that the contractual AEs and SAEs in the PIU of KWSP-2 would be shifted to permanent employees if they passed the paper and viva voce exam. These employees are to be assigned with priority to the PIU of the Project, so that their experience can be utilized in the Project (the two AEs and one SAE who have already been assigned to the PIU of the Project are from the contractual employees of KWSP-2). Similar decision will be made for the other contractual employees of KWSP-2 and other projects such as CWSISP funded by the World Bank.



Source: JICA Survey Team

**Figure 7.2.4 PIU Structure in Detailed Design and Tendering Phase**



Source: JICA Survey Team

**Figure 7.2.5 PIU Structure in Construction Phase**

**Table 7.2.3 Proposed Members of PIU for the Project (D/D and Tendering Phase)**

Designation	Detailed Design Phase				Tendering Phase			
	Permanent		Contract (Full-time)	Sum	Permanent		Contract (Full-time)	Sum
	Full-time	Acting			Full-time	Acting		
1 Superintending Engineer (P/D)	1	-	-	1	1	-	-	1
2 Executive Engineer	1 (Planning and Monitoring)	1 (Deputy P/D)	-	2	1 (Planning and Monitoring)	1 (Deputy P/D)	-	2
3 Sub-Divisional Engineer	1	-	-	1	1	-	-	1
4 Assistant Engineer	C: 1	-	-	1	C: 1	M:1, E: 1	-	3

Designation		Detailed Design Phase				Tendering Phase			
		Permanent		Contract (Full-time)	Sum	Permanent		Contract (Full-time)	Sum
		Full-time	Acting			Full-time	Acting		
5	Sub-Assistant Engineer	-	-	-	-	-	-	-	-
6	Accountant	-	-	-	-	-	-	-	-
7	Computer Operator	-	-	-	-	-	-	-	-
8	Driver	-	-	-	-	-	-	-	-
9	Office Assistant	-	-	1	1	-	-	1	1
Total		4	1	1	6	4	3	1	8

Note: C: Civil; M: Mechanical; E: Electrical

Source: JICA Survey Team

**Table 7.2.4 Proposed Members of PIU for the Project (Construction Phase)**

Designation		Construction Phase				Specialty
		Permanent		Contract (Full-time)	Sum	
		Full-time	Acting			
1	Superintending Engineer (P/D)	1	-	-	1	
2	Executive Engineer	1 (Planning and Monitoring)	1 (Deputy P/D)	-	2	
3	Sub-Divisional Engineer	1	-	-	1	
4	Assistant Engineer	C: 1	M: 1, E: 1	C: 1, M: 1, E: 1	6	C: 2, M: 2, E: 2
5	Sub-Assistant Engineer	-	C: 3	C: 9	12	C: 12
6	Accountant	1	-	-	1	
7	Computer Operator	-	-	1	1	
8	Driver	-	-	1	1	
9	Office Assistant	-	-	2	2	
Total		5	6	16	27	

Note: C: Civil; M: Mechanical; E: Electrical

Source: JICA Survey Team

### 7.3 Organization Structure for O&M

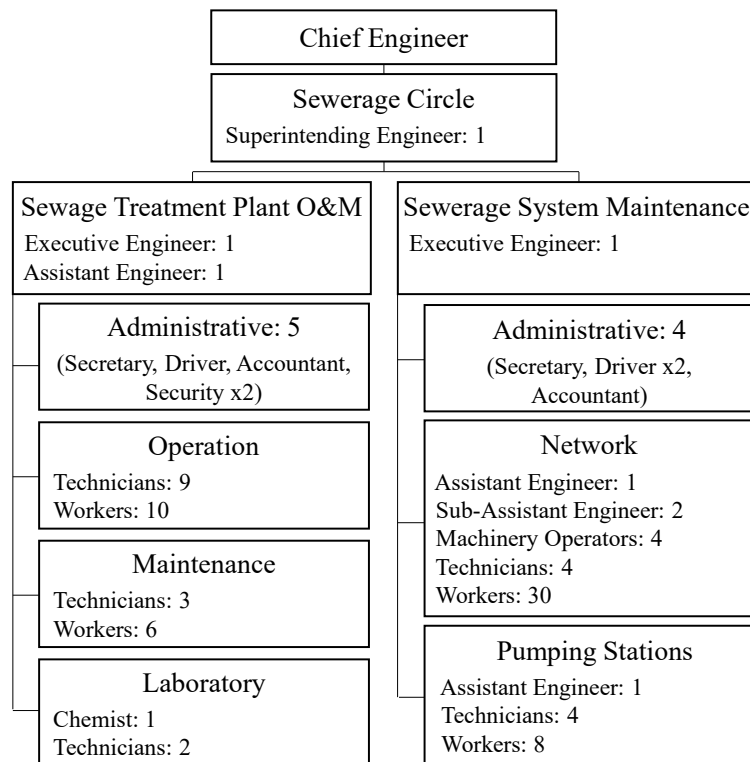
#### 7.3.1 Organization Structure Proposed in MP

##### (1) Organization Structure for O&M of Sewerage System

The organization structure in the operation phase of the sewerage system was proposed in the MP as shown in Figure 7.3.1. The Sewerage Division in Figure 7.3.1 is assumed to be upgraded to a Sewerage Circle six months before the construction is to be completed, and an SE will head the Circle, which is expected to have 90-100 staff. The P/D during the construction phase should be re-designated as the SE heading the Circle, and the other five staff of the Sewerage Division during the construction phase are assumed to be appointed to positions in the Sewerage Circle.

The department in-charge of branch sewer construction which is to be continued by CWASA after the completion of sewerage projects is unclear, as well as the involvement of MOD offices that are expected to be the core in-charge department of household connections and bill delivery and collection. In addition, a phased organizational structure should be developed for the intermediate period when the

sewerage construction in some catchments and the O&M of constructed sewerage works in the other catchments run in parallel.

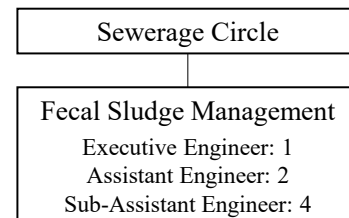


Source: MP

**Figure 7.3.1 Organization Structure Proposed in MP in Operation Phase**

**(2) Organization Structure for FSM**

The organization structure for fecal sludge management (FSM) was proposed in the MP as shown in Figure 7.3.2. FSM is put under the responsibility of CWASA. It is proposed that FSM is placed under the future Sewerage Circle with employment of around seven staff, namely, one XEN, two AEs, and four SAEs.



Source: MP

**Figure 7.3.2 Organization Structure Proposed in MP for FSM**

**7.3.2 Two Options for the Management of Water Supply and Sewerage Services**

The two basic options regarding the management structure of water supply and sewerage services were proposed and discussed with CWASA, as shown in Figure 7.3.3. Option 1 is an independent operation model of water supply and sewerage services, while Option 2 is a combined operation model of both services. The advantages and disadvantages of these options are summarized in Table 7.3.1.

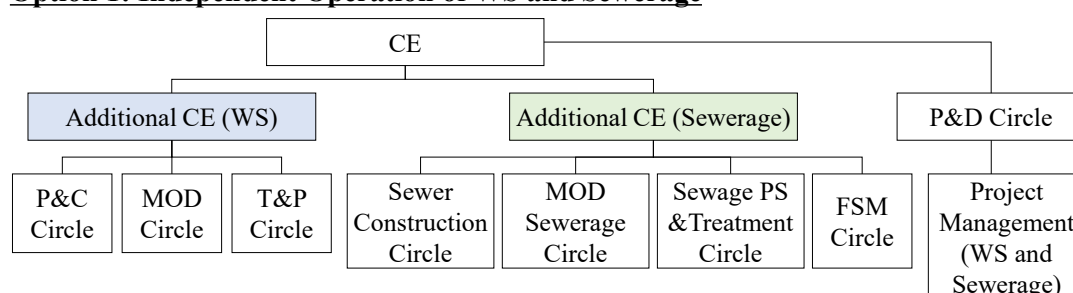
Since it is unlikely that CWASA can identify enough qualified staff within CWASA who could be moved to new departments related to sewerage, most of the sewerage staff are expected to be recruited from the outside. Option 1 (independent operation of WS and sewerage) is more advantageous than Option 2 in this respect, which enables quality O&M by newly hired and qualified employees, especially in



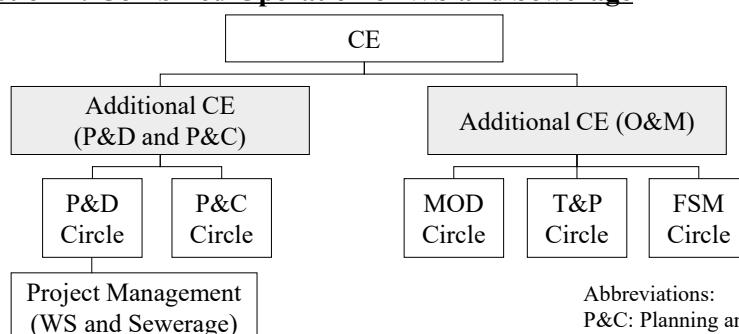
MODs. Based on this and other staffing reasons, e.g., to secure the succeeding positions for the increased SEs to be assigned to PIUs after the completion of projects, CWASA has agreed to take Option 1 in favor of the independent operation of WS and sewerage services.

It should be noted that CWASA has suggested to split the Sewerage Circles into two (Sewerage Circle -A and -B) under the Additional CE (Sewerage), where Sewerage Circle -A will manage catchments 1, 5, and 6, while Sewerage Circle -B will manage catchments 2, 3, and 4, considering the location of STPs and the reallocation of increased SEs initially assigned to PIUs after the completion of sewerage projects as stated in the preceding paragraph. Each Sewerage Circle will have a full function and be responsible for the O&M of sewerage works and the management of sewerage services in their respective catchments.

**Option 1: Independent Operation of WS and Sewerage**



**Option 2: Combined Operation of WS and Sewerage**



Abbreviations:  
P&C: Planning and Construction  
MOD: Maintenance, Operation, and Distribution  
T&P: Treatment and Production  
P&D: Planning and Development  
FSM: Fecal Sludge Management

Source: JICA Survey Team

**Figure 7.3.3 Management Structure Options for Water Supply and Sewerage Services**

**Table 7.3.1 Advantages and Disadvantages of Service Management Structure Options**

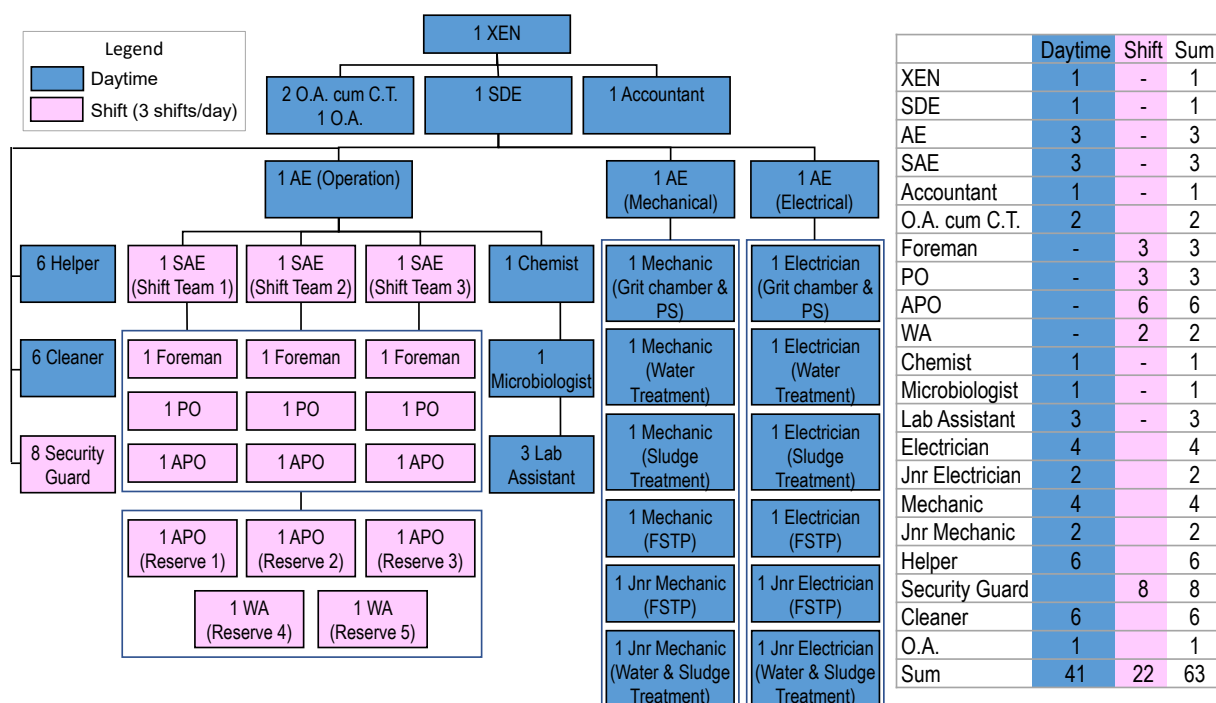
Aspect	Option 1 (Independent Operation)	Option 2 (Combined Operation)
Flexibility	<ul style="list-style-type: none"> <li>Ensures appropriate customer service by qualified employees.</li> </ul>	Enables flexible staffing and vehicle allocation in MODs.
Customer Service	<ul style="list-style-type: none"> <li>Dual responsibility of two Additional CEs for MODs may disturb chains of command and harm flexibility and integrated customer service.</li> </ul>	Ensures one-stop service on water supply and sewerage by MODs.
Expertise	Enables quality O&M by newly hired and qualified employees, especially in MODs (but experienced candidates may be few in Bangladesh).	<ul style="list-style-type: none"> <li>Needs training for existing plumbers on sewer connection and plumbing work.</li> </ul>

Aspect	Option 1 (Independent Operation)	Option 2 (Combined Operation)
		<ul style="list-style-type: none"> <li>Existing technical employees can give OJT to newly hired employees on O&amp;M of waterworks.</li> </ul>
Management	<ul style="list-style-type: none"> <li>Enables integrated management specific to sewerage, from planning and construction to O&amp;M &amp; customer service.</li> <li>Much burden on Additional CE (Sewerage) after starting operation of Catchment-1, i.e., being responsible for sewerage O&amp;M as well as sewer extension, property connection, and FSM.</li> </ul>	<ul style="list-style-type: none"> <li>Enables specialized management on planning and construction, O&amp;M, and customer service, cross-cutting water supply and sewerage.</li> <li>Much burden on Additional CE (O&amp;M), i.e., being responsible for the O&amp;M of both water supply and sewerage.</li> </ul>
Preceding Practice	<ul style="list-style-type: none"> <li>In Japan, waterworks and sewerage are usually split into individual sections, except for administration, customer call center and financial functions.</li> <li>There exist similar examples in neighboring countries such as India, Pakistan, and Sri Lanka.</li> </ul>	DWASA

Source: JICA Survey Team

### 7.3.3 Staffing Plan at STP for Catchment-2 and Catchment-4

The staffing plan at the STP for catchments 2 and 4 is proposed in Figure 7.3.4. In total 63 staff are required for the O&M of the STP including the FSTP, of which 41 are for daytime assignment, while 22 are for shift assignment (three shifts per day).

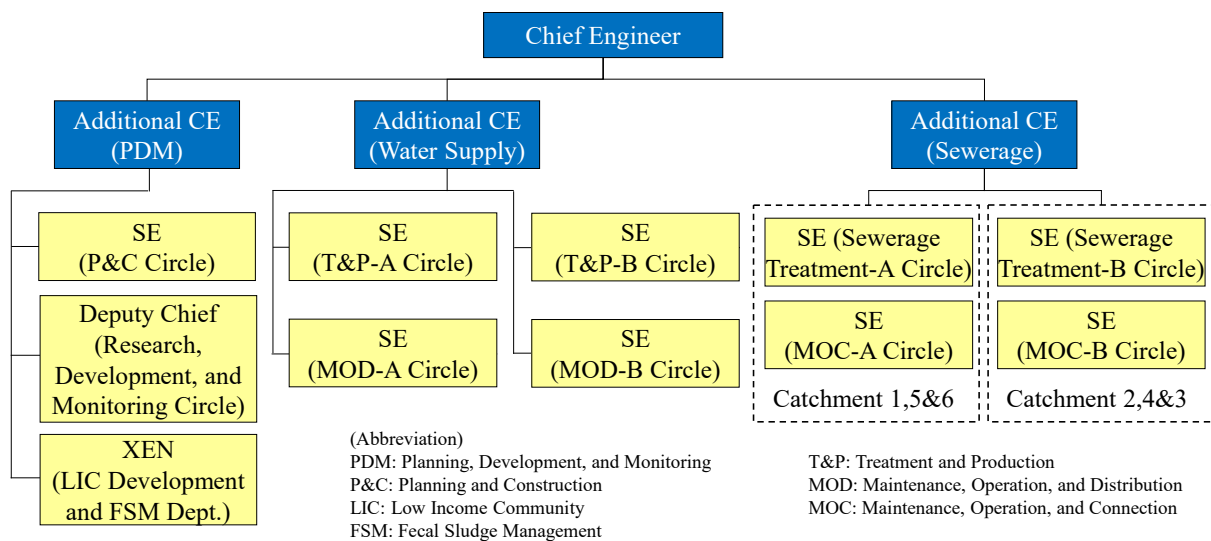


Source: JICA Survey Team

Figure 7.3.4 Staffing Plan at STP for Catchment-2 and Catchment-4

### 7.3.4 Proposed Organization Structure for O&M

Considering the balance of workload among CE, Additional CE (WS), and Additional CE (Sewerage) in Option 1 of Figure 7.3.3 and the drafted MoU on FSM among CWASA, CCC, and CDA, the management structure of CWASA in the O&M phase is proposed in Figure 7.3.5. It should be noted that the O&M of sewer network shall be the responsibility of Sewerage MOD-A and MOD-B Circles. The necessary tools and equipment required for the inspection, investigation, and flushing of sewer network shall be procured by the package W3 of the PESSCM-1, of which items and quantity are deemed to be sufficient to cover the whole sewerage service area of CWASA including the Project area.

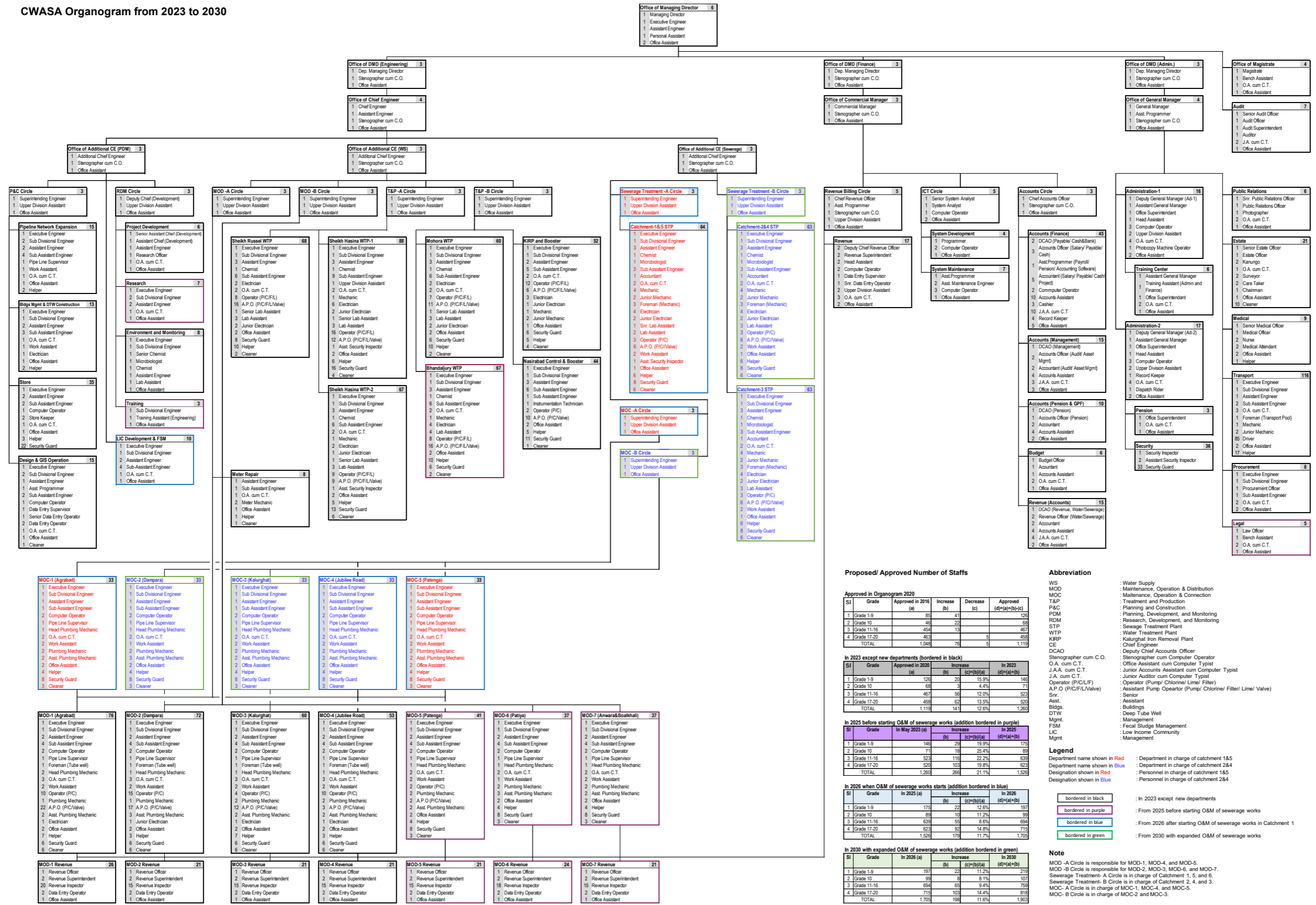


Source: JICA Survey Team

**Figure 7.3.5 Proposed Management Structure in O&M Phase**

A more detailed organogram of CWASA with staffing levels and numbers as of 2030 is proposed as shown in Figure 7.3.6, where the necessary personnel for the O&M of sewerage works in catchments 2 and 4 (including the LIC Development and FSM Department) and in the other catchments are indicated in blue and red, respectively. As summarized in Table 7.3.2 and Table 7.3.3, a total of 145 personnel should be assigned, including ten personnel assigned, to the LIC Development and FSM Department which oversees the whole CWASA area.

CWASA Organogram from 2023 to 2030



Source: JICA Survey Team

Note: Blue means personnel in charge of catchment 2&4; red means personnel in charge of catchment 1.

Figure 7.3.6 Detailed Organogram in O&M Phase of the Project (in 2030)

**Table 7.3.2 CWASA Employees to be Assigned for Catchments 2 and 4 at O&M Stage**

Department	Designation	Number	Note	Department	Designation	Number	Note
Office of SE (Sewerage Treatment-B)	Superintending Engineer	1		Office of SE (MOC-B)	Superintending Engineer	1	
	Stenographer cum C.T.	1			Stenographer cum C.T.	1	
	Office Assistant	1			Office Assistant	1	
Catchment 2&4 STP	Executive Engineer	1	O&M of Catchment 2&4 STP including FSTP	MOC-2 (Dampara)	Executive Engineer	1	• Handle connection applications from residents and supervise/ construct/ inspect house connection works; • O&M of sewer network and house connections; • Fix customer complaints regarding sewerage works.
	Sub Divisional Engineer	1			Sub Divisional Engineer	1	
	Assistant Engineer	3			Assistant Engineer	1	
	Chemist	1			Sub Assistant Engineer	1	
	Microbiologist	1			Computer Operator	2	
	Sub Assistant Engineer	3			Pipe Line Supervisor	1	
	Accountant	1			Head Plumbing Mechanic	1	
	O.A. cum C.T.	2			O.A. cum C.T.	2	
	Mechanic	4			Work Assistant	1	
	Junior Mechanic	2			Plumbing Mechanic	2	
	Foreman	3			Asst. Plumbing Mechanic	3	
	Electrician	4			Office Assistant	2	
	Junior Electrician	2			Helper	4	
	Lab Assistant	3			Security Guard	8	
	Operator (P/C)	3			Cleaner	3	
	A.P.O. (P/C//Valve)	6			Executive Engineer	1	
	Work Assistant	2			Sub Divisional Engineer	1	
	Office Assistant	1			Assistant Engineer	1	
	Helper	6			Sub Assistant Engineer	1	
	Security Guard	8			Computer Operator	2	
Cleaner	6	Pipe Line Supervisor	1				
Sewerage Treatment-B Total				MOC-3 (Kalurghat)			
LIC Development and FSM	Executive Engineer	1	Supervision of contractors for collecting and transporting of fecal sludge	Executive Engineer	1		
	Sub Divisional Engineer	1		Sub Divisional Engineer	1		
	Assistant Engineer	2		Assistant Engineer	1		
	Sub-Assistant Engineer	4		Sub Assistant Engineer	1		
	O.A. cum C.T.	1		Computer Operator	2		
Office Assistant	1	Head Plumbing Mechanic	1				
LIC Development and FSM Total				O.A. cum C.T.			2
				Work Assistant			2
				Plumbing Mechanic			2
				Asst. Plumbing Mechanic			2
				Office Assistant			2
				Helper			4
				Security Guard			8
				Cleaner			3
				MOC-B Total			69
				Sum			145

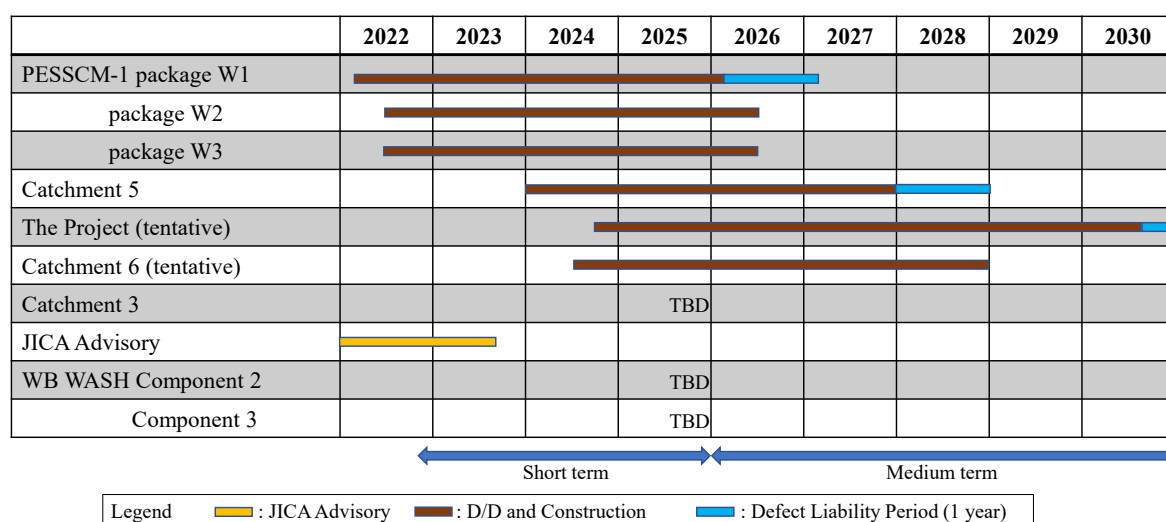
Department	Designation	Number	Note
Number of Staff as per designation	Superintending Engineer	2	
	Executive Engineer	4	
	Sub-Divisional Engineer	4	
	Assistant Engineer	7	
	Sub-Assistant Engineer	9	
	Chemist	1	
	Microbiologist	1	
	Lab Assistant	3	
	Pipeline Supervisor	2	
	Head Plumbing Mechanic	2	
	Plumbing Mechanic	4	
	Asst. Plumbing Mechanic	5	
	Work Assistant	5	
	Electrician	4	
	Junior Electrician	2	
	Mechanic	4	
	Junior Mechanic	2	
	Foreman	3	
	Operator	3	
	Assistant Pump Operator	6	
	Stenographer cum C.T.	2	
	O.A. cum C.T.	7	
	Office Assistant	8	
	Helper	14	
Security Guard	24		
Cleaner	12		
Accountant	1		
Computer Operator	4		
Sum		145	

Source: JICA Survey Team

## 7.4 Mid-Term Action Plan to Strengthen the Management Capacity of Sewerage Works

### 7.4.1 Milestones in Short-/ Medium-Term Progress of Sewerage Service

The prospective progress of sewerage construction is shown in Figure 7.4.1. Since the O&M in Catchment-1 will start from January 2026 and the completion of the construction work of the Project will be in 2030, the short-term and medium-term periods are proposed to be 2022-2025 and 2026-2030, respectively.



Source: JICA Survey Team

**Figure 7.4.1 Short/ Medium Term Progress of Sewerage Construction**

### 7.4.2 Roadmap for Institutional Capacity Development Prepared in F/S for Catchment-5

The F/S for Catchment-5 includes a scope to prepare a road map for institutional capacity development covering institutional and organizational development and individual/human resource development of CWASA. The drafted road map is shown in Table 7.4.1, where the proposed support programs from relevant donors, i.e., AFD and the World Bank, are also inserted\*<sup>3</sup>. Most of the listed topics (except organizational restructuring) are covered by the programs to be provided by the AFD and the World Bank, particularly the latter.

**Table 7.4.1 Roadmap and Program for Institutional Capacity Development of CWASA**

Category	2022	2023-2025	2026 Onwards
Institutional	<ul style="list-style-type: none"> <li>Initiate policy dialogue on FSM institutional framework and officialized standards.</li> </ul>	Policy and institutional changes for citywide inclusive sanitation.	Sectoral strategic partnership for sustainable and integrated city-wide sanitation.
CWASA Organizational /Operational	<ul style="list-style-type: none"> <li>Elaborate on TOR for medium-term capacity development packages.</li> <li>Priority training focusing on</li> </ul>	<ul style="list-style-type: none"> <li>Focus on CWASA:                             <ul style="list-style-type: none"> <li>Organizational restructuring.</li> <li>Business model, tariff reform.</li> <li>Climate change mitigation.</li> <li>Emergency response.</li> </ul> </li> </ul>	-

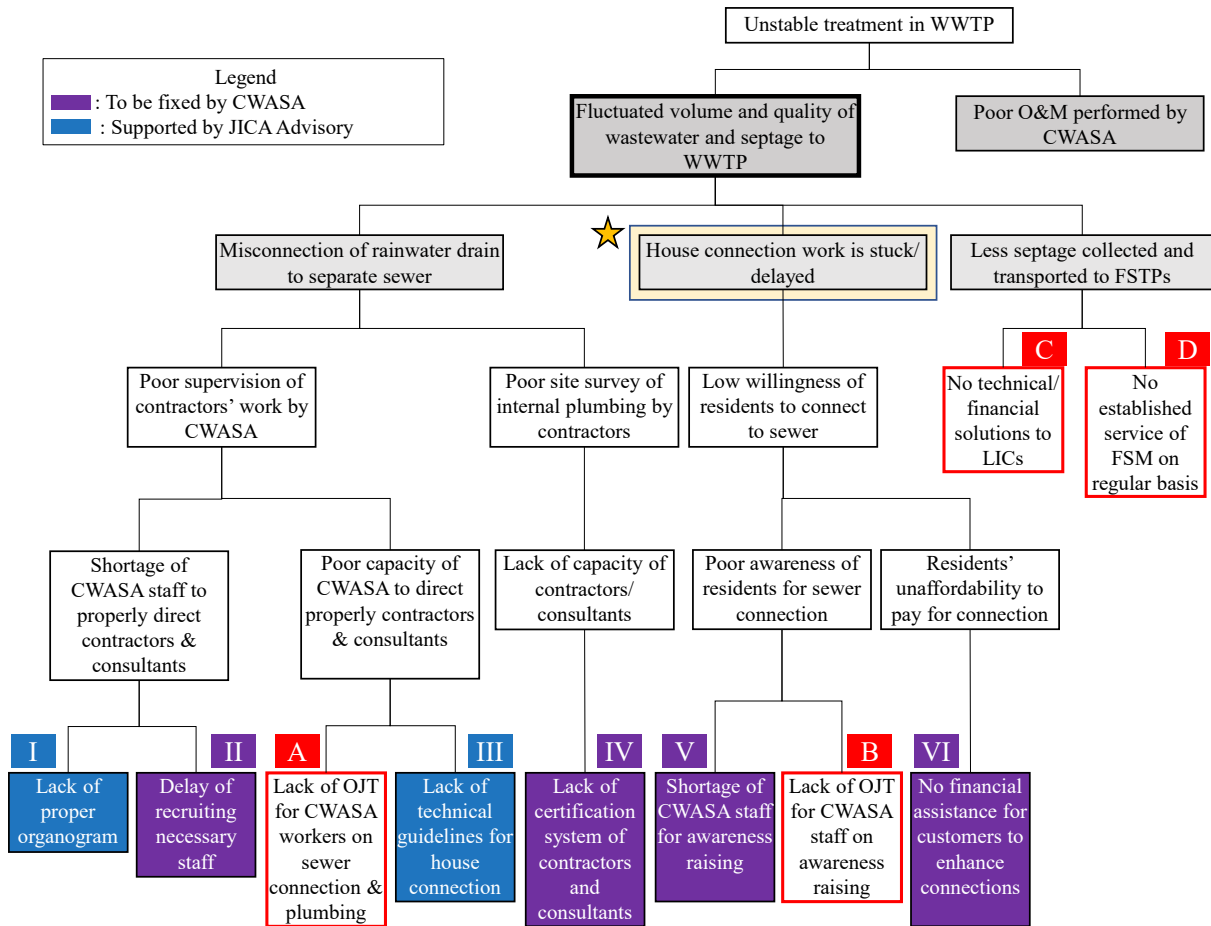
\*<sup>3</sup> AFD/ CDIA will start discussion with CWASA to formulate specific T/A projects based on the institutional and capacity development roadmap prepared in the F/S for Catchment-5. Regarding the assistance program proposed by World Bank, the DPP prepared by CWASA will be approved by LGD by October 2023.

Category	2022	2023-2025	2026 Onwards
	infrastructure development.	<ul style="list-style-type: none"> <li>• Asset management, O&amp;M best practices, GIS, network modelling, ESIA.</li> <li>• Billing performance for revenue increase.</li> <li>• Second priority training (management, O&amp;M, water quality, etc.).</li> <li>❖ Focus on FSM: <ul style="list-style-type: none"> <li>• Setup of inspection/ enforcement unit.</li> <li>• Setup to centralized dispatching.</li> <li>• IEC and awareness campaigns.</li> <li>• Comprehensive sector-wide training, etc.</li> </ul> </li> </ul>	
Program by AFD	-	FSM capacity building in Catchment-5	
Program by the World Bank (WASH)	Component 2: Support for Non-Network Sanitation. (1) Assistance in drafting MoU among CWASA, CCC, and CDA. (2) New or improved toilets. (3) Communal septic tank and decentralized wastewater treatment plant.		
	-	Component 3: Institutional Capacity Development: (1) Long term infrastructure and business/capital investment plans. (2) Digital transformation strategy & integrated data management system. (3) Integrated SCADA and automated quality testing system. (4) GIS enabled centralized asset management system. (5) NRW management. (6) Customer relationship management. (7) Resilient and inclusive strategies, collaboration workshops, and SOPs. (8) CWASA's training center.	

Source: JICA Survey Team

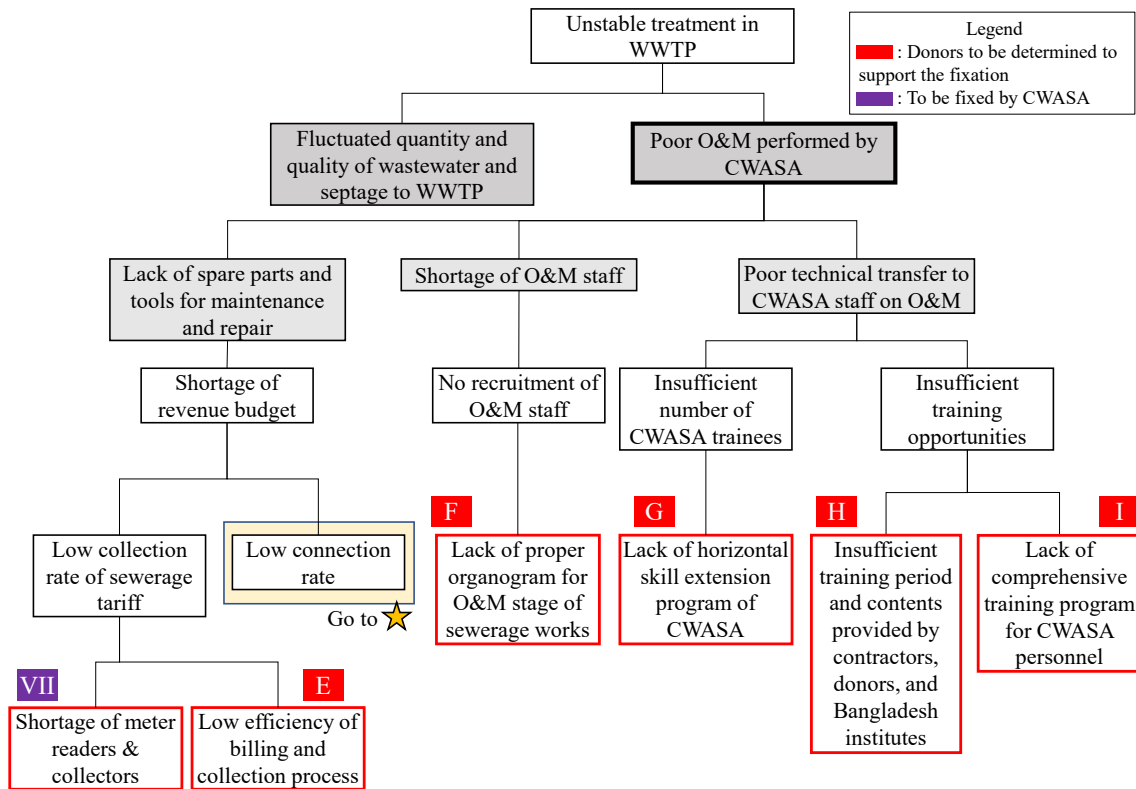
### 7.4.3 Problems Analysis

A problem tree was developed in the O&M phase of sewerage works in CWASA, setting “unstable treatment in WWTP” as a core problem (refer to Figure 7.4.2 and Figure 7.4.3), where the problems hatched in purple are to be fixed by CWASA as its normal responsibilities (and with LGD), while the problems hatched in blue are being supported by on-going JICA Advisory Service (The Advisor on Urban Sanitation Improvement), and the problems hatched in red are to be fixed with the demarcated cooperation of donors due to the expected difficulty to be solved solely by CWASA.



Source: JICA Survey Team

Figure 7.4.2 Problem Tree in O&M Phase (1/2)



Source: JICA Survey Team

Figure 7.4.3 Problem Tree in O&M Phase (2/2)



The status of the problems being tackled or to be tackled by JICA and CWASA is shown in Table 7.4.2.

**Table 7.4.2 Problems having been Tackled/ to be Tackled by JICA and CWASA**

I	Developing Organogram 2023 for sewerage construction; Revising “Employees Service Regulations 2020”; and Developing “Employees Service Guideline 2023”						
II V VII	(Recruiting) Having announced job circulars for 18 positions in 2022						
III	Developing “CWASA Water and Sewerage Connection Rules” and “Manual for Household Connection”						
IV	(Certification system) <i>To be discussed with LGD</i>						
VI	(Financial assistance) House connections will be done by contractors and paid by CWASA in PESSCM-1						
<table border="1" style="width: 100%;"> <tr> <th colspan="2">Legend</th> </tr> <tr> <td style="background-color: #800080; width: 20px; height: 10px; display: inline-block;"></td> <td>: To be fixed by CWASA</td> </tr> <tr> <td style="background-color: #000080; width: 20px; height: 10px; display: inline-block;"></td> <td>: Support on-going by JICA Advisory</td> </tr> </table>		Legend			: To be fixed by CWASA		: Support on-going by JICA Advisory
Legend							
	: To be fixed by CWASA						
	: Support on-going by JICA Advisory						

Source: JICA Survey Team

Regarding the problems hatched in red in Figure 7.4.2 and Figure 7.4.3, the tentative demarcation among donors is shown in Table 7.4.3, taking into consideration the programs proposed by the AFD and the World Bank as shown in Table 7.4.1 and the (unofficial and verbal) requests from CWASA to JICA.

**Table 7.4.3 Demarcation of Support from Donors for Remaining Problems**

A	Short	OJT for CWASA workers on sewer connection & plumbing work	PESSCM1											
B	Short	OJT for CWASA staff on awareness raising activities	AFD											
C	Mid	Technical / financial solutions for LICs	WB	AFD										
D	Mid	Establish FSM service provision scheme on regular basis	WB	AFD										
E	Mid	Efficient customer management, billing, and collection	WB											
F	Short	<i>Organogram for O&amp;M stage</i>	JICA											
G	Short	<i>Skill extension and rotation program among CWASA staff</i>	P											
H	Short/Mid	Adequate training opportunities by contractors and donors	JICA	WB	AFD	PESSCM1								
I	Short	<i>Comprehensive training modules for CWASA personnel</i>	P											
<table border="0" style="width: 100%;"> <tr> <td style="font-size: small;">(Legend)</td> <td style="background-color: #000080; color: white; padding: 2px;">JICA</td> <td>JICA</td> <td style="background-color: #ADD8E6; padding: 2px;">WB</td> <td>World Bank</td> <td style="background-color: #000080; color: white; padding: 2px;">AFD</td> <td>AFD</td> <td style="background-color: #FFD700; padding: 2px;">PESSCM1</td> <td>Contractor of PESSCM1</td> <td style="background-color: #ADD8E6; padding: 2px;">P</td> <td>Supporting organization pending</td> </tr> </table>				(Legend)	JICA	JICA	WB	World Bank	AFD	AFD	PESSCM1	Contractor of PESSCM1	P	Supporting organization pending
(Legend)	JICA	JICA	WB	World Bank	AFD	AFD	PESSCM1	Contractor of PESSCM1	P	Supporting organization pending				

Source: JICA Survey Team

#### 7.4.4 Summary of Mid-Term Action Plan

A summary of short-/medium-term action plan is shown in Table 7.4.4 to strengthen the management capacity of sewerage works.

**Table 7.4.4 Summary of Medium-Term Action Plan**

Category	Program	Supporting Entity	
Short term	I	Organogram for construction stage	JICA (Advisory)
	G	Organogram for O&M and FSM	JICA (Advisory)
	J	Comprehensive training modules	TBD
	H	Skill extension and rotation program	TBD
	II, V	Recruitment of staff	CWASA
	III	Technical guideline for house connection	JICA (Advisory)

Category	Program	Supporting Entity
	<b>IV</b> Certification system of consultants and contractors	CWASA with LGD
	<b>VI</b> Financial assistance for house connection	CWASA
	<b>A</b> OJT on sewer connection and plumbing work	PESSCM-1
	<b>B</b> OJT on awareness raising activities	AFD
	<b>E</b> Recruitment of meter inspectors	CWASA
Medium term	<b>F</b> Efficient customer management, billing, and collection	WB
	<b>C</b> Technical and financial solutions of LICs	AFD and WB
	<b>D</b> FSM service provision scheme	AFD and WB
	<b>I</b> Ensure sufficient training period and contents	<ul style="list-style-type: none"> <li>• JICA (Consulting service in the Project)</li> <li>• AFD (Consulting service and O&amp;M contract in loan project)</li> <li>• WB (Training Center)</li> <li>• PESSCM-1</li> </ul>

Source: JICA Survey Team

## CHAPTER 8 PROJECT IMPLEMENTATION PLAN

### 8.1 Construction Plan

#### 8.1.1 Technical Standards and Relevant Laws and Regulations of the Region Covered

The Bangladesh National Building Code 2021 (BNBC) published by the Ministry of Housing and Public Works is the minimum technical standard for design and construction. The major BNBCs relevant to this project are listed in Table.8.1.1. Since there are no design standards for sewerage systems in Bangladesh, it is our policy to comply with the standards widely used in Japan and internationally. In addition to the above, this Study will also check the building regulations of each city and confirm the procedures for obtaining licenses and development projects.

**Table.8.1.1 Related Design and Construction Regulations of Bangladesh (BNBC)**

Part	Subject	Remarks
Part I	General Building Requirements for Occupancy	Sewage
Part III Appendix-1	Planning and Development Control	Land Use
Part IV	Equipment and In-Built Facilities Standards	Fire Hydrant System (STP)
Part V	Building Materials	Construction Material
Part VI	Soils And Foundations	Land Development

Source: BNBC

**Table 8.1.2 Technical Standards to be Complied**

1	International Organization for Standardization (ISO)
2	American Society for Testing and Materials (ASTM)
3	American Association of State Highway and Transportation Officials (AASHTO)
4	British Standard (BS)
5	Japanese Industrial Standards (JIS)

Source: JICA Survey Team

#### 8.1.2 Project Components

The Project consists of the components as shown in Table 8.1.3.

The components listed in Table 8.1.3 are proposed work types, construction methods, and quantities assumed based on the schematic design. and will need to be reviewed during the detailed design stage.

**Table 8.1.3 Project Components**

Project Components	Item
Land Filling	-Land Filling: 15ha (G.L + 3.5 m raise) -Slope Protection : 10,819 m <sup>2</sup>
Sewage Treatment Plant	-Sewage Treatment Facility (A <sub>2</sub> O method) Q=60,000 m <sup>3</sup> /day - In-situ concrete piles: 2,712 nos -PVD Installation: 1,125,000 m -Access Bridge : RC Girder Bridge (L=30 m, W=15 m)

Trunk Sewer (Trenchless method)	Pipe Length : 11,000 m (D600 – 2200 mm) Manhole : 99 nos (100 m Span)
Branch Sewer (Open-Cut Method)	Pipe Length : 70,000 m (D200 – 900 mm) Manhole : 833 nos (100 m Span)
Connection Pipe (Open-Cut)	Pipe Length : 70,000 m (D150 mm)
Property connection • Catch pit	14,000 nos

Source: JICA Survey Team

### 8.1.3 Construction Method of Pipeline

Based on the conceptional design in Chapter 6, the JICA Survey Team calculated the application points for each construction method (open cut, trenchless, etc.) and the quantity for each method based on the surrounding conditions. The construction procedures and construction period for the sewer pipe will be described at the time of the Draft Final Report.

#### (1) Trunk Sewer • Shafts

The trunk sewer is planned to be constructed by trenchless method, of which 600 mm - 1,800 mm diameter will be constructed by pipe-jacking method and 2200mm diameter will be constructed by shield-tunneling method. With regard to pipe-jacking method, a hydraulic jack installed in the launching shaft directly moves the propulsion machine and the propulsion pipe forward, thereby placing the pipe underground. In other words, the propulsive force is derived from the bending force of the backward hydraulic jack.

On the other hand, with regard to shield tunnelling method, the excavator moves forward against the assembled segment, so the propulsive force is always in front of the excavator. With the shield tunnelling method, however, long-distance excavation is possible.

In selecting the construction method, the pipe jacking method is applied to the short-distance branch sewer (pipe diameters: 600 mm -1,800 mm) and the shield method to the 3.4 km-long trunk sewer (pipe diameter: 2,200 mm), based on the interviews and pipe for jacking method used in Catchment-1.

The two construction methods will be finally determined by comparing and examining the distance, location, alignment, and construction cost of pipe at the time of the detailed design stage. The construction procedure using the trenchless method is shown in Figure 8.1.1. Considering the traffic condition that the main roads in Chattogram are backed up all day and all night, it is recommended to reduce the number of vertical shafts as much as possible and select the trenchless methods that can apply to long distance and curve construction.

The construction of the trunk sewer is expected to be implemented as shown in Figure 8.4.1. In Bangladesh, half of the year (May-October) is the rainy season, where the groundwater level is high. Therefore, progressing the construction during the dry season is the key to completing the Project within the construction period.

Basically, construction at the end of the stream during the dry season reduces the amount of labor and time required for drainage and minimizes the impact of earthwork, thereby ensuring quality.

Moreover, if the installation of sewer pipe under the narrow road is required, it is necessary to confirm the effect on buildings/houses along the road and necessity of countermeasure or damage compensation.

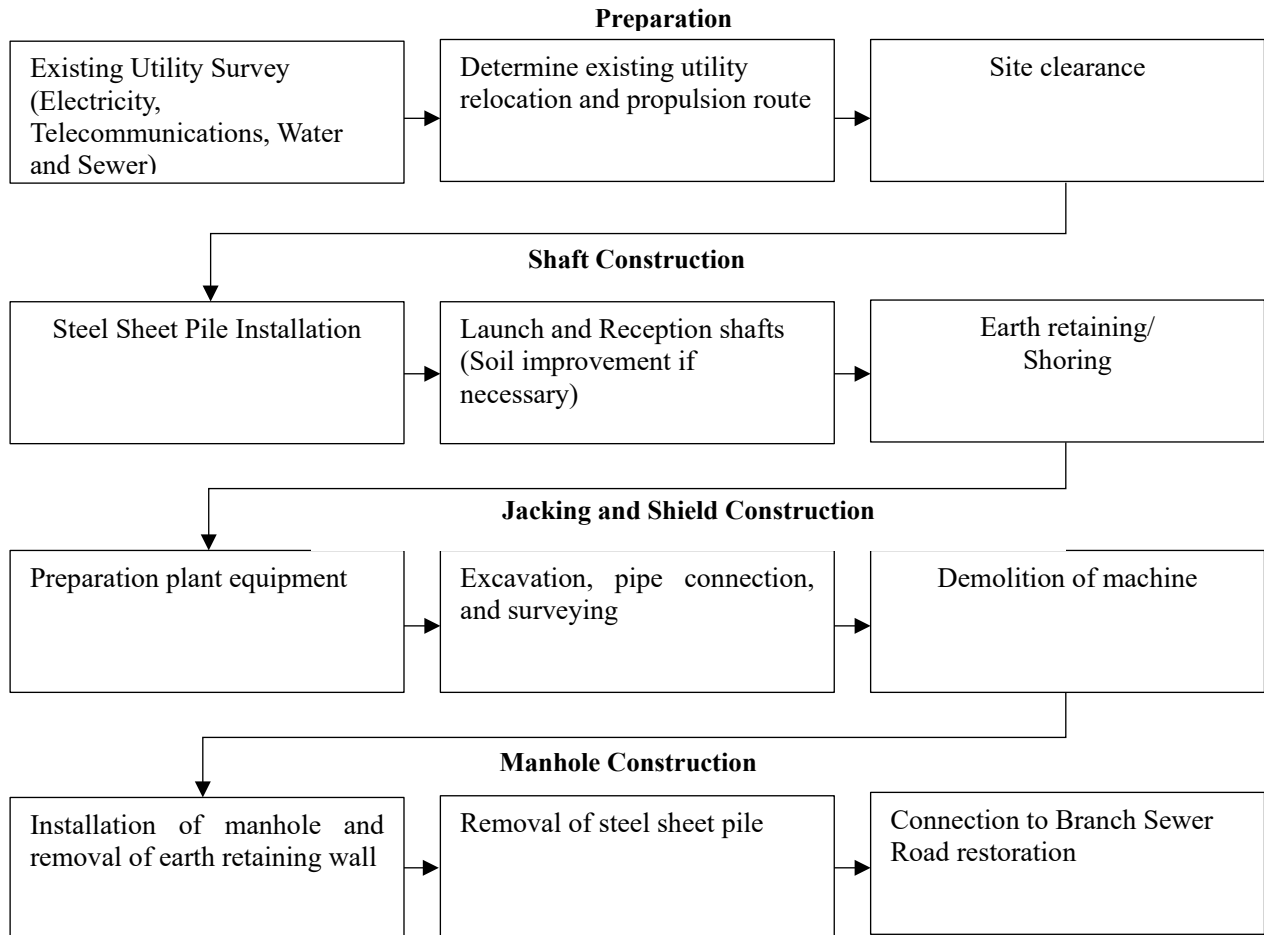
An assembled manhole is assumed as in the first treatment area. Generally, an assembled manhole consists of an iron cover, a receiving frame, an adjusting ring, a diagonal wall, a straight wall, a pipe attachment wall, and base slab, and is collectively called a manhole. Compared to cast-in-place manholes, factory production provides more stable quality and better workability.

The shaft will be constructed on the existing road right-of-way. The existing utility cables and pipes for electricity, telecommunications, water, and sewer will be located prior to the start of construction and relocated, if necessary.

Prior to sheet pile installation, a search trench will be excavated to ensure that no utilities are present. Lane restrictions will be required in areas adjacent to the road. There is an implementation of the safety measures such as fencing and signage at the work site. The contractor shall submit the above construction plans to the relevant authorities to obtain permission for road construction. The shafts will serve as manholes after the construction is completed.

## **(2) Branch Sewer, Lateral Sewer, Property Connection**

Branch sewer will be constructed using high-density polyethylene (HDPE) pipes with D200 mm – 900 mm, using the open-cut method. As shown in Figure 8.4.1, construction of the branch line culverts is expected to start in March 2028. It is recommended that construction work during rainy weather be avoided from the viewpoint of quality control, or that waterproof sheets, or other covers be used.



Source: JICA Survey Team

**Figure 8.1.1 Construction Process by Trenchless Method**

Also, as described in Section 5.2.6, lateral sewer will be installed, and property connection will be implemented to complete the separate sewer system. Although there are many high-rise apartment buildings in Catchment-2 and Catchment-4 where the property connection work can be implemented efficiently, it is recommended to implement the project at the prioritized area where the understanding of the residents can be won easily.

### 8.1.4 Construction Method for the STP

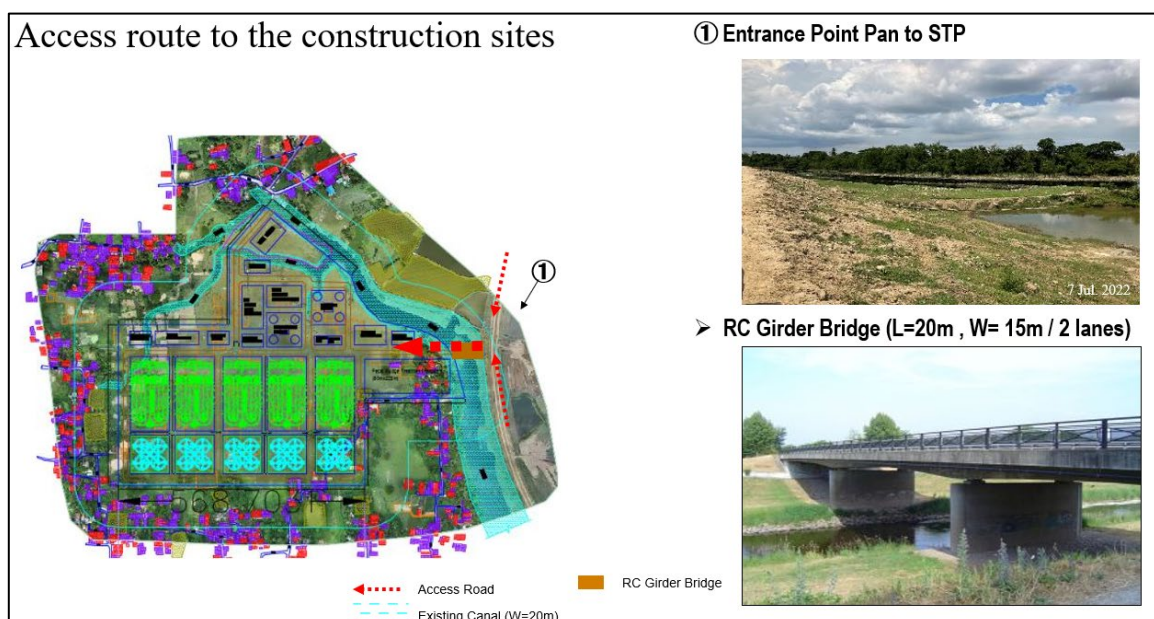
Based on the conceptional design, the construction procedure (step diagram) and construction period from the start of construction to commissioning of the sewage treatment plant will be described in Figure 8.1.3 and Figure 8.1.4. Through this work, efficient procedures and realistic construction period reduction will be proposed. Regarding construction work during the rainy season, while there is basically little direct impact on the laying of sewer pipes, earthwork such as manholes and foundations of the treatment plant will be carried out during the dry season as much as possible, and furthermore, measures for construction during the rainy season will be considered

In Component-1 Sewage Treatment Plant (STP), the construction of an access bridge for onsite access will be considered (Figure 8.1.2). There is an existing ring road connecting the east and west sides of the STP site to the east, but it is not directly connected to the STP site; therefore, a concrete girder bridge would be constructed between the ring road and the STP to allow access for large machinery and personnel during construction.

Construction work for each facility will consist of civil, electrical, and mechanical work. The civil work will begin with ground improvement (PVD method) and pile foundation construction. The construction area of the STP is used for livestock grazing and is some distance away from the homes of nearby residents, so noise and other impacts are expected to be minimum.

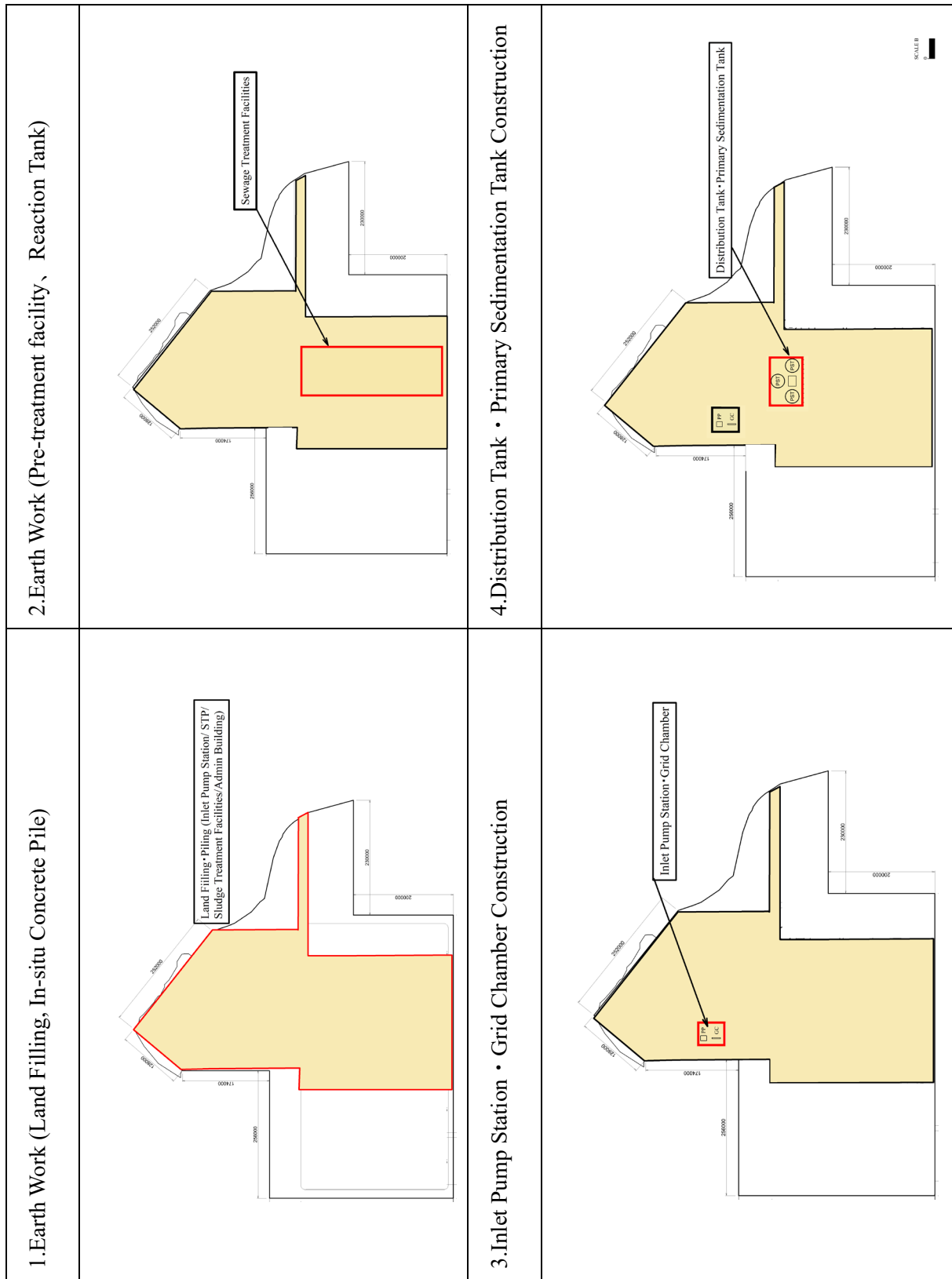
Electrical and mechanical equipment will be installed after the civil structures are completed. A certificate of delivery will be issued upon completion of the commissioning tests.

Moreover, there is an existing aerial electrical cable on the STP site near the access bridge that will interfere the construction traffic. Therefore, it is necessary to study the necessity of relocation of the existing aerial electrical cable and discuss with BPDP on who the owner of the electrical cable is.



Source: JICA Survey Team

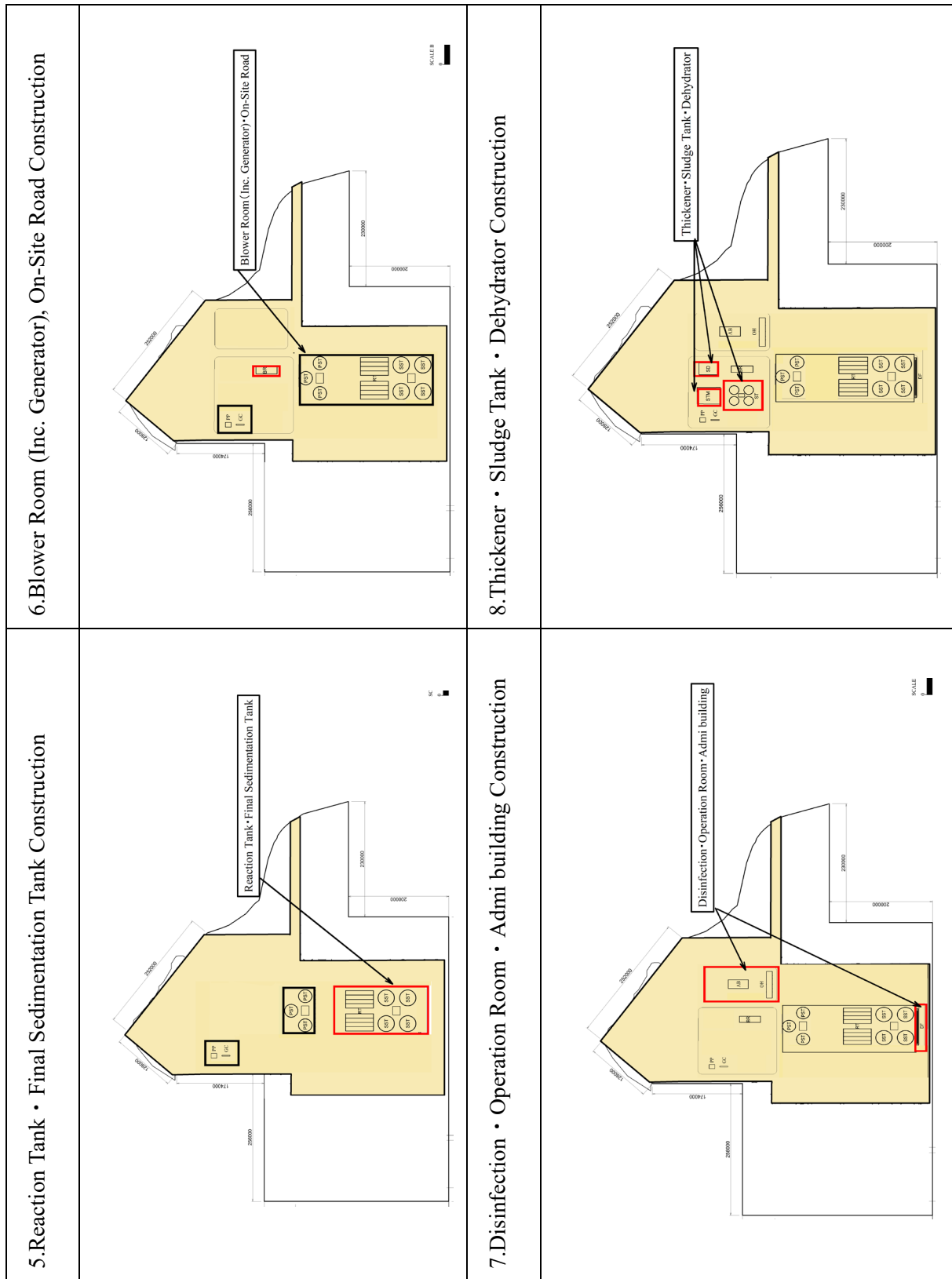
**Figure 8.1.2 Proposed Access Bridge Construction Site**



Source: JICA Survey Team

Figure 8.1.3 STP Construction Step Diagram (1/2)





Source: JICA Survey Team

Figure 8.1.4 STP Construction Step Diagram (2/2)

## **8.2 Procurement Planning and Contract Packages**

### **8.2.1 Procurement Plans for Material and Equipment**

Construction materials, construction machineries, and equipment that can be procured in Chattogram will be transported to the temporary yard by land transportation. The transportation plan will be examined in consideration to the existing site conditions that houses are scattered around the planned construction site for the STP and small khals across the site.

Imported goods such as special equipment can be carried in at Chattogram Port or by air transportation if it is a small equipment, and after being unloaded, will be transported by land to the construction site.

#### **(1) Construction Materials**

Construction materials required for earthwork include concrete, soil, sand, reinforcing bars, and temporary materials. According to discussions with local contractors, these materials can be supplied almost without delay.

##### **1) Concrete**

Cement and aggregates can be procured in Chattogram City, and it is possible to carry out the work within the specified time, from carrying out the batching plant to concrete casting on the site.

##### **2) Reinforcing Bar**

Steel bars, round steel, etc. necessary for construction are procured from local supplier

##### **3) Sheet-Pile, Formwork, and Scaffolding**

Pile retaining materials (steel sheet piles, cut beams, etc.), formwork, scaffolding support materials, and temporary construction materials can be procured in Chattogram City.

##### **4) Sewer Pipe**

Pipe materials such as HDPE pipes are available in Bangladesh, but there are cases where they are imported from neighboring countries such as India and China rather than local procurement because it is cheaper.

##### **5) Pipe Materials for Jacking Method and Segments for Shield Method**

Pipe materials used for jacking method and segments for the shield method are not available in Bangladesh, so they must be imported from a third country.

#### **(2) General Equipment and Machines**

Construction equipment is widely used during construction of sites, hotels, and apartment buildings in Chattogram and Dhaka cities.



In the construction of sewage treatment plants, heavy equipment for driving piles on site, and vibro-hammers for driving sheet piles can be procured for the construction of pile foundations.

In addition, pipe jacking machine for laying sewer pipes and service connection can also be procured in Bangladesh.

### (3) Special Equipment

In this project, either propulsion or shield tunneling is planned for laying the trunk pipeline culvert. As shown in Table 8.2.1, it is possible to procure machinery for trenchless methods in Bangladesh, but as a result of the market survey, only machinery with a bore diameter of 450 mm or smaller could be procured. Since the diameter of the trunk line envisioned in this Project will be 600 mm or larger, it will be necessary to import equipment and pipe materials from a third country.

**Table 8.2.1 Pipe Jacking Method in Bangladesh**

Water Pipe Installation Using Horizontal Directional Drilling	Pipe Fusion Machine
	

Source: JICA Survey Team

### 8.2.2 Procurement of Consultants

Chattogram Water and Sewerage Authority (CWASA) will procure a consultant to provide pre-construction services (preparation of bid documents and bidding assistance) and construction supervision. Procurement of consultants can begin after pre-notification (pledge).

The procurement is expected to take approximately 13 months, beginning with the issuance of the Request for Expression of Interest (EOI), followed by the selection of the Consultant through bidding, contract negotiations, and contract award.

JICA's prior approval is required to send a Request for Proposal (RFP) to the consultants on the pre-prepared shortlist and the consent of JICA is also required for the selection results of the consultants and the conclusion of the contract.

### 8.2.3 Procurement of Contractors

The selected Consultant shall do the following tasks:

- Preparation of prequalification (PQ) documents for the contractor
- Preparation of bid documents (including technical requirements)
- Preparation of cost estimates

- Assistance with PQ evaluation
- Assistance with bid evaluation

The PQ documents, PQ evaluation results, bid documents, bid evaluation results, and JICA approval are required for contract award.

After the contractor procurement by CWASA, the contractor will begin construction in accordance with the contract.

## 8.2.4 Contract Package and Contract Method

## 8.3 Permission Relevant to the Project

The construction work areas such as roads and rivers are currently controlled and maintained under several authorities. Before starting the construction works by the Contractor, permissions from related authorities need to be obtained.

The necessary permissions and related authority for getting permissions are shown in Table 8.3.1.

**Table 8.3.1 Permissions for Construction Works**

Before Construction	Authority	Situation (Person in charge)
Land Acquisition	Local Government Division (LGD)	Complete (CWASA)
	Chattogram Development Authority (CDA)	
	Department of Environment (DoE)	
	Urban Development Directorate (UDD)	
	District Commissioner (DC Office)	
Layout Drawing Approval	Chattogram Development Authority (CDA)	In process (CWASA)
During Construction		
Occupancy of Road	Roads and Highways Department (RHD)	Notice is necessary before starting of work (CWASA)
	Chattogram Development Authority (CDA)	
	Chattogram City Corporation (CCC)	
	Local Government Engineering Department (LGED)	
Utilities	Karnaphuli Gas Distribution Company Limited (KGDCL)	Notification is necessary before construction (CWASA)
	Bangladesh Telecommunications Company Limited (BTCL)	
	Bangladesh Power Development Board (BPDP)	
	Power Grid Company of Bangladesh (PGCB)	
	Bangladesh Rural Electrification Board (BREB)	
	Karnaphuli Gas Distribution Company Limited (KGDCL)	
	Mobile Company (FOC)	

Source: JICA Survey Team

## **8.4 Project Implementation Schedule**

### **8.4.1 Overall Schedule of the Project**

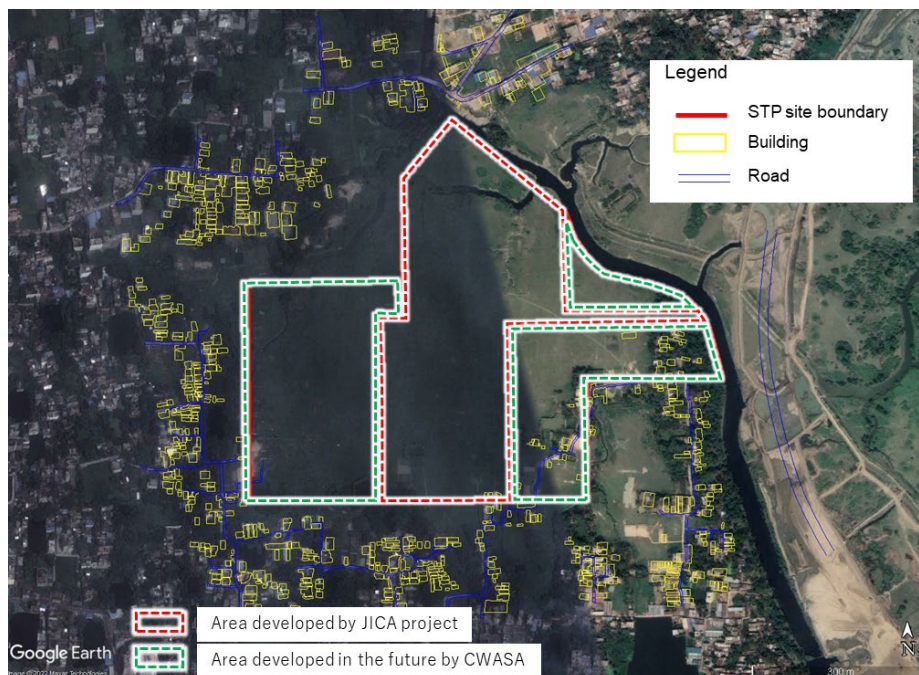
The draft project implementation schedule is described in Figure 8.4.1, which is proposed for the following case:

- i) Target year: 2035
- ii) The population ratio to be covered in the initial stage of the project against whole population of the Catchment-2 and Catchment-4: 35%
- iii) STP capacity: 60,000m<sup>3</sup>/day



#### 8.4.2 Schedule for Land Acquisition

As described in Chapter 5, a site with approximately 30 ha located nearby the outer ring road along Karnaphuli River and the Dom Khali Khal was selected as the STP site. This site can allocate the whole treatment facilities with the capacity of 300 MLD to treat the planned sewage volume of the ultimate target year, 2070. On the other hand, as described in Chapter 5 and 6, the sewerage system will be developed in a step-by-step manner, the capacity of STP to be developed in Japanese ODA project is 60 MLD. Therefore, the area necessary for Japanese ODA project is the area highlighted with red dot line in Figure 8.4.2 (approximately 15 ha (36.24 acre)).



Source: JICA Survey Team

Figure 8.4.2 Target Area and Facilities under This Project

#### 8.5 Consideration for the Impact of COVID-19 on Project Implementation Schedule

As of October 2022, the coronavirus disease 2019 (COVID-19) pandemic has not yet been settled all over the world, however, the time of “With Corona” has already started in many countries including Bangladesh. People’s economic activities have reverted to the time before the pandemic.

Therefore, particular consideration for the impact of COVID-19 is not added in the project implementation schedule proposed in the Section 8.4 above unless another large epidemic of the variant of COVID-19 will happen and restrictions on economic activities will again be imposed in Bangladesh.

## CHAPTER 9 HPROJECT COST ESTIMATE

### 9.1 Condition of Project Cost Estimate

### 9.2 Project Components and Construction Cost

### 9.3 Estimated Project Cost and Disbursement Plan

### 9.4 Operation and Maintenance Cost

The maintenance and management costs after completion of the project were estimated based on the unit prices used in the F/S of Catchment-6 and the standard unit prices of CWASA, and for some items such as labor unit price, standard values based on interviews with local contractors and suppliers were used. Table 9.4.1 shows the annual O&M cost.

**Table 9.4.1 Annual O&M Cost**

STP	Item	O&M Cost (million JPY)
	Energy Cost	258
	Chemical Cost	11
	Manpower Cost	63
	Maintenance Cost	293
	Sub-Total	625
Sewer Pipe	Item	O&M Cost (million JPY)
	Energy Cost	102
	Manpower Cost	5
	Maintenance Cost	381
	Sub-Total	488
	<b>Total</b>	<b>1,113 million JPY/year</b>

Source: JICA Survey Team

### 9.5 Consideration for the Impact of COVID-19 on Project Cost

As of October 2022, the coronavirus disease 2019 (COVID-19) pandemic has not yet been settled all over the world. However, the time of “With Corona” has started in many countries including Bangladesh and people’s economic activities have returned to the time of “before pandemic”.

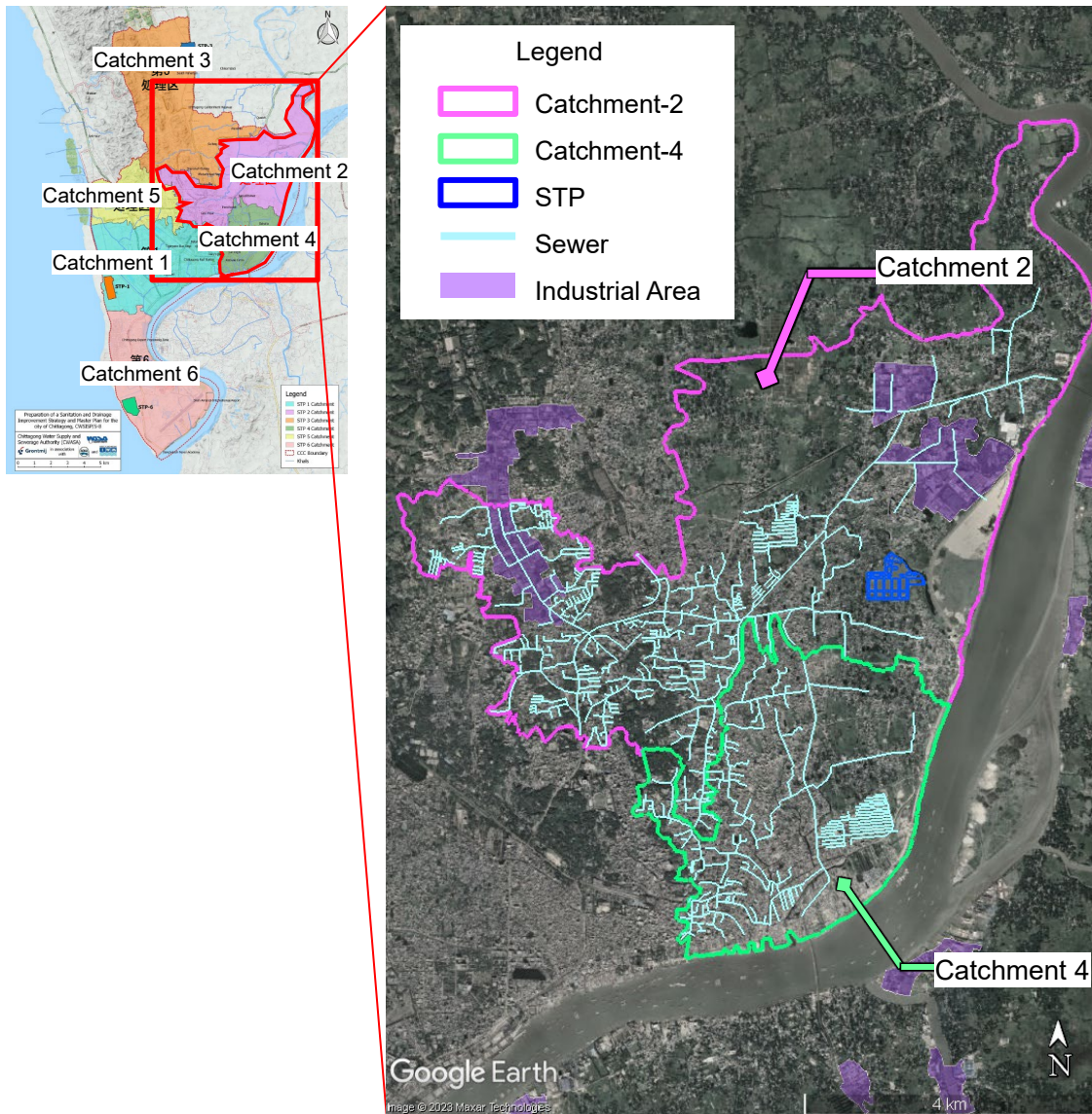
Therefore, the particular consideration for the impact of COVID-19 is not added in the above-described project cost unless another large epidemic of COVID-19 variants will happen and the restrictions on economic activities will be imposed in Bangladesh.



## CHAPTER 10 ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

### 10.1 Project Components which Cause Environmental and Social Impact

This project is a sewerage system development project based on the Sanitation Master Plan developed in 2017 (supported by the World Bank). The project site covers Catchment-2 and Catchment-4 sites in Chattogram as shown in Figure 10.1.1 and the project proponent is CWASA as the project implementing agency.



Source: JICA Survey Team

**Figure 10.1.1 Location of Target Areas**

Outlines of the developed facilities and related facilities are described in Table 10.1.1. The sludge generated in the sewage treatment plant will be disposed in new waste disposal site which is developed by CCC, because the existing waste disposal site (Arefin Nagar Landfill) is nearing full capacity.

According to CCC, the main purpose of the new waste disposal site that is planned for construction is to receive the waste from households, not including the sludge from the project. Thus, the project is not included in the scope of the new waste disposal site construction. Under the JICA Guidelines for Environmental and Social Considerations, the construction of a waste disposal site is not considered “indivisible project” (unless (1) applies), based on the following definition of an indivisible project.

Definition of "indivisible project " in FAQs on the JICA Guidelines for Environmental and Social Considerations (20 July 2011):

With reference to the definition in the International Finance Corporation (IFC) Performance Standard 1, the "indivisible project" is defined as a related project in which JICA does not provide cooperation, and in which (1) if there is no project for which JICA provides cooperation, the related project would not be constructed or expanded, and (2) in the absence of the related project, the project for which JICA provides cooperation has no possibility of being implemented.

**Table 10.1.1 Constructed Facilities**

Facilities	Outline
Sewage Treatment Plant	The sewage treatment plant will receive wastewater of catchments 2 and 4. The plant is located in Kalurghat and its area is 30 ha.
Pump Station	Not including the Yen Loan project Phase 1. (Installed in one location in the future.)
Sewer	Sewer will be installed along existing roads and connected from each household to the sewage treatment plant.

Source: JICA Survey Team

Project components and anticipated impacts are shown in Table 10.1.2.

**Table 10.1.2 Project Components and Expected Impact**

Phase	Project Components	Expected Environmental and Social Impact
Before construction	Land acquisition and resettlement	The land for the sewage treatment plant is privately owned and is being used as grazing land by the surrounding community. The land will be acquired by CWASA. The land acquisition plan, livelihood restoration plan and resettlement action plan should be prepared and implemented properly. In addition, since the land for the pumping station is owned by CWASA, land acquisition and resettlement are not required for the pumping station construction.
During construction	Soil improvement (sewage treatment plant)	When soil improvement work is conducted to prevent ground subsidence, it is necessary to consider the impact of soil contamination.
	Landfilling (sewage treatment plant)	When implementing landfilling work on the project site to prevent flooding, it is assumed that river sand will be used, and it is necessary to consider the impact of river bed sediment.
	Sewage treatment plant construction	

	Access bridge construction	Impacts on environmental pollution of the natural environment due to the use of construction vehicles and machinery need to be evaluated.
	Sewerage installation	In the case of trenchless technology, it is necessary to secure a site for a shaft (a tunnel excavated vertically). It is also necessary to consider how to dispose of excavated soil and assess environmental impacts of construction vehicles and machinery.
	Pumping station installation	Impacts on environmental pollution and natural environment due to the use of construction vehicles and machinery need to be evaluated.
Operation	Discharge of treated water	The impact to the water quality of Karnaphuli River where treated water will be discharged should be evaluated.
	Sludge treatment	The impact of odors generated from the sludge disposal site needs to be assessed.

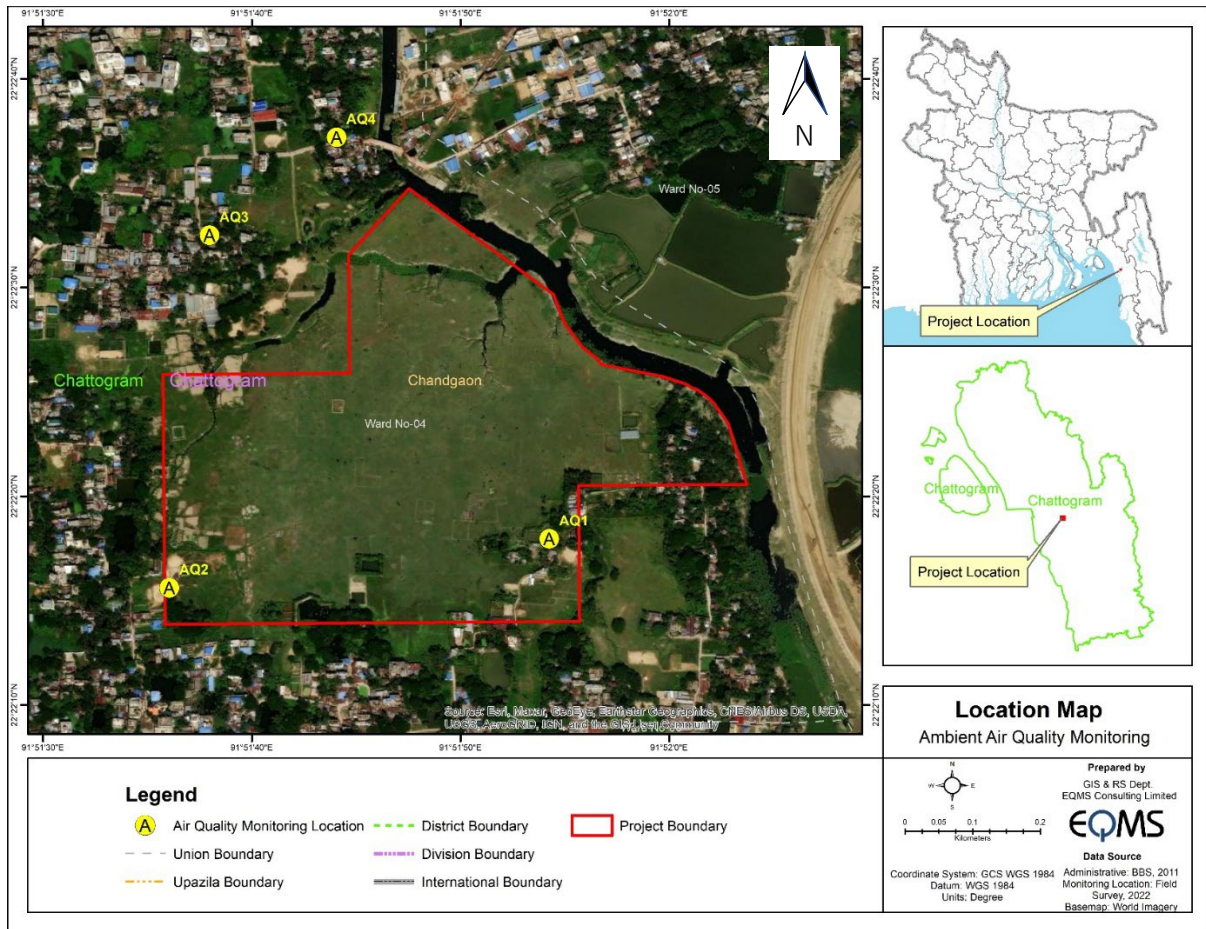
Source: JICA Survey Team

## 10.2 Baseline of Environmental and Social Conditions

### 10.2.1 Air Quality

#### (1) Monitoring Location

To assess the present air quality of the area, four ambient air quality monitoring (AAQM) stations were setup. The locations of the monitoring stations for air quality study were selected on the basis of meteorological data, topography, sensitive locations, easy access and security. The details of the locations of air quality monitoring are presented in Figure 10.2.1.



Source: JICA Survey Team

**Figure 10.2.1 Air Quality Sampling Locations**

## (2) Monitoring Results

The air quality survey results obtained every minute at each monitoring site were combined to make daily average values (8-hour and 24-hour average values) for further evaluation and comparison with corresponding National Ambient Air Quality Standards (NAAQS) and WHO standard (recommended value for public health protection). The monitored ambient air quality is summarized in Table 10.2.1.

The 24-hourly average PM<sub>10</sub> concentrations in the monitoring locations ranged from 30.61 µg/m<sup>3</sup> (AQ1) to 57.18 µg/m<sup>3</sup> (AQ2) in the wet season (August) and 40.12 µg/m<sup>3</sup> (AQ4) to 60.84 µg/m<sup>3</sup> (AQ2) in the dry season (December). PM<sub>10</sub> concentration was found to be higher in the dry season compared to the wet season. During summer or wet season, the lowest layer of the atmosphere is warmer and lighter as compared to winter, which makes it easy for air to rise upwards. As a result, the pollutants are carried away from the ground. However, during winter, the air near the atmosphere of the earth is denser and cooler. The warm air traps the cool air and forms a kind of atmospheric lid, which is known as inversion. The vertical mixing of air happens within this layer, the result of which is that the pollutants disperse back into the atmosphere. The average concentration of PM<sub>10</sub> was within the NAAQS (150 µg/m<sup>3</sup>-24 hourly average) in all the monitoring locations.

The 24-hourly average PM<sub>2.5</sub> concentrations in the monitoring locations ranged from 13.91 µg/m<sup>3</sup> (AQ4) to 21.94 µg/m<sup>3</sup> (AQ2) in the wet season and 28.94 µg/m<sup>3</sup> (AQ1) to 38.22 µg/m<sup>3</sup> (AQ2) in the dry season. The PM<sub>2.5</sub> concentration was found to be higher in the dry season compared to the wet season. During the winter season, PM<sub>2.5</sub> concentration is usually high due to the burning of biomass to warm up and brick kiln which mainly operate in the winter season. The average concentration of PM<sub>2.5</sub> was within the NAAQS (65 µg/m<sup>3</sup>-24 hourly average) in all the monitoring locations.

The average SO<sub>2</sub> concentrations at the monitoring locations ranged from 28.55 µg/m<sup>3</sup> (AQ4) to 46.43 µg/m<sup>3</sup> (AQ2) during wet season whereas it was found to be 27.83 µg/m<sup>3</sup> (AQ1) to 41.0 µg/m<sup>3</sup> (AQ2) in dry season. The average concentration of SO<sub>2</sub> was within the NAAQS (80 µg/m<sup>3</sup>-24 hourly average) in all the monitoring locations. However, the average concentration of SO<sub>2</sub> exceeded standard of WHO. In Bangladesh, grasses are often burned in the field and such activity is one of the sources of SO<sub>2</sub>.

The average NO<sub>2</sub> concentrations in the monitoring locations ranged from 3.0 µg/m<sup>3</sup> (AQ4) to 16.14 µg/m<sup>3</sup> (AQ1) in the wet season and 9.01 µg/m<sup>3</sup> (AQ2) to 30.56 µg/m<sup>3</sup> (AQ1) in the dry season. The average concentration of NO<sub>2</sub> was within the NAAQS (80 µg/m<sup>3</sup>-24-hour average) in all the monitoring locations. The 8 hourly average concentration of CO in the monitoring locations was found as 0.02 mg/m<sup>3</sup> (AQ1, AQ4) to 0.04 mg/m<sup>3</sup> (AQ3) in the wet season whereas it was 0.13 mg/m<sup>3</sup> (AQ1) to 0.43 mg/m<sup>3</sup> (AQ3) in the dry season. Both are within the allowed value of NAAQS (5 mg/m<sup>3</sup>-8 hourly average).

The 24-hourly average Pb concentrations in the monitoring locations ranged from 0.021 µg/m<sup>3</sup> (AQ2) to 0.046 µg/m<sup>3</sup> (AQ4) in the wet season and <0.001 µg/m<sup>3</sup> in the dry season. The average concentration of Pb was within the NAAQS (0.5 µg/m<sup>3</sup>-24 hourly average) in all the monitoring locations.

**Table 10.2.1 Ambient Air Quality in the Study Area**

Location	PM <sub>10</sub> ( $\mu\text{g}/\text{m}^3$ )		PM <sub>2.5</sub> ( $\mu\text{g}/\text{m}^3$ )		CO ( $\text{mg}/\text{m}^3$ )		NO <sub>2</sub> ( $\mu\text{g}/\text{m}^3$ )		SO <sub>2</sub> ( $\mu\text{g}/\text{m}^3$ )		Pb ( $\mu\text{g}/\text{m}^3$ )	
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
AQ1	30.61	43.76	14.28	28.94	0.02	0.13	16.14	30.56	35.11	27.83	0.039	<0.001
AQ2	57.18	60.84	21.94	38.22	0.03	0.36	4.02	9.01	46.43	41.0	0.021	<0.001
AQ3	41.65	51.03	18.32	35.15	0.04	0.43	4.85	12.03	39.27	40.29	0.043	<0.001
AQ4	33.14	40.12	13.91	29.07	0.02	0.19	3.0	9.55	28.55	34.24	0.046	<0.001
<b>Standard</b>												
Bangladesh (NAAQS)**	150		65		5		80		80		0.50	
WHO***	45		15		-		25		40		-	

Source: Primary Monitoring (Wet season: 29.08.2022 – 01.09.2022 & Dry season: 04.12.2022-07.12.2022)

\* CO concentrations and standards are 8-hourly only.

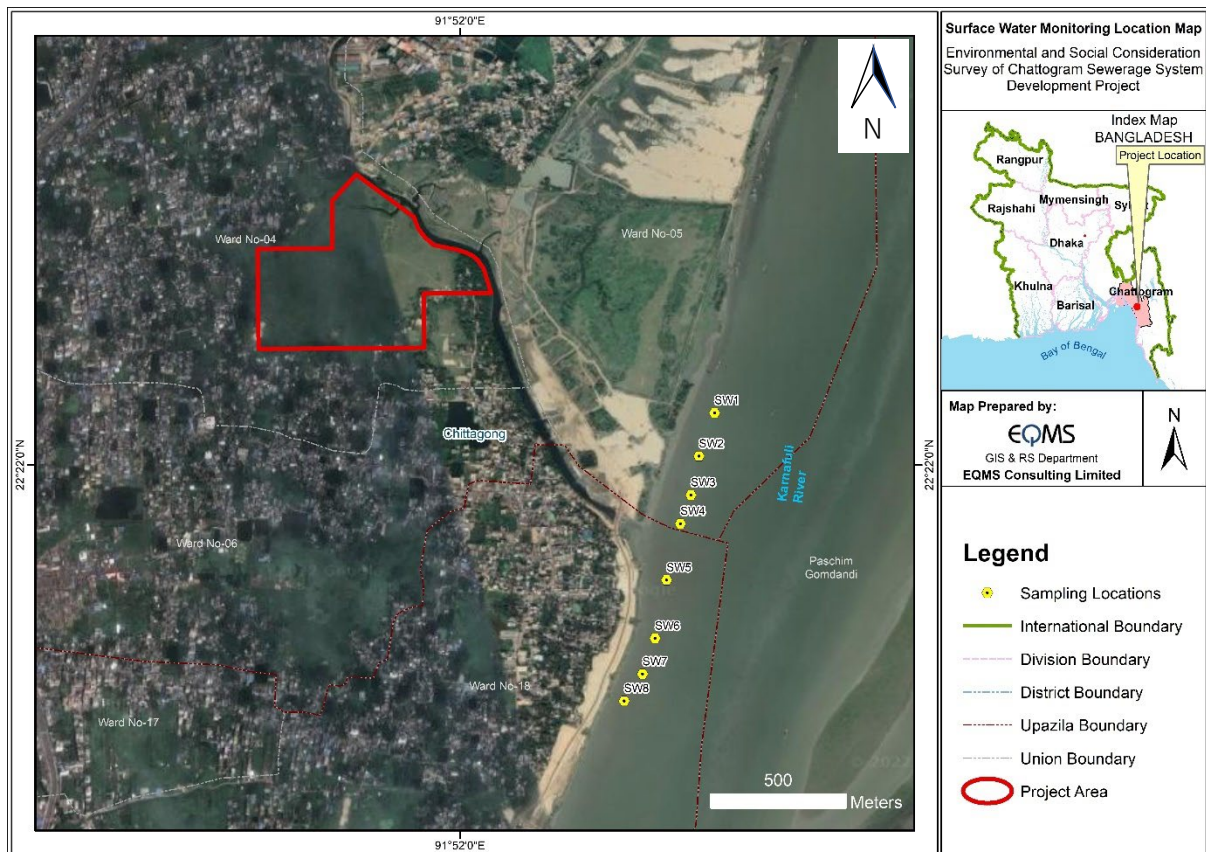
\*\*Air quality control rules, 2022

\*\*\*WHO Ambient Air Quality Guideline Values (2005 and 2000), which are also being referred in the World Bank and IFC's General EHS Guidelines (2007)

## 10.2.2 Water Quality

### (1) Monitoring Locations

Surface water samples were collected at eight points of the Karnaphuli River which is flowing at the south-west side of the project site. SW1-3 and SW5-8 were additionally surveyed, so sampling was conducted only during the dry season. The water sample collection location is depicted in Figure 10.2.2. Water samples were collected in a standard sampling bottle and 250 ml sterilized clean PET bottle for complete physio-chemical and bacteriological tests, respectively. The samples were analyzed as per standard procedure given in Standard Method for Examination of Water and Wastewater Edition 20, published by the APHA, which is used as international standard.



Source: JICA Survey Team

**Figure 10.2.2 Surface Water Sampling Locations**

## (2) Monitoring Results

The surface water of the project area is analyzed depending on the biological and chemical parameters, then all the parameters are compared with the standard levels. Table 10.2.2 presents the surface water analyzed results in comparison to the standard (Bangladesh national standard). Additional studies were conducted for SW1-3 and SW5-8, which were analyzed by a different analytical laboratory than SW4, which may account for differences in the measurement results.

The pH ranged from 7.50 (SW4, bottom, dry) to 8.27 (SW4, bottom, wet), meeting environmental water quality standards for use as drinking water after disinfection; DO ranged from 5.1 mg/L (SW5) to 5.9 mg/L (SW1, SW3), meeting environmental water quality standards for use as drinking water after disinfection. Although the water did not meet the water quality standard, it meets the environmental water quality standard for use for recreational purposes.

Phosphate was measured only in SW4 and ranged from less than 0.01 mg/L (SW4, Surface, Dry) to 3.1 mg/L (SW4, bottom, wet), with some sites meeting the most stringent environmental standard of 0.1 mg/L (usable as a drinking water source after disinfection), and others falling short of the least stringent environmental standard of 2.0 mg/L (can be used for irrigation).

Nitrate, measured only in SW4, ranged from less than 3.0 mg/L (SW4, Bottom, Wet) to 5.26 mg/L (SW4, bottom, dry), with some sites meeting the most stringent environmental standard of 5.0 mg/L (available for irrigation) and others exceeding the least stringent environmental standard of 7.0 mg /BOD ranged from 1.2 mg/L (SW4, bottom, wet) to 46.0 mg/L (SW6), with some sites meeting the most stringent environmental standard of 2 mg/L or less (usable as a drinking water source after disinfection) and others meeting the least stringent environmental standard of 12 mg/L (usable for cooling water and various treatments).

The COD ranged from 23 mg/L (SW4, bottom, wet) to 87.0 mg/L (SW2), none of which met the most stringent environmental standard of 10 mg/L (usable as a source of drinking water after disinfection and for recreational purposes), but they all satisfied the least stringent environmental standard of 100 mg/L (can be used for cooling water and various treatments and can be used for irrigation).

Coliform counts ranged from 40 n/100 ml (SW4, bottom, dry) to over 1600 (SW1,2,3,5,6,8), with some sites meeting the most stringent environmental standard of 50 CFU/100 ml. No environmental criteria were set for total nitrogen, total phosphorus, oil, nor SS.



**Table 10.2.2 Surface Water Quality in the Study Area**

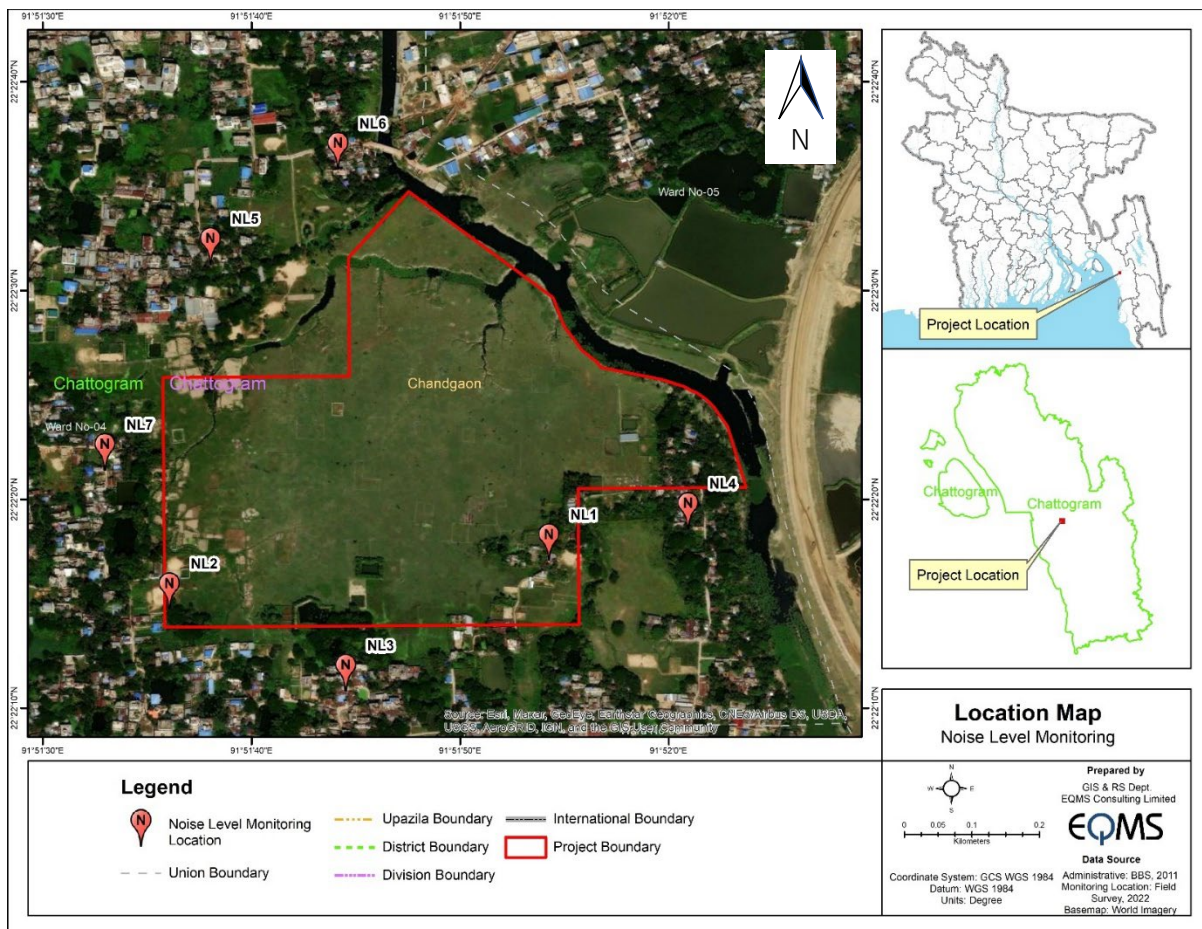
Parameter	Unit	SW1	SW2	SW3	SW4 (Surface)		SW4 (Bottom)		SW5	SW6	SW7	SW8	
		Dry	Dry	Dry	Wet	Dry	Wet	Dry	Dry	Dry	Dry	Dry	
Temp.	oC	29.0	29.8	28.4	31.3	29.0	30.9	29.0	28.3	28.3	28.2	28.5	
pH	-	7.84	7.86	7.78	7.67	7.60	8.27	7.50	7.95	7.97	7.82	7.82	
DO	mg/L	5.9	5.8	5.9	5.8	5.5	5.5	5.2	5.1	5.4	5.2	5.8	
PO <sub>4</sub> <sup>3-</sup>	mg/L	-	-	-	2.8	<0.01	3.1	0.2	-	-	-	-	
NO <sub>3</sub>	mg/L	-	-	-	3.93	4.33	<3.0	5.26	-	-	-	-	
T-N	mg/L	1.10	1.20	1.10	-	-	-	-	1.40	1.10	1.10	1.10	
T-P	mg/L	<0.1	<0.1	<0.1	-	-	-	-	<0.1	<0.1	<0.1	<0.1	
Oil & Grease	mg/L	5.37	10.4	6.87	<2.0	<2.0	<2.0	<2.0	16.15	25.89	22.79	20.93	
BOD	mg/L	24.0	27.0	33.0	1.6	1.8	1.2	1.4	39.0	46.0	42.0	45.0	
COD	mg/L	51.0	87.0	51.0	28	31	23	26	63.0	73.0	70.0	67.0	
SS	mg/L	81.0	119.0	114.0	173	64	141	61	66.5	44.50	50.0	90.0	
Coliform (total)	n/100 ml	>1600	>1600	>1600	60	48	52	40	>1600	>1600	220	>1600	
Environmental Standard(ECR2023)													
Type of Use	pH	DO mg/l	BOD mg/l	NO3-N mg/l	NH4-N mg/l	PO <sub>4</sub> <sup>3-</sup> -P mg/l	Total Cr mg/l	Pb mg/l	Hg mg/l	Total Coliform (CFU/100ml)	TDS mg/l	COD mg/l	
Source of drinking water for supply only after disinfecting:	6.5 – 8.5	≥6	≤2	7.0	0.1	0.1	0.02	0.03	0.001	≤100	1000	10	
Water usable for recreational activity:	6.5 – 8.5	≥5	≤3	7.0	0.3	0.5	0.2	0.05	0.001	≤50	1000	10	
Source of drinking water for supply after conventional treatment:	6-9	≥5	≤3	7.0	0.3	0.5	0.02	0.03	0.001	≤5000	1000	25	
Water usable by fisheries:	6-9	≥5	≤6	7.0	0.3	0.5	0.05	0.1	0.004	≤5000	1000	50	
Water usable by various process and cooling industries:	6.5 – 8.5	≥1	≤12	-	2.7	-	0.1	0.1	0.05	-	1000	100	
Water usable for irrigation:	6.5 – 8.5	-	≤12	5.0	1.5	2.0	0.1	0.1	0.002	≤50,000	1000	100	

Source: ECR 2023, JICA Survey Team

### 10.2.3 Noise

#### (1) Monitoring Locations

Noise levels were recorded at seven locations in the study area during the monitoring period of August 29 - 30, 2022. Noise levels were recorded in the form of sound pressure levels using Tekcoplus SLM25 sound level meter. The details of the noise monitoring locations are depicted in Figure 10.2.3. The purpose of ambient noise level measurement was to determine the sound intensity at the monitoring locations. These locations are chosen in such a way that representative data could be recorded all over the block. The sound level is recorded in the form of A-weighted equivalent continuous sound pressure level ( $L_{eq}$ ) values with the use of A-weighting filters in the noise-measuring instrument.



Source: JICA Survey Team

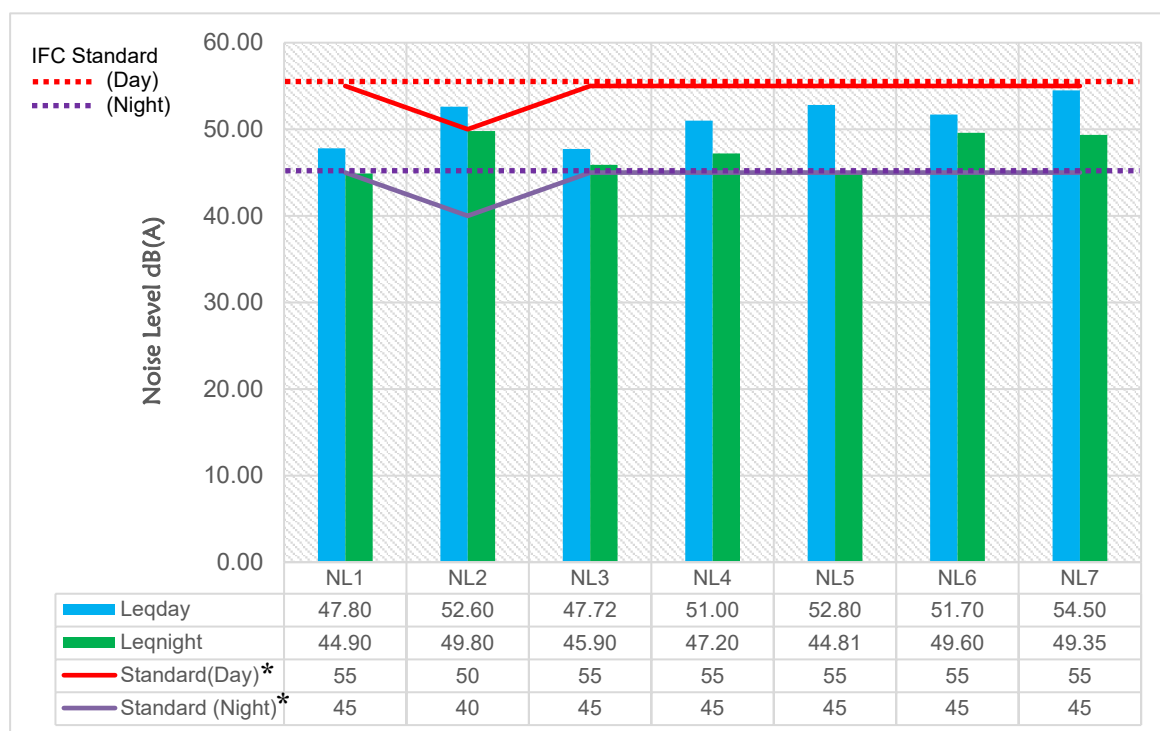
**Figure 10.2.3 Noise Level Monitoring Locations**

#### (2) Monitoring Results

The equivalent sound pressure level ( $L_{eq}$ ) during day and nighttime measured during the monitoring period is presented in Figure 10.2.4.

Ambient daytime noise level (Leqday) was recorded in the range of 47.72 to 54.50 dB (A). Whereas ambient nighttime noise level (Leqnight) in the study area varied in the range of 44.81 to 49.80 dB (A). Maximum noise levels (Lmax) at the monitoring locations were recorded in the range of 65.90 to 77.0 dB(A) and the minimum noise levels (Lmin) were recorded in the range of 30.79 to 41.50 dB(A).

The project site falls into the residential zone classification according to the Bangladesh Sound Pollution Control Rules 2006 categorization and IFC standard as well. The background noise level in the project site (NL1) is under the national standard value. Average noise level at daytime NL2 and nighttime in five locations (NL2, NL3, NL4, NL6 to NL7) were higher than national noise level standard due to domestic activities, vehicle movement and people’s movement. The rest of the locations were well within the standard limit of ECR ‘97 (subsequent amendment in 2006).



Note: Sound Pollution Control Rules 2006

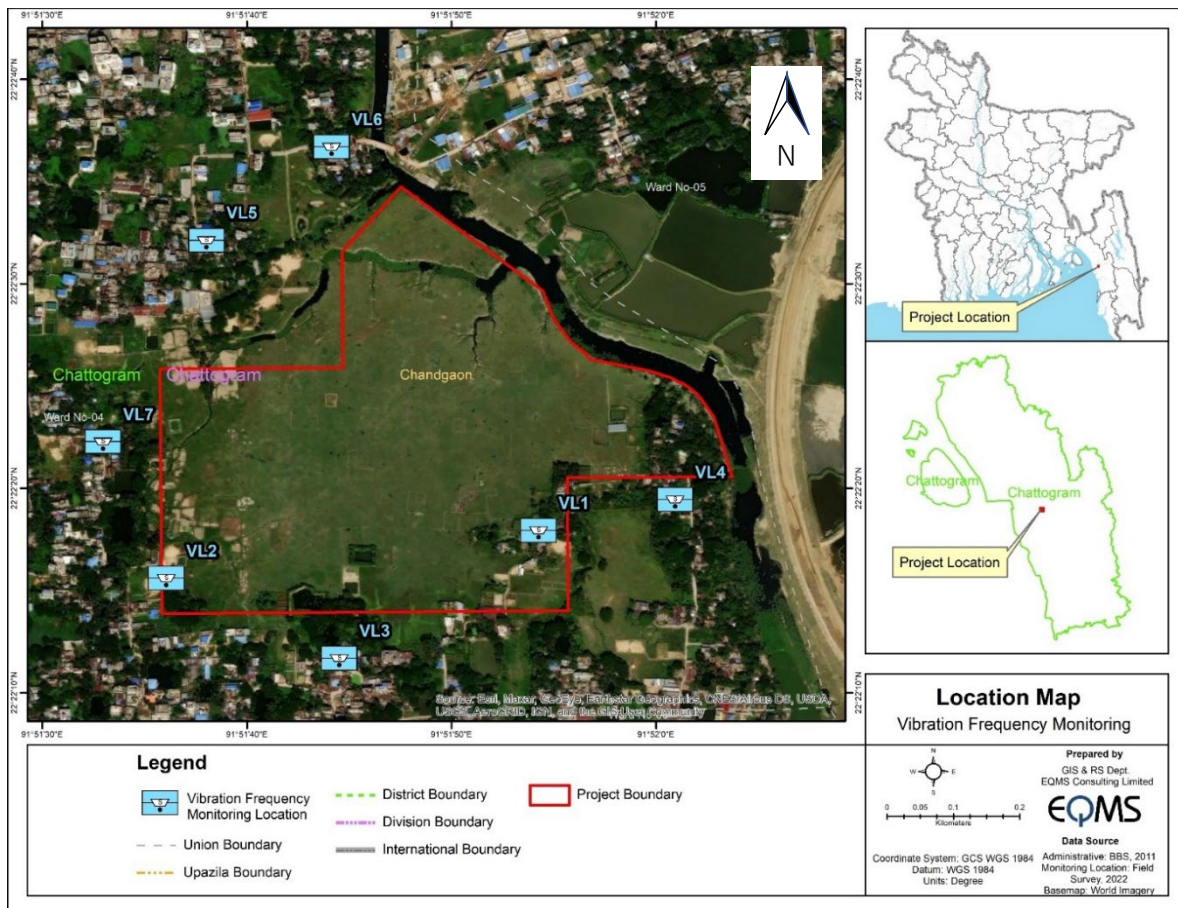
Source: JICA Survey Team

**Figure 10.2.4 Noise Levels Recorded in the Study Area**

## 10.2.4 Vibrations

### (1) Monitoring Location

Vibration levels were recorded at seven locations in the study area during the monitoring period of August 29 – 31, 2022. These were recorded in the form of mm/s levels using UNI-T vibration level meter. The details of vibration monitoring locations are depicted in Figure 10.2.5.



Source: JICA Survey Team

**Figure 10.2.5 Vibration Level Monitoring Locations**

## (2) Monitoring Results

Vibration level monitoring was carried out for 30 minutes during the monitoring periods, and not any vibration activity was observed. Detailed results are given below in Table 10.2.3. All monitoring points are residential. Since there is no vibration standard in Bangladesh, the Japanese standard is used as reference. Based on the field level vibration level and comparison with the standard, it can be concluded that the baseline vibration levels are within the acceptable level.

**Table 10.2.3 Vibration Level in the Study Area**

Location	Area	Average Vibration (ppv, mm/s)	Vibration Velocity Level in Decibels (VdB)
VL1	Residential	0.10	59.86
VL2	Residential	0.04	51.90
VL3	Residential	0.07	56.76
VL4	Residential	0.12	61.45
VL5	Residential	0.02	45.88
VL6	Residential	0.05	53.84
VL7	Residential	0.05	53.84
Vehicle vibration standard in Japan (Vibration Regulation Act)			
Peak component particle velocity at daytime			dB
Residential			65
Residential, factory, and commercial facilities			70

Source: JICA Survey Team

## 10.2.5 Flora and Fauna

### (1) Terrestrial Flora

Floral species composition was evaluated employing primary survey data from five transects planted in the study area. Terrestrial flora covers most of the vegetation in the study area. A total of 51 species under 26 families of floral species were enumerated during the field survey from the transect samples during wet and dry season survey. The highest number of floral species (9 species) were recorded under the Fabaceae family and the second-highest number of species (5 species) were under Arecaceae family. Major floral species observed in and around the study area included Jackfruit (*Artocarpus heterophyllus*), Mango (*Mangifera indica*), Elephant Apple (*Dillenia indica*), Java Plum (*Syzygium cumini*), Mahogany (*Swietenia mahagoni*), Coconut (*Cocos nucifera*), Shishu (*Dalbergia sissoo*), Mangrove apple (*Sonneratia apetala*), mango pine (*Barringtonia acutangula*), Shirish (*Albizia lebbek*), and Calamus Palm (*Clamus gibbsianus*). Most of the recorded species are producing fruits (42%) and timber (40%). Teak (*Tectona grandis*) which are categorized into Endangered (EN) as per IUCN Red list is observed.

### (2) Herpetofauna (Amphibians & Reptiles)

Diverse species of amphibians and reptiles were found in study area, attributable to the diverse vegetation types and the availability of wetlands of different types. During the wet season survey, a total of six (6) species of amphibians belonging to three (3) families- Asian Common Toad (*Duttaphrynus melanostictus*), Indian Bull Frog (*Hoplobatrachus tigerinus*), Common Tree Frog (*Polypedates leucomystax*), Bombay Wart Frog (*Fejervarya syhadrensis*), Indian Skipper Frog (*Euphlyctis cyanophlyctis*), Nepal Wart Frog (*Fejervarya nepalensis*)- and ten (10) species of reptiles belonging to seven (7) families- Banded Krait (*Bungarus fasciatus*), Bengal Monitor Lizard (*Varanus bengalensis*), Checkered Keelback (*Xenochrophis piscator*), Common Garden Lizard (*Calotes versicolor*), Common House Gecko (*Hemidactylus frenatus*), Common Smooth-scaled Water Snake (*Enhydryis enhydryis*), House Lizard (*Hemidactylus bowringii*), Indian Mabuya (*Eutropis carinata*), Indian Rat snake (*Ptyas mucosus*), Spectacled Cobra (*Naja naja*)- were listed from the project area based on primary and secondary data.

All the amphibian species are included in the Bangladesh Wildlife (Conservation and Security) Act, 2012 in Schedule-II which protects them from hunting, killing, and capturing. On the other hand, two (2) Near Threatened (NT) reptile species such as Bengal monitor lizard (*Varanus bengalensis*) and the spectacled cobra (*Naja naja*) were found in the study area.

During the dry season (December 3 to December 7, 2022), the study team observed one (2) species of amphibian -*Duttaphrynus melanostictus* and *Euphlyctis cyanophlyctis* and two (2) species of reptiles - *Calotes versicolor* and *Hemidactylus bowringii*- in the study area.

### (3) Avifauna

During the wet season survey, a total of 41 species under 25 families have been found within the study area. The highest number of birds dominated the study area are belonging to the family Sturnidae (4

species) and in addition, Accipitridae, Alcedinidae, Ardeidae, Columbidae, Corvidae are the second dominated family (3 species). Homestead forests, grassland and bush, and some aquatic habitats of this area have supported the wild birds as a feeding and roosting ground. All the bird species found in this area are classified as least concern (LC) both locally and globally according to IUCN red list.

During the dry season field visit, a total 51 species under 30 families have been found within the study area. The highest number of birds dominated in the study area are belonging to the family Sturnidae and Ardeidae (4 species of each family). However, Alcedinidae, Charadriidae, Columbidae, Corvidae, and Cuculidae, are the second dominated family (3 species of each family). Eight species of winter migrant species such as, black-headed ibis (*Threskiornis melanocephalus*), brown shrike (*Lanius cristatus*), grey-headed lapwing (*Vanellus cinereus*), common sandpiper (*Actitis hypoleucos*), white wagtail (*Motacilla alba*), black-headed gull (*Larus ridibundus*), brown-headed gull (*Larus brunnicephalus*) and citrine wagtail (*Motacilla citreola*) were observed in the study area.

#### (4) Mammals

During the wet season survey, mammals that were observed in the project area include the common mongoose (*Herpestes edwardsii*), common Indian field mouse (*Mus booduga*), Indian fruit bat (*Pteropus giganteus*), common house rat (*Rattus rattus*), and the irrawaddy squirrel (*Callosciurus pygerythrus*).

During the dry season field visit, three mammalian species were reported to have been observed in the study area. Observed mammalian species included the Indian fruit bat (*Pteropus giganteus*), Irrawaddy squirrel (*Callosciurus pygerythrus*), and Asian house shrew (*Suncus murinus*). All the mammalian species found in the study area are classified as Least Concern (LC), both locally and globally according to IUCN Red List.

#### (5) Butterflies

Butterflies play a vital role in the ecosystem and act as bioindicators- the diversity and abundance of butterflies indicate the health of the ecosystem. A total of 12 species of butterflies including the blue mormon (*Papilio polymnestor*), common crow butterfly (*Euploea core*), common emigrant (*Catopsilia pomona*), common grass yellow (*Eurema hecabe*), common gull butterfly (*Cepora nerissa*), common mime (*Papilio clytia*), grey pancy (*Junonia atlites*), Indian cabbage white (*Pieris canidia*), mottled emigrant (*Catopsilia pyranthe*), peacock pancy (*Junonia almana*), striped albatross (*Appias libythea*), and the three spot grass yellow (*Eurema blanda*) were recorded from the project site and the adjacent area.

A total of 13 species of butterflies were observed during the dry season field visit, including the plain tiger (*Danaus chrysippus*), psyche (*Leptosia nina*), and the common sator (*Ariadne merione*) were observed which was not seen during the previous wet season field visit. All the species found in the study area are very common in nature and widely distributed as per IUCN Red List of Bangladesh, 2015.

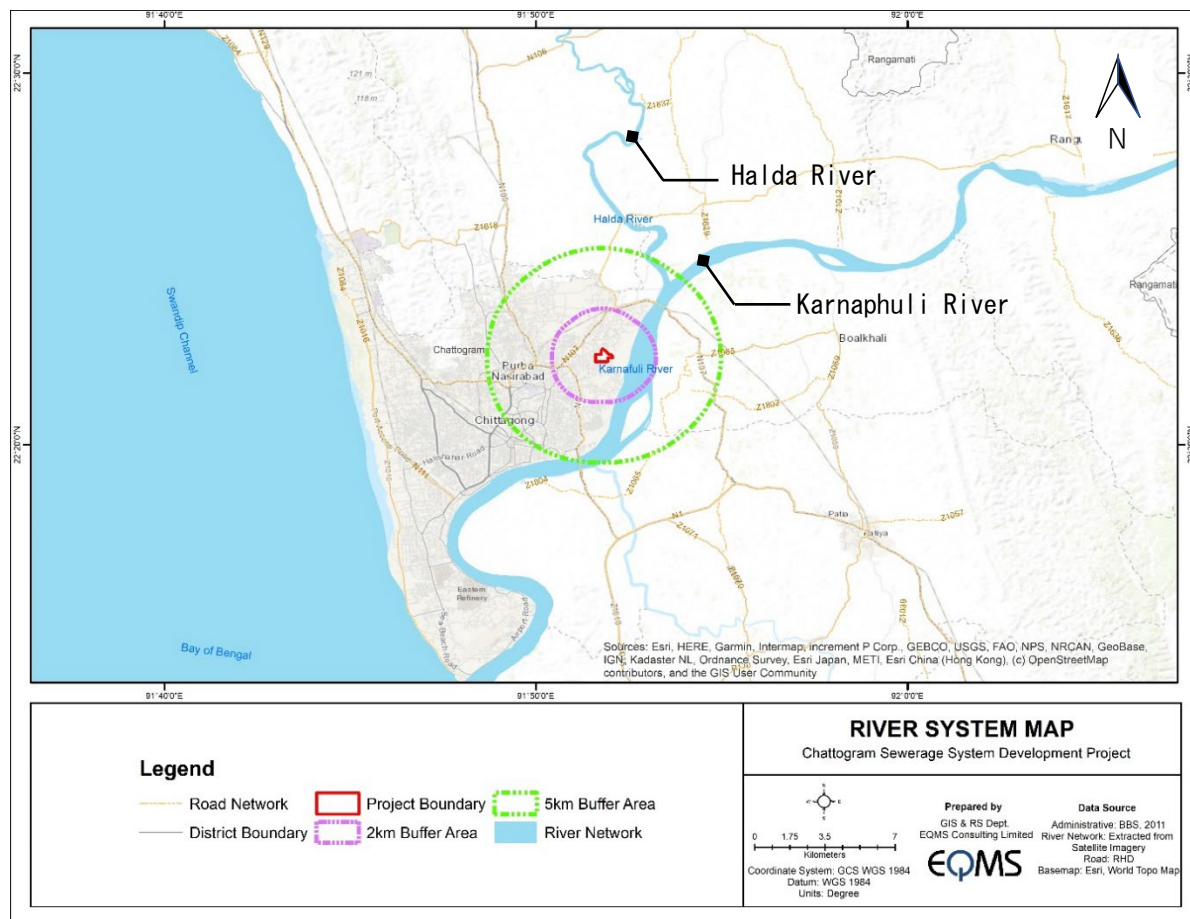
## (6) Fish

During the fisheries study, fishing boats were observed in the Karnaphuli River adjacent to the proposed project site. During the wet season survey, a total of 38 species of fish and four species of prawn and shrimps were recorded. Most of the fish found in the study area were species commonly caught in fisheries. The abundant fish species found in the Karnaphuli River adjacent to the study area were basa (*Pangasius bocourti*), tular dandi (*Sillaginopsis panijus*), poa (*Otolithoides pama*), phasa (*Setipinna phash*), chiring (*Apocryptes bato*), topshe (*Polynemus paradiseus*), and gura icha (*Macrobrachium lamarrei*). Threatened species are not confirmed.

During the dry season fisheries study, 36 fish species and seven species of prawns were recorded. According to the direct observation and informal consultation with fishermen, generally bacha (*Eutropiichthys vacha*), poa (*Otolithoides pama*), phasa (*Setipinna phash*), topshe (*Polynemus paradiseus*), mola (*Amblypharyngodon mola*), golda chingri (*Macrobrachium rosenbergii*) and gura chingri (*Macrobrachium lamarrei*) are commonly found in the Karnaphuli river adjacent to the project area. Four Endangered species (EN), featherback (*Chitala chitala*), great snakehead (*Channa marulius*), pabda catfish (*Ompok pabda*), pangus (*Pangasius Pangasius*) and four vulnerable species (VU), long-whiskered catfish (*Sperata aor*), Indian mottled eel (*Anguilla bengalensis*), Indian river shad (*Gudusia chapra*), silver hatchet chela (*Chela cachius*), as per IUCN Bangladesh Red List were observed. One species, Endangered (EN) species as per IUCN Red List, striped catfish (*Pangasiadon hypophthalmus*) was observed.

### 10.2.6 Hydrology

The Karnaphuli River is a major river that flows beside the project area. Figure 10.2.6 shows major rivers and water body around the project area. The Karnaphuli is the nearest river located at the south-east side from the proposed project site, and the largest and the most important river in Chattogram. The river originates from the Lushai Hills in Mizoram, India. It flows about 270 km (170 miles) southwest through Chattogram Hill Tracts and Chattogram and finally falls into the Bay of Bengal near Patenga. The width of the river is about 667 meters (2188 feet) and the channel is braided in type. The main tributaries of the Karnaphuli River are the Halda, Ichamati, Kasalong, and Thega rivers. The river is influenced by tidal effect, and the highest difference between high and low tide is about 4 meters. Boats of different types and size move around the whole year. Some ponds and canals are also found around the project site.



Source: JICA Survey Team

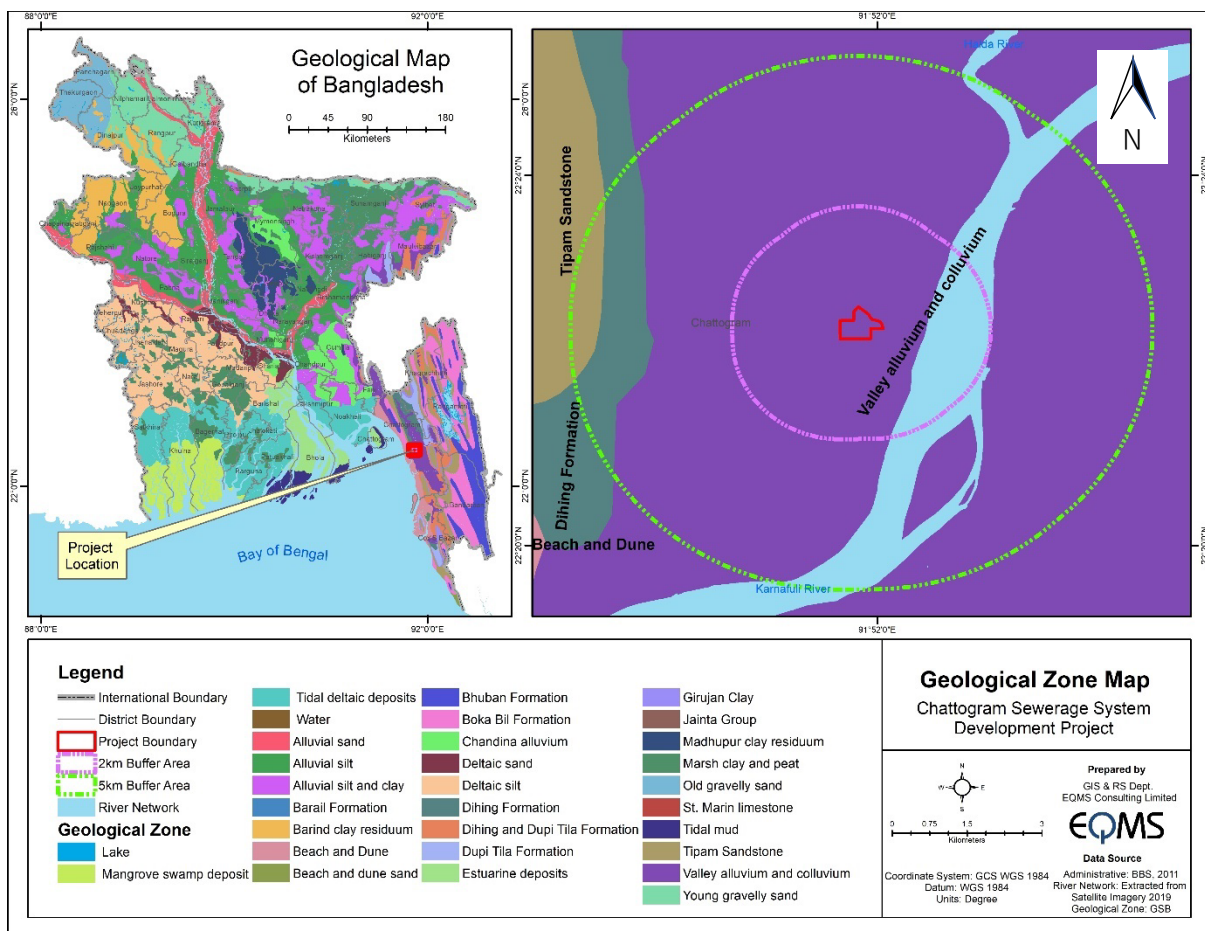
**Figure 10.2.6 River System Around the STP**



### 10.2.7 Geology

The geology of Bangladesh is affected by the country's location, with it being mainly a riverine country. It is the eastern two-thirds of the Ganges and Brahmaputra River delta plain stretching to the north from the Bay of Bengal. According to the Geological Survey of Bangladesh (GSB) map, the 5-km study area falls under Dihing formation, Tipam sandstone, and valley alluvium and colluvium geological zones. The project site falls under the valley alluvial and colluvium geological zone (Figure 10.2.7).

Valley alluvium and colluvium is medium-to-dark grey or light brown silt, clayey silt and fine-to-medium sand, and locally contains coarse debris derived from local bedrock and organic matter. Colluvium is flushed into narrow valleys and reworked by alluvial processes.



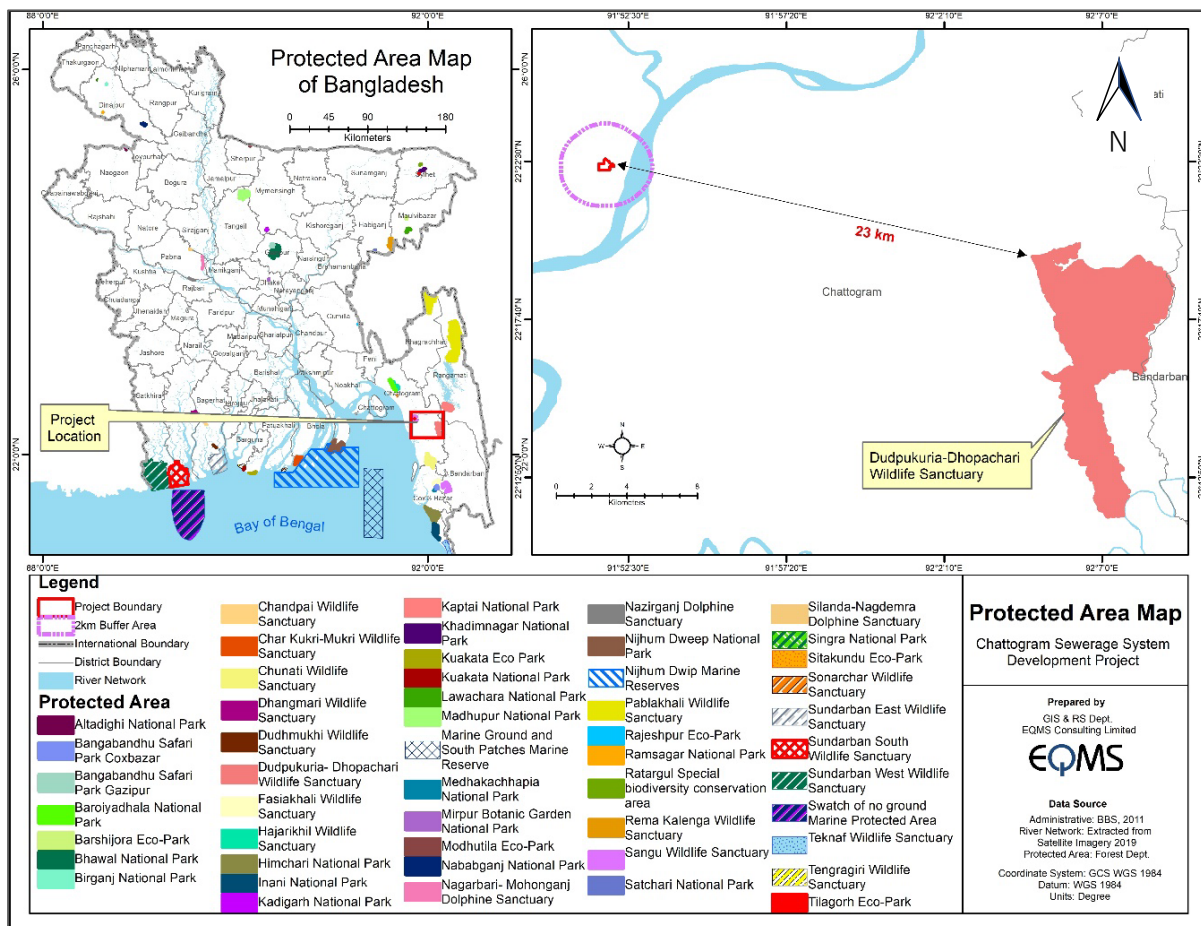
Source: JICA Survey Team based on Geological Survey of Bangladesh

Figure 10.2.7 Geology of the Study Area

### 10.2.8 Protected Area

Protected areas (PAs) or conservation areas are locations that receive protection because of their recognized natural, ecological, or cultural values. There are several kinds of protected areas, which vary by level of protection, depending on the enabling laws of each country or the regulations of the international organizations involved. The different categories of PAs in Bangladesh defined by the Wildlife (Conservation and Security) Act, 2012 are Wildlife Sanctuary, National Park, Safari Park, Ecopark, Botanical Garden, Wild Animal Breeding Center, Special Biodiversity Conservation Area, National Heritage, Memorial Tree, Sacred Tree, and Kunjaban. There are 59 PAs (as of February 16, 2022) in Bangladesh in total according to the Forest Department website and 49 of them are managed by the Bangladesh Forest Department.

There are 12 PAs in total in the Chattogram region, however, no PA is present within the study area. According to the Forest Department’s list of wildlife sanctuary, the nearest PA from the project site is Dudpukuria- Dhopachari Wildlife Sanctuary at an aerial distance of 23 km (Figure 10.2.8) The sanctuary is categorized as IV in IUCN category.



Source: JICA Survey Team

Figure 10.2.8 Protected Areas (PAs) near the Project Site

### 10.2.9 Cultural Heritage

As of 2022, there are two cultural and one natural world heritage sites in Bangladesh as inscribed in the world heritage list of UNESCO as shown in Figure 10.2.9. These heritage sites are not located in Catchment-2 and Catchment-4.



Source: Google Map edited by the JICA Survey Team

**Figure 10.2.9 Location of World Heritage Sites**

### 10.2.10 Land Use

Land use/cover studies are an essential component in land resource evaluation and environmental studies. The land use study of the proposed project site and the 2-km study area has been conducted through analysis of google earth imagery.

The results were analyzed based on the distribution of various land use / land cover classification and the results are presented both in tabular form.

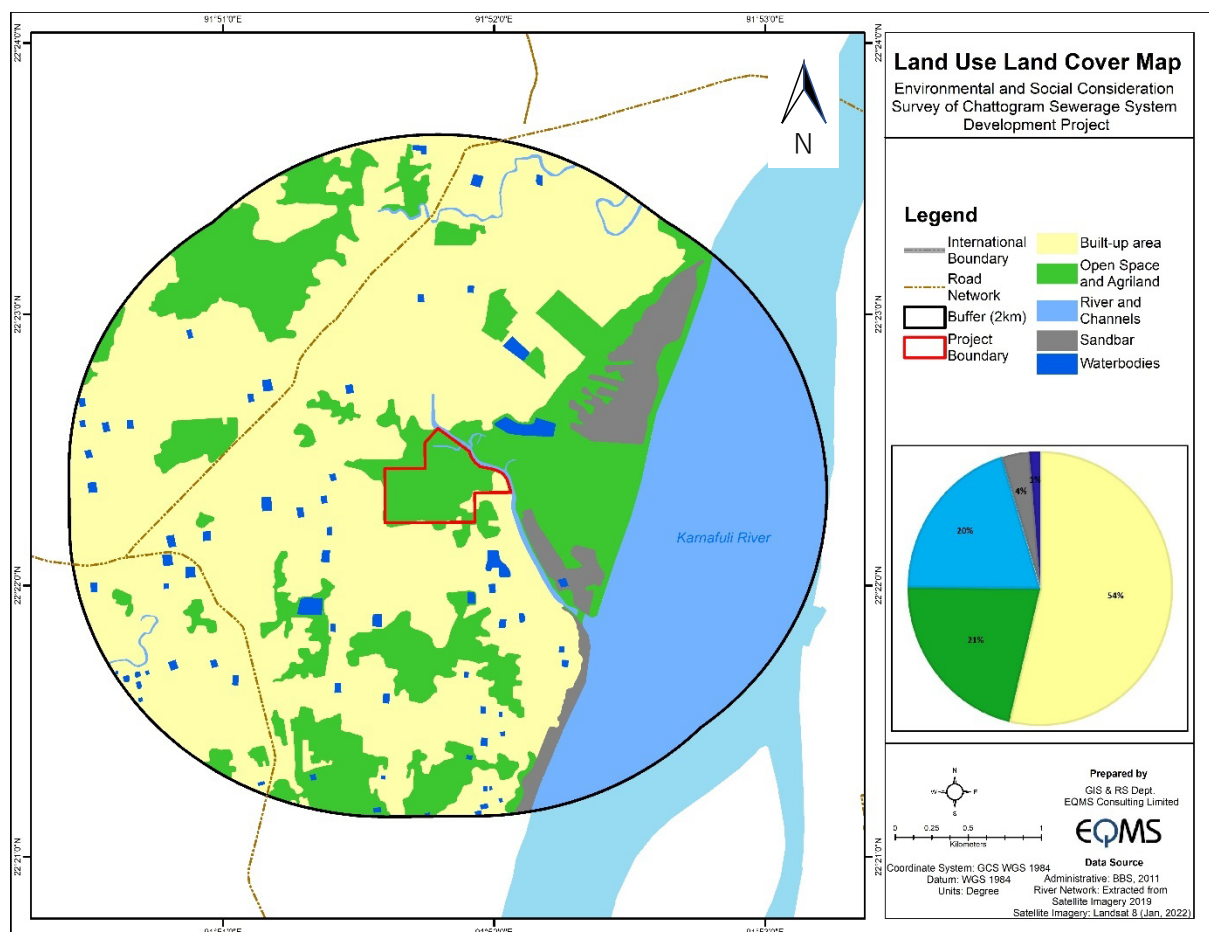
Table 10.2.4 presents the land use scenario of the study area from the statistics prepared for the various land use, and Figure 10.2.10 presents the land use map of study area.

Total land within the 2-km radius is 1756.7 ha. Land use data shows that majority of the area surrounding the proposed project site is built-up area which covers 53.7% of the land within the 2-km radius zone. Open space and agricultural land are about 21.4%, followed by 20.2% river and channels, 3.4% sandbar, and 1.3% waterbodies (pond), respectively. There is no declared forest area but has significant area covered by trees, mostly rural orchard and plantations. At present, the land use of the project site is in open land with grass.

**Table 10.2.4 Land Use of the Study Area**

Classes	2-km Radius Zone	
	Area in ha	Land (%)
Built-up Area	944.5	53.7%
Open Space and Agricultural Land	375.3	21.4%
River and Channels	354.3	20.2%
Sandbar	60.1	3.4%
Water Bodies	22.6	1.3%
Total	1756.7	100.0%

Source: JICA Survey Team based on Google earth imagery analysis



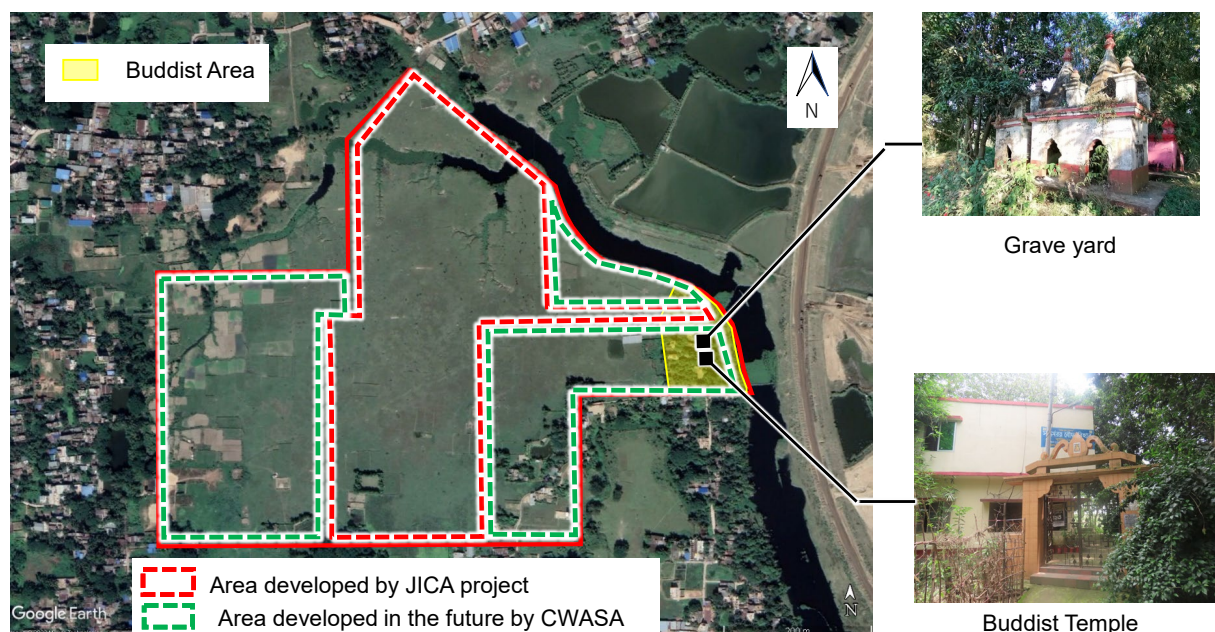
Source: JICA Survey Team based on Google earth imagery analysis

**Figure 10.2.10 Land Use of the Study Area**

### 10.2.11 Ethnic Minorities and Indigenous People

According to the Population and Housing Census 2022 (Preliminary Report), the ethnic minority population in Bangladesh is 1,650,159 people, representing 1.00% of the population. About 990,860 of these indigenous people are in Chattogram, which represents 2.99% of the total city population. This means that 60.05% of the ethnic minorities are in Chattogram. Bangladesh has at least 50 ethnic minorities, with Chakma, Marma, Tripura, Saontal, Oraon, and Garo as the most populous, in that order.

As shown in Figure 10.2.11, a Buddhist community exists on the east side of the treatment plant site, and residents and the existence of temples and cemeteries were also confirmed. In this JICA project, resettlement of this community and removal of temples and cemeteries will be avoided. This project is not expected to cause resettlement, thus there is no impact on ethnic minorities.

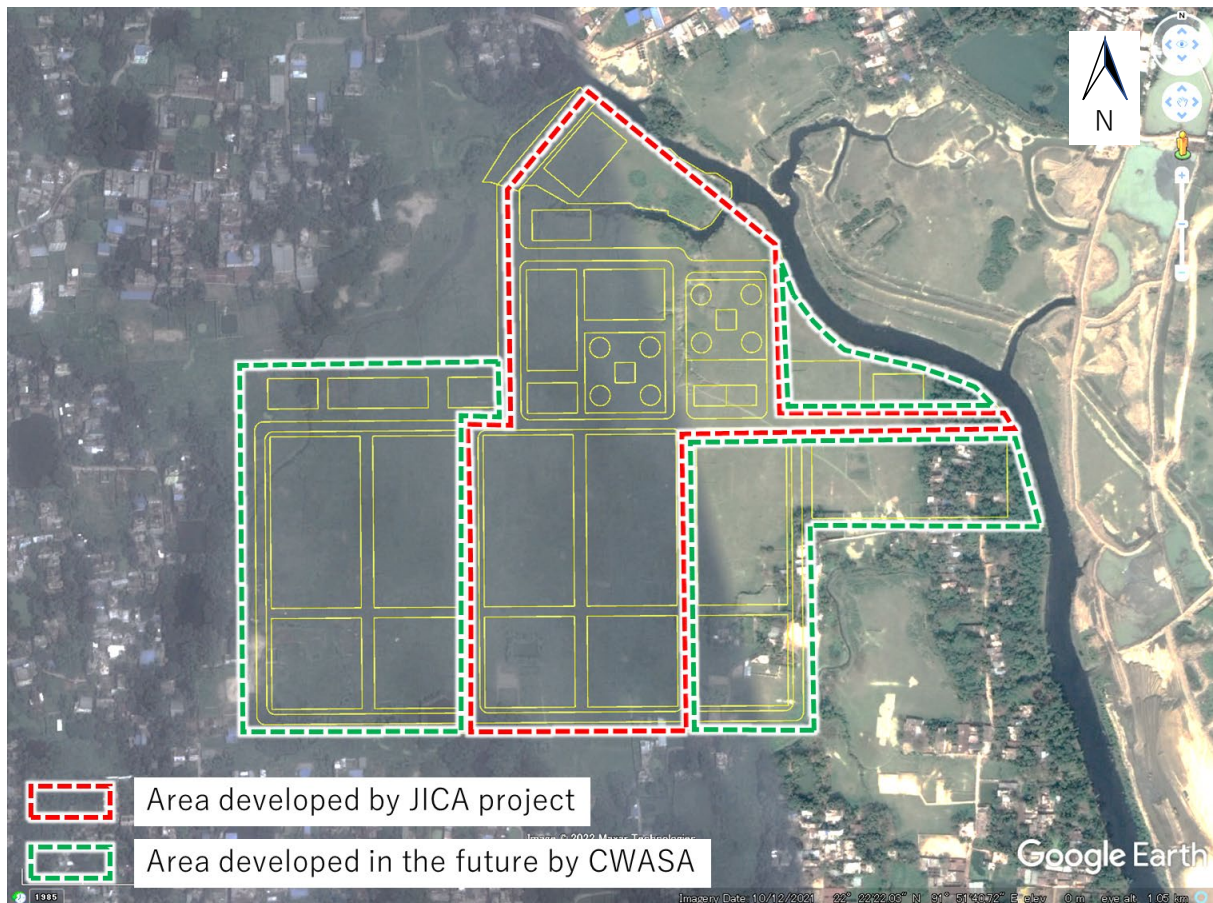


Source: JICA Survey Team

**Figure 10.2.11 Location of Buddhist Community**

### 10.2.12 Land Acquisition and Resettlement

The land for the STP site described in the DPP and total area is 30ha. The land is privately owned and being used as grazing land for buffaloes and cows, and people also live in a part of the land. CWASA will acquire the 30-ha land, thus, people who lives within the project site will require resettlement. However, as shown in Figure 10.2.12, the project site is limited, and resettlement is not required on this project site. Moreover, CWASA intends to acquire land for the site to be used for this project and in the future. Thus, land acquisition and resettlement will be implemented at the same time for the entire land, including for this project by JICA and the future project by CWASA.



Source: JICA Survey Team

**Figure 10.2.12 Target Area and Facilities under This Project**

### 10.3 Institution and Organization for Environmental and Social Considerations in Bangladesh

#### 10.3.1 Environmental Legislation

The environmental legislation in Bangladesh related to the sewerage development project is shown in Table 10.3.1. The only permits and approvals required for environmental and social considerations in Bangladesh are environmental clearance certificates as stipulated in the Environmental Conservation Rules of 1997 (ECR'97), which are issued upon EIA approval.

**Table 10.3.1 Environmental Laws and Key Features**

Act/Rule/Law/ Ordinance	Key Features-Potential Applicability
Bangladesh Environmental Conservation Act, 1995 (ECA, 1995) and Environment	In 1995, the Government of Bangladesh adopted a comprehensive environmental law called the Bangladesh Environment Conservation Act, which provides directions and legal bindings for conservation of the environment, improvement of environmental standards and control and mitigation of environmental pollution. Definition of ecologically critical areas, procedure for environmental clearance, categorization of industries based on pollution level are also stipulated in the Act. The Act also provides

Act/Rule/Law/ Ordinance	Key Features-Potential Applicability
Conservation Rules 2023 (ECR, 2023)	<p>the standards for management of water, air and soil and defines certain environmental damages and offenses and prescribes punishment for them.</p> <p>The Environment Conservation Rules (ECR), which was adopted in 1997, provided detail guidelines for the implementation of the Act of 1995. However ECR1997 was replaced by ECR2023 in 2023. The Rules categorized all the industries and development projects in different categories for the purpose of obtaining Environmental Clearance Certificate and Environmental Impact Assessment (EIA).</p>
Noise Pollution Control Rules 2006	Categorization of area based on maximum allowable noise level, Standards of maximum allowable noise level in different areas, and allowable noise from vehicles
Environmental Court Act 2000	Environment Court Act 2000 (amended in 2010) established the environmental courts at the district levels and defines the jurisdiction of the courts and nature of offenses and punishments. However, monitoring and compliance mechanisms remain very weak in the basic environmental regulatory regime due to the lack of comprehensive legislative approaches and inadequate institutional structures in particular for mitigation and management of environmental damage and also for addressing the environmental damages.
National Water Policy 1999	National Water Policy intends to ensure protection, restoration, and preservation of natural habitats, particularly wetlands, mangroves and other forests, and endangered species that depend on them
Water Act 2013	This Bangladesh Water Act, consisting of seven chapters, provides the right to water when it is used for the purposes of drinking, sanitation and sewage disposal, water control, protection and conservation of water resources. In addition, it regulates land ownership requirements, surface water, etc. that are subject to the provisions of this Act. The Executive Committee may, for preventing the wastage and misuse of water, and for protection and conservation thereof, issue a protection order to the owner of such private land without discrimination.
National Water Rules 2018	Bangladesh Water Rules was prepared and finalized following Bangladesh Water Act, 2013. The Water Resources Planning Organization (WARPO) of the Ministry of Water Resources has taken the lead coordination role to implement the Act and has organized several consultations with relevant sector actors. The Act prescribes the rights for water use, international and regional cooperation in water-related matters, national water policy, implementation of the policy, removal of illegal structures on water bodies, inspection and monitoring, procedures for obtaining clearance certificates for projects related to water infrastructures, establishment of different committees for evaluating projects for providing clearance certificates, structure, roles and responsibilities of the committees It also regulates the areas of water-related crisis and their management, no objection certificate (NOC) for project use of groundwater, management of natural water flows of water bodies, water storage prohibition, flood control area declaration procedure, water resources protection order, and penalties for violation.

Act/Rule/Law/ Ordinance	Key Features-Potential Applicability
Bangladesh Climate Change Strategy and Action Plan (2008)	The Government of Bangladesh's Vision is to eradicate poverty and achieve economic and social well-being for all the people. This will be achieved through a pro-poor Climate Change Strategy, which prioritizes adaptation and disaster risk reduction, and also addresses low carbon development, mitigation, technology transfer and the provision of adequate finance. It has six strategic pillars for action, including: (1) food security, social protection, and health, (2) disaster management, (3) protective infrastructure, (4) research and knowledge management, (5) decreased carbon development, and (6) capacity building and institutional strengthening.
Bangladesh Biodiversity Act 2017	This Act purports to protect biodiversity of Bangladesh and advocates sustainable uses of biodiversity resources, advocates to ensure proper distribution of benefits from bio-resources and knowledge of its uses.
National Land Use Policy 2001	This policy advocates optimum uses of land and water, planned use of land and water resources and natural environment, integrating the uses of three natural resources for optimum results and prevents land depletion.
National Fisheries Policy 1998	This policy includes the maintaining biodiversity in all-natural water bodies and in marine environment, ensuring that chemicals harmful to the environment will not be used in fish shrimp farms, It also promotes using environment friendly fish shrimp culture technology, expanding fisheries areas and integrating rice, fish and shrimp cultivation, undertaking control measures against the activities that have a negative impact on fisheries resources and vice-versa, and formulating laws to ban the disposal of any untreated industrial effluents into the water bodies
EIA Guidelines for Industries 2021	DoE (Department of Environment) published the EIA Guidelines for Industries in 1997 outlining simpler procedure to be followed for preparing EIA and their review. However, DoE considered it desirable to revise that book of guidelines by taking into account the present environmental status as well as the need for rapid economic development of Bangladesh. These considerations had essentially been kept in view while revising the handbook of general EIA Guidelines for Industries.

Source: JICA Survey Team

### 10.3.2 Social Legislation

Table 10.3.2 shows the outline of the social legislation in Bangladesh relating to the sewerage development project.

**Table 10.3.2 Social Legislations Relating to the Project**

Act/Rule/Law/ Ordinance	Key Features-Potential Applicability
Acquisition and Requisition of Immovable	The Government of Bangladesh promulgated and enacted new acquisition law titled "The Acquisition and Requisition of Immovable Property Act (2017)" replacing the 1982 ordinance II. The new law made some amendments in the determination of property



Act/Rule/Law/ Ordinance	Key Features-Potential Applicability
Properties Act (ARIPA), 2017	value fixation. According to this new law for land, an additional 200 percent compensation on the market rate if any land is acquired for the government project and the compensation will be an additional 300 percent if the land is for any non-governmental organization. This law also provides affected persons additional 100% for structures, trees, crops and other assets, and has provisions for resettlement of those who will be displaced from their homestead with living structures due to the project.
The Transfer of Property Act of 1882 (Act No. IV of 1882)	The Act relates to transfer of properties. It came into force on the first day of July 1982. The Act defined any transaction relating to immovable property is required by law to be and has been affected by registered instruments. According to the Act No. IV of 1882 donors can transfer his/their property for the benefit of the public in the advancement of religion, knowledge, commerce, health, safety, or any other object beneficial to mankind and the transfer must be enforced by registration.
Property Emergency Acquisition Act, 1989	The Act was formulated to expedite the emergency acquisition of land to enable the Government 'to control inundation, flood and upsurge caused by natural calamity and to prevent river erosion. Use of this Act to acquire land for development would require extremely compelling reasons.
The East Bengal State Acquisition and Tenancy Act, 1950 (Revised 1994)	The State Acquisition and Tenancy Act defines the law relating to the tenancies to be held under the State. The Act provides stipulations for the acquisition by the state of the interest of rent received and certain other interests in Bangladesh. This act mainly contains land to be retained in the possession of rent-receivers, cultivating raiyats, cultivating under raiyats and non-agricultural tenants, acquisition of the interest of certain rent-receiver and their consequence, and preparation of record of rights.
Hats and Bazaars (Establishment)and acquisition Ordinance,1959;	An ordinance to control the establishment of hats and bazaars and acquire certain hats and bazaars already established. This Act stipulates that no person shall establish any hat or bazaar in Bangladesh, discusses the power of the government to acquire hats and bazaars and determinations of compensation, interpretation, and rulemaking power.
National Land Transport Policy (NLTP), 2004	The government approved the NLTP in April 2004, which established a transport sector coordination wing under the planning commission to introduce the concept of long-term network planning in economic activities and integration of transport policy, planning, and appraisal across land transport modes. The objective is to provide a safe and dependable transport system, removal of unnecessary controls and formulations of laws and regulations, fare control, maintenance of an economic activity and environmental balance, determination of the roles of the Government sector and private sector, ensuring of maximum good utilization of government funds, poverty alleviation, reduction of transport cost and creating awareness regarding better standard of life and safety, among others.
Agricultural Khas Land Management and Settlement Policy, Bangladesh, 1997	The Government of Bangladesh under the Ministry of Land adopted a new Agricultural Khas Land Management and Settlement Policy, in April 1997. The Agricultural Khas Land Settlement process passes through several stages and ends with handing over possession along with Khatian and title deed. The policy has given priority to the

Act/Rule/Law/ Ordinance	Key Features-Potential Applicability
	women's ownership over the settled land and the land title document is prepared both in the name of husband and wife. Widows are getting priority in the Khas land settlement.
National Land Use Policy,2001	The National Land Use Policy was enacted in 2001, aimed at managing land use effectively to support trends in accelerated urbanization, industrialization, and diversification of development activities. The policy urges that increasing the land area of the country may be not possible through the artificial land reclamation process, which is cost-effective only in the long run. Major contents of this policy include: <ol style="list-style-type: none"> <li>1. Stopping the high conversion of agricultural land to non-agricultural land</li> <li>2. Utilizing agro-ecological zones (land zoning based on agricultural and ecological characteristics) to determine maximum land use efficiency</li> <li>3. Adopting measures to discourage the conversion of agricultural land for under development purposes</li> <li>4. Improving the environmental sustainability of land use practices</li> </ol>
National Land Use Policy,2011	The main objectives of the 'National Land Use Policy 2011' are criteria-based uses of land, providing guidelines for usage of land for the purpose of agriculture (Crop production, fish cultivation, and rearing of ducks and chickens), housing, afforestation, commercial and industrial establishments and providing guidance.
The Chittagong Hill Tracts Regulation ,1900	This regulation came into force on May 1, 1900 (Regulation I of 1900) is the regulatory framework for State sovereignty over the traditional rights of the adibasis living in the Chittagong Hill Tracts (CHTs) region. This Regulation has recognized the traditional customs and social laws of the tribes and ensured social security by recognizing the rights of the indigenous peoples to their lands. This Act purports to protect biodiversity of Bangladesh and advocates sustainable uses of biodiversity resources, advocates to ensure proper distribution of benefits from bio-resources and knowledge of its uses
The Forest Act, 1927 (Act XVI of 1927)	The Act was revised as of 2000 and deals with reserved forest, village forest, protected forest, control over forests on lands not being the property of the government. The Act also includes details on the duty on timber and other forest products in transit, collection of drift and stranded timber, penalties and procedure, cattle trespass, forest officers, subsidiary rules, and other miscellaneous items.
The Chittagong Hill –Tracts (Land Acquisition) Regulation, 1958	This regulation was established on the 25th day of June 1958, under Article 193 of the Constitution of the Islamic Republic of Pakistan. This regulation's main focus point is that when any land on valid title, which does not resemble under The Chittagong Hill Tracts Regulation ,1900 or rules made thereunder, is required for any public purpose, the deputy commissioner may acquire such land by an order in writing.
The CHT Regional Council Act, 1998	The National Parliament of Bangladesh on 24 May 1998 passed the Peach Accord 1997 as the —Chittagong Hill Tracts Regional Council Act, 1998 (Act 12 of 1998). In addition to re- establishing peace, the Accord recognized the ethnic people ‘s right to land, culture, language, and religion.

Source: JICA Survey Team

### 10.3.3 Environmental Standards

#### (1) Air Quality

Environmental standard of air quality is shown in Table 10.3.3

**Table 10.3.3 Environmental Standard of Air Quality**

Parameter	Bangladesh	
	24hourly (µg/m3)	Annual(µg/m3)
SPM*	200	-
PM10	150	50
PM2.5	65	15
SO2	365	80
NOx	-	100
CO*	10,000 (8 hours) 40,000 (1 hour)	-
Pb	-	0.5
Ozone	235 (1 hours) 157 (8 hours)	-

Notes: CO and SPM concentrations and standards are 8-hourly only.

Source: The Bangladesh National Ambient Air Quality Standards have been taken from the Environmental Conservation Rules, 1997 which was amended on 19th August 2005 vide S.R.O. No.220-Law/2005.

#### (2) Surface Water Quality

Environmental standard of air quality is shown in Table 10.3.4. Water quality of Karbaphuli river meets the standard value of d) Water usable by fisheries.

**Table 10.3.4 Environmental Standard of Surface Water Quality**

*	pH	DO mg/l	BOD mg/l	NO3-N mg/l	NH4-N mg/l	PO4 <sup>3-</sup> -P mg/l	Total Cr mg/l	Pb mg/l	Hg mg/l	Total Coli. (CFU/100ml)	TDS mg/l	COD mg/l
a	6.5 – 8.5	≥6	≤2	7.0	0.1	0.1	0.02	0.03	0.001	≤100	1000	10
b	6.5 – 8.5	≥5	≤3	7.0	0.3	0.5	0.2	0.05	0.001	≤50	1000	10
c	6-9	≥5	≤3	7.0	0.3	0.5	0.02	0.03	0.001	≤5000	1000	25
d	6-9	≥5	≤6	7.0	0.3	0.5	0.05	0.1	0.004	≤5000	1000	50
e	6.5 – 8.5	≥1	≤12	-	2.7	-	0.1	0.1	0.05	-	1000	100
f	6.5 – 8.5	-	≤12	5.0	1.5	2.0	0.1	0.1	0.002	≤50,000	1000	100

Note: Type of use is as follows:

- \*a) Source of drinking water for supply only after disinfecting;
- \*b) Water usable for recreational activity;
- \*c) Source of drinking water for supply after conventional treatment;
- \*d) Water usable by fisheries;
- \*e) Water usable by various process and cooling industries;
- \*f) Water usable for irrigation;

Source: ECR2023

### (3) Noise

Environmental standard of noise is shown in Table 10.3.5.

**Table 10.3.5 Environmental Standard of Noise**

Category of Area/ Receptor	Day (dB)	Night (dB)
Silent Zone	45	35
Residential Area	55	45
Mixed Area	60	50
Commercial Area	70	60
Industrial Area	75	70

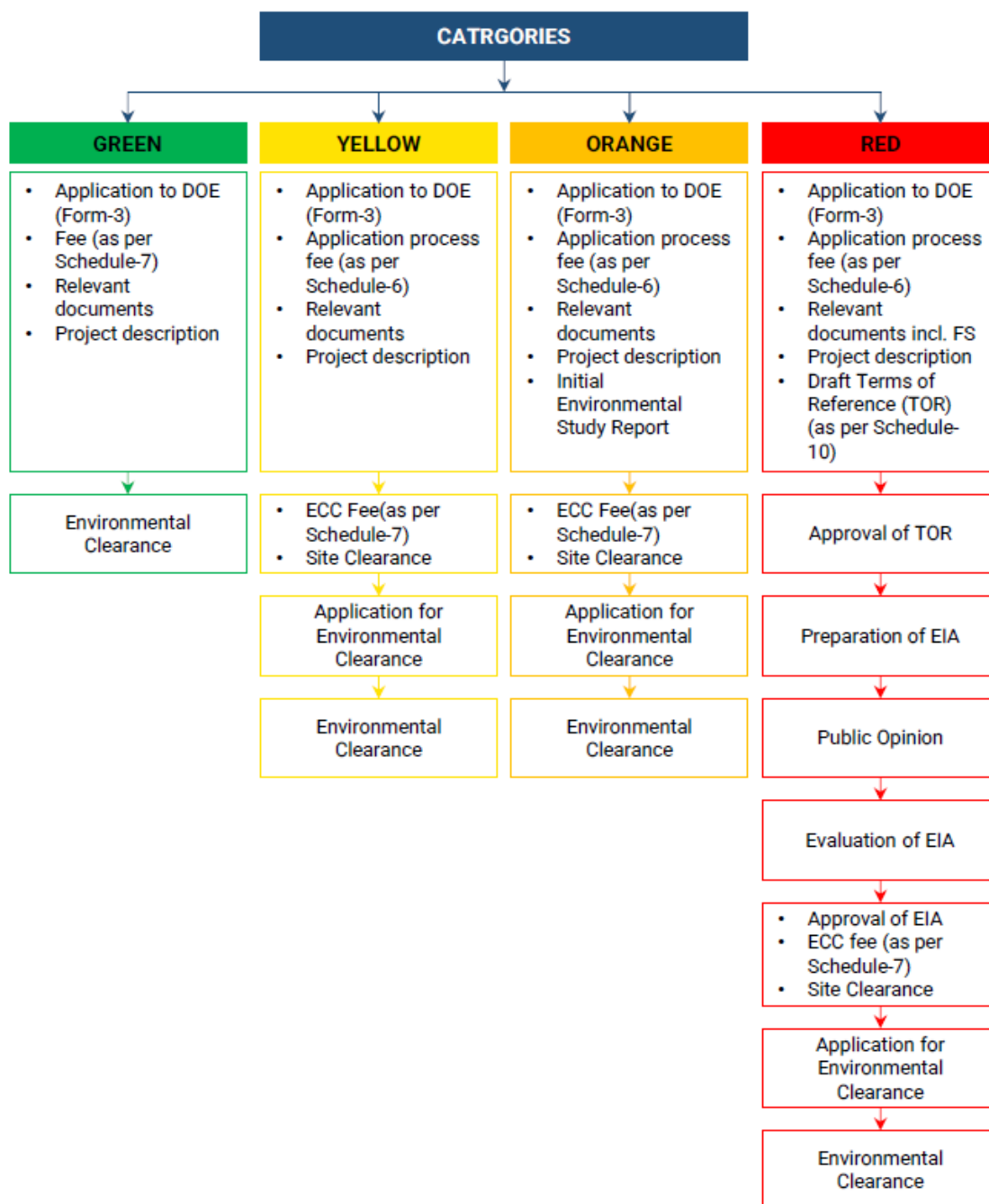
Source: The Bangladesh National Ambient Noise Standards have been taken from Schedule 4 (Standards for Sound) of the Environmental Conservation Rules, 1997 amended October 7, 2006.

#### 10.3.4 EIA System

ECR2023 describes the EIA system by detailing the procedures for obtaining an Environmental Clearance Certificate (ECC). It categorizes the industries into four types. Green, Yellow, Orange and Red. Schedule-1 of the ECR2023 lists the industries as per above categories. Only the Red category project is required to conduct EIA study as a high impact project. The EIA in Bangladesh has been undertaken following a systematic process that predicts and evaluates impacts of a project covering the aspects of the physical, biological, social/socio-economic, and cultural environment. Further, the project shall identify measures to avoid, minimize/reduce, mitigate, offset or compensate for adverse impacts; and enhance positive impacts where practicable. The EIA methodology follows the overall impact assessment approach illustrated in Figure 10.3.1. 30 working days for TOR approval, 45 working days for collecting public comments (after disclosure of draft EIA report), 30 working days for EIA report review (after EIA report submission), and 30 working days for issuance of EIA clearance (after application) are regulated.

According to the Schedule -1 of ECR2023, the sewerage treatment project is categorized under the Red group. Thus, EIA study is necessary. The project proponent should get the EIA approval before the construction work.

ECR 1997 has been revised to ECR 2023 on March 5, 2023, new gaps with the JICA Guidelines for Environmental and Social Considerations have not been identified. Details are described in 10.3.5.



Source: EQMS

**Figure 10.3.1 Procedure of the EIA Study in Bangladesh**

### 10.3.5 Gap Analysis between National Laws and JICA Guidelines

There is gap between guidelines for environmental and social considerations of JICA (JICA Guidelines) and environmental law in Bangladesh. Table 10.3.6 and Table 10.3.7 shows the outline of gaps.

**Table 10.3.6 Gap Analysis between JICA Guideline and Bangladesh Law (Environmental)**

<b>JICA Guidelines for Environmental and Social considerations 2010</b>	<b>Relevant law in Bangladesh (ECA'95, ECR2023 and EIA Guideline for Industries)</b>	<b>Gap between JICA Guidelines and Government Law/ Actions to be taken</b>
<p>&lt; Underlying principles &gt;</p> <p>1. Environmental impacts that may be caused by projects must be assessed and examined in the earliest possible planning stage. Alternatives or mitigation measures to avoid or minimize adverse impacts must be examined and incorporated into the project plan.</p>	<p>1. As per ECA 1995, “No industrial unit or project shall be established or undertaken without obtaining, in the manner prescribed by rules, an Environmental Clearance Certificate from the Director General.” In addition, ECR 2023 classifies projects into four categories based on the degree of pollution, environmental and human hazards, and requires that environmental permits be obtained and that mitigation measures be taken to avoid impacts for projects in any of the categories.</p>	<p>Though ECA 1995 and ECR 1997 does not explain in detail regarding basic principle of environmental safeguard, by virtue of requiring IEE/ EIA (depending on intervention type), in principle the target and objectives are similar to the JICA guideline.</p> <p>There is no gap.</p>
<p>&lt; Disclosure of information &gt;</p> <p>1. EIA reports (which may be referred to differently in different systems) must be written in the official language or in a language widely used in the country in which the project is to be implemented. When explaining projects to local residents, written materials must be provided in a language and form understandable to them.</p> <p>2. EIA reports are required to be made available to the local residents of the country in which the project is to be implemented. The EIA reports are required to be available at all times for perusal by project stakeholders such as local residents and copying must be permitted;</p>	<p>1. There is no prescription of language which is used on EIA report in ECR2023. However, EIA guidelines mention “The EIA document is written in clear, understandable language, with technical issues presented in a manner that allows novices to understand” ECR 2023 stipulates the submission of a Bengali summary of the EIA report in the stakeholder consultation process.</p> <p>ECR 2023 stipulates that approved EIAs shall be made publicly available on the web, and the EIA Guidelines also mention the disclosure of information in libraries, government offices, and online, as well as public access to EIA documents.</p>	<p>In EIA guideline prescribe using understandable language and public accessibility. In ECR2023, disclosure of approved EIA on the web site is required.</p> <p>There is no gap.</p>
<p>&lt; Social acceptability &gt;</p> <p>1. For projects with a potentially large environmental impact, sufficient consultations with local stakeholders, such as local residents, must be conducted via disclosure of information at an early stage, at which time alternatives for project plans may be examined. The outcome of such consultations must be incorporated into the contents of project plans.</p>	<p>1. There is prescription of implementation of public consultation for EIA report in ECR2023. EIA guideline says that information about the proposed project can be provided very early in the planning stage and continued throughout the project planning, design and implementation stages.</p> <p>2. The public consultation for the EIA report is not clearly prescribed in ECR2023. However, EIA guidelines mention to</p>	<p>Implementation of the stakeholder consultation is prescribed in ECR2023. EIA guideline mentions to secure the social accessibility of the project information.</p> <p>There is no gap.</p>

<b>JICA Guidelines for Environmental and Social considerations 2010</b>	<b>Relevant law in Bangladesh (ECA'95, ECR2023 and EIA Guideline for Industries)</b>	<b>Gap between JICA Guidelines and Government Law/ Actions to be taken</b>
<p>2. In preparing EIA reports, consultations with stakeholders, such as local residents, must take place after sufficient information has been disclosed. Records of such consultations must be prepared.</p> <p>3. Consultations with relevant stakeholders, such as local residents, should take place, if necessary, throughout the preparation and implementation stages of a project. Holding consultations is highly desirable, especially when the items to be considered in the EIA are being selected, and when the draft report is being prepared.</p>	<p>“Communicate in a manner (preferably in the local language or dialect) that would enable all to understand what one wants to say.” for public briefing.</p> <p>3. The public consultation for the EIA report is not clearly prescribed in ECR2023. However, EIA guideline says that information about the proposed project can be provided very early in the planning stage and continued throughout the project planning, design, and implementation stages.</p>	
<p>&lt; Scope of impacts to Be Assessed &gt;</p> <p>1. The impacts to be assessed with regard to environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. These also include social impacts, including migration of population and involuntary resettlement, local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children’s rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety.</p> <p>2. In addition to the direct and immediate impacts of projects, their derivative, secondary, and cumulative impacts as well as the impacts of projects that are indivisible from the project are</p>	<p>1. Scope of impacts are not mentioned in ECA'95 or ECR2023. However, the scoping methodology is mentioned in the EIA guideline.</p> <p>2. There are no provisions about derivative and secondary impact assessment for the EIA study in ECR2023. However, the Cumulative impact assessment and project life cycle are mentioned in EIA guidelines.</p>	<p>There is a small gap.</p> <p>Since there are no provisions in ECR'97 regarding the scope of impacts, consequential impacts or secondary impact assessment, the consideration of impact study items based on the JICA Guidelines should be needed.</p>

<b>JICA Guidelines for Environmental and Social considerations 2010</b>	<b>Relevant law in Bangladesh (ECA'95, ECR2023 and EIA Guideline for Industries)</b>	<b>Gap between JICA Guidelines and Government Law/ Actions to be taken</b>
also to be examined and assessed to a reasonable extent. It is also desirable that the impacts that can occur at any time throughout the project cycle should be considered throughout the life cycle of the project.		
<p>&lt; Monitoring &gt;</p> <p>1. Project proponents should make efforts to make the results of the monitoring process available to local project stakeholders.</p> <p>2. When third parties point out, in concrete terms, that environmental and social considerations are not being fully undertaken, forums for discussion and examination of countermeasures are established based on sufficient information disclosure, including stakeholders' participation in relevant projects. Project proponents should make efforts to reach an agreement on procedures to be adopted with a view to resolving problems.</p>	<p>1. The monitoring process is not clearly prescribed in ECR2023. However, the monitoring program is mentioned in EIA guideline.</p> <p>2. There is no provision about the actions to be taken to solve environmental or social impact during construction and operation in ECR 2023. However, EIA guideline mention about Environmental auditing. Environmental auditing is applied as a post-EIA evaluation process to determine the effectiveness and performance of the proposed mitigation measures. Emphasis is given on interpretation, focusing on the factors of performance with the objective to identify how the aspects, processes or systems under review can be improved. This process can be undertaken during and/ or after project construction and requires review of surveillance reports and monitoring data.</p>	There is no gap.
<p>&lt; Ecosystem and biota &gt;</p> <p>1. Projects must not involve significant conversion or significant degradation of critical natural habitats and critical forests.</p>	<p>1. EIA guideline says that the long-term objectives of EIA are to safeguard valued resources, natural areas and ecosystem components.</p>	There is no gap.

Source: JICA Survey Team



Table 10.3.7 Gap Analysis between JICA Guideline and Bangladesh Law (Social)

Sl.	JICA Environmental Guidelines (2022)	GOB's Acquisition and Requisition of Immovable Property Act (ARIPA) 2017	Gaps Between ARIPA and JICA's Policies and Action Taken to Bridge the Gap	Proposed Gap Filling Measures
1	Involuntary resettlement should be avoided wherever possible	Not specified	The legislated 2017 Act did not specify measures for resettlement, while the JICA Environmental Guidelines requires to avoid/minimize resettlement and loss of livelihood	The approach of avoiding involuntary resettlement shall be taken care during preparing this project. This will be further practiced during detailed design stage.
2.	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken.	Not specified for non-titled people.	There are no provisions for compensation to the non-titled residents in Bangladesh Act, While JICA Environmental Guidelines acknowledge all affected persons whether legally residing or not, eligible for compensation	Compensations are proposed even if non-titled affected people providing: <ul style="list-style-type: none"> <li>- Compensation for structures, trees</li> <li>- Structure transfer assistance</li> <li>- Structure reconstruction assistance</li> <li>- Moving assistance for residential house owner</li> <li>- Tenant moving allowance</li> </ul>
3.	People who must be settled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.	Not specific for keeping living standard of affected people same or above pre-project levels.	There are no provisions for maintaining living standard of affected people at same or above pre-project levels in Bangladesh Act, while JICA Environmental Guidelines require that no one is worse off as a result of resettlement and would maintain their living level at least original levels.	Usually, additional assistance can be proposed in the form of: <ul style="list-style-type: none"> <li>- Grant for business loss</li> <li>- Compensation for loss of plant and fish-stock</li> <li>- Grant for loss of wage employment</li> <li>- Rental fee loss for displaced rented house owner</li> <li>- One time moving assistance for tenant business owner</li> <li>- Introduction of micro-credit</li> <li>- Provision of job training</li> <li>- Provision of priority employment etc.</li> </ul>

Sl.	JICA Environmental Guidelines (2022)	GOB's Acquisition and Requisition of Immovable Property Act (ARIPA) 2017	Gaps Between ARIPA and JICA's Policies and Action Taken to Bridge the Gap	Proposed Gap Filling Measures
4.	Compensation must be based on the full replacement cost as much as possible.	Compensation is made based on the pre-determined Government prices as are usually quite cheaper than market price.	Compensation is made based on the pre-determined government prices that are usually lower than replacement cost.	The resettlement plan addresses all these issues and spells out a mechanism to fix the replacement cost by having an independent evaluator (committee) who will be responsible for deciding the replacement costs.
5.	Compensation and other kinds of assistance must be provided prior to displacement compensation and other kinds of assistance must be provided prior to displacement.	Payment is made on predetermined time, regardless before or after the construction starts.	Compensation and other assistance are made regardless before or after construction, while JICA Environmental Guidelines require making it prior to relocation.	The resettlement plan addresses all these issues and spells out a mechanism for all the compensation will be paid prior to possession of the acquired land / prior to displacement.
6.	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public	There is no provision for the formulation of RAP and public hearing. The Deputy Commissioner contacts the landowner through Land Acquisition Officer (LO), and if landowner has no objection, confirm operation for compensation amount etc. will be proceeded.	There is no provision for preparation of resettlement action plan that describes all features of resettlement requirements and ready to disclose to public.	The Resettlement Action Plan (RAP) needs to be prepared for with all features of resettlement requirements and mechanism of disclosure to the public is integral part of RAP. This will be further practiced during design and implementation stages
7.	In preparing a Resettlement Action Plan (RAP), consultations must be held with the affected people and their communities based on sufficient information made available to them in advance.	The 2017 Act have provisions to notify only the owners of property to be acquired.	There is no provision in the law for consulting the stakeholders but the land allocation committees at district, division, and central government level.	The RAP for the project has been prepared following a consultation process which involves all stakeholders (affected persons, government department/line agencies, local community, NGO, etc.) and the consultation will be a continuous process at all stages of the project development such as project formulation, feasibility study, design,

Sl.	JICA Environmental Guidelines (2022)	GOB's Acquisition and Requisition of Immovable Property Act (ARIPA) 2017	Gaps Between ARIPA and JICA's Policies and Action Taken to Bridge the Gap	Proposed Gap Filling Measures
				implementation, and post-implementation, including the monitoring phase.
8.	When consultations are held, explanation must be given in a form, manner, and language that are understandable to the affected people	There are no provisions	Requirements of JICA Environmental Guidelines are not specifically mentioned in the Bangladesh laws and rules	The resettlement plan for the project has been prepared following a consultation process with all stakeholders in local language and by following participatory process with question and explanation on the components of the RAP through participation of all the stakeholders representing different groups and the consultation will be a continuous process at all stages of the project development such as project formulation, feasibility study, design, implementation, and post-implementation, including the monitoring phase.
9.	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.	There is no provision for the monitoring related activities with the participation of affected people	There are no provisions in Bangladesh Acts, while JICA Environmental Guidelines recommend a participation of affected people in planning, implementation and monitoring of RAP	The resettlement plan for the project has been prepared following a consultation process with all stakeholders and the consultation will be a continuous process at all stages of the project development such as project formulation, feasibility study, design, implementation, and post-implementation, including the monitoring phase.
10.	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.	PAPs have the right to objection to compensation amount. The PAP should protest and entrust the matter to the Arbitrator if the AP has to appeal against compensation amount.	The laws of Bangladesh states appeal to Arbitrator and court case, while JICA Environmental Guidelines recommend establishing appropriate grievance redress.	The RAP has made a provision of setting up of grievance redress mechanism accessible for all the affected people including non-titled affected people.

Sl.	JICA Environmental Guidelines (2022)	GOB's Acquisition and Requisition of Immovable Property Act (ARIPA) 2017	Gaps Between ARIPA and JICA's Policies and Action Taken to Bridge the Gap	Proposed Gap Filling Measures
11.	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socio-economic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advantage of such benefit.	No such an activity required	There is no provision in Bangladesh Acts, while JICA Environmental Guidelines recommend identification of affected people there in least possible time preferably at the project identification stage.	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socio-economic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advantage of such benefit.
12.	Eligibility of benefits includes the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who do not have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying	There is no provision.	Requirements of the JICA Environmental Guidelines are not specifically mentioned in the Bangladesh laws and rules.	The RAP ensures the compensation and assistance to all affected persons, whether physically displaced or economically displaced, irrespective of their legal status. The end of the census survey will be considered as the cut-off date, and affected persons listed before the cut-off date will be eligible for assistance.
13.	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based.	There is no provision.	Requirements of the JICA Environmental Guideline are not specifically mentioned in the Bangladesh laws and rules.	Though this option may be a difficult proposition given the lack of government lands and the difficulties associated with the acquisition of private lands, the RAP proposes land-for-land compensation as its priority, if feasible. Attempt will be made to find alternate land for the loss of land, in case it is available and if it is feasible, looking at the concurrence of host community and land value.

Sl.	JICA Environmental Guidelines (2022)	GOB's Acquisition and Requisition of Immovable Property Act (ARIPA) 2017	Gaps Between ARIPA and JICA's Policies and Action Taken to Bridge the Gap	Proposed Gap Filling Measures
14.	Provide support for the transition period (between displacement and livelihood restoration)	There is no provision for support for the transition period.	There is no provision in Bangladesh Acts, while JICA Environmental Guidelines require providing support for the transition period.	Following are provided in the RAP: - Moving assistance for residential house owners - Tenant moving allowance
15.	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc.	There is no provision for either acknowledgment of or compensation to vulnerable groups.	There is no provision in Bangladesh Acts, while JICA Environmental Guidelines require providing special attention to vulnerable people and groups.	Vulnerable allowances were proposed to poor old, disabled and female headed households such as: Special Assistance for Vulnerable households
16.	For project that entails land acquisition or involuntary resettlement of more than 200 people RAP is to be prepared.	There is no provision.	Requirements of JICA Environmental Guidelines are not specifically mentioned in the Bangladesh laws and rules.	Under the JICA project, involuntary resettlement is not required because the location of STP facilities is designed to avoid resettlement.

Source: JICA Survey Team

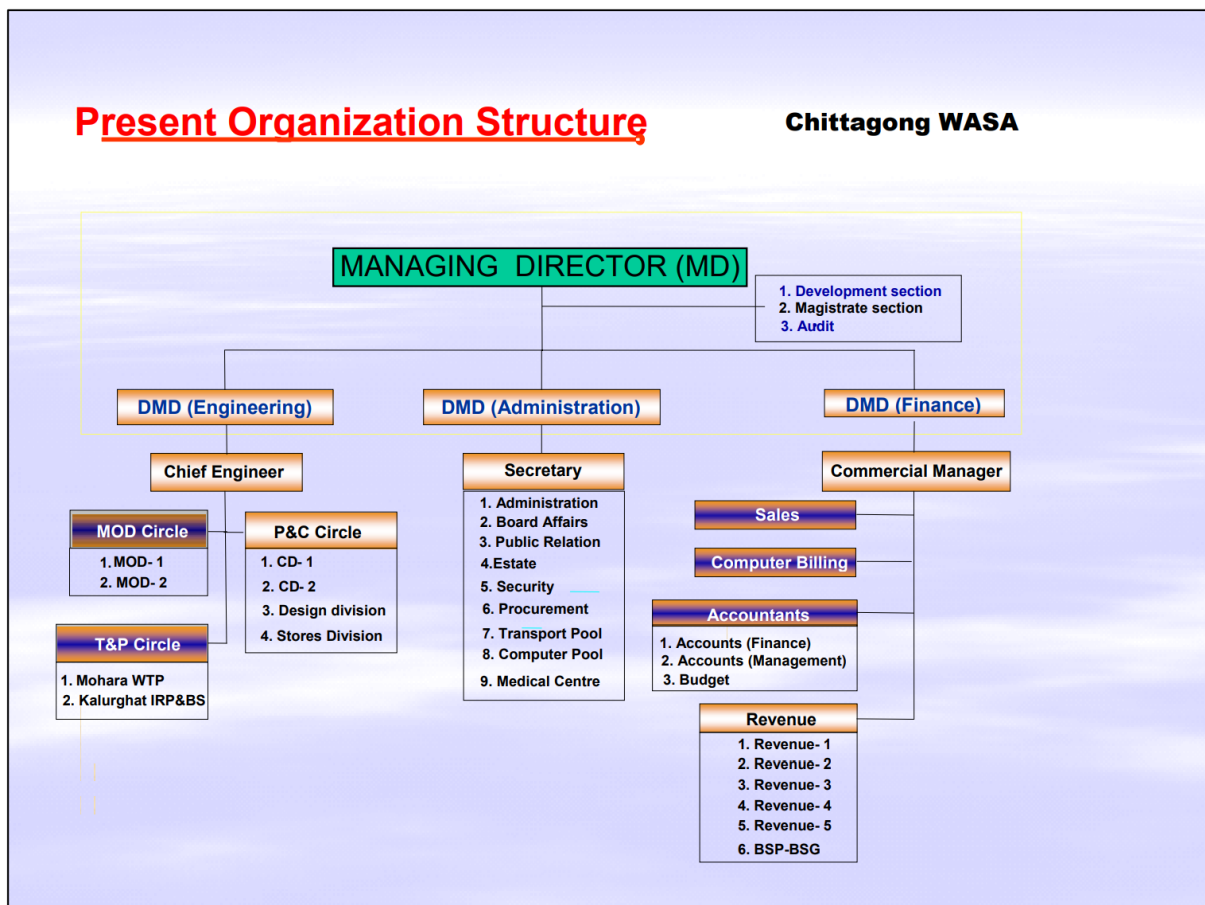
### 10.3.6 Policy on Land Acquisition and Resettlement

The resettlement policy based on the JICA Guidelines for Environmental and Social Considerations (April 2010) and the policy for land acquisition and resettlement in this project are shown in Attachment 10-1. Note that resettlement is not expected to occur in this project, and the policy on resettlement is for reference only.

### 10.3.7 Related Organizations

#### (1) CWASA

CWASA is the project proponent of the project. The organization structure is shown in Figure 10.3.2. CWASA was first established in 1963, by Ordinance No.19 of the erstwhile government of East Pakistan, to have overall responsibility for the operation and management of the water supply and sanitation services to the City of Chattogram and its designated suburban areas. Government of Bangladesh enacted the WASA Act in 1996 and autonomy (rights to operate a business) was given and management and organization improvement were promoted. The Act was applied to CWASA in 2008 and management board of CWASA is established in 2012. As of now, the Authority is charged with the responsibility of providing water supply and preparing providing sewer service of Chittagong City.



Source: Strategic Plan 2015-2020

Figure 10.3.2 Organization Structure of CWASA

**(2) DOE**

The responsible authority for the EIA is the Department of Environment (DOE). The DOE was established in 1989 and is the executing agency for planning and implementing environmental issues including, but not limited to, the following activities:

- Issuing and improving environmental laws and standards
- Reviewing environmental impact assessments and issuing environmental clearance where appropriate;
- Undertaking safety measures and determination of remedial measures to prevent environmental degradation and pollution;
- Issuing Environment Clearance Certificate (ECC) and controlling, preventing and regulating industrial pollution affecting the environment;
- Conducting inquiries on pollution of the environment and rendering direction, guidance and assistance to any other authority or organization regarding those matters;
- Implementing environmental monitoring programs and enforcement measures;
- Developing and maintaining environmental data bases, and
- Coordinating international events with the MoEF (e.g., representing Bangladesh in the meetings of various multi-lateral environmental agreements, international seminars, workshops, etc.).

## 10.4 Comparison of the Alternatives (Including “Without Project Scenario”)

### 10.4.1 Without-Project Alternative

With- and without-project alternatives are compared as shown in Table 10.4.1. In the with-project scenario, environmental impact is expected during construction stage, although the impact is limited and can be mitigated. The social impact is also expected; however, the impact can be amicably solved with appropriate considerations and compensation procedures. Current serious environmental problems such as odor of drains and public water quality deterioration due to untreated water discharge are solved. In the without-project scenario, no social impact is incurred, however, odor from drainage and water quality deterioration will be more serious because population will increase, and amount of wastewater will also increase. Therefore, the with-project scenario is obviously recommended.

**Table 10.4.1 Comparison of Without Project Alternative**

	With Project	Without Project
Description	<ul style="list-style-type: none"> <li>- The population of Catchment 2 and 4 is expected to increase from 1.07 million (2022) to 1.18 million (2030).</li> <li>- Public sewerage systems are in place</li> <li>- The sewerage is collected and treated water is discharged into Karnaphuli River.</li> <li>- The amount of wastewater flowing into the drainage canal will be reduced and the occurrence of road flooding will be mitigated.</li> <li>- Odor, and the deterioration of water quality in public water bodies is improved.</li> </ul>	<ul style="list-style-type: none"> <li>- The population of Catchment 2 and 4 is expected to increase from 1.07 million (2022) to 1.18 million (2030).</li> <li>- Public sewerage systems are not in place</li> <li>- The sewerage is discharged into rivers, sea areas and other public waters via drainage channels without treatment.</li> <li>- Ditches and drains are impeded in their flow by solid waste, often causing road flooding during the rainy season.</li> <li>- The waterlogging of sewage causes odor, and the deterioration of water quality in public water bodies is becoming more serious.</li> </ul>
Environmental Impact	<ul style="list-style-type: none"> <li>- Environmental impacts on air quality, noise, and water quality due to construction are expected, however, the impacts are limited and can be mitigated.</li> <li>- Odor from drainage and water quality in public water body is improved.</li> </ul>	<ul style="list-style-type: none"> <li>- Odor from drainage and water quality deterioration will be more serious.</li> </ul>
Social Impact	Land acquisition is required.	No additional social impact is expected.
Evaluation	Recommended	-

Source: JICA Survey Team

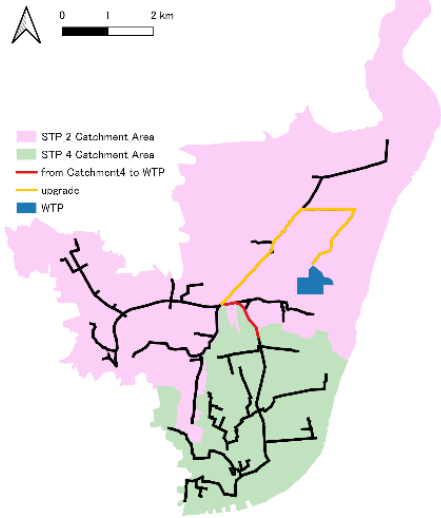
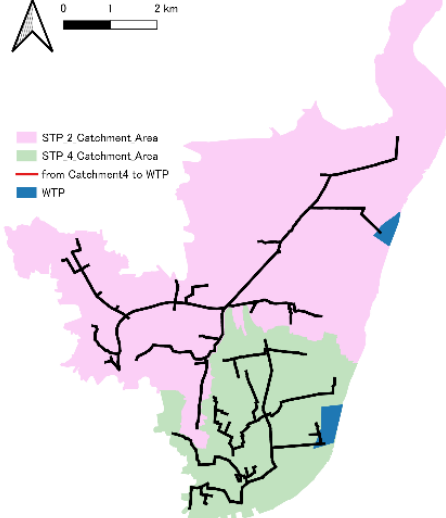
### 10.4.2 Alternative Sites

Location of the STP was originally proposed in the Sanitation Master Plan (M/P) and STP construction was planned in Catchment-2 and Catchment-4 respectively. However, Bangabandhu Maritime University is being constructed in the land for STP-2 as proposed in the M/P. In addition, the land for the sewage treatment plant (STP-4) in Catchment-4 will be used as a site for the outer ring road improvement project and a residential development site. In such a situation, the CDA, in charge of ongoing Chattogram Metropolitan Master Plan Project, found that an area of 30 hectares which is reserved for education and research purposes in the Detailed Area Plan (DAP) of the CDA is available.



The utilization of the land for STP-2 and STP-4 construction has been decided. Option 1 was adopted based on the above circumstances. For environmental impacts, Option 1 and 2 have the same level of impacts (positive and mitigable negative impacts). For social impacts, Options 1 and 2 would result in land acquisition and resettlement, which would have the same level of impact as shown in Table 10.4.2. Since impact is mitigable negative impacts in both options, no significant environmental and social impact is expected for both options.

**Table 10.4.2 Comparison of Alternative Sites**

	Option-1	Option-2
Description	 <ul style="list-style-type: none"> <li>- One STP is constructed for Catchment-2 and Catchment-4, respectively.</li> <li>- Location was considered through discussion among CWASA, CDA and JICA Expert Team (Pre-FS).</li> <li>- Required land area is about 30 ha.</li> </ul>	 <ul style="list-style-type: none"> <li>- STPs are constructed for Catchment-2 and Catchment-4, respectively.</li> <li>- Location was proposed in Sanitation Master Plan (June 2017)</li> <li>- Required land areas are 19 ha for STP-2 and 33 ha for STP-4.</li> </ul>
Environmental Impact	<ul style="list-style-type: none"> <li>- Environmental impacts such as air quality, noise, and water quality due to construction is expected, however, the impact is limited and can be mitigated.</li> <li>- Odor from drainage and water quality in public water body is improved.</li> </ul>	<ul style="list-style-type: none"> <li>- Same as option-1</li> </ul>
Social Impact	<ul style="list-style-type: none"> <li>- Land is privately owned. Thus, land acquisition is required.</li> </ul>	<ul style="list-style-type: none"> <li>- The land for STP-2 is owned by CDA.</li> <li>- The land for STP-4 is owned by CDA and some part is privately owned. Thus, land acquisition is required.</li> <li>- In the STP-4 area, land use change is required.</li> <li>- Area is next to a residential area under development; public acceptance will be problematic.</li> <li>- Requirement of resettlement is not confirmed.</li> </ul>
Evaluation	<p>No significant environmental and social impact is expected.</p>	<p>No significant environmental and social impact is expected.</p>

Source: JICA Survey Team

### 10.4.3 Pipeline Route Alternatives

Pipeline route from Catchment-4 to the STP alternatives are shown in Table 10.4.3. There were five options (Options 1 to 5), however, three options were identified as not technically feasible, thus, two options (Option 2 and 4) were compared (Detailed analysis is discussed in Chapter 6). Pipeline route from Catchment-4 to the STP was selected mainly based on technical aspects such as cost and construction advantages and Option 2 was selected. Regarding environmental and social impact for these options, no significant impact is expected.

**Table 10.4.3 Comparison of Pipeline Routes from Catchment-4 to STP Alternatives**

	Option 2	Option 4
Over view		
	Total length: 227,388 m Cost: 185.84 million USD	Total length: 230,239 m Cost: 192.84 million USD
Features	<ul style="list-style-type: none"> <li>- Way to convey sewage from Catchment-4 to the WTP together with the sewage from Catchment-2</li> <li>- Pipe size can be bigger than that of Option 4</li> <li>- The trunk line is planned to be installed under the wide main road and the construction for both of Catchment-2 and Catchment-4 shall be finished at once (Advantage in construction)</li> </ul>	<ul style="list-style-type: none"> <li>- Way to convey sewage from Catchment-4 to the WTP through the pipe only for Catchment-4</li> <li>- Pipe size can be smaller than that of Option 2</li> <li>- Total pipe length shall be longer than that of Option 2 (Disadvantage in O&amp;M)</li> </ul>
Environmental Impact	Environmental impact such as air quality, noise, and water quality due to construction is	Same as Option 2

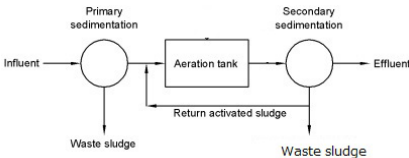
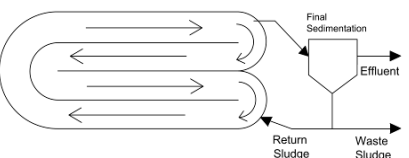
	expected, however, the impact is limited and can be mitigated.	
Social Impact	Traffic congestions will occur during construction; however, the impact is limited. Since the pipeline will be laid underground, land acquisition and resettlement will not be involved.	Same as Option 2
Evaluation	No environmental and social significant impact is expected.	No environmental and social significant impact is expected.

Source: JICA Survey Team

#### 10.4.4 Wastewater Treatment Process Alternatives

Wastewater treatment process alternatives are shown in Table 10.4.4. There were 4 options of wastewater treatment processes, and 2 options were considered as technically recommendable options. Regarding environmental and social impact of these options, no significant impact is expected.

**Table 10.4.4 Wastewater Treatment Process Alternatives**

Item	Option 1 Anaerobic- Anoxic- Oxic (A <sub>2</sub> O)	Option 2 Oxidation Ditch with Nitrate Treatment (OD)
Outline of Process		
	Conventional activated sludge (CAS) method is commonly used all over the world and A <sub>2</sub> O is its modified treatment process for advance treatment. Even if the effluent quality standard is upgraded to require nitrogen and phosphorus treatment in the future, this treatment process is relatively easy to upgrade with additional facilities compared with other treatment processes.	OD was developed in Europe and multiple WWTPs apply this treatment process in Japan. OD consist of circuit channel with an aeration equipment. The most significant advantage of this process is the ease of operation and maintenance while its disadvantage is the requirement for a huge land area for the facilities.
1) Effluent Quality	Discharge standard can be satisfied	Discharge standard can be satisfied
2) N and P treatment (future)	Advanced treatment such as A <sub>2</sub> O process can be applied in future with additional facilities (or expansion of facility).	Advanced OD process with nitrate treatment and chemical phosphorous treatment can be applied.
3) Required Area	Moderate	Large
4) Operation skill	Fair	Easy
5) Influence on surrounding environment	Moderate with deodorization facility	Moderate with deodorization facility
6) Cost for Construction	Higher than Option 2	Lower than Option 1 (About 90% of Option 1)
7) Cost for O&M (energy)	Lower than Option 2 (About 56% of Option 2)	Higher than Option 1
Evaluation	Recommended	Recommended if the area is large enough
Environmental Impact	Wastewater will be treated, and environment of public water body will be improved.	Same as CAS.
Social Impact	No social impact is expected.	Same as CAS.

Source: JICA Survey Team

## **10.5 Scoping and TOR for Survey for Environmental and Social Considerations**

The project will accept domestic and commercial wastewater and sewage generated from factories, including black water and gray water. Although the proposed site for the STP is privately owned, the Project will avoid construction in an area where residents live. It is assumed that resettlement will not be needed because the land on which the STP and pumping station will be constructed is owned by CWASA. Based on the abovementioned background, the project does not fall under the large-scale sewage treatment sector defined in the “Guidelines for Environmental and Social Considerations of JICA” (April 2010), thus, adverse impacts on the environment are expected not significant. The project does not fall under the sensitive areas either, as explained in the Guidelines. Thus, it is appropriate to classify it as a Category B project based on JICA’s guidelines. The environment check sheet is shown in Attachment 5-2.

### **10.5.1 Introduction**

The main objective of this section is to make a provisional identification of environmental and social impacts based on the project description and overall environmental and social conditions in and around the project area, which need to be addressed in subsequent EIA studies.

### **10.5.2 Methodology and Approach**

Since the scoping process is conducted before the detailed field survey, the information from the desk study by the consultant team with preliminary assessment checklist/matrix depending on expert judgments was used to determine the assessment items, which are the most critical issues to study.

### **10.5.3 Identification of Environmental and Social Impacts**

The potential impacts resulting from the project are preliminarily presented and analyzed in this section with respect to the following aspects:

- Pollution control measures;
- Natural environment;
- Social environment; and
- Others.

Environmental and social impact assessment items which are impacts of the project, both assumed or unknown are marked with a 'v' separately for pre-construction (PC) stage, construction (CO) stage, and operation (OP) stage. For items marked 'v', the reason for selection is described as an assumed impact or necessity of investigation to clarify unknown impact. Items not marked with 'v' are described as having no assumed impact or only negligible impact is assumed. The result of scoping for environmental and social impact assessment is shown in Table 10.5.1.

**Table 10.5.1 Results of Scoping for Environmental and Social Impact Assessment**

Impacts	Selection		Reason for Selection/Not Selection	
	PC/C O	OP		
<b>Pollution Control Measures</b>				
1	Air quality	v		[CO] Due to the construction work, transportation of the construction vehicle and activities of the machineries, temporary deterioration of air quality is predicted. [OP] Facilities and equipment in the STP and pumping stations will not cause air quality deterioration.
2	Water quality	v	v	[CO] The STP is located near the Bolirhat Canal, which is connected to the Karnaphuli River, and drainage from the construction site may cause water quality deterioration. [OP] Wastewater from households in non-target areas will continue to be discharged, which may have an impact; however, the level of pollution is expected to be reduced compared to before the project was implemented.
3	Waste	v	v	[CO] Certain amount of excavated soil from the construction of the pipeline and STP may be generated. [OP] Sludge is generated from the treatment process of the STP.
4	Soil contamination	v	v	[CO] Soil contamination due to reinforcement of the ground by injection of cement or chemical agent grout is predicted. [OP] No activities are assumed to cause impact or soil contamination is predicted.
5	Noise and vibration	v	v	[CO] Due to the construction, vehicle transportation and activities of machineries, temporary impact of noise and vibration is predicted. [OP] The STP and pumping station may generate noise and vibration.
6	Ground subsidence	v		[CO] Fill work to reinforce the ground at STP will be implemented, however the possibility of ground subsidence at the STP site is anticipated due to the weight of the filled soil. [OP] No activities are assumed to cause impact or ground subsidence is predicted.
7	Offensive odor		v	[CO] Construction activity will not cause offensive odor. [OP] Generated sludge may cause offensive odor.
8	Bottom sediment	v		[CO/OP] Due to drainage (high turbidity water) from backfill dredged from the Karnaphuli River, sedimentation in the existing channel is expected to occur. [OP] No activities are assumed to cause impact to bottom sediment.
<b>Natural Environment</b>				
9	Protected area			[CO/OP] There is no protected area or reserved forest in the Catchment-2, Catchment-4, and STP sites.

Impacts		Selection		Reason for Selection/Not Selection
		PC/C O	OP	
10	Flora/Fauna and biodiversity	v	v	[CO] STP is located near Karnaphuli River, thus, impact to ecosystem of the river due to construction work is not negligible. [OP] Treated water is discharged into the Karnaphuli River, however a positive impact on the ecosystem is assumed because untreated wastewater is treated and enters the Karnaphuli River.
11	Hydrology			[CO/OP] There is no activity included to change current condition of river flow.
12	Topography and geology			[CO] Construction site is located in an urban area, and not a mountainous site, thus no large-scale excavation work is implemented. [OP] The operation works of the STP such as wastewater treatment and pumping water will not cause any impact to topography and geology.
<b>Social Environment</b>				
13	Involuntary resettlement	v		[PC] Land for the STP and pumping stations are private lands and being used as grazing land. However, there are no households within the boundary of the STP which is developed as under JICA project. [OP] The operation works of the STP such as wastewater treatment and pumping water will not cause involuntary resettlement.
14	Poverty	v	v	[PC] The STP site is currently used as grazing land and the land will be acquired. Impact on poverty is not negligible. [OP] Positive impact to poverty is predicted such as job creation around the project site.
15	Ethnic minorities and indigenous peoples			[CO/OP] The project site is an urban area and existence of ethnic minorities and indigenous people is not confirmed. Thus, impact on ethnic minority and indigenous people is negligible.
16	Local economy (Employment)	v	v	[CO/OP] Positive impact to local economy is predicted such as job creation around the project site.
	(Livelihood)	v	v	[PC] The STP site is currently used as grazing land and the land will be acquired. Impact on livelihood is not negligible. [CO/OP] Positive impact to livelihood is predicted such as job creation around the project site.
17	Land use and utilization of local resources			[CO/OP] The project activities are construction and operation of STP including pumping station, thus no impact is predicted to land use and utilization of local resources.
18	Water usage			[CO/OP] In Chattogram City, water is supplied as well as river water, pond water, and ground water are also used for their daily life. Construction and operation of the STP, including the pipeline and pump station, would not use these water sources. Therefore, there would be no impact on water use. In addition, treated wastewater will be discharged to the Karnaphuli River, which is expected to have a positive impact on improving the water environment since untreated wastewater will be treated and discharged into the Karnaphuli River.

Impacts		Selection		Reason for Selection/Not Selection
		PC/C O	OP	
19	Existing social infrastructure and service	v	v	[CO] Temporary traffic congestion due to construction vehicles are predicted. [OP] The operation works of the STP such as transportation of generated waste to landfill site may cause impact to existing social infrastructure and services.
20	Social institutions such as social infrastructure and local decision-making institutions			[CO/OP] The project activities are construction and operation of STP including pumping station, thus no impact is predicted to social institutions such as social infrastructure and local decision-making institutions.
21	Maldistribution of damage and benefit			[CO/OP] The project activities are construction and operation of STP including pumping station, thus no impact is predicted as maldistribution of damage and benefit.
22	Local conflict of interest			[CO/OP] The project activities are construction and operation of STP including pumping station, thus no impact is predicted to local conflict of interest.
23	Cultural heritage			[CO/OP] There is no cultural heritage within the Catchment-2, and Catchment-4, and STP sites.
24	Landscape			[CO/OP] There is no landscape resource within the project site.
25	Gender	v	v	[CO/OP] Equal payment for same job of male and female worker/staff must be complied.
26	Children's rights	v	v	[CO/OP] Clarification of securing children's right is necessary.
27	Infectious disease and HIV/AIDS	v	v	[CO] Risk of infectious disease and HIV/AIDS will be high due to the increase of migrant and seasonal workers in the project site.
28	Occupational health & safety	v	v	[CO/OP] There is possibility that risk of occupational incidents due to construction and operation of STP will be high.
<b>Others</b>				
29	Accident	v	v	[CO] Certain risks of accidents due to the use of construction vehicles and machines and accidents involving third parties are predicted. [OP] Certain risks of accidents in treatment facilities such as pond or tank are predicted.
30	Cross-border impact, climate change			[CO/OP] Amount of GHG emission is not large and no impact is predicted as cross-border impact or contributing to climate change. Moreover, positive impact such as decreasing inundation during the rainy season due to improvement of drainage due to the development of the STP is expected.

Source: JICA Survey Team

### 10.5.4 TOR of Environmental and Social Survey in Feasibility Study

Based on the scoping results, the terms of references (TORs) for surveys of necessary environmental items as shown in Table 10.5.2 were developed to evaluate the project-induced impacts qualitatively.

**Table 10.5.2 TORs for Environmental and Social Impact Assessment**

Item	Survey Item	Method
<b>Pollution Control Measures</b>		
Air quality	- Confirmation of emission standard - Obtain baseline data	- Data collection on related legislation - Air quality survey
Water quality	- Confirmation of effluent standard - Obtain baseline data	- Data collection on related legislation - Water quality survey
Waste	- Confirmation of waste management system - Confirmation of amount volume of generated sludge	- Data collection on related legislation - Opinion hearing of related organizations - Collect information on good practices
Soil contamination	- Prevention measures for soil contamination	- Confirmation of construction contents and method
Noise and vibration	- Confirmation of noise and vibration standards - Obtain baseline data	- Data collection on related legislation - Noise and vibration survey
Ground subsidence	- Confirmation of impact on ground subsidence	- Confirmation of construction contents and method
Offensive odor	- Confirmation of waste management system	- Data collection on related legislation - Opinion hearing of related organizations - Collect information on good practices
Bottom sediment	- Confirmation of impact on bottom sediment	- Confirmation of construction contents and method
<b>Natural Environment</b>		
Flora/Fauna and biodiversity	- Confirmation of emission standard and environmental standard of sea water - Confirmation of mitigation measures for wastewater discharge	- Data collection on related legislation - Opinion hearing to related organizations - Collect information on good practice
<b>Social Environment</b>		
Involuntary resettlement	- Confirmation of land ownership of project site	- Site visit to confirm current situation - Opinion hearing of related organizations
Poverty	- Confirmation of land ownership of project site	- Site visit to confirm current situation - Opinion hearing of related organizations
Local economy	- Confirmation of income source	- Data collection on statistical information
Existing social infrastructure and service	- Location of household and public facilities such as school and hospital around the project site	- Site visit to confirm current situation
Gender	- Impact on gender	- Site visit to confirm current situation - Opinion hearing of related organizations
Children's rights	- Impact on children right's	- Site visit to confirm current situation - Opinion hearing of related organizations
Infectious disease and HIV/AIDS	- Confirmation of current situation of infectious disease prevalence	- Data collection on statistical information



Item	Survey Item	Method
Occupational health and safety	- Measures for occupational health and safety	- Site visit to confirm current situation - Opinion hearing of related organizations
<b>Others</b>		
Accident	- Expected increase of accidents	- Site visit to confirm current situation - Opinion hearing of related organizations

Source: JICA Survey Team

## 10.6 Impact Assessment

### 10.6.1 Air Quality

During construction, activities would have impact on air quality as shown in the table below. Dust could be generated from excavation, backfilling, transportation, and transport and storage of sand/gravel, especially during the dry season when the soil is dry. Exhaust gas from construction vehicles, equipment, and machinery would also induce construction site air quality impacts. Dust, carbon monoxide, sulfur oxides, particulate matter, nitrous oxides, and hydrocarbons, etc. are included in exhaust gas and increase of the concentration of such parameters is anticipated. Therefore, mitigation measures shall be taken for surrounding households and local people. The implementation of mitigation measures reduces impacts, and it is also important to note that these impacts would be temporary only during construction activities, thus, the impact on air quality is considered of low significance.

**Table 10.6.1 Source of Air Pollution in Construction Phase**

Construction Activity	Pollution Source
Soil improvement (Sewage treatment plant)	For soil improvement work, sheet pile will be driven, holes for piles will be drilled, and piles will be driven (including Jumbo-jet Special Grout (JSG) construction method). The exhaust gas and dust from machinery used in these construction and excavation work is considered to be a source of pollution.
Land filling (Sewage treatment plant)	Sand for land filling is mainly transported from the river bottom to the treatment plant site through pipes. Therefore, no air pollutants are expected to be generated during transport by pipe. However, since some sand is transported by vehicle, the possibility of air pollution from dust and exhaust gases during transport and unloading at the site is anticipated.
Sewage treatment facility construction	Dust and exhaust gases from the manufacture and processing of concrete and cement, operation of construction equipment and vehicles, and transportation of construction materials are expected to cause air pollution.
Access bridge construction	
Sewerage system laying	In the section where the open cut method is applied, it is assumed that dust and exhaust gases from the operation of excavation equipment and transportation of surplus soil will cause air pollution. Similarly, in the sections where the non-excavation method is applied, the installation of shafts is required, thus the shafts installation work is considered to be a source of dust and exhaust gases. In addition, the impact of exhaust gases from pipe jacking equipment and other construction machinery is expected.
Pumping station construction	Since the pumps will be installed underground, excavation work will be required, and dust and exhaust gas will be generated due to the operation of the excavation

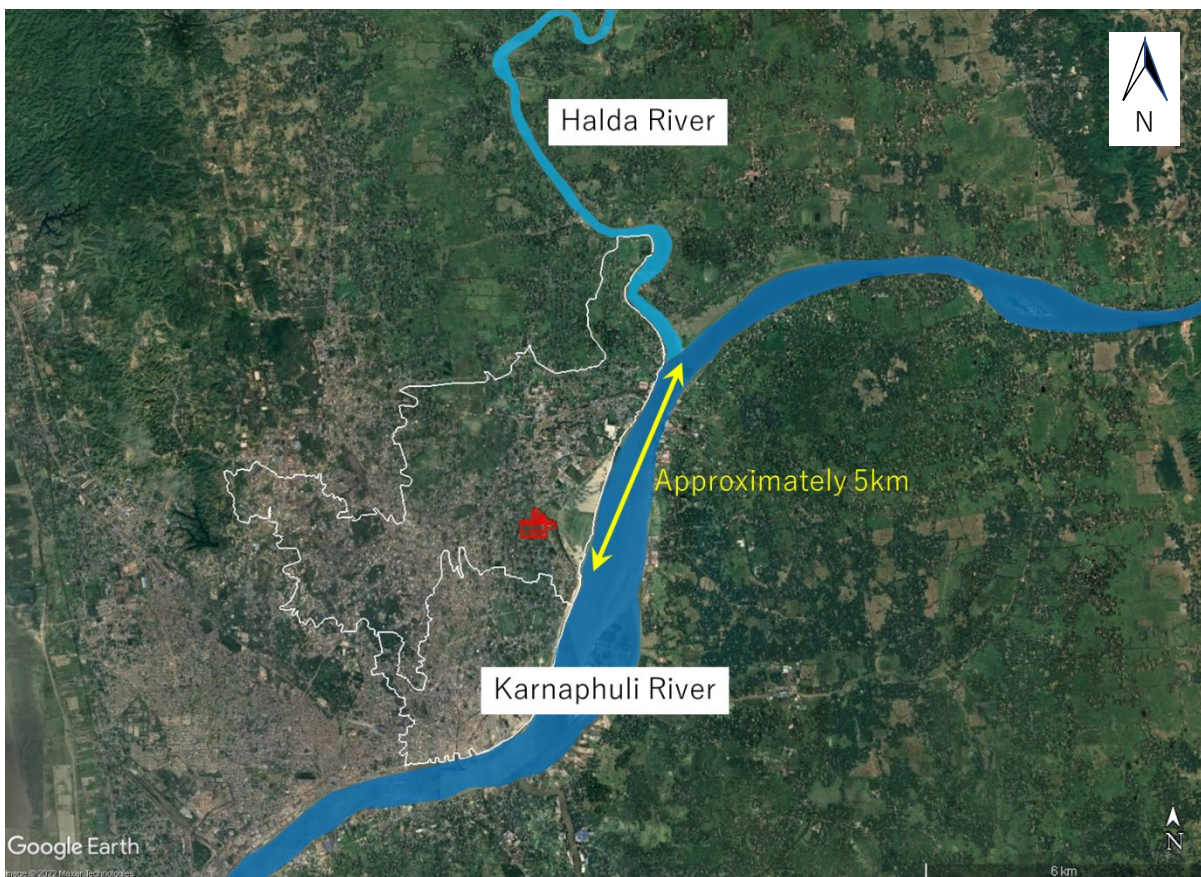
	machinery. During the construction of structures (facilities), dust and exhaust gases would be generated from the production and processing of concrete and cement, operation of construction equipment, and transportation of construction materials.
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Source: JICA Survey Team

## 10.6.2 Water Quality

### (1) Construction Phase

Dredged sand from Karnaphuli River will be used for land filling work. There is concern that the turbidity of the Karnaphuli River will increase during the dredging work. And also, since dredged sand with certain amount of water will be transported through a pipe to the STP construction site, it is necessary to drain water from the sand. Thus, the impact on surface water quality is induced when the water with high turbidity is discharged from sand to surface water. The Halda River, especially important for carp breeding, is located about 5 km upstream of the Karnaphuli River where the STP faces as shown in Figure 10.6.1. The dredging site will be designated by the Bangladesh Water Developing Board (BWDB) at the start of construction. Therefore, mitigation measures such as considering the carp spawning season (April to June) and prevention of discharging high turbidity water shall be taken. The implementation of mitigation measures will reduce the impact, which would be temporary and only during construction activities. As a result, the impact on water quality is considered of low significance.



Source: Google Map edited by the JICA survey team

**Figure 10.6.1 Location of Halda River**

## (2) Operation Phase

Currently, untreated wastewater flows into the Borihat Canal and is discharged into the Karnaphuli River. After the STP is operated, treated water will be discharged into the Borihat Canal and Karnaphuli River. As shown in Table 10.6.2, designed discharge standard is set to comply with ECR2023 discharge standard. Thus, the BOD, COD, oil and grease and SS in the Borihat Canal will be improved after the STP is operated. In addition, the baseline for nitrate, phosphate, and coliforms are below the standard values as shown in Table 10.6.2 (Baseline sampling locations are shown in Figure 10.6.2). The flow rate of the Karnaphuli River was also measured during the field survey at the two locations shown in Figure 10.6.3. The results of the measurements are shown in Table 10.6.3. the flow rate of treated water discharged from the STP is 60,000 m<sup>3</sup>/day, which equivalent to 0.7 m<sup>3</sup>/s. The minimum flow rate of the Karnaphuli River from the field survey is 195.24 m<sup>3</sup>/s (wet season: high tide), and the treated water leaving the STP accounts for about 0.4% of the total flow. Therefore, no negative environmental impacts on water quality are expected after the STP is operated.

**Table 10.6.2 Comparison of Discharge Standard, Designed Discharge Standard and Baseline Data**

Parameter	Standard of Sewage Discharge in the Environment Conservation Rules, 2023	Designed Discharge Standard	Bolirhat Canal (Discharged Water Without Treatment) *	
			Morning	Evening
Temperature	30 °C	30 °C	31.5 °C	32.4 °C
pH	6-9	6-9	7.22	4.13
BOD	30 mg/L	20 mg/L	44.3 mg/L	33.8 mg/L
COD	125mg/L	125 mg/L	390 mg/L	360 mg/L
SS	100 mg/L	30 mg/L	150 mg/L	145 mg/L
Oil and grease	10mg/L	10 mg/L	2308mg/L	142mg/L
Nitrate	50 mg/L	50 mg/L (11.3 mg/L of N-NO <sub>3</sub> )	3.1 mg/L	1.4 mg/L
Phosphate	15 mg/L	15 mg/L (4.9 mg/L of P-PO <sub>4</sub> )	13.1 mg/L	14.2 mg/L
Coliform	1000 MPN/100ml	1000 MPN/100mL	515 CFU/100ml	545 CFU/100ml

\*: Survey was conducted in 8 August 2022

Source: JICA Survey Team

**Table 10.6.3 Flow Rate of the Karnaphuli River**

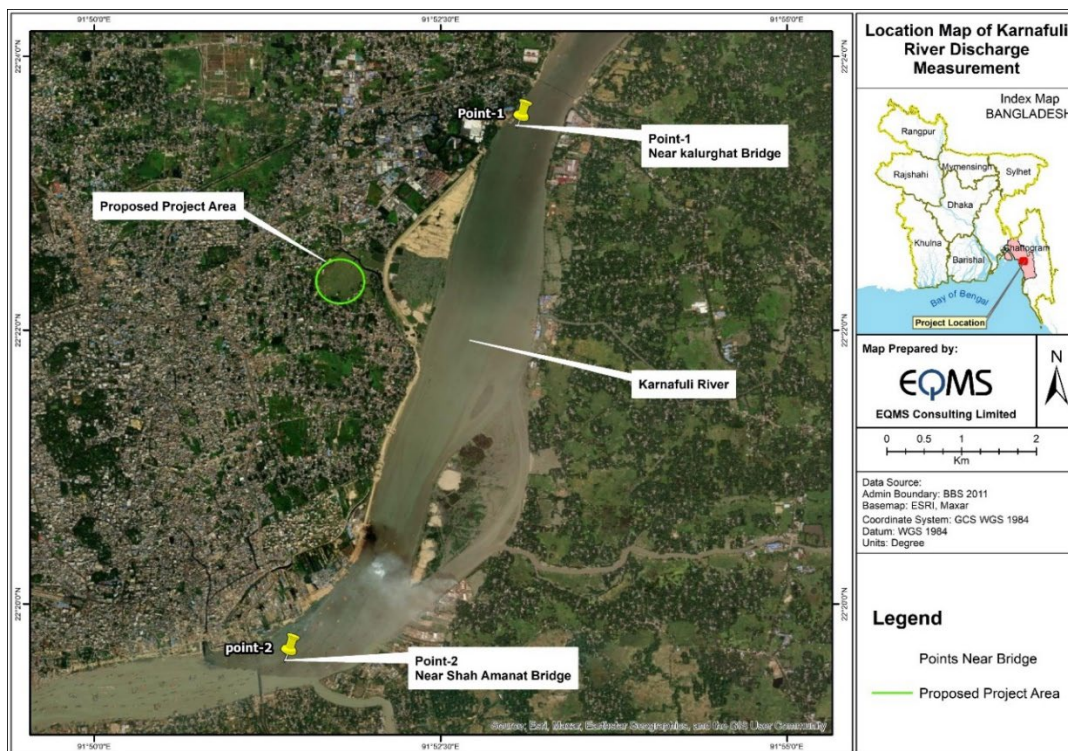
Flow Rate (m <sup>3</sup> /s)	Point1				Poin2			
	Wet Season		Dry Season		Wet Season		Dry Season	
	High Tide	Low Tide	High Tide	Low Tide	High Tide	Low Tide	High Tide	Low Tide
<b>Max.</b>	4,851.48	5,239.17	3,612.38	3,840.78	6,345.19	4,533.09	5,105.07	4,747.56
<b>Ave.</b>	2,271.29	4,330.12	2,219.13	2,560.84	2,718.29	3,547.01	3,952.20	2,989.00
<b>Min.</b>	195.24	3,175.74	923.93	1,076.30	456.77	2,350.00	2,242.62	277.84

Source: JICA Survey Team



Source: Google Map edited by the JICA Survey Team

Figure 10.6.2 Location of Baseline Sampling Point



Source: Google Map edited by the JICA Survey Team

Figure 10.6.3 Location of Measurement Point of Flow Rate of Karnaphuli River

### 10.6.3 Waste

#### (1) Construction Phase

During construction, waste will be generated as shown in Table 10.6.4. The generated waste will be managed and treated by the contractor in accordance with the Environmental Management Plan.

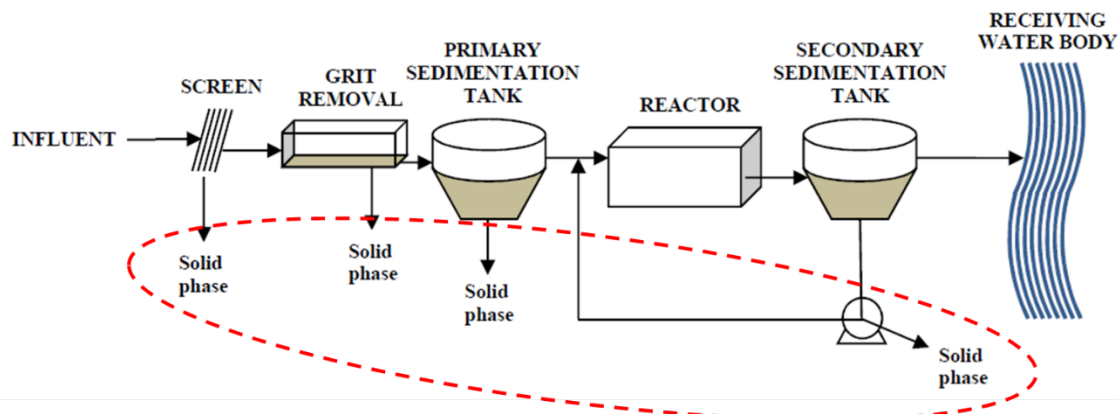
**Table 10.6.4 Generated Waste in the Construction Phase**

Construction Activity	Generated Waste
Soil improvement (Sewage treatment plant)	- Tree - Grass - Concrete - Re-bar - Soil waste
Sewage treatment facility construction	- Concrete - Re-bar - Soil waste
Access bridge construction	- Concrete - Re-bar - Soil waste
Sewerage system laying	- Soil waste - Asphalt - Concrete - Pipe
Pumping station construction	- Concrete - Re-bar - Soil waste

Source: JICA Survey Team

#### (2) Operation Phase

Sludge is generated through the sewage treatment process as shown in Figure 10.6.4. Projected volume of dewatered sludge is shown in Table 10.6.5. The sludge generated from the STP will be disposed at CCC's newly planned landfill site located in Sandwip colony, north of Chattogram, approximately 11 km away from the STP as shown in Figure 10.6.5. The new landfill site is approximately 50 acres in total area. According to the CCC on 15 March 2023, the CCC plans to acquire the private land with its own funds and receive approval for land acquisition in March of this year and to complete the land acquisition by the end of April. However, as of April 2023, approval for land acquisition is not obtained yet. A controlled landfill is planned to be constructed, and sludge generated from the STP will be received based on the MOU between CCC and CWASA. The existing landfill site (Arefin Nagar Landfill) cannot be used due to insufficient capacity. When transporting sludge, odor countermeasures should be taken, such as placing sludge in sealable containers/tanks and selecting routes to avoid residential areas. CCC intends to begin preparing a DPP and conducting an EIA for the land fill site development after land acquisition, however, a detailed schedule has not yet been determined (as of March 2023).



Source: JICA Survey Team

**Figure 10.6.4 Sludge Generation through Sewage Treatment Process**

**Table 10.6.5 Projection of Generated Volume of Dewatered Sludge**

Year	Target Sewage Volume (MLD)	Dewatered Sludge Volume (m <sup>3</sup> /day)*
2030	130	65
2035	139	70
2050	219	110
2070	261	131

\* Assumption: Moisture content=80%

Source: JICA Survey Team



Source: Google Map edited by the JICA Survey Team

**Figure 10.6.5 Location of Landfill Site**

#### 10.6.4 Soil Contamination

Bentonite will be used for preventing the collapse of the soil by forming a layer over the exposed pile foundation surface. Since bentonite is inorganic and a natural substance, filling bentonite in the pile hole will not cause any soil contamination impact.

Since fuel and oil for construction machinery and vehicle are used, accidents or improper management could result in fuel or oil spills. Therefore, proper management and accident prevention measures must be implemented as mitigation measures. With the implementation of the aforesaid mitigation measures, impacts would be minimal and therefore, soil contamination impacts would be not significant.

#### 10.6.5 Noise and Vibration

##### (1) Construction Phase

Noise and vibration expected to be generated from construction activities are shown in the table below. The driving of piles and sheet pile and excavation of holes for piles at the STP construction site, and demolition of pavement at the section of sewer line where the open-cut method will be applied will be the main sources of noise and vibration. Noise and vibration from the operation of construction equipment is also expected. In the section of the sewer line where the open-cut method will be applied, there are households and buildings along the road. In addition, a school is located adjacent to the STP site boundary. Therefore, mitigation measures shall be taken for surrounding households and the local people. Since the implementation of mitigation measures reduce impact and the impact would be temporary and only during construction activities, the impacts of noise and vibration are considered of low significance.

**Table 10.6.6 Source of Noise and Vibration in Construction Phase**

Construction Activity	Pollution Source
Soil improvement (STP)	For soil improvement work, sheet piles will be driven, holes for piles will be drilled, and piles will be driven (including JSG construction method). Heavy machinery for these construction activities is considered to be a source of noise and vibration.
Land filling (STP)	Sand for land filling is mainly transported from the river bottom to the treatment plant site through pipes. Sand is pumped by pumps, and pumps are installed at relay points as well as at the beginning of the pipe. Noise and vibration will be generated from the pump. In addition, noise and vibration are generated from the vehicles used for transportation of sand.
Construction of STP Access bridge construction	Noise and vibration are generated from the manufacturing and processing of concrete and cement, operation of construction equipment and vehicles, and transportation of construction materials.
Sewer laying	In the section where the open cut method is applied, noise and vibration are generated from the operation of excavation equipment and transportation of surplus soil. Similarly, in the sections where the non-excavation method is applied, noise and vibration are generated from the installation work of shafts. In addition, the impact of noise and vibration from pipe jacking equipment and other construction machinery is expected.

Pumping station construction	Since the pumps will be installed underground, excavation work will be required, and noise and vibration will be generated due to the operation of the excavation machinery. During the construction of structures (facilities), noise and vibration would be generated from the production and processing of concrete and cement, operation of construction equipment, and transportation of construction materials.
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Source: JICA Survey Team

## (2) Operation Phase

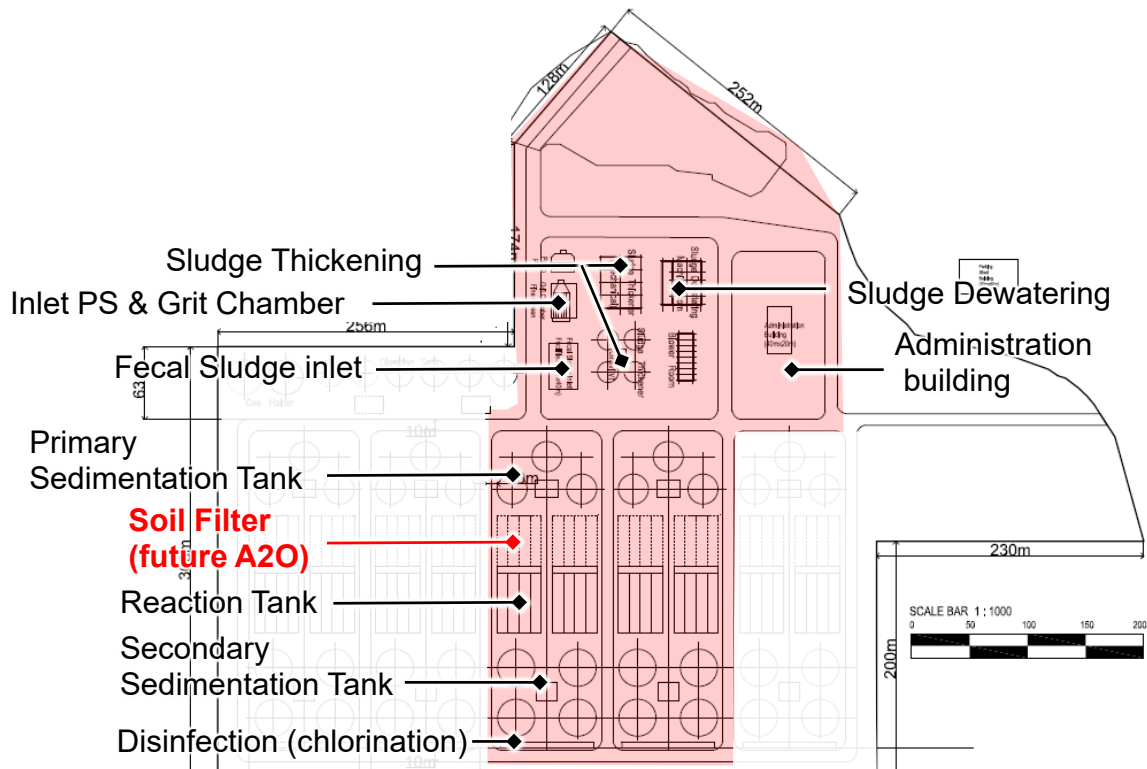
During the operation phase, the noise emissions of the STP will mainly be generated by the aeration system, engines, and pumps. It is noteworthy that the noise emission will be continuous (night and day) and rather stable in intensity, which usually reduces the adverse effects of noise. The noise level generated by the plant should not be detectable from the background noise during the day and barely detectable by the closest houses during the night.

### 10.6.6 Ground Subsidence

Since the area has soft ground and there is a possibility of land subsidence, piles will be driven for soil improvement. Thus, the impact on ground subsidence is considered of low significance.

### 10.6.7 Offensive Odor

The offensive odor of the STP will be mainly generated from the sludge thickening, fecal sludge inlet, and sludge dewatering facilities. As mitigating measure, soil filter will be installed for deodorization as shown in Figure 10.6.6.



Source: JICA Survey Team

Figure 10.6.6 Layout of the STP Site



### 10.6.8 Bottom Sediment

Sand for the land filling is dredged from the bottom of the Karnaphuli River and transported to the site through a pipe. The amount of sand is estimated to be approximately 300,000 m<sup>3</sup> and will be dredged at locations decided by the authorized agency, the Bangladesh Water Developing Board (BWDB).

### 10.6.9 Flora/Fauna and Biodiversity

#### (1) Construction Phase

In and around the STP construction site, existence of rare territorial flora and threatened fauna are studied as shown in Table 10.6.7 and Table 10.6.8. There is the possibility of the loss of these flora and fauna due to cutting trees and soil erosion from construction site. Therefore, mitigation measures (compliance with unnecessary logging bans, protection of vegetation, etc.) shall be taken to minimize impact. Since the implementation of mitigation measures reduce impact and the STP site is not categorized as biodiversity sensitive area as explained in 10.2.8, the impact on flora and fauna are considered of low significance.

**Table 10.6.7 List of Rare Territorial Flora**

Common Name	Local Name	Scientific Name	Uses	Local Status	IUCN Red List Status
Acacia	Akashmoni	<i>Acacia auriculiformis</i>	Timber	R	LC
Water Apple	Amrul	<i>Syzygium aqueum</i>	Timber	R	NE
Garuga	Bhadi	<i>Garuga pinnata</i>	Timber	R	NE
Green Tampang	Borta	<i>Artocarpus lacucha</i>	Timber	R	NE
Green Tampang	Chapalish	<i>Artocarpus chaplasha</i>	Timber	R	NE
Indian Mahogany	Chikrassi	<i>Chukrasia tabularis</i>	Timber	R	LC
Eucalyptus	Eucalyptus	<i>Eucalyptus citriodora.</i>	Timber	R	LC
white teak	Gamar	<i>Gmelina arborea</i>	Timber	R	LC
India Gurjan	Garjan	<i>Dipterocarpus turbinatus</i>	Timber	R	VU
Yellow Myrobalan	Haritoki	<i>Terminalia citrina</i>	Timber	R	LC
Shirish	Kala Koroï	<i>Albizia lebeck</i>	Timber	R	LC
Lebbek tree	Koroï	<i>Albizia chinensis</i>	Timber	R	NE
Bengal currant	Koromcha	<i>Carissa carandas</i>	Fruit	R	NE
White Siris	Sada Koroï	<i>Albizia procera</i>	Timber	R	LC
Teak	Segun	<i>Tectona grandis</i>	Timber	R	EN

Note: R: Rare (VC: Very common, C: Common, R: Rare, 3 categorie)s

Source: JICA Survey Team

**Table 10.6.8 List of Threatened Fauna**

Common Name	Local Name	Scientific Name	IUCN Bangladesh Status, 2015*	IUCN Red List Version -2022-1**
<b>Amphibians</b>				
There are no threatened species.				
<b>Reptiles</b>				
There are no threatened species.				

Common Name	Local Name	Scientific Name	IUCN Bangladesh Status, 2015*		IUCN Red List Version -2022-1**
<b>Avifauna Species</b>					
Black-headed Ibis	Kalamatha Kasteychora	<i>Threskiornis melanocephalus</i>	VU	NT	
<b>Mammalian Species</b>					
There are no threatened species.					
<b>Butterfly Species</b>					
There are no threatened species.					
<b>Fish</b>					
Long-whiskered Catfish	Ayre	<i>Sperata aor</i>	VU		LC
Indian Mottled Eel	Baim	<i>Anguilla bengalensis</i>	VU		NT
Indian River Shad	Chapila	<i>Gudusia chapra</i>	VU		LC
Silver Hatchet Chela	Chep Chela	<i>Chela cachius</i>	VU		LC
Great Snakehead	Gojar	<i>Channa marulius</i>	EN		LC
Featherback	Chitol	<i>Chitala chitala</i>	EN	NT	
Pabda Catfish	Pabda	<i>Ompok pabda</i>	EN		NT
Pangus	Pangas	<i>Pangasius Pangasius</i>	EN		LC
Striped Catfish	Thai Pangus	<i>Pangasiadon hypophthalmus</i>	NE		EN

Source: JICA Survey Team

## (2) Operation Phase

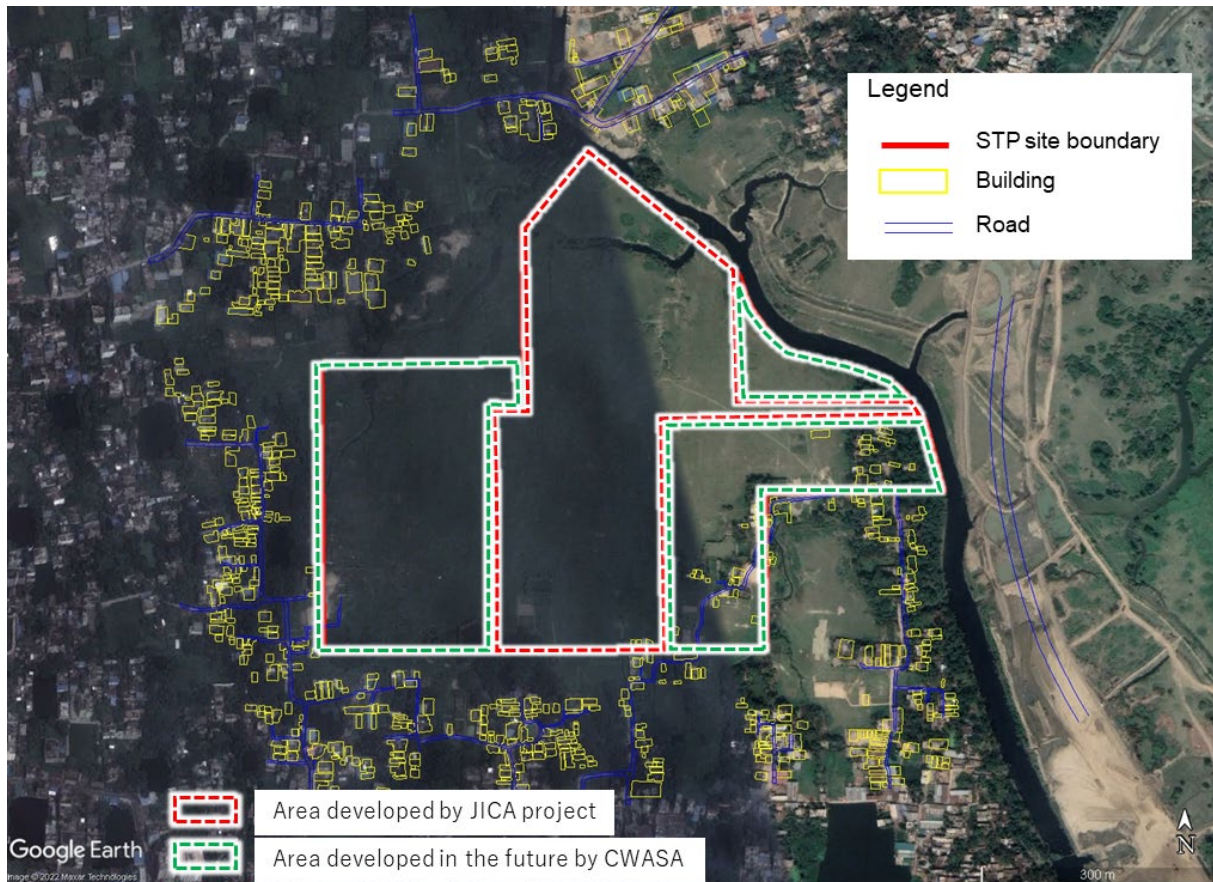
Although treated wastewater will be discharged to Karnaphuli River, and Halda River, which is especially important for carp (Catla (*Labeo catla*), Rui (*Labeo rohita*), Mrigel (*Cirrhinus mrigala*), Kalibaush (*Labeo calbasu*), all are categorized into Least Concern species (LC) as per IUCN Red List) breeding is located approximately 5 km upstream of the discharge point in Karnaphuli River, as explained in 10.6.2, no negative environmental impacts on water quality are expected after the STP is operated. Moreover, the STP site is not categorized as biodiversity sensitive area. Thus, the impact on flora and fauna are considered of low significance.

### 10.6.10 Involuntary Resettlement

#### (1) Project Components

For laying the sewers and construction of pump station, resettlement is not required because the land is owned by the government. The land for the STP site is privately owned and currently used for grazing cattle. Currently, six people are engaged in grazing, however, individual consultations regarding resettlement have not yet taken place. The Bangladesh National Legislation (ARIPA2017) provides for compensation for loss of land and relocation, but not for relocation of grazer, so compensation is proposed in the draft abbreviated resettlement action plan. In addition, there are structures including house and business tenant within the boundary of the STP site. However, the boundary for the STP includes future planning and STP facilities and structures constructed by this JICA project will not use the entire land. No resettlement will take place in this project, and only land acquisition will be carried out for the JICA project. Since the STP facilities will be developed in phases, construction work will initially be implemented only in the area/facilities developed by JICA projects, and the timing of

construction work in the future planned areas has not yet been determined. However, CWASA plans to proceed with the acquisition of the land and resettlement of residents for the future planned portion at the same time as the land acquisition for the JICA project. The affected area is shown in Figure 10.6.7.



Source: JICA Survey Team

**Figure 10.6.7 STP Site Boundary and Developed Area by JICA Project**

**(2) Initial Design Alternatives**

The site alternative is discussed in 10.4.2 and involuntary resettlement is not required in this JICA project.

**(3) Methods to Minimize Involuntary Resettlement During Project Implementation**

Although the boundary of the STP includes the land where resettlement is required, the boundary is for future planning and the STP will be constructed in phases. Under this JICA project, the land where resettlement is required is avoided.

**(4) Impact of Land Acquisition**

Summary of the impact of land acquisition in this project is shown in Table 10.6.9.

**Table 10.6.9 Summary of Impact of Land Acquisition**

No.	Project Impacts	Total	JICA Project (Phase 1)	Future Project (After Phase 1)
1	Amount of private land in acre	73.54	35.72	37.82
2	Amount of public land in acre	1.00	0.51	0.49

3	No. of total landowners	325	140	185
4	Total no. of households requiring physical relocation (residential structures are fully or mostly affected)	70	0	70
5	No. of CPRs	3	0	3
6	No. of commercial structures	3	0	3
7	No. of affected trees	1340	76	1264

Source: JICA Survey Team

### (5) Contents of Compensation

Contents of compensation is shown in Table 10.6.10.

**Table 10.6.10 Contents of Compensation**

Type of Loss	Entitled Persons (Beneficiaries)	Entitlement (Compensation Package)
Loss of land (all types of land to be acquired for the project)	Legal title holders of land	<ul style="list-style-type: none"> <li>• Compensation at Replacement Cost (RC)</li> <li>• Replacement Value (RV) of land (Cash Compensation under Law (CCL) including 200% premium and additional grant to cover the current market price of land and stamp duty and registration cost @10% of CMP for land) to be determined by PVAC.</li> <li>• Stamp duty, registration cost, tax, value added tax and other fees incurred for replacement land will be paid at actual cost for those affected landowners purchasing alternative land within the one year from the date of CCL received</li> <li>• Dislocation allowance @ BDT 300/decimal for agricultural, fish ponds, ditches, etc.</li> </ul>
Loss of trees	<ul style="list-style-type: none"> <li>• Person with legal ownership of the land</li> <li>• Socially recognized owner/ Unauthorized occupant of the trees</li> </ul>	<ul style="list-style-type: none"> <li>• Cash compensation at market rates for replacement of trees value</li> <li>• For fruit bearing trees- compensation for fruits at 30% of timber value X 1 year</li> <li>• 5 saplings will be distributed free of cost among each affected household losing trees</li> <li>• Owners will be allowed to fell and take away their trees, perennial crops/ fishes etc. free of cost.</li> </ul>
Temporary impact during construction	Community/ Individual	<ul style="list-style-type: none"> <li>• The contractor shall bear the cost of any impact on structure or land due to movement of machinery and in connection with collection and transportation of borrow materials.</li> <li>• All temporary use of lands outside proposed AOI to be through written approval of the landowner and contractor.</li> <li>• Land will be returned to owner rehabilitated to original preferably better standard.</li> </ul>

Source: JICA Survey Team

### **10.6.11 Poverty/ Local Economy (Employment, Livelihood)**

#### **(1) Pre-Construction Phase**

Since the land for STP site that is currently used for grazing cattle will be acquired, loss of livelihood activities is concerned. To mitigate the impact, mitigation measures such as implementation of a Livelihood Restoration Program is needed for those who lose their livelihood activities.

#### **(2) Construction Phase/ Operation Phase**

The construction phase will create job opportunities for both unskilled and skilled manpower mainly recruited within the Chattogram District. The main staff-demanding activities will be ground improvement works and construction of STP and pumping station and laying sewer and making connections. Construction of the STP will require local and imported materials and equipment which are likely to be provided by local retailers or wholesalers which will enhance local economy for a short period.

### **10.6.12 Land Use and Utilization of Local Resources**

Currently, the STP site is used as cattle grazing land, however, a portion of the land will no longer be available for grazing after the STP is operated. Since only a part of the STP site will be developed in this JICA project, the land around the STP site remains available for grazing land. Since the grazing land is a future plan to be developed as the STP, it is expected that it will not be possible to use it as grazing land in the future under the current plan. If there will be project-affected persons who will lose their livelihood, it will be necessary to implement livelihood restoration programs and other measures to minimize the impact.

### **10.6.13 Existing Social Infrastructure and Services**

Most of the new sewage pipes will be laid along narrow two-lane roads (4-6 m wide), without formal sidewalks, and the works (open trench, excavated material, pipes and machinery) will likely occupy one full lane of the carriage way. Often, the sides of these narrow roads are occupied by mobile street vendors. As a result, the presence of works could consequently cause:

- Traffic disruption, or just allowing a tuk-tuk to pass
- Difficulty to access on foot, two-wheel vehicles or tuk-tuk, to some housing and other building located on the same side of the open trenches, and sometimes on each side
- Difficulty for pedestrians to walk along the streets

### 10.6.14 Gender Issues

#### (1) Women's Participation in the Project Proponent

As of August 2022, 48 of the 499 CWASA employees are women (8%), and 5 of the 49 CWASA executives are women (10.2%). Note that as of December 2015, 5 of the 53 executives were women (9.4%). In the Chattogram Metropolitan Sewerage Project for North Kattoli Catchment, which is implemented by CWASA in Catchment-5, the draft report on gender analysis on June 2022, and “Induced Positive Impacts (Against the Present Situation)” is discussed as shown in Table 10.6.11.

**Table 10.6.11 Positive Impacts on Women and Enhancement Measures**

Present Situation	Potential Issues for Women Associated with Sanitation	Positive Impacts Induced by the Project	Women-oriented Enhancement Measures
Women have very low access to work in the water and sanitation sector as the very low rate of women working in CWASA (8 %) can attest.	Raising the rate of female employees in CWASA and other water and sanitation activities can take time and still discourage young women to apply and to study in these fields	The Project will generate a lot of new jobs in the sanitation sector, from the construction and maintenance of the network to the operation and maintenance of the Sewage Treatment Plant.	<ul style="list-style-type: none"> <li>• Requirement for contractors to hire at least 10 % of women, 50 % of which in qualified position (not only for cleaning and cooking)</li> <li>• Promote high-level education (technician, engineer, master) for women in the fields of sanitation. This can be done first at the high-school level by some lecture given by CWASA female staff. At upper level, education on the water and sanitation jobs should be reinforced and made more accessible to female students.</li> </ul>

Source: Prepared by the JICA Survey Team based on Draft Gender Action Plan of Chattogram Metropolitan Sewerage Project for North Kattoli Catchment

#### (2) Consideration on Gender in this Project

In this project which is construction of infrastructure, there are needs and issues for gender equality as shown in the table below.

**Table 10.6.12 Needs and Issues for Gender Equality**

Needs	Issues
Safety working environment	It is assumed that women have less experience working on construction sites than men. In construction sites, accidents may occur because they may be unaware of the possible risks due to their lack of work experience. In addition, because women are smaller in size than men, it is assumed that their personal protective equipment may not fit them, and their safety may not be ensured.

Privacy protection	Women need more privacy than men. Particular attention should be paid to women's privacy in situations where privacy needs to be protected, such as restrooms, changing clothes, and breaks.
Women-friendly work environment	In construction sites, it is expected that there will be more male workers than female, and there may be inequalities between men and women, such as not asking for or hearing inputs from women, or not providing opportunities for women to express their opinions.

Source: JICA Survey Team

Measures to meet needs for gender equality are shown in the table below.

**Table 10.6.13 Measures to Meet Needs for Gender Equality**

Needs	Measures	Effectiveness Indicator
Safety working environment	<ul style="list-style-type: none"> <li>- Conducting safety training</li> <li>- Provide workers with personal protective equipment that fits their body size</li> </ul>	Number of accidents involving female workers due to carelessness or incorrect use of personal protective equipment
Privacy protection	<ul style="list-style-type: none"> <li>- Provide separate men's and women's restrooms, changing rooms, and break rooms</li> <li>- Establishment of a complaints desk for women</li> </ul>	Number of complaints from female workers to contractors regarding privacy interference
Women-friendly work environment	<ul style="list-style-type: none"> <li>- Conduct gender equality awareness activities/training</li> <li>- Establishment of a complaints desk for women</li> </ul>	Number of complaints from female workers to contractors regarding gender inequality

Source: JICA Survey Team

In addition, in Bangladesh, laws and policies acknowledge and advocate gender equality as shown in Table 10.6.14.

**Table 10.6.14 Laws and Policies on Gender Equality**

Laws and Policies	Gender Provisions
National Parliament (Reserved Women Seat) Election Act, 2004	Sets aside a number of National Parliament seats as reserved for women.
Bangladesh Labor Act, 2006	Upholds gender equality while providing definitions. Chapter 4 makes provisions for pregnant women in work. The law has prevented the discharge of women from service through the provisions of Section 50.
Local Government (Pouroshova) Act, 2009, Local Government (Union Parishad) Act, 2009 and Local Government (City Corporation) Act, 2009	Secure reserved seats for women within the structures of local government bodies to ensure representation of women in local governance.
National Women Development Policy, 2011	Sets four objectives and a way forward for providing women with their equal rights by ensuring fundamental freedoms and protection of women
National Labor Policy, 2012	Facilitates women's labor and equality in employment with a view to eliminating discrimination in employment.

Source: Prepared by JICA Survey Team based on State of Gender Equality and Climate Change in Bangladesh

### 10.6.15 Children’s Rights/Consideration on Disabled Person

It is inevitable that many of children have to work for their livelihood, which deprives them of a healthy childhood that includes access to nutrition, health care, education and recreation. Generally, children from the poorest families are deprived of access to basic services and to family care and support. They include children living in the streets or in institutions such as orphanages, children involved in the most hazardous forms of work, especially domestic work, or sex work, children in conflict/contact with law or victims of law enforcement agencies.

The Constitution of Bangladesh has provisions relevant to children's rights in its directive principles of state policy [Articles 15, 17 and 25(1)], the fundamental rights [Articles 27, 28(1)(2)(3)(4), 31, 32, and 39(1)(2)], and the power of judicial review' [Articles 26(1)(2)]. Articles 27, 28 and 31 of the Constitution lay down the general principles regarding the protection of children from all forms of discrimination. The Constitution in these articles provide that all citizens, being equal before the law and being entitled to equal protection, must be treated in accordance with law without any discrimination.

The other laws relating to the protection and welfare of children in Bangladesh are not contained in a single statute; rather they can be found scattered over numerous laws and statutes as shown in Table 10.6.15.

**Table 10.6.15 Legislation Related to Children’s Rights**

Laws	Children’s Rights Provisions
The Bangladesh Labour Act, 2006	<p>This law has replaced the Employment of Children’s Act, 1938, Factories Act, 1965 and The Children (Pledging of Labour) Act, 1933. It provides for:</p> <ul style="list-style-type: none"> <li>- Prohibition on engagement of children (not exceeding fourteen years of age) and adolescents (over fourteen years of age but not exceeding 18 years) in any profession or institution (sec. 34);</li> <li>- Adolescents can be engaged in a profession or institution subject to certification by a registered practitioner regarding his/her capability to carry out the particular work (sec. 34(2)(ka));</li> <li>- No adolescent worker to be engaged in cleaning, lubricating or processing any machinery when the switch is working (sec. 39).</li> <li>- An adolescent worker shall not handle any machinery unless he is fully aware of the machinery and the precautions needed to handle the same (sec. 40).</li> <li>- Prohibition of adolescents from employment in deep soil or water activities (sec. 42).<sup>1</sup></li> </ul> <p>Although children are not to be engaged in any profession or institution, on completion of twelve years, they may be engaged in some light work that is not hazardous to their health and physical growth and which does not disrupt their education (sec. 44). In such cases, if the child workers are school goers, their working hours have to be fixed in a way that their school time is not hampered.</p>
The Minimum Wages Ordinance, 1961	<p>The Act provides for the payment of minimum wages to all workers including juveniles and prohibits employers from paying juveniles (below the age of 18 years) less than the minimum rates fixed by the Board set up under this Act. Any contravention is met with punishment.</p>
The Children’s Act of 1974 /	<p>The Act and Rules are intended to protect the child’s best interests during all kinds of legal processes. They require the court to have regard for the age and character</p>



Children’s Rules of 1976	of the child and other related factors before passing any order under the Act. The Act provides for separate juvenile courts and forbids the joint trial of an adult and a child offender even where the offence has been jointly committed. The Act lays down measures for the care and protection of destitute and neglected children, including children under the care of parents/guardians who habitually neglect, abuse or ill-treat them.
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Source: JICA Survey Team

In consideration of persons with disabilities, Bangladesh ratified the Convention on the Rights of Persons with Disabilities in 2007, and it is necessary to comply with the Convention. The relevant provisions and specific responses in this project are shown in .

**Table 10.6.16 Considerations on Disabled Person**

Relevant provisions	Specific responses
Article 4 (General Obligations) Prohibition of Discrimination on the Basis of Disability	- Conduct educational activities for workers on the prohibition of discrimination on the basis of disability - Considering employment of people with disabilities for minor tasks such as cleaning and light office work
Article 9. Accessibility	Assign personnel or establish a system to assist people with disabilities in order to provide them with the physical and mental care they need in their work.
Article 21 Freedom of expression and opinion, and access to information	Consideration for means of communication with persons with disabilities (e.g., substitute reading, writing, sign language, explanations in easy-to-understand language, etc.)
Article 27 Work and employment	- Ensure work safety for persons with disabilities - Considering employment of people with disabilities for minor tasks such as cleaning and light office work

Source: JICA Survey Team

### 10.6.16 Infectious Disease and HIV/AIDS

The influx of workers may increase the risk of COVID-19, dengue fever, and sexually transmitted diseases (STDs). During construction, migrant and seasonal workers will live together in temporary quarters or in nearby accommodations, and there is concern about infectious diseases such as COVID-19 and dengue fever. According to WHO, as of 20 November 2022, a total of 52,807 laboratory-confirmed dengue cases and 230 related deaths have been reported by the Ministry of Health & Family Welfare of Bangladesh since 1 January 2022 with a case fatality rate (CFR) of 0.44%. This is the second-largest outbreak since 2000, with the largest having occurred in 2019. The current dengue outbreak is unusual in its scale and seasonality.

The HIV infection rate among Bangladeshis aged 15-49 is estimated to be less than 0.1%, and there are 14,000 HIV-infected people in the country. According to MOHFW, migrant and seasonal workers account for 30% to 40% of the confirmed HIV-positive population, and in recent years, HIV-positive migrant and seasonal workers have increasingly been infecting their spouses. By region, HIV-positive individuals are more prevalent in the Dhaka, Sylhet, and Chattogram districts.

### **10.6.17 Occupational Health and Safety**

#### **(1) Construction Phase**

At the construction sites, exhaust gases, dust, and noise will be generated from the use of construction machinery and vehicles cause air pollution and noise, and there is concern about the impact on workers. In addition, the humidity and high temperatures during the rainy season increase the risk of heat stroke. Therefore, mitigation measures need to be implemented to protect the physical health of workers.

#### **(2) Operation Phase**

Some of the treatment facilities are deep in water and there is a risk of drowning and other risks of death from falling. Safe facility design is needed, including measures to prevent accidental falls.

### **10.6.18 Accidents**

#### **(1) Construction Phase**

There are concerns about the risk of accidents due to unskilled workers and other errors in the use of construction machinery, traffic accidents due to the increase in the number of construction vehicles, and accidents involving third parties who accidentally enter the yard. Thus, mitigation measures shall be implemented.

#### **(2) Operation Phase**

There is concern about the risk of traffic accidents due to sludge transport and worker movements inside and around the STP site. Appropriate traffic management is needed.

### **10.6.19 Cross-Border Impact and Climate Change**

Increases in water temperature due to climate change are expected to cause deterioration of water quality by decreasing the amount of dissolved oxygen and accelerating microbial decomposition of organic matter and nitrification with dissolved oxygen consumption. Sewage is a major source of nutrients and preventing nutrient influx through sewage treatment is expected to mitigate water quality deterioration caused by climate change.

## 10.7 Summary of Environmental and Social Impacts of the Project

Results of environmental and social impact assessment are summarized in Table 10.12.2.

**Table 10.7.1 Summary of Environmental and Social Impacts**

Items		Phase		Impacts
		PC/ CO	OP	
<b>Pollution Control Measures</b>				
1	Air quality	B-	N/A	[CO] Dust from excavation work (especially dry season) and exhaust gas from construction machinery and vehicles will be the main source of air pollution in the construction site of the STP and sewer laying. The impact is temporary and can be reduced with mitigation measures such as water spraying and regular inspections of construction machinery/vehicles, thus, the impact is considered of low significance. [OP] STP operation will not cause air quality deterioration.
2	Water quality	B-	A+	[CO] The impact on surface water quality is induced when the water with high turbidity is discharged from land filling work. The Halda River, especially important for carp breeding, is located about 5 km upstream of the Karnaphuli River where the STP is located. The impact is temporary and can be reduced with mitigation measures such as considering the carp spawning season (April to June) and prevention of discharging high turbidity water, thus, the impact is considered low significance. [OP] Treated water will be discharged into the Borihat Canal and Karnaphuli River. The BOD and SS in the Borihat Canal will be improved after the STP is operated. Water quality improvement in Karnaphuli River is expected.
3	Waste	B-	B-	[CO] Certain amounts of waste will be generated such as tree, grass, concrete, re-bar, soil waste, and asphalt. The generated waste will be managed and treated by the contractor in accordance with the Environmental Management Plan. [OP] Sewer sludge is generated through the sewage treatment process. The volume of dried sewage sludge is estimated at 20.5 t-DS/day (=98m3/day) when inflow quality is same as design parameter. The sludge generated from the STP will be disposed at CCC's newly planned landfill site located in Sandwip colony, north of Chattogram, approximately 11 km away from the STP.
4	Soil contamination	B-	D	[CO] Pile driving for soil improvement work will not cause soil contamination because bentonite, which is inorganic and a natural substance, is used for preventing the collapse of the soil by forming a layer over the exposed pile foundation surface. Since fuel and oil for construction machinery and vehicles are used, accidents or improper management could result in fuel or oil spills. With mitigation measures such as storing hazardous materials in adequately protected sites, the impacts would be minimal. [OP] No activities that are assumed to cause impact as soil contamination is predicted.
5	Noise & vibration	B-	D	[CO] Noise and vibration will be mainly generated from construction activities such as driving of piles in the STP site and demolition of pavement by open-cut method for laying pipelines. The impact is temporary and can be reduced with mitigation measures such as coordinating with local people and using modern machinery/vehicles, thus, the impact is considered of low significance. [OP] The noise emissions of the STP will mainly be generated by the aeration system, engines, and pumps. The noise level generated by the plant should not be detectable from the background noise during the day and barely detectable from the closest houses during the night.

Items		Phase		Impacts
		PC/ CO	OP	
6	Ground subsidence	D	D	[CO/OP] Since the area has soft ground and there is a possibility of land subsidence, piles will be driven for soil improvement. Thus, the impact on ground subsidence is considered of low significance.
7	Offensive odor	N/A	B-	[CO] Construction activity will not cause offensive odor. [OP] Even offensive odor of STP will be mainly generated from sludge thickening, fecal sludge inlet, and sludge dewatering facilities, soil filter will be installed for deodorization.
8	Bottom sediment	B-	N/A	[CO/OP] The amount of dredged sand from the bottom of the Karnaphri River for the land filling is estimated to be approximately 300,000 m <sup>3</sup> . Although dredging is only to be performed and it is assumed that bottom sediment will be rolled up during dredging, no change in bottom sediment is expected and the impact is considered low significance. [OP] No activities are assumed to cause impact to bottom sediment.
<b>Natural Environment</b>				
9	Protected Area	N/A	N/A	[CO/OP] There is no protected area, reserved forest in the Catchment 2 and 4 and STP site.
10	Flora/Fauna and biodiversity	B-	A+	[CO] There is a possibility of loss of these flora and fauna due to cutting trees and soil erosion from construction site. The impact can be minimized with mitigation measures such as compliance with unnecessary logging bans, protection of vegetation, etc. and the STP site is not categorized as biodiversity sensitive area, thus, the impact is considered of low significance. [OP] Since treated water will be discharged into the Borihat Canal and Karnaphuli River, water quality of these water bodies will be improved. Water quality of Halda River which are especially important for carp breeding located approximately 5 km upstream of the discharge point in Karnaphuli River may also be improved.
11	Hydrology	N/A	N/A	[CO/OP] There is no activity included to change current condition of the river flow.
12	Topography and geology	N/A	N/A	[CO] Construction site is located an urban area and not in a mountainous area, thus no large scale excavation work is implemented. [OP] The operation works of the STP will not cause any impact to topography and geology.
<b>Social environment</b>				
13	Involuntary resettlement	B-	N/A	[PC] Land acquisition and resettlement will be proceeded in accordance with related law and regulation. [OP] No activities are assumed to cause involuntary resettlement.
14	Poverty/ Local Economy (Employment, Livelihood)	B-	A+	[PC] Since the land for the STP site currently used for grazing cattle will be acquired, loss of livelihood activities is a concern. To mitigate the impact, measures such as implementation of a livelihood restoration program is needed for those who lose their livelihood activities. [CO] The construction phase will create job opportunities for both unskilled and skilled manpower mainly recruited within Chattogram District. In addition, procurement of materials and equipment from local retailers or wholesalers will enhance the local economy for a short period. [OP] The operation of the sewage treatment plant and sewerage system is expected to create employment opportunities for poor, unskilled workers in areas such as sludge transportation and pipeline maintenance. It is also expected to revitalize local businesses by procuring materials for equipment maintenance.
15	Ethnic minorities & indigenous peoples	N/A	N/A	[CO/OP] Existence of ethnic minorities and indigenous people is not confirmed in the project site. Thus, impact on ethnic minority and indigenous people is negligible.

Items		Phase		Impacts
		PC/ CO	OP	
16	Land use and utilization of local resources	B-	D	[CO] A portion of the land will no longer be available for grazing due to the STP construction. Since only a part of the STP site will be developed in this project, the land around the STP site remains available for grazing land. It is necessary to implement livelihood restoration programs and other measures to minimize the impact. [OP] No activities are assumed to cause impact to land use and utilization of local resources.
17	Water usage	N/A	N/A	[CO/OP] In Chattogram City, water is supplied as well as river water, pond water, and ground water are also used for their daily life. Construction and operation of the STP, including the pipeline would not use these water sources. Therefore, there would be no impact on water use. In addition, treated wastewater will be discharged to the Karnaphuli River, which is expected to have a positive impact on improving the water environment since untreated wastewater will be treated and discharged into the Karnaphuli River.
18	Existing social infrastructure and service	B-	B-	[CO] Laying pipeline by open-cut method will likely occupy one full lane of the carriage way and will cause traffic congestion. The impact is temporary and can be reduced with mitigation measures such as coordinating with local people; thus, the impact is considered of low significance. [OP] Transportation of generated sewer sludge to landfill site may cause traffic congestion in the community near the STP site. The impact can be reduced with mitigation measures such as coordinating with local people and avoiding rush hour; thus, the impact is considered of low significance.
19	Social institutions such as social infrastructure and local decision-making institutions	N/A	N/A	[CO/OP] The project activities include construction and operation of STP, thus no impact is predicted on social institutions such as social infrastructure and local decision-making institutions.
20	Maldistribution of damage and benefit	N/A	N/A	[CO/OP] The project activities are construction and operation of STP; thus, no impact is predicted that is related to maldistribution of damage and benefit.
21	Local conflict of interest	N/A	N/A	[CO/OP] The project activities are construction and operation of STP; thus, no impact is predicted concerning local conflict of interest.
22	Cultural heritage	D	N/A	[CO/OP] There is no UNESCO world heritage site and some heritage sites which are declared by CDA in Catchment-2 and Catchment-4 area. However, these heritage sites will not be affected by this project.
23	Landscape	N/A	N/A	[CO/OP] There is no landscape resource within the project site.
24	Gender	B-	B-	[CO/OP] Equal payment for same job of male and female worker/staff should be ensured.
25	Children's rights	B-	B-	[CO/OP] In order to prevent child labor and other violations of children's rights, contractors and project implementing agencies must comply with the related laws and regulations and take measures to manage and monitor workers.
26	Infectious disease and HIV/AIDS	B-	D	[CO] The influx of workers may increase the risk of COVID-19, dengue fever, and sexually transmitted diseases (STDs). Mitigation measures such as education of workers and awareness program for workers shall be conducted to reduce impact. [OP] No activities are assumed to cause impact to infectious disease and HIV/AIDS.

Items		Phase		Impacts
		PC/ CO	OP	
27	Occupational health & safety	B-	B-	[CO] Impact to workers due to exhaust gases, dust, and noise by construction in construction sites is expected. The impact can be reduced with mitigation measures such as wearing Personal Protective Equipment (PPE); thus, the impact is considered low significance. [OP] Work at STP is physically demanding and may involve hazards such as open water, trenches, slippery walkways, working at heights, energized circuits, and heavy equipment and may also involve entry into confined spaces, including manholes, sewers, pipelines, storage tanks, wet wells, digesters, etc. Mitigation measures such as using a life line and personal flotation device (PFD) and safe facility design to prevent accidental falls etc. to minimize the impact on occupational health & safety.
<b>Others</b>				
28	Accident	B-	B-	[CO] There are concerns about the risk of accidents due to unskilled workers and other errors in the use of construction machinery, and traffic accidents due to the increase in the number of construction vehicles, and accidents involving third parties who accidentally entered the yard. Mitigation measures such as education of workers and implementing traffic management plans shall be taken to minimize the risk if accident. [OP] There is concern about the risk of traffic accidents due to sludge transport and worker movement inside and around the STP site. Mitigation measures such as education of workers and implementing traffic management plan shall be taken to minimize the risk if accident.
29	Cross-border impact, climate change	D	B+	[CO] Construction period is limited and amount of GHG emission is not large, and no impact is predicted related to cross-border impact or climate change. [OP] Wastewater is a major source of nutrients and preventing nutrient influx through sewage treatment is expected to mitigate water quality deterioration caused by climate change.

Note: Project stage: PC: Pre-construction stage, CS: Construction stage, OS: Operation stage

Impact: A+/-: Significant positive/negative impact is expected.

B+/-: Positive/negative impact is expected to some extent.

D: No impact is expected.

N/A: Impact assessment isn't conducted because the items was not checked "v" in scoping phase.

Source: JICA Study Team

## 10.8 Mitigation Measures and Cost

### (1) Pre-Construction Phase

Mitigation measures in Pre-Construction Phase is shown in Table 10.8.1.

**Table 10.8.1 Mitigation Measures in Pre-Construction Phase**

No.	Items	Mitigation Measures	Implementing Organization	Responsible Organization	Cost
1	Overall	All of the necessary permits, clearances, and NOCs etc. shall be obtained before the start of construction.	CWASA	CWASA	100,000 BDT
2	Involuntary resettlement (land acquisition)	<ul style="list-style-type: none"> <li>- Land Acquisition Plan has to be prepared by the project proponent following the national legal frameworks and JICA Environmental and Social Considerations Guidelines in order to proceed appropriate compensation procedure.</li> <li>- Compensation has to be paid based on the Land Acquisition Plan prior to construction.</li> </ul>	Contractor	CWASA	Approximately 22 billion BDT  (Overall, including not only acquisition of land for JICA projects but also relocation of sites for future plans)
3	Poverty/ Livelihood/ Land use and utilization of local resources	<ul style="list-style-type: none"> <li>- Livelihood restoration plan has to be prepared by the project proponent following the national legal frameworks and JICA Environmental and Social Considerations Guidelines.</li> <li>- Livelihood restoration activities has to be started prior to construction.</li> </ul>	Contractor	CWASA	

Source: JICA Survey Team

### (2) Construction Phase

Mitigation measures during the Construction Phase is shown in Table 10.8.2.

**Table 10.8.2 Mitigation Measures in Construction Phase**

No.	Items	Mitigation Measures	Implementing Organization	Responsible Organization	Cost
1	Air quality	<ul style="list-style-type: none"> <li>- Tire cleaning prior to leaving the STP site to the public roads and streets.</li> <li>- Regular inspections of the vehicles and equipment;</li> <li>- Vehicles travelling to and from the construction site must adhere to speed limits so as to avoid producing excessive dust;</li> <li>- Cover with tarpaulin vehicles transporting soil and sand;</li> <li>- Cover stockpiled construction materials with tarpaulin or plastic sheets;</li> <li>- Trenching and transport vehicles shall move only in designated areas and roads;</li> <li>- Water spraying of access roads, camp sites and work sites to reduce dust emissions;</li> <li>- Repair and maintain access roads, as necessary;</li> <li>- Monitor air quality according to the environmental monitoring plan.</li> </ul>	Contractor	CWASA	Included in construction cost
2	Water quality	<ul style="list-style-type: none"> <li>- Provision of temporary sedimentation canal and/or silt traps along construction areas;</li> <li>- Avoid excavation work during the monsoon season;</li> <li>- Fuel and other petroleum products stored at storage areas away from water drainage;</li> <li>- For effluents from work-places, camps, and offices, provide treatment arrangements such as retention ponds and septic tanks;</li> <li>- Discharge of oil-contaminated water will be prohibited;</li> <li>- Monitor water quality according to the environmental monitoring plan.</li> </ul>	Contractor	CWASA	Included in construction cost
3	Waste	<ul style="list-style-type: none"> <li>- The contractor is required to prepare, implement, and maintain a Waste Management Plan approved by PMU throughout the construction period;</li> </ul>	Contractor	CWASA	Included in construction cost



No.	Items	Mitigation Measures	Implementing Organization	Responsible Organization	Cost
		<ul style="list-style-type: none"> <li>- Insist on waste segregation by source- organic wastes in one pot and inorganic wastes in another pot;</li> <li>- The contractor will record the quantity in tons and types of waste and materials leaving site during the construction phase;</li> <li>- Establish waste collection, transportation and disposal systems with the manpower, equipment/vehicles needed, and disposal sites approved by local authorities.</li> </ul>			
4	Soil contamination	<ul style="list-style-type: none"> <li>- Fuel, oil and other hazardous substances will be stored in adequately protected sites consistent with national and local regulations to prevent soil and water contamination;</li> <li>- Equipment/ vehicle maintenance and refueling will be confined to areas in construction sites designed to contain spilled lubricants and fuels. Such areas will be provided with drainage leading to an oil-water separator that will be regularly skimmed off of oil and maintained to ensure efficiency;</li> <li>- The contractor will identify personnel in the Waste Management Plan in charge of these sites, and ensure they are properly trained to control access to these areas; entry will be allowed only under authorization.</li> </ul>	Contractor	CWASA	Included in construction cost
5	Noise and vibration	<ul style="list-style-type: none"> <li>- Communicate the construction schedule with the neighboring sensitive receptors before starting works;</li> <li>- Generators will be located away from sensitive receivers and will be enclosed;</li> <li>- Use modern vehicles and machinery with standard adaptations to reduce noise and vibration, and ensure they are maintained to the manufacturers' specifications;</li> <li>- Optimize the use of noisy construction equipment and turn off any equipment if not in use;</li> </ul>	Contractor	CWASA	Included in construction cost

No.	Items	Mitigation Measures	Implementing Organization	Responsible Organization	Cost
		<ul style="list-style-type: none"> <li>- Regular maintenance of all equipment and vehicles;</li> <li>- Installation of soundproof sheet;</li> <li>- Measure noise level according to the environmental monitoring plan.</li> </ul>			
6	Flora/Fauna and biodiversity	<ul style="list-style-type: none"> <li>- Only trees that will require removal within the proposed construction areas of the sites will be cut;</li> <li>- For trees not proposed to be cut, taking all precautions to protect them from any damage from construction activities.</li> </ul>	Contractor	CWASA	Included in construction cost
7	Existing social infrastructure and service	<ul style="list-style-type: none"> <li>- Vehicles travelling to and from the construction site must adhere to speed limits;</li> <li>- Construction vehicles travel only on defined routes;</li> <li>- Prepare traffic management plan.</li> </ul>	Contractor	CWASA	Included in construction cost
8	Gender	<ul style="list-style-type: none"> <li>- Provide adequate toilets, separate for women and men, at the construction sites, with septic tanks;</li> <li>- A program to promote awareness of the construction workers on avoiding gender-based violence such as sexual harassment;</li> <li>- The contractor will make sure that no discrimination is made on the basis of gender while hiring workers in order to provide equal opportunity and fair treatment;</li> <li>- Provide safety training;</li> <li>- Provision of personal protective equipment appropriate to body size;</li> <li>- Establishment of a complaints desk for women;</li> <li>- Conducting educational activities (including promotion of employment of women) and training for gender equality.</li> </ul>	Contractor	CWASA	Included in construction cost

No.	Items	Mitigation Measures	Implementing Organization	Responsible Organization	Cost
9	Children's rights/ Consideration on disabled person	<ul style="list-style-type: none"> <li>- Prohibition of forced and children labor;</li> <li>- Compliance of Bangladesh legislation related to labor;</li> <li>- Conduct educational activities for workers on the prohibition of discrimination on the basis of disability;</li> <li>- Considering proactive employment of people with disabilities for minor tasks such as cleaning and miscellaneous office work;</li> <li>- Assign personnel or establish a system to assist people with disabilities in order to provide them with the physical and mental care they need in their work;</li> <li>- Consideration for means of communication with persons with disabilities (substitute reading of documents, substitute writing, written communication, sign language, explanation in easy-to-understand language, etc.);</li> <li>- Ensure occupational safety for persons with disabilities.</li> </ul>	Contractor	CWASA	Included in construction cost
10	Infectious disease and HIV/AIDS	<ul style="list-style-type: none"> <li>- Provide regular health check-ups, sanitation and hygiene, health care, and control of epidemic diseases to the workforce;</li> <li>- Launch awareness programs and training concerning human trafficking and the possibility of spread of sexually transmitted diseases (STDs) and HIV/AIDS using brochures, posters, and signboards;</li> <li>- Prepare the health and safety guidance for COVID-19 at work sites;</li> <li>- Ensure sufficient stock of soap, sanitizer, washing facility and safe water at the workers' dwellings (both camp site and home);</li> <li>- Clean water hole around accommodation and construction site and protect workers from mosquitos using mosquito fogger and mosquito coil to avoid spreading dengue fever.</li> </ul>	Contractor	CWASA	Included in construction cost

No.	Items	Mitigation Measures	Implementing Organization	Responsible Organization	Cost
11	Occupational health and safety	<ul style="list-style-type: none"> <li>- Provide personal protective equipment (PPE) to all the laborers working at the construction site such as ear-muffs/protective hearing equipment, mask, gloves and hard shoes;</li> <li>- Training on how and when to use PPEs shall be conducted and ensure everyone entering the worksite must wear PPE;</li> <li>- A proper occupational health and safety plan has to be prepared referring relevant regulation and guidelines such as the Bangladesh Labor Act, 2006, WHO guidelines and World Bank EHS Guidelines and will have to be followed to avoid health hazard of the workers;</li> <li>- At every workplace, a readily available first aid unit and nursing staff;</li> <li>- Compensation for the loss of life (a zero tolerance to loss of life policy should be developed and implemented) or for any type of injuries;</li> <li>- Provide insurance to the workers;</li> <li>- Provide safe drinking water in sufficient quantity for the workforce at the construction site as well as at the construction camps.</li> </ul>	Contractor	CWASA	Included in construction cost
12	Accidents	<ul style="list-style-type: none"> <li>- Vehicles travelling to and from the construction site must adhere to speed limits;</li> <li>- Construction vehicles travel only on defined routes;</li> <li>- Installation of measures to prevent crashes and falls;</li> <li>- Installation of fences and sign boards to prevent third parties from accidentally entering the yard;</li> <li>- Provide training for workers on the proper use of machinery and safety management;</li> <li>- Prepare traffic management plan.</li> </ul>	Contractor	CWASA	Included in construction cost

Source: JICA Survey Team

**(3) Operation Phase**

Mitigation measures in the operation phase is shown in Table 10.8.1.

**Table 10.8.3 Mitigation Measures in Operation Phase**

No.	Items	Mitigation Measures	Implementing	Responsible Organization	Cost
1	Water quality	Monitoring water quality in discharge point of treated water	CWASA	CWASA	60,000 BDT/month
2	Noise and vibration	- Optimize the use of noisy facilities and turn off any equipment if not in use; Regular maintenance of all equipment and vehicles.	CWASA	CWASA	-
3	Offensive odor	Installation of deodorization facility	CWASA	CWASA	-
4	Gender	- Provide adequate toilets, separate for women and men, at the construction sites, with septic tanks; - A program to promote awareness of the construction workers on avoiding gender-based violence such as sexual harassment; - The contractor will make sure that no discrimination is made on the basis of gender while hiring of workers such as equal opportunity and fair treatment; - Provide safety training; - Provision of personal protective equipment appropriate to body size; - Establishment of a complaints desk for women; Conducting educational activities (including promotion of employment of women) and training for gender equality.	CWASA	CWASA	-
5	Children's rights/ Consideration on disabled person	- Prohibition of forced and children labour; - Compliance of Bangladesh legislation related to labour; - Conduct educational activities for workers on the prohibition of discrimination on the basis of disability; - Considering proactive employment of people with disabilities for minor tasks such as cleaning and miscellaneous office work;	CWASA	CWASA	-

No.	Items	Mitigation Measures	Implementing	Responsible Organization	Cost
		<ul style="list-style-type: none"> <li>- Assign personnel or establish a system to assist people with disabilities in order to provide them with the physical and mental care they need in their work;</li> <li>- Consideration for means of communication with persons with disabilities (substitute reading of documents, substitute writing, written communication, sign language, explanation in easy-to-understand language, etc.);</li> </ul> <p>Ensure occupational safety for persons with disabilities.</p>			
6	Occupational health and safety	<ul style="list-style-type: none"> <li>- Workers must be trained to understand potential hazards, proper work procedures, appropriate emergency evacuation procedures, and appropriate use of PPEs;</li> <li>- First aid facilities required to immediately attend to meeting emergency situations will be made available at the facility;</li> </ul> <p>Use specially trained personnel to demount electrical parts.</p>	CWASA	CWASA	50,000 BDT/month
7	Accident	<ul style="list-style-type: none"> <li>- Vehicles will be parked inside the facility premises in the designated slots;</li> <li>- Entry and exit routes from the premises will be clearly marked;</li> <li>- Adequate lighting and reflective boards will be put up for night-time safety;</li> </ul> <p>All routes will be planned to cause minimal disturbance to local community.</p>	CWASA	CWASA	50,000 BDT/month

Source: JICA Survey Team

### 10.9 Monitoring Plan

Monitoring plan is shown in Table 10.9.1.

**Table 10.9.1 Monitoring Plan**

Environmental Item	Items	Location	Frequency	Responsible Agent	Supervisor	Cost
<b>Pre-Construction</b>						
Social Environment (Land Acquisition/ Resettlement/ Livelihood Restoration)	Land Acquisition/ Resettlement/ Grievance	STP	Once a Week	CWASA	CWASA	-
<b>Construction Phase</b>						
All	Visual check to confirm the implementation of mitigation measures	Construction sites	Daily	Contractor	Consultant/CWASA	Included in the construction cost
Air quality	PM <sub>10</sub> , PM <sub>2.5</sub> , SO <sub>2</sub> , CO, NO <sub>2</sub> , Pb	4 locations around construction sites	Once a month	Contractor	Consultant/CWASA	Included in the construction cost
Water quality	Temperature, pH, DO, BOD, Nitrate, Ammonium, Phosphate, Total Cr, Hg, Coliform, TDS, COD, SS	Bolihat Canal and Karnaphuli River	Once a month	Contractor	Consultant/CWASA	Included in the construction cost
Waste	Types and amount of solid waste	Waste collection point	Once every three-month or collection period	Contractor	Consultant/CWASA	Included in the construction cost
Soil contamination	Spilled fuel	Construction sites	Daily	Contractor	Consultant/CWASA	Included in the construction cost
Noise and vibration	Sound level and vibration.	7 locations around construction sites	Once a month	Contractor	Consultant/CWASA	Included in the construction cost
Flora/Fauna	Confirmation of implementation status, Visual check	Construction sites	If necessary	Contractor	Consultant/CWASA	Included in the construction cost

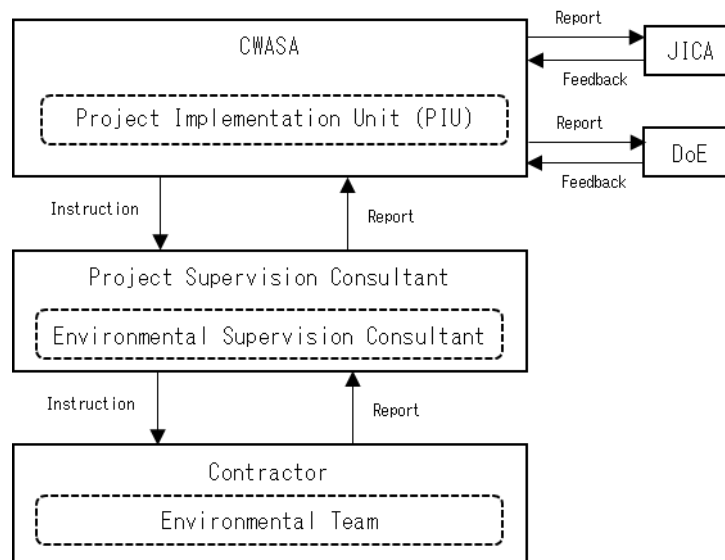
Infectious diseases such as HIV/AIDS	Visible observation, interview, grievance records, record of education	Construction sites	Once a month	Contractor	Consultant/CWASA	Included in the construction cost
Gender	Grievance from women	-	Once a month	Contractor	Consultant/CWASA	Included in the construction cost
Occupational health and safety	Visible observation, interview, grievance records, record of education, record of safety patrol, sign boards	Construction sites	Once a month	Contractor	Consultant/CWASA	Included in the construction cost
Accident	Record of accident, record of education, sign boards	Construction sites and surrounding areas	Once a month, on demand	Contractor	Consultant/CWASA	Included in the construction cost
<b>Operation Stage</b>						
Water quality	Temperature, pH, DO, BOD, Nitrate, Ammonium, Phosphate, Total Cr, Hg, Coliform, TDS, COD	Bolihat Canal and Karnaphuli River	Once a month	CWASA	CWASA	60,000 BDT/month
Waste	Amount of sewer sludge and hazardous waste	Waste collection point	Once every three-month or collection period	Contractor	Consultant/CWASA	Included in the construction cost
Odor	Grievance on odor	-	Once a month	CWASA	CWASA	50,000 BDT/month
Gender	Grievance from women	-	Once a month	CWASA	CWASA	50,000 BDT/month
Occupational health and safety	Visible observation, interview, grievance records, record of education, record of safety patrol, sign boards	STP	Once a month	CWASA	CWASA	50,000 BDT/month
Accident	Record of accident, record of education, sign boards	STP	Once a month, on demand	CWASA	CWASA	50,000 BDT/month

Source: JICA Survey Team



### 10.10 Implementation Structure

CWASA is a responsible organization of the monitoring which is conducted by the contractor based on the instruction of the consultant. Results of monitoring is submitted from CWASA to DoE and JICA. Feedback will be sent from DoE and JICA to CWASA, if necessary. The implementation structure is shown in Figure 10.10.1.



Source: JICA Survey Team

**Figure 10.10.1 Implementation Structure**

### 10.11 Grievance Mechanism

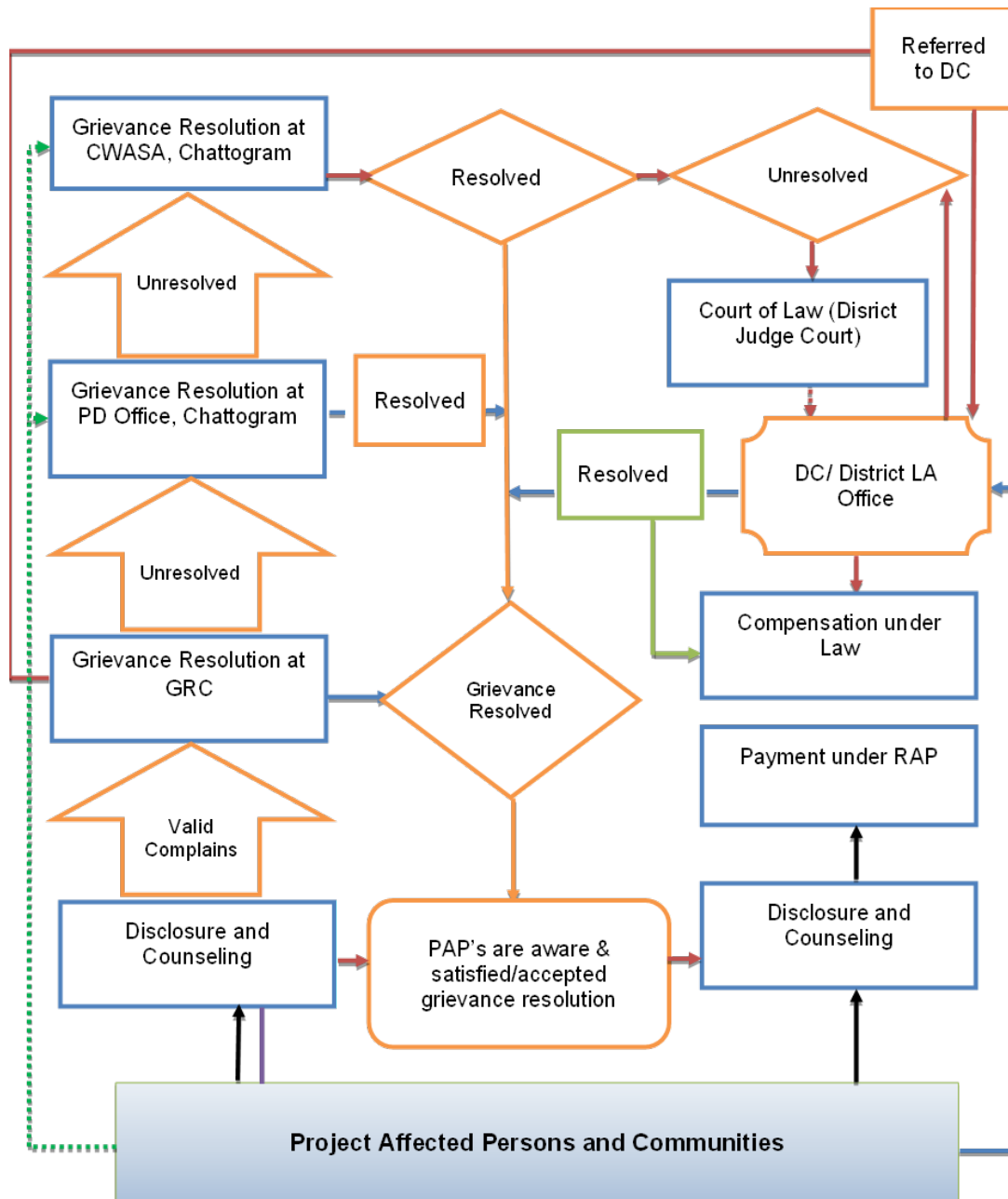
The grievance mechanism operates in the following manner:

- i. After receiving the complaints/grievances, the Grievance Redress Committee (GRC) will review, consider, and resolve grievances related to social/resettlement issues during implementation, as received by the committee.
- ii. Ideally, grievances should be resolved on the first day of the hearing. More complicated cases that require further investigation should be resolved within one month.
- iii. The GRC will also review grievances of individuals who have been indirectly or directly displaced during the project's implementation.
- iv. The GRC will not review the legal status of an "awardee" beyond matters of direct loss or the distribution of acquired property among legal owners, compensation, or entitlement issues.
- v. Ideally, the GRC will arrive at decisions through consensus. If consensus cannot be reached, decisions will be based on a majority vote. All decisions must relate to land acquisition, resettlement, and resettlement-related social issues.

- vi. The GRC will not address matters that are currently before a court of law. However, if both parties agree in writing, the GRC can mediate, and the parties will withdraw the litigation.
- vii. At least three members must be present for a GRC meeting to be considered valid.

GRC members will consist of local level (CWASA staff, ward counselor, and resident representatives) and project level (CWASA project director, CWASA environmental and social considerations staff, and NGO/company team leaders). Meetings will be held in the convener's field office or at another location agreed upon by committee members. If necessary, GRC members may conduct field visits to verify and review issues in dispute, such as title/share disputes or payment delays. All travel, meeting, and sitting costs will be covered by CWASA.

The RAP project will ensure that PAPs can raise their complaints without fear of intimidation. If necessary, the RAP IA will help them draft their grievances, which must be submitted in writing or via SMS/email to the GRC Chair. The complainant may represent themselves or appoint an agent, such as a locally elected representative or legal advisor. The GRC's decision will be communicated in writing, and if dissatisfied, the PAP can request a review by the PD. If still dissatisfied, the RAP can seek resolution from the court of law. The GRC's procedures and rules will be widely publicized in the local language through community meetings and pamphlets. All GRC documents will be maintained by the RAP IA, and the CWASA Head Office will act as the Secretariat to the GRC. The flow of the grievance mechanism is shown in Figure 10.11.1.



Source: JICA Survey Team

Figure 10.11.1 Flow of Grievance Mechanism

### 10.12 Stakeholder Consultation Meeting

Stakeholder consultation meeting was held on December 29, 2022 (1st stakeholder meeting) and on 20 March 2023 (2nd stakeholder meeting) at the Orchid Community Center. An estimated 90 people (76 men and 14 women) in the 1st stakeholder meeting and 85 people (71 men and 14 women) in the 2nd stakeholder meeting attended. The purpose of the consultations was to introduce and explain the project, collect opinions from stakeholders, provide a forum for presenting opinions and avoiding conflicts among stakeholders, increase trust among them, and create their sense of ownership of the project.

Stakeholders were organized as shown in Table 10.12.1, and invitations were sent one week before the implementation date.

**Table 10.12.1 Identification of Stakeholders**

No.	Stakeholder Group/Category	Key Stakeholders	Description of the Stakeholder Profile
<b>Affected Parties</b>			
1	Project Affected Persons (PAPs)	<ul style="list-style-type: none"> <li>- Physically displaced people</li> <li>- Economically displaced people</li> <li>- Impacted land users</li> <li>- Impacted landowners</li> <li>- Community Property Resources (CPR)</li> </ul>	<ul style="list-style-type: none"> <li>- Landowner whose land will be acquired for the implementation of the project.</li> <li>- Both physically and economically displaced persons</li> <li>- Land users who are residing in the project area and grazing land for livestock used by the community.</li> </ul>
<b>Interested Parties</b>			
2	Institutional Stakeholders	<ul style="list-style-type: none"> <li>- Regulatory Authorities</li> <li>- Local Administration- City Corporation</li> <li>- DC office</li> </ul>	This stakeholder group is a regulatory authority at the district and national level that are responsible for various permits and licenses pertaining to the project.
3	Ownership	<ul style="list-style-type: none"> <li>- Project Owner</li> <li>- EPC</li> </ul>	This stakeholder is responsible for the whole project implementation
4	Project Financing Agencies/ Institutions	Financiers and Investors	This stakeholder includes Japan International Cooperation Agency (JICA) who is evaluating the potential investment opportunity into the Project.
5	Local Community	<ul style="list-style-type: none"> <li>- Local community residing near the project footprint</li> <li>- Labor of existing plant from the local community</li> </ul>	<ul style="list-style-type: none"> <li>- This stakeholder group comprises of the community residing near the vicinity of the project area.</li> <li>- This group is expecting to be directly or indirectly impacted by the Project activities.</li> </ul>
6	Institutional Stakeholders	<ul style="list-style-type: none"> <li>- Department of Agriculture</li> <li>- Department of Fisheries</li> </ul>	These stakeholder groups will have expertise for different sectors and will provide inputs and information which are crucial for the project design and implementation.
7	Secondary stakeholder	<ul style="list-style-type: none"> <li>- Local NGOs</li> <li>- Civil Societies</li> </ul>	This stakeholder group is important for getting input or information during project implementation.

Source: JICA Survey Team

The summary of the stakeholder consultations is shown in Table 10.12.2.

**Table 10.12.2 Summary of Stakeholder Consultation**

Issue Raised	Commentor	Comments	Response
<b>1st Stakeholder Meeting</b>			
Environmental Pollution	Shekhar Barua, Assistant Manager, One Bank	As it is a STP project, living next to the plant will be extremely difficult due to the bad odor.	In order to measure and mitigate the problem, a proper survey and study will be conducted in the area.
Resettlement Action Plan	Asutosh Barua, Service Holder, President of Buddha Mandir Management Committee	In the Buddhist area, there is a lack of basic necessities such as gas, water, and communication. Since the project will acquire the Buddhist area (Barua Para), please relocate the people to a location where they can easily access these facilities.	All of these points have been noted and will be incorporated into the study report for future consideration.
	Prokash Dewanji, Community Representative	What is the procedure for distributing the compensation for affected land, structures, and trees?	The procedure will be determined by the DC office, and will be informed timely as and when required.
Fishing and Fish Culturing	Md. Wahidur Rahman, Senior Assistant Director, District Fisheries Office, Chattogram.	Will the project have an impact on local fish culture?	The problem will be identified and possible mitigation measures will be shared if it is impacted in the feasibility study.
Employment Opportunities	Md. Wahidur Rahman, Senior Assistant Director, District Fisheries Office, Chattogram.	Local people should be given preference in terms of employment prospects.	The locals, depending on their ability and skills, will be given opportunity to work in the project and it will be included in the report.
<b>2nd Stakeholder Meeting</b>			
Environmental Pollution	Shekhar Barua, Assistant Manager, One Bank	As this is an STP project, there is a significant concern regarding air pollution. During the construction phase, it is important to be aware that living in close proximity to the project site may not be feasible.	To mitigate air pollution, advanced technologies will be utilized throughout the construction phase. Additionally, CWASA and JICA will closely monitor the situation to prevent any related issues from arising.
	Asutosh Barua, Service Holder,	He expressed that the Buddhist Community,	Advanced technologies will be implemented by

	President of Buddha Mandir Management Committee	residing in this area for over 250 years, lacks access to basic amenities such as gas and water. He also raised concerns regarding the potential generation of unpleasant odors during the project's operational phase.	CWASA to maintain an odorless environment. Therefore, CWASA will monitor the operational phase to prevent the spread of unpleasant odors to the surrounding areas and address any related issues as necessary.
Resettlement Action Plan	Biplab Barua, Community Representative	In the event that they are required to vacate the area due to land acquisition, what is the process for obtaining compensation?	The procedure will be determined by the DC office and will be informed timely as and when required.
Employment Opportunities	Chandan Barua, Community Representative	The individuals residing in the vicinity of the project area are encountering various challenges, and they are seeking employment opportunities from the project.	Opportunities to work on the project will be extended to the locals based on their abilities and skills, and this will be documented in the report.

Source: JICA Survey Team

### 10.13 Study of Climate Change

The following effects of the Project on the countermeasures against climate change are estimated with reference to the "JICA Climate Finance Impact Tool" named JICA Fit" and the "Manual on Global Warming Countermeasures in Sewerage Systems" (Ministry of the Environment and Ministry of Land, Infrastructure, Transport and Tourism, Japan).

#### (1) Reduction of Greenhouse Gases by Effective Treatments of Sewage and Sludge (Mitigation)

CO<sub>2</sub> is emitted from STP because wastewater treatment facilities and sludge treatment facilities require huge amounts of electricity. According to the "Manual on Global Warming Countermeasures in Sewerage Systems", especially blower equipment for aeration tank consume 46% electricity of the whole STP. Therefore, if an energy-saving blower equipment is utilized for the aeration tank, electricity consumption and CO<sub>2</sub> emission can be reduced. Table 10.13.1 shows the result of trial calculation of the effect of energy-saving equipment on the reduction of CO<sub>2</sub> emission from the STP. With the energy-saving equipment in sewage treatment facilities and sludge treatment facilities in STP, 17% of CO<sub>2</sub> emission from STP can be reduced.

**Table 10.13.1 Effect of Energy-Saving Equipment on Reduction of CO<sub>2</sub> Emission from STP**

(Conditions) Sewage treatment method: Advanced (A2O), Capacity of STP: 300,000 m<sup>3</sup>/day

Equipment	Without Countermeasure		Effect of Countermeasure (Reduction ratio) (%)	With Energy-Saving Equipment	
	Electricity Consumption (1,000kW/year)	CO <sub>2</sub> Emission (t-CO <sub>2</sub> /year)		Electricity Consumption (1,000kW/year)	CO <sub>2</sub> Emission (t-CO <sub>2</sub> /year)
Blower	15,924	8,408	25	11,943	6,306
Stirrer of reactor	5,007	2,644	81	927	489
Mechanical sludge thickener	3,678	1,942	35	2,403	1,269
Sludge dehydrator	636	336	25	477	282
Other equipment	14,124	7,457	-	14,124	7,457
Total	39,369	20,787	24	29,874	15,803

Source: Calculated by JICA Survey Team based on the "Manual on Global Warming Countermeasures in Sewerage Systems" and JICA Climate-FIT

**(2) Reduction of Effluent of Dissolved Organic Carbon by Collection and Treatment of Sewage (Adaptation)**

According to "JICA Climate Fit", the increase of dissolved organic carbon (DOC) is listed as the climate risk in the sewerage sector. Currently, there is no sewerage system to collect and treat the sewage in Catchment-2 and Catchment-4, therefore, untreated domestic and commercial wastewater are discharged to public water bodies without any treatment.

However, in this project for the development of sewerage system in the Catchment-2 and Catchment-4, the sewerage system consisting of the STP, pumping station, sewer network and house connection will be developed that can meet the Bangladesh effluent standard. The BOD load generated by domestic wastewater in whole Catchment-2 and Catchment-4 in 2035 is described as the following result of trial calculation in Table 10.13.2.

**Table 10.13.2 Discharged BOD Load of Whole Catchment-2 and Catchment-4 Expected in 2035**

Ratio of Population to be Served by Sewerage System	Discharged BOD Load	Reduction Ratio
0 % (Current condition)	37,500 kg/day	0 %
100 %	7,100 kg/day	81 %
50 %	22,500 kg/day	40 %
30 %	28,500 kg/day	24 %

Source: JICA Survey Team

After the completion of sewerage system in the whole Catchment-2 and Catchment-4, 81% of BOD load to be discharged to public water bodies can be reduced.

### (3) Analysis Based on JICA Climate-Fit (Adaptation)

#### 1) Forecast of Climate Change

According to the “World Bank, Climate Change Knowledge Portal”, the average temperature of Bangladesh is forecasted to increase 1.2 – 1.9 °C by 2060 and 1.3 – 3.9 °C by 2090. Currently, it is difficult to forecast the change of rainfall specifically, however, the occurrence frequency of heavy rain in rainy season is forecasted to increase due to the temperature increase.

#### 2) Matrix of Climate Risk

The items related to the Project including 1) Climate hazard, 2) Current occurrence frequency, 3) Items that may be exposures in the Project, 4) Evaluation of the item that has already occurred, 5) Directionality of future change of the target climate hazard are summarized in Table 10.13.3.

**Table 10.13.3 Matrix of Climate Risk of the Project**

		Climate hazard			
		H1 Water temperature raise	H2 Sea level rise	H3 Flood	H4 Heavy rain
		Current occurrence frequency	+	+	+
Directionality of future change	↗	↗	↗	↗	
Exposure	E1 STP	0	0	1	1
	E2 Inflowing sewage	0	0	0	0
	E3 Water quality of existing water channel	1	0	0	0
	E4 O&M structure of STP	0	0	0	0

Source: JICA Survey Team

As above described, four items of climate hazards (H1 – H4) and four items of exposures are proposed.

Since currently CWASA does not own and operate the sewerage system, there is no visible impact as of this moment. Moreover, most of water supply facilities operated and maintained by CWASA are not affected frequently by the climate hazards. Therefore, the evaluation of E3 to H1 and the evaluation of E1 to H2 are regarded as point 1 and other evaluations are regarded as point 0.

On the other hand, each climate hazard is forecasted to increase in the future.

#### 3) Climate Risk That May be Serious in the Future

The climate risk that may be serious in the future is summarized in Table 10.13.4, which is based on the combination of climate hazard to watch out and exposure and the vulnerabilities of target exposures.



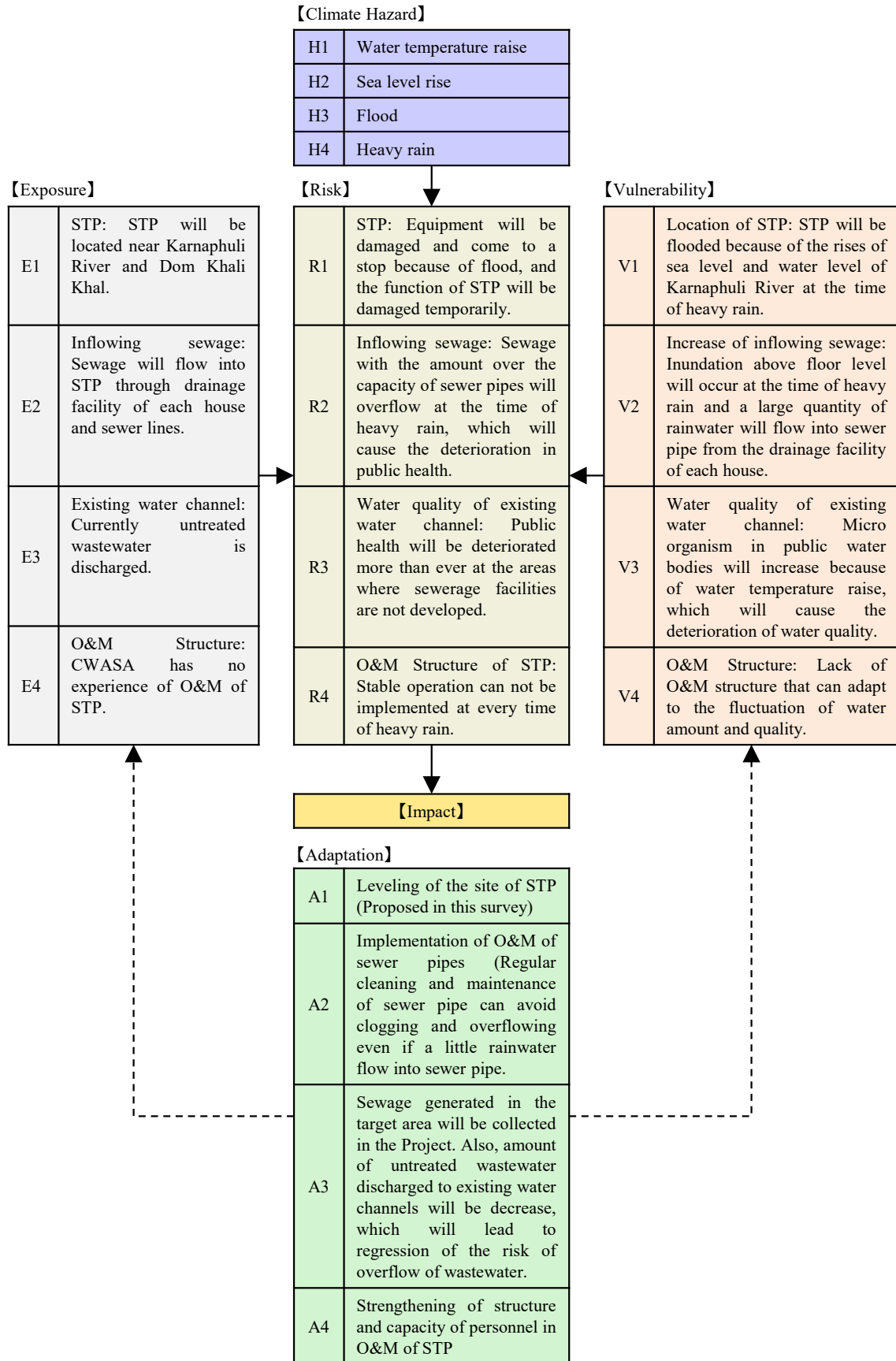
**Table 10.13.4 Climate Risk in the Project That May be Serious in the Future**

	(A)	(B)	(C)
	Combination of climate hazard to watch out and exposure	Vulnerability to cause the occurrence of climate risk	Climate risk that may be serious in the future
1	H2 (Sea level rise), H3 (Flood), H4 (Heavy rain) + E1 (STP)	Location of STP, elevation (STP will be flooded because of the rises of sea level and water level of Karnaphuli River at the time of heavy rain.)	H2 (Sea level rise), H3 (Flood), H4 (Heavy rain) + E1 (STP) Equipment will be damaged and come to a stop because of flood, and the function of STP will be damaged temporarily.
2	H4 (Heavy rain) + E2 (Inflowing sewage)	Increase of inflowing sewage (Inundation above floor level will occur at the time of heavy rain and a large quantity of rainwater will flow into sewer pipe from the drainage facility of each house.)	H4 (Heavy rain) + E2 (Inflowing sewage) Sewage with the amount over the capacity of sewer pipes will overflow at the time of heavy rain, which will cause the deterioration in public health.
3	H1 (Water temperature raise) + E3 (Water quality of existing water channel)	Water quality of existing water channel (Micro organism in public water bodies will increase because of water temperature raise, which will cause the deterioration of water quality.)	H1 (Water temperature raise) + E3 (Water quality of existing water channel) Public health will be deteriorated more than ever at the areas where sewerage facilities are not developed.
4	H4 (Heavy rain) + E4 (O&M structure of STP)	O&M Structure (Lack of O&M structure that can adapt to the fluctuation of water amount and quality.)	H4 (Heavy rain) + E4 (O&M structure of STP) Stable operation can not be implemented at every time of heavy rain.

Source: JICA Survey Team

#### 4) Tree of Climate Risk

The tree of climate risk is described in Figure 10.13.1, which is based on the climate risk that may be serious in the future.



Source: JICA Survey Team

Figure 10.13.1 Tree of Climate Risk of the Project

## CHAPTER 11 ECONOMIC AND FINANCIAL ANALYSES

### 11.1 General Assumptions

#### 11.1.1 General Assumptions

Economic analysis and financial analysis of the Project are presented in this chapter. General assumptions applied to the analyses are summarized in Table 11.1.1. Total evaluation period is set at 47 years including 40 years of operation period considering the manual issued by the Japan International Cooperation Agency (JICA). Standard conversion factor at 0.9 and social discount rate at 10%, which are popular values, are used in the feasibility study of international institutes including JICA.

**Table 11.1.1 General Assumptions of Economic and Financial Analyses**

Items	Assumptions	Note
Project Scope	Construction of STP-2&4 and related sewer network	
With-Project and Without-Project	With-Project: STP-2&4 and related sewer pipeline are constructed and operated Without-Project: STP-2&4 and related sewer pipeline are not constructed	
Evaluation Period	2024 - 2070, 47 years Construction: 2024 - 31 (8 years) Operation: 2031 - 2070 (40 years)	30-40 years (IRR Calculation Manual, JICA 2017)
Exchange Rate	USD/BDT 101.0 BDT/JPY 1.31	February 2023
Standard Conversion Factor	0.9	Generally used value for feasibility study funded by international institutes
Social Discount Rate	10.0%	Popular value used for feasibility study of international institutes
WACC (Weighted Average Rate of Return)	1.00%	CWASA's general interest rate of loan borrowed from MOF

Source: JICA Survey Team

#### 11.1.2 Sewage Treatment Volume

The operation of the sewage treatment plant (STP) starts in 2031, and the annual treated amount is assumed to be stable at the design capacity level (60,000m<sup>3</sup>/day) throughout the operating period.

#### 11.1.3 Project Cost

##### (1) Capital Investment Cost

The financial cost and its disbursement schedule in the project are estimated as shown in Table 11.1.2, excluding transaction costs of taxes and price contingency from Table 9.4.1 and Table 9.4.2. The land acquisition cost is also excluded following the conditions in JICA manual. The economic cost, which is

used for economic analysis, is also calculated by multiplying the standard conversion factor at 0.9 to the local currency portion of the financial cost.

**Table 11.1.2 Estimated Capital Investment Cost**

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**(2) O&M Cost**

Financial and economic costs of annual operation and maintenance (O&M) cost to treat the capacity amount are estimated as shown in the table (breakdown is shown in Table 9.5.1).

**Table 11.1.3 Annual O&M Cost of the Project**

	Treatment Amount (m <sup>3</sup> /day)	Unit Cost (BDT/m <sup>3</sup> )	Annual Cost (BDT million/year)
Financial Cost	60,000	33.0	723
Economic Cost	60,000	29.7	651

Source: JICA Survey Team

**(3) Replacement Cost of Equipment**

Replacement cost of the equipment worth BDT 2,757 million is added every 15 years in 2046 and 2061. The same cost is used for financial cost and economic cost assuming all costs are procured from abroad (foreign currency portion).

**(4) Residual Value**

Residual value of constructed facilities and equipment is added in the final year of the evaluation. Life period of the STP and pipe network is assumed at 50 years, and that of equipment is assumed at 15 years.

**11.2 Financial Analysis**

In this section, financial feasibility of the project is evaluated comparing the projected revenue and estimated financial costs of the project. The analysis is implemented focusing into the project area, and the projects in other area are excluded from the evaluation.

**11.2.1 Revenue Projection**

Revenue is projected based on the assumptions indicated in the table. Sewerage tariff relevant to 100% of the current water tariff (Residential BDT 18.0/m<sup>3</sup>, Non-residential BDT 37.0/m<sup>3</sup>) is assumed to be charged in addition to the water tariff every month following the regulation of Statutory Regulatory Order (SRO) No. 91-Act/2011 as prescribed in Section 2.4.1(1).

**Table 11.2.1 General Assumptions of Revenue Projection**

Indicators	Assumptions
Sewerage Tariff Level	Sewerage tariff is the same level as the water tariff. The billed amount is determined according to the water consumption.
Starting Time	CWASA starts charging sewerage tariff in 2031 after the operation of STP Catchment-2&4 starts. Tariff revenue is estimated to start without delay after the operation as the connection works of household are included in the project scope, and users can connect to the service smoothly free of charge.
Tariff Increase Rate	Base case (no tariff increase) and three alternative cases (Increase rate: 2%, 4%, 6% /year, respectively)
Price Escalation	Not considered for financial analysis
Collection Rate	92.6% (average collection rate from 2014/15 to 2021/22, refer to Table3.2.4)

Source: JICA Survey Team

Billed water amount in the project area is estimated as shown in Table 11.2.2. The treatment amount does not change during operation period as the projected treatment amount exceeds the capacity of the STP. Annual revenue amount is calculated at BDT 410.3 million multiplying the collection rate at 92.6% to the total billing.

**Table 11.2.2 Current Tariff Rate and Estimated Charged Water Amount**

Billed amount	Tariff rate (BDT/m <sup>3</sup> )	2031-2064	Share
Domestic	18.0	49,200 m <sup>3</sup> /day	84.9%
Non-domestic	37.0	5,100 m <sup>3</sup> /day	8.7%
New Non-domestic	37.0	3,700 m <sup>3</sup> /day	6.4%
Total	20.9 (average)	58,000 m <sup>3</sup> /day	100%
Revenue of Base Case	BDT 410.3 million (collection rate: 92.6%)		

Source: JICA Survey Team

In addition to the base case, of which tariff increase is not considered, the following three alternative cases of tariff increases are calculated. For project-based financial analysis, price escalation on costs and revenue are ignored in the calculation. The assumed tariff increase means the real tariff increase in addition to the tariff adjustment for price escalation as conducted every year.

- Base Case: Current tariff level is retained
- Alternative 1: Tariff increase by 2.0% every year after 2023
- Alternative 2: Tariff increase by 4.0% every year after 2023
- Alternative 2: Tariff increase by 6.0% every year after 2023

**Table 11.2.3 Estimated Sewerage Tariff Revenue**

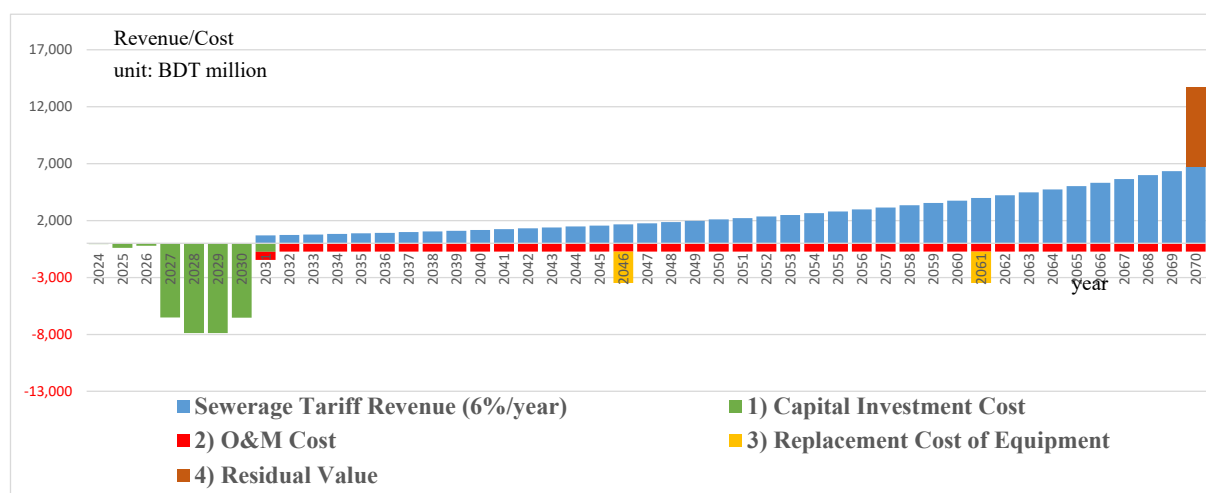
(Unit: BDT million)

Billed Amount	2031	2040	2050	2060
Revenue of Base Case	410.3	410.3	410.3	410.3
Revenue of Alternative 1 (+2%/year)	490.3	586.0	714.3	870.8
Revenue of Alternative 2 (+4%/year)	584.0	831.2	1,230.4	1,821.2
Revenue of Alternative 3 (+6%/year)	693.2	1,171.1	2,097.3	3,756.0

Source: JICA Survey Team

### 11.2.2 Result of Financial Analysis

The revenue and cost flow under Alternative 3 Case (+6%/year) during the evaluation period is shown in Figure 11.2.1.



Source: JICA Survey Team

**Figure 11.2.1 Revenue and Cost Flow under Alternative 3 Case (+6%/year)**

Financial internal rate of return (FIRR), benefit-cost ratio (B/C), and financial net present value (FNPV) are calculated under the base case and three alternative cases as shown in Table 11.2.4. Detailed calculations of the four cases are attached in Appendix 3. B/C and FNPVs are calculated using a discount rate at 1.0%, which is the Chattogram Water Supply and Sewerage Authority (CWASA) interest rate of loans borrowed from the Ministry of Finance (MOF).

FIRR values could not be obtained under three cases as revenues are much lower than the O&M costs. The FIRR under Alternative 3 case (+6%/year) is 3.1%. The B/C ratio varies from 0.25 to 1.51. FNPV values become – BDT 37,919 million to BDT 25,917 million. The B/C ratio, excluding capital expenditure (CAPEX), is also calculated to know the tariff level which could cover the usual operational costs. The B/C values without CAPEX become 0.57 to 3.50.

**Table 11.2.4 Result of Financial Analysis**

Revenue Alternatives	FIRR	B/C	FNPV (BDT million)	B/C without CAPEX
Base Case	n.a.	0.25	-37,919	0.57
Alternative1 (+2%/year)	n.a.	0.44	-28,393	1.01
Alternative2 (+4%/year)	n.a.	0.80	-10,094	1.85
Alternative3 (+6%/year)	3.1%	1.51	25,917	3.50

Source: JICA Survey Team

From the above evaluation, it became clear that the project is financially feasible only in case the sewerage tariff level could increase at 6% every year (Alternative 3), as the FIRR surpasses the weighted

average cost of capital (WACC) (1.0%), and B/C is more than 1. Whereas, the project is not financially feasible under the Base Case, and Alternatives 1 and 2, if subsidy is not provided.

The necessary subsidy amounts at 2025 price level to balance the revenue and cost are shown as the FNPV under each case, which are BDT 37,919 million, BDT 28,393 million and BDT 10,094 million, under Base Case, Alternative 1 and Alternative 2, respectively.

Values of “B/C without CAPEX” shows the ability to pay the O&M cost of the Project. If tariff is increased more than 2.0% every year, the value is higher than 1.0, and it means tariff revenue is larger than the sum of the O&M cost and replacement cost of equipment.

To make the project financially sustainable, the JICA Survey Team suggests for CWASA to increase tariff level by at least 2.0%/year in average to cover the O&M cost in the short term. In addition, as a long-term target, CWASA needs to increase the tariff by 6.0%/year to achieve full cost recovery of the sewerage project as monitoring the affordability and willingness to pay of users carefully as the economy growth in the project area.

### 11.3 Economic Analysis

In this section, economic and social feasibility of the project is evaluated by comparing the economic costs and quantified economic benefits of the project.

#### 11.3.1 Potential Economic Benefits

The potential benefits induced by the project implementation is itemized in Table 11.3.1. For economic analysis of the project, all four benefits are quantified.

**Table 11.3.1 Potential Economic Benefits of the Project**

Potential Benefits	Explanation	Quantified	Not quantified
1) Improvement of sewerage service	Better hygiene and sanitary condition contribute to the better living conditions of service users. This benefit is quantified by calculating the Willingness to Pay (WTP) and Affordability to Pay (ATP) of beneficiaries.	x	
2) Medical cost reduction	Illness in the project area will be reduced, and medical costs is saved as influence of the project.	x	
3) Reduction of cleaning costs of septic tanks	The current cost for cleaning septic tank could be saved if the sewer network is installed.	x	
4) Land price escalation around the project area	Land price can be increased as the living condition is improved in the project area.	x	

Source: JICA Survey Team

### 11.3.2 Benefit of Improvement of Sewerage Service

The living welfare in the project area will be improved as the sewerage water is treated and drained properly and the living area is kept cleaner. The JICA manual<sup>1</sup> recommends calculating the value of this benefit using the user's WTP (Willingness to Pay) and ATP (Affordability to Pay). Benefit is quantified according to the following formula using both WTP and ATP in this study.

Benefit of Improved Sewerage Service = "Incremental Water Amount (m<sup>3</sup>/year)" x "WTP or ATP (BDT/m<sup>3</sup>)"

- Incremental Water Amount: 21.2 million m<sup>3</sup>/year (58,000 m<sup>3</sup>/day) (Calculated in Table 11.2.2)
- WTP: BDT 20.9 /m<sup>3</sup> (BDT 383.4/month for average consumption)
- ATP: BDT 144.3 /m<sup>3</sup> (3.0% of average income per capita)

The benefit is calculated using the consumption amount of water supply service, as the sewerage bill is determined according to this amount. For the economic analysis, collection rate is not considered as the whole provided water has economic value even if the users do not pay the bill.

The annual benefits are estimated at BDT 443.1 million (WTP) and BDT 3,059.9 million (ATP) during the operation period.

#### (1) Calculation of WTP

To determine the WTP, the past survey result and current tariff level are reviewed. The last WTP study in Chattogram was implemented in the Sanitation MP held in 2015, and weighted average WTP was BDT 254.2/month<sup>2</sup> at 2015 price level. The 2023 price is calculated at BDT 394.0/month after multiplying the CPI rates from 2015 to 2023. The average sewerage tariff amount of average consumption house is also calculated at BDT 383.4/month at 2023 price level, using the average sewerage tariff rate (BDT 20.9/m<sup>3</sup>) shown in Table 11.2.2. Calculated values are in similar range and the gap is only BDT 10.6/month. The latter one, the current average sewerage tariff level (BDT 20.9 /m<sup>3</sup>) is used as the WTP value as the data source is newer and more reliable.

#### (2) Calculation of ATP

The ATP is calculated at BDT 159.2 /m<sup>3</sup> based on the formula below.

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<sup>1</sup> IRR Calculation Manual, JICA, 2017

<sup>2</sup> Answer of resident's expected WTP amount for sewerage service was BDT 1-200/month (42.6%) BDT 201-350/month (30.0%), and BDT 351-500/month (21.1%), BDT 501-700/month (4.7%) and more (1.6%). The weighted average WTP calculated by this composition becomes at BDT 3,050 /year at 2015 price level.



$ATP (BDT/m^3) = \text{“Average Monthly Income per Capita (BDT/month)”} \times \text{“Affordable level for Sewerage Service (%)”} / \text{“Water Consumption per Capita (m}^3\text{/month)}$

- Average monthly income per capita: BDT 19,371/month
- Affordable level for sewerage service: 3.0% of household income
- Water consumption per capita: 3.65m<sup>3</sup>/month (=120 l/day)

Referring to the social survey implemented during the Sanitation Master Plan Study in 2015, the average monthly income per capita was BDT 9,052/month, which is calculated as dividing the average monthly household income (BDT 52,895/month) by the average household size (5.84). The value becomes BDT 19,371/month at 2023 prices after multiplying the growth rates (+114%, compared with 2015 level) of “per capita GDP at current price” assuming that the growth rate after 2021-23 is the same as the average growth rate from 2015 to 2020 quoted from the Bangladesh Bureau of Statistics (BBS).

Related to the affordable level for sewerage service, the JICA manual (2017) explains that affordable payment amount for water and sewerage service is “6% (4% for water supply and 2.0% for sewerage service) of household income” for domestic use. As the planned sewerage tariff rate of CWASA is the same as the water tariff rate, the affordable percentage for sewerage is assumed at 3.0% of household income for calculation.

### 11.3.3 Benefit of Medical Cost Reduction

The new sewerage service in the project area contributes in improving the sanitary conditions, and waterborne diseases are expected to be reduced. The reduction of the social cost spent on the diseases compared with the project and without project is quantified as a benefit. The annual benefit is estimated at BDT 25.7 million.

$\text{Benefit of Medical Cost Reduction} = \text{“Total number of beneficiaries”} \times \text{“Incidence rate of waterborne disease (/year)”} \times \text{“Average social cost for treatment (BDT)”} \times \text{“Estimated Reduction Rate (%)”}$

- Total number of beneficiaries: 483,300 people (estimated from billed water amount 58,000 m<sup>3</sup>/day, consumption per capita 120 l/p)
- Incidence rate of waterborne disease: 1.639% (diarrhea cases 2,560,598 / total population 156,256,287, Health Bulletin 2015)
- Average social cost for treatment: BDT 6,477.0 (CPI rate is reflected on average treatment cost in 2015, BDT 4,178.8, Source: Economic Cost of Hospitalized Diarrheal Disease in Bangladesh: A Societal Perspective, Abdur R. S. and et al, 2018)
- Estimated Reduction Rate: 50%, number of incidents is assumed to be reduced by half

Average social treatment cost, BDT 4,178.8, is estimated through comprehensive interviews of 801 diarrheal patients in December 2015. Average social cost for treatment is composed of the direct

expenses (BDT 1,688.8) and indirect expenses, which are the patients' and caregivers' income losses (BDT 2,490.0).

#### 11.3.4 Benefit of Cleaning Cost Reduction of Septic Tank

After implementation of the project, the current cost for cleaning septic tanks installed at a user's house could be saved. This reduced cost is quantified as the economic benefit of the project based on the following formula. The annual benefit is estimated at BDT 69.9 million during operation period.

“Benefit of cleaning cost reduction (BDT/year)” = “Total number of influenced houses” x “Composition of houses installing septic tanks (%)” x “Average cleaning cost of beneficiaries (BDT/year)”

- Total number of influenced houses: 82,800 houses, estimated from treatment amount (58,000 m<sup>3</sup>/day, 96.6% of treatment amount), average water consumption of users (120l/day) and average household number (5.84)
- Composition of houses installing septic tanks or pits: 82.2% (septic tank 64.8% + pit 17.4%) (Sanitation MP 2015, page 40)
- Average cleaning cost of beneficiaries (BDT/year): BDT 1,027.7/year-house, CPI is reflected on the monthly average cost BDT 55.25/month-house referring to the result of the social survey in Sanitation MP 2015.

#### 11.3.5 Benefit of Land Price Escalation around the Project Area

At present, the sewerage water inflow to the street ditches and it causes odor and accumulation of garbage, and increase of unsanitary creatures such as rats, mosquitoes and roaches. After the project implementation, the sewerage water inflow directly to the sewerage network, and odor and unsanitary small animals at ditches will be decreased. The sanitary conditions and scenery around the project area will be also improved, and this will contribute to enhancing the value of residential areas and it results in the land prices escalation. This incremental value is considered as an economic benefit and added at BDT 1,400.0 million/year for the first 10 years after the project operation starts.

“Benefit of Land Price Escalation (BDT/year)” = “Affected Area” x “Average Land Price” x “Increase Rate of Land Price (%/year)”

- Affected Area: 2.8 km<sup>2</sup>, Length of Street Ditches (140 km, both side of installed branch pipes of the project, 70 km) x Average Building Width (20 m)
- Average Land Price: BDT 50,000/m<sup>2</sup>, official data for valuating land price under property transfer (around BDT 50,000/m<sup>2</sup>, 23 sites), posted land prices at property sales website (BDT 62,000 - 82,000/m<sup>2</sup>, 5 sites), former land price is chosen standing on conservative side.
- Increase Rate of Land Price (%/year): 1%/year, assumed to increase by 10% in total after the operation starts in 2031. According to a past study (Sara, J, W, 2000), land price has increased at

11% per 10 years in San Francisco (the USA), and 18.5% per 14 years at Hamilton Harbor (Canada), where surrounding water became clean. The said increased amount of land price is considered.

### 11.3.6 Result of Economic Analysis

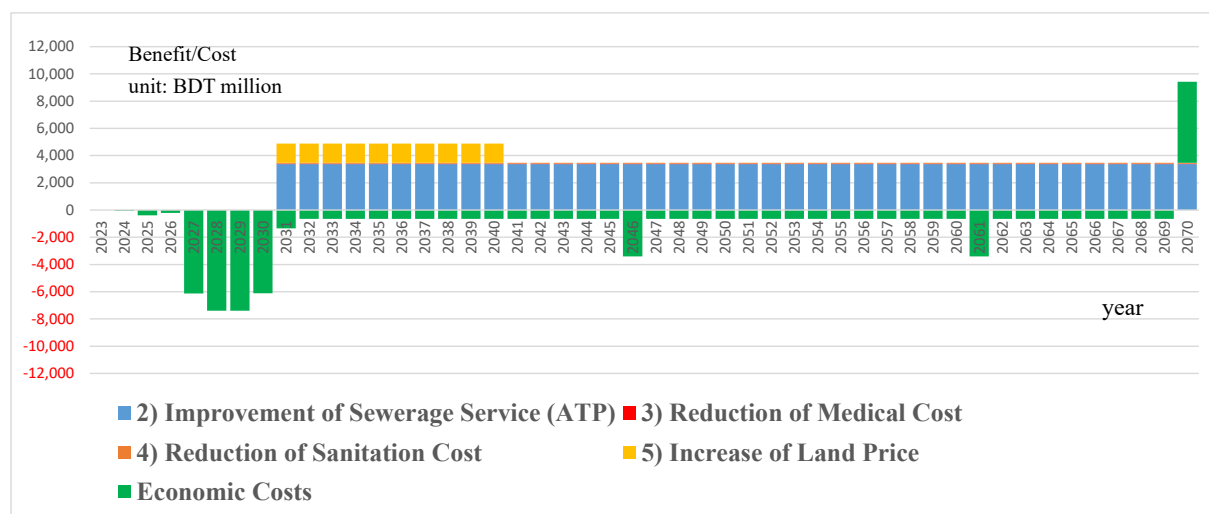
Result of the economic analysis is indicated in Table 11.3.2. Detailed economic benefits and economic cost flows are shown in Appendix 3.

Under the “Base case using WTP”, economic internal rate of return (EIRR) is not calculated as annual benefit amount is lower than the economic costs during evaluation period. The B/C and economic net present value (ENPV) become 0.35 and - BDT 13,414 million. Result of the “Base case using ATP” is better as EIRR, B/C and ENPV become 10.8%, 1.06 and BDT 1,301 million.

**Table 11.3.2 Result of Economic Analysis**

Alternatives	EIRR	B/C	ENPV (BDT million)
Base Case using WTP	n.a.	0.35	-13,414
Base Case using ATP	10.8%	1.06	1,301

Source: JICA Survey Team



Source: JICA Survey Team

**Figure 11.3.1 Economic Benefit and Cost Flow under Base Case using ATP**

It is well known that user’s WTP of “discarding services” including sewerage and solid water is lower than the real economic value as it is difficult for users to recognize the benefit instantly. Therefore, result of “Base case using ATP” is believed to show more accurate and reasonable value of the project compared with “Base case using WTP”.

The EIRR of “Base case using ATP” is 10.8%. It is 0.8% higher than the hurdle rate at 10%, and the project is economically feasible. This project includes preliminary investment part of treatment plant and future extension of pipe network. Taking account of whole future plan in Catchment 2&4, EIRR

would become higher than this value. To determine the project implementation, the project should be evaluated carefully from many aspects such as consistency with national and international policy, and existence of un-quantified benefits.

### 11.3.7 Sensitivity Analysis

Sensitivity analysis is conducted to evaluate the impact under negative conditions under Base Case using ATP. The following alternative cases are assumed, and the result is shown in Table 11.3.3. Detailed calculation sheets of those four cases are attached in Appendix 3.

Sensitivity Case 1: All costs increases by 10%

Sensitivity Case 2: Benefit reduces by 10%

Sensitivity Case 3: Cost increases by 10%, and benefit reduces by 10%

Under all negative cases, EIRR values reduced by 1.2% - 2.5% compared with the Base Case. To retain the economic effect of the project high, the project implementation should be managed carefully to avoid the cost increase and benefit reduction.

**Table 11.3.3 Result of Economic Analysis**

Revenue Alternatives	EIRR	B/C	ENPV (BDT million)
Base Case using ATP	10.8%	1.06	1,301
- Sensitivity Case1 (Cost +10%)	9.6%	0.97	-752
- Sensitivity Case2 (Benefit -10%)	9.4%	0.96	-882
- Sensitivity Case3 (Cost +10%, Benefit -10%)	8.3%	0.87	-2,936

Source: JICA Survey Team

## **CHAPTER 12 PROJECT EVALUATION AND INDICATORS FOR PROJECT EFFECTS**

### **12.1 Project Evaluation**

#### **12.1.1 Technical Evaluation**

The facility plans of the project are described in Chapters 5 and 6.

In accordance with the Chattogram Water Supply and Sewerage Authority (CWASA) policy, separate sewer system will be developed and every household/building in the target area will be connected by property connection. Although the property connection requires long period of time for completion, separate sewer system is the ideal to improve the sanitation condition and quality of public water body.

A<sub>2</sub>O process, the modified CAS was proposed as the sewage treatment method of sewage treatment plant (STP) to meet the new discharge standard in ECR2023 that enhanced the regulations of nitrogen and phosphorous.

#### **12.1.2 Economic and Financial Evaluation**

Project-based economic and financial analyses were conducted in Chapter 11.

According to the result of financial analysis in Catchment-2 and Catchment-4, sewerage tariff revenue can cover operational costs (O&M and replacement cost of equipment) when tariff level is increased at 2% every year (Alternative1). If tariff level is increased at 6% every year (Alternative3), all costs including capital investment cost can be covered by the total revenue.

Regarding the economic analysis, the economic internal rate of return (EIRR) of base case using Affordability to Pay (ATP) is estimated at 10.8% and the benefit-cost ratio (B/C) becomes 1.06. The major economic benefits are: 1) Improvement of sewerage service (using WTP or ATP), 2) Medical cost reduction, 3) Cleaning cost reduction of septic tank and 4) Land price escalation around the project area. As a result, EIRR is higher than the hurdle rate of 10%, and the project is economically feasible.

#### **12.1.3 Environmental Evaluation**

The environmental and social considerations of the project are described in Chapter 10. Based on the results of environmental survey, no serious environmental impacts have been found in the project. As for the social aspect, impact will be minimized by the basic policy of using vacant land for the installation of the facilities.

## 12.2 Operation and Effect Indicators

Operation and effects indicators applied for this project were selected based on "JICA Indicator Reference and Typical Lessons Learned in Technical Cooperation Projects". The indicators proposed for this project are as shown in Table 12.2.1.

**Table 12.2.1 Operation and Effect Indicators**

Type	Indicator	Base line (2022)	Target Year of the Project (2032) 2 Years after the Completion of Japanese Loan Project	Ultimate Target Year for CWASA (2070)
Operation Indicator	Population to be served by sewage treatment	0	350,000 Male: 177,000 Female: 173,000	1,730,000 Male: 874,000 Female: 856,000
	Amount of sewage treated	0 m <sup>3</sup> /day	55,000 m <sup>3</sup> /day	261,000 m <sup>3</sup> /day
	Usage rate of sewage facilities (STP)	0 %	100 %	100 %
	BOD concentration of effluent from STP	280 mg/L (Planned influent quality of STP: currently discharged without treatment)	20 mg/L	20 mg/L
Effect Indicator	Ratio of population to be served by sewage treatment against whole population of Catchment-2 and 4	0 %	31 %	100 %

Source: Edited by the JICA Survey Team based on the survey results and Gender Statistics of Bangladesh 2018

## 12.3 Qualitative Effects

The qualitative effects of the Project are evaluated for the following three items.

### 1) Improvement of living and sanitation conditions, improvement of water quality

Sewerage system will be developed in the priority area of the Project, then the water qualities of public water bodies including khals will be improved as well as the living and sanitation conditions. Although the current BOD concentrations of public water bodies in Catchment-2 and Catchment-4 are 30 – 200 mg/L based on the results of water quality analysis in this survey, the water quality of public water bodies in the priority area will be less than 10 mg/L, which is the environmental standard of inland water.

### 2) Capacity development of CWASA

CWASA's new staff will be assigned to the O&M of sewerage facilities and integrated management of sewerage works, then the capacity development of these new staff will be expected through their practices. Based on the above-described Chapter 7, 193 staff are expected to be assigned at the O&M stage of Catchment-2 and 4.

### **3) Benefits to Japanese companies for expanding their business in Bangladesh**

The living and sanitation condition will be improved and the reduction of risk of infection disease for employees can be expected. As described in Table 12.2.1, the ratio of population to be served by sewage treatment against the whole population of Catchment-2 and Catchment-4 will go up to 31% with the Project. Especially, the center of Chattogram City Corporation (CCC) area, where the CWASA head office is located will be targeted as the priority area, which will provide benefits to the companies who have their offices around the center of CCC area.

# **APPENDIX-1**

## **Supplementary Documents/Materials of Preliminary Design**



# **APPENDIX-1.1**

## **Calculation Sheet of Planned Sewage Amount in the Target Year (2070)**

**Calculation Sheet of Planned Sewage Amount in the Target Year (2070)**

No.	Wards		Ward Area	Total Ward Area in Catchment-2 and 4	%Ward Area in Catchment-2 and 4	Estimated Population in Catchment-2 and 4 (2070)	Coverage of sewerage system	Water Consumption	Domestic (incl. commercial and institutional flow)			Industrial Flow (Only domestic use)	Groundwater Infiltration (GWI)		Average Dry Weather Flow (ADWF)	Daily Peak Factor	Daily Maximum Dry Weather Flow
									Return Factor	Domestic flow per capita	Daily Average Domestic Flow (2070)		-	2070			
	Ward No.	Name	ha	ha	%	Capita	%	LPCD	%	LPCD	m <sup>3</sup> /d	m <sup>3</sup> /d	%	m <sup>3</sup> /d	m <sup>3</sup> /d	-	m <sup>3</sup> /d
1	2	Jalalabad	1,483	157	10.6%	45,237	98.6%	120	90	108	4,819	643	15	819	6,281	1.25	7,647
2	3	Panchlaish	555	220	39.6%	97,037	99.6%	120	90	108	10,443		15	1,566	12,009	1.25	14,620
3	4	Chandgaon	1,068	988	92.5%	346,764	95.9%	120	90	108	35,918	4,789	15	6,106	46,813	1.25	56,990
4	5	Mohra	767	767	100.0%	201,428	74.7%	120	90	108	16,240	2,165	15	2,761	21,166	1.25	25,767
5	6	East Sholashahar	240	240	100.0%	70,566	100.0%	120	90	108	7,621	1,016	15	1,296	9,933	1.25	12,092
6	7	West Sholashahar	315	138	43.6%	146,105	96.0%	120	90	108	15,146		15	2,272	17,418	1.25	21,205
7	8	Sholokbahar	532	387	72.8%	127,017	99.4%	120	90	108	13,639	1,819	15	2,319	17,777	1.25	21,642
8	9	North Pahartali	640	21	3.3%	7,095	64.2%	120	90	108	492		15	74	566	1.25	689
9	13	Pahartali	326	34	10.3%	13,357	100.0%	120	90	108	1,443		15	216	1,659	1.25	2,020
10	14	Lalkhan Bazar	124	32	25.9%	18,042	100.0%	120	90	108	1,949		15	292	2,241	1.25	2,728
11	15	Bagmaniram	207	86	41.5%	20,391	95.8%	120	90	108	2,110		15	317	2,427	1.25	2,955
12	16	Chawkbazar	203	200	98.4%	68,911	98.7%	120	90	108	7,344		15	1,102	8,446	1.25	10,282
13	17	West Bakalia	185	185	100.0%	172,493	100.0%	120	90	108	18,629		15	2,794	21,423	1.25	26,080
14	18	East Bakalia	396	396	100.0%	120,455	84.9%	120	90	108	11,047	1,473	15	1,878	14,398	1.25	17,528
15	19	South Bakalia	79	79	100.0%	55,893	100.0%	120	90	108	6,036		15	905	6,941	1.25	8,450
16	20	Dewan Bazar	43	43	100.0%	45,232	100.0%	120	90	108	4,885		15	733	5,618	1.25	6,839
17	21	Jamal khan	78	53	68.0%	48,862	98.1%	120	90	108	5,175		15	776	5,951	1.25	7,245
18	32	Anderkilla	77	49	63.7%	35,584	83.3%	120	90	108	3,201		15	480	3,681	1.25	4,481
19	33	Firinghee Bazar	38	29	76.9%	27,777	87.1%	120	90	108	2,612		15	392	3,004	1.25	3,657
20	34	Patharghata	72	72	100.0%	32,814	91.2%	120	90	108	3,232		15	485	3,717	1.25	4,525
21	35	Boxirhat	168	168	100.0%	30,088	67.2%	120	90	108	2,184		15	328	2,512	1.25	3,058
<b>TOTAL</b>			<b>7,596</b>	<b>4,343</b>	<b>-</b>	<b>1,731,150</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>174,165</b>	<b>11,905</b>	<b>-</b>	<b>27,911</b>	<b>213,981</b>	<b>-</b>	<b>260,500</b>

# **APPENDIX-2**

## **Supplementary Documents/Materials of Environmental and Social Considerations**

# **APPENDIX-2.1**

## **Land Acquisition and Resettlement Policy**

## JICA's Policy on Resettlement

The key principle of JICA policies on involuntary resettlement is summarized below.

- I. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.
- II. When, after such an examination, avoidance is proved unfeasible, effective measures to minimize impact and to compensate for losses must be agreed upon with the people who will be affected.
- III. People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.
- IV. Compensation must be based on the full replacement cost as much as possible.
- V. Compensation and other kinds of assistance must be provided prior to displacement.
- VI. For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A.
- VII. In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.
- VIII. Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.
- IX. Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

Above principles are complemented by World Bank OP 4.12, since it is stated in JICA Guideline that "JICA confirms that projects do not deviate significantly from the World Bank's Safeguard Policies". Additional key principle based on World Bank OP 4.12 is as follows

- X. Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers or others who wish to take advantage of such benefits.
- XI. Eligibility of Benefits include, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying.
- XII. Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based.
- XIII. Provide support for the transition period (between displacement and livelihood restoration).
- XIV. Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc.
- XV. For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated

resettlement plan is to be prepared.

In addition to the above core principles on the JICA policy, it also laid emphasis on a detailed resettlement policy inclusive of all the above points; project specific resettlement plan; institutional framework for implementation; monitoring and evaluation mechanism; time schedule for implementation; and, detailed Financial Plan etc.

## **Policy on Land Acquisition and Resettlement for this Project**

- I. The Government of **Bangladesh** will use the Project Resettlement Policy (the Project Policy) for the **Preparatory Survey on Chattogram Sewerage System Development Project** specifically because existing national laws and regulations have not been designed to address involuntary resettlement according to international practice, including JICA's policy. The Project Policy is aimed at filling-in any gaps in what local laws and regulations cannot provide in order to help ensure that PAPs are able to rehabilitate themselves to at least their pre-project condition. This section discusses the principles of the Project Policy and the entitlements of the PAPs based on the type and degree of their losses. Where there are gaps between the **Bangladesh** legal framework for resettlement and JICA's Policy on Involuntary Resettlement, practicable mutually agreeable approaches will be designed consistent with Government practices and JICA's Policy.
- II. Land acquisition and involuntary resettlement will be avoided where feasible, or minimized, by identifying possible alternative project designs that have the least adverse impact on the communities in the project area.
- III. Where displacement of households is unavoidable, all PAPs (including communities) losing assets, livelihoods or resources will be fully compensated and assisted so that they can improve, or at least restore, their former economic and social conditions.
- IV. Compensation and rehabilitation support will be provided to any PAPs, that is, any person or household or business which on account of project implementation would have his, her or their:
  - Standard of living adversely affected;
  - Right, title or interest in any house, interest in, or right to use, any land (including premises, agricultural and grazing land, commercial properties, tenancy, or right in annual or perennial crops and trees or any other fixed or moveable assets, acquired or possessed, temporarily or permanently;
  - Income earning opportunities, business, occupation, work or place of residence or habitat adversely affected temporarily or permanently; or
  - Social and cultural activities and relationships affected or any other losses that may be identified during the process of resettlement planning.
- V. All affected people will be eligible for compensation and rehabilitation assistance, irrespective of tenure status, social or economic standing and any such factors that may discriminate against achievement of the objectives outlined above. Lack of legal rights to the assets lost or adversely affected tenure status and social or economic status will not bar the PAPs from entitlements to such compensation and rehabilitation measures or resettlement objectives. All PAPs residing, working, doing business and/or cultivating land within the project impacted areas as of the date of the latest census and inventory of lost assets(IOL), are entitled to compensation for their lost assets (land and/or non-land assets), at replacement cost, if available and restoration of incomes and businesses, and will be provided with rehabilitation measures sufficient to assist them to improve or at least maintain their pre-project living standards, income-earning capacity and production levels.
- VI. PAPs that lose only part of their physical assets will not be left with a portion that will be inadequate to sustain their current standard of living. The minimum size of remaining land and structures will be agreed during the resettlement planning process.

- VII. People temporarily affected are to be considered PAPs and resettlement plans address the issue of temporary acquisition.
- VIII. Where a host community is affected by the development of a resettlement site in that community, the host community shall be involved in any resettlement planning and decision-making. All attempts shall be made to minimize the adverse impacts of resettlement upon host communities.
- IX. The resettlement plans will be designed in accordance with Bangladesh's National Involuntary Resettlement Policy and JICA's Policy on Involuntary Resettlement.
- X. The Resettlement Plan will be translated into local languages and disclosed for the reference of PAPs as well as other interested groups.
- XI. Payment for land and/or non-land assets will be based on the principle of replacement cost.
- XII. Compensation for PAPs dependent on agricultural activities will be land-based wherever possible. Land-based strategies may include provision of replacement land, ensuring greater security of tenure, and upgrading livelihoods of people without legal land titles. If replacement land is not available, other strategies may be built around opportunities for re-training, skill development, wage employment, or self-employment, including access to credit. Solely cash compensation will be avoided as an option if possible, as this may not address losses that are not easily quantified, such as access to services and traditional rights, and may eventually lead to those populations being worse off than without the project.
- XIII. Replacement lands, if the preferred option of PAPs, should be within the immediate vicinity of the affected lands wherever possible and be of comparable productive capacity and potential<sup>7</sup>. As a second option, sites should be identified that minimize the social disruption of those affected; such lands should also have access to services and facilities similar to those available in the lands affected.
- XIV. Resettlement assistance will be provided not only for immediate loss, but also for a transition period needed to restore livelihood and standards of living of PAPs. Such support could take the form of short-term jobs, subsistence support, salary maintenance, or similar arrangements.
- XV. The resettlement plan must consider the needs of those most vulnerable to the adverse impacts of resettlement (including the poor, those without legal title to land, ethnic minorities, women, children, elderly and disabled) and ensure they are considered in resettlement planning and mitigation measures identified. Assistance should be provided to help them improve their socio-economic status.
- XVI. PAPs will be involved in the process of developing and implementing resettlement plans.
- XVII. PAPs and their communities will be consulted about the project, the rights and options available to them, and proposed mitigation measures for adverse effects, and to the extent possible be involved in the decisions that are made concerning their resettlement.
- XVIII. Adequate budgetary support will be fully committed and made available to cover the costs of land acquisition (including compensation and income restoration measures) within the agreed implementation period. The funds for all resettlement activities will come from the Government.
- XIX. Displacement does not occur before provision of compensation and of other assistance required for relocation. Sufficient civic infrastructure must be provided in resettlement site prior to relocation. Acquisition of assets, payment of compensation, and the resettlement and start of the livelihood rehabilitation activities of PAPs, will be completed prior to any construction activities, except when a court of law orders so in expropriation cases.



(Livelihood restoration measures must also be in place but not necessarily completed prior to construction activities, as these may be ongoing activities.)

- XX. Organization and administrative arrangements for the effective preparation and implementation of the resettlement plan will be identified and in place prior to the commencement of the process; this will include the provision of adequate human resources for supervision, consultation, and monitoring of land acquisition and rehabilitation activities.
- XXI. Appropriate reporting (including auditing and redress functions), monitoring and evaluation mechanisms, will be identified and set in place as part of the resettlement management system. An external monitoring group will be hired by the project and will evaluate the resettlement process and final outcome. Such groups may include qualified NGOs, research institutions or universities

# **APPENDIX-2.2**

## **Environmental Check List**

## Environmental Check List

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process? (b) Have EIA reports been approved by authorities of the host country's government? (c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied? (d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(a) N (b) N (c) N/A (d) N/A	(a) Currently being prepared. (b) Not yet submitted. (c) There is possibility that EIA approval will be issued with conditions. If there are conditions, the conditions must be responded. (d) Required environmental permits are only EIA.
	(2) Explanation to the Local Stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the Local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders? (b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(a) Y (b) Y	(a) Stakeholder consultations were conducted and the understanding of local stakeholders was obtained. (b) Comments from residents and others were incorporated into the project.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Alternatives were considered for the no project option, project site location option, pipe run route option, and treatment method option.

A.2.2-1

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
2 Pollution Control	(1) Water Quality	(a) Do pollutants, such as SS, BOD, COD, pH contained in treated effluent from a sewage treatment plant comply with the country's effluent standards? (b) Does untreated water contain heavy metals?	(a) Y (b) N	(a) The quality of treated sewage water meets Bangladesh national standards. (b) Only domestic wastewater is accepted, so it does not contain heavy metals.
	(2) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed of in accordance with the country's standards?	(a) Y	(a) The waste will be treated and disposed at a new disposal site to be developed by CCC.
	(3) Soil Contamination	(a) If wastes, such as sludge are suspected to contain heavy metals, are adequate measures taken to prevent contamination of soil and groundwater by leachates from the wastes?	(a) N/A	(a) Sludge does not contain heavy metals.
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as sludge treatment facilities and pumping stations comply with the country's standards?	(a) Y	(a) For vibration, there is no Bangladesh national reference value, however, no impact is assumed due to the operation of the STP. As for noise, no noise impact is expected due to the operation of the STP.
	(5) Odor	(a) Are adequate control measures taken for odor sources, such as sludge treatment facilities?	(a) Y	(a) Soil filters will be used to prevent odors.
3 Natural Environment	(1) Protected Areas	(a) Is the project site located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) There are no protected areas on the STP site or at the discharge site. There are also no protected areas in the vicinity, therefore, there will be no impact on protected areas.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(2) Ecosystem	<p>(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)?</p> <p>(b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions?</p> <p>(c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem?</p> <p>(d) Is there a possibility that the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?</p>	<p>(a) N</p> <p>(b) N</p> <p>(c) N/A</p> <p>(d) N</p>	<p>(a) There is no critical habitat or other habitat present at the STP site and discharge site.</p> <p>(b) There is no habitat for valuable species at the STP site and discharge site.</p> <p>(c) No significant ecological impacts are anticipated.</p> <p>(d) The project is expected to improve the aquatic environment.</p>
4 Social Environment	(1) Resettlement	<p>(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement?</p> <p>(b) Is adequate explanation on compensation and resettlement given to affected people prior to resettlement?</p> <p>(c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic</p>	<p>(a) N</p> <p>(b) Y</p> <p>(c) N/A</p> <p>(d) N/A</p> <p>(e) Y</p> <p>(f) N/A</p> <p>(g) N/A</p> <p>(h) N/A</p> <p>(i) N/A</p> <p>(j) Y</p>	<p>(a) Under the JICA project, involuntary resettlement is avoided and only land acquisition is required; STP sites are acquired including those for future planning, and resettlement is expected to occur in the sites for future planning.(b) Explanation of compensation and livelihood restoration measures will be provided at stakeholder consultation meeting.(c) Resettlement will not occur under JICA projects.(d) No resettlement will take place in JICA projects.(e) The compensation policy is stipulated in Bangladesh laws and regulations.(f) Resettlement will not occur under JICA project.(g) Resettlement does not occur under JICA project.(h) Resettlement</p>

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		<p>studies on resettlement?</p> <p>(d) Is the compensations going to be paid prior to the resettlement?</p> <p>(e) Is the compensation policies prepared in document?</p> <p>(f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?</p> <p>(g) Are agreements with the affected people obtained prior to resettlement?</p> <p>(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?</p> <p>(i) Are any plans developed to monitor the impacts of resettlement?</p> <p>(j) Is the grievance redress mechanism established?</p>		<p>does not occur under JICA project.(i) Resettlement will not occur under JICA project.(j) Grievance redress mechanism will be established.</p>
	(2) Living and Livelihood	<p>(a) Is there a possibility that changes in land uses and water uses due to the project will adversely affect the living conditions of inhabitants?</p> <p>(b) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary?</p>	<p>(a) Y</p> <p>(b) N</p>	<p>(a) Livelihood restoration measures will be implemented since the land for grazing cattles will be acquired.</p> <p>(b) The project is expected to create employment opportunities.</p>

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) No impact on cultural heritage is expected from the STP site and pipeline construction.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N/A	(a) No significant landscape exists.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples?  (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to lands and resources respected?	(a) N/A (b) N/A	(a) There are no ethnic minorities or indigenous peoples on the STP site.  (b) There are no ethnic minorities or indigenous peoples on the STP site.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project?  (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials?  (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health)	(a) Y (b) Y (c) Y (d) Y	(a) The Bangladesh Labour Act, 2006 needs to be observed. In particular, the rights of children must be protected.  (b) Occupational health and safety considerations are described in the environmental management plan.  (c) Occupational health and safety considerations are described in the environmental management plan.  (d) Occupational health and safety considerations are described in the environmental management plan.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		<p>for workers etc.?</p> <p>(d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?</p>		
5 Others	(1) Impacts during Construction	<p>(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?(d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?</p>	<p>(a) Y (b) N (c) N (d) Y</p>	<p>(a) Necessary measures are described in the environmental management plan.</p> <p>(b) A small scale of cutting of vegetation is required. Reforestation is proposed within the STP site as a mitigation measures.</p> <p>(c) Positive impacts are expected, including the creation of employment machinery.</p> <p>(d) Traffic congestion is usually occurred in the city, however mitigation measures are being considered, such as informing residents of the construction schedule in advance.</p>
	(2) Monitoring	<p>(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts?</p> <p>(b) What are the items, methods and frequencies of the monitoring program?</p> <p>(c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and</p>	<p>(a) Y (b) Y (c) Y (d) Y</p>	<p>(a) Monitoring is conducted in accordance with the environmental monitoring plan.</p> <p>(b) Items and frequency are specified in the environmental monitoring plan.</p> <p>(c) Implementation organization is studied.</p> <p>(d) The environmental monitoring plan and implementation system are studied.</p>



Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?		
6 Note	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N/A	(a) No impact on global environmental issues is anticipated.

# **APPENDIX-2.3**

## **Monitoring Form**

## Monitoring Form

### 1. Pre-Construction Phase and Construction Phase

The latest results of the below monitoring items shall be submitted to the JICA as part of the Quarterly Progress Report throughout the construction phase.

#### 1.1 Air Pollution

##### - Exhaust Gases (Measurement)

Location	Date	PM <sub>10</sub> (µg/m <sup>3</sup> )	PM <sub>2.5</sub> (µg/m <sup>3</sup> )	CO (µg/m <sup>3</sup> )	NO <sub>2</sub> (µg/m <sup>3</sup> )	SO <sub>2</sub> (µg/m <sup>3</sup> )	Pb (µg/m <sup>3</sup> )	Frequency
STP	(Day, Month, Year)							Monthly
Reference	Bangladesh Standard Value**	150 (24hr)	65 (24hr)	5 (8hr)	80 (24hr)	80 (24hr)	0.50 (24hr)	-
	International Standard Value (WHO)***	45 (24hr)	15 (24hr)	-	25 (24hr)	40 (24hr)	-	-

\*\*Air Pollution Control Rules, 2022 (Schedule 2)

\*\*\*WHO Ambient Air Quality Guideline Values 2021, which are also being referred in the World Bank and IFC's General EHS Guidelines (2007)

Log Book: to be prepared and recorded by contractor(s) which is submitted to CWASA monthly.

If any problem arises (parameters measured are more than the reference values), such vehicles and equipment to be sustained to use or be replaced by appropriate ones as well as necessary instruction and education on exhaust gases to drivers and operators.

Baseline												
Location	PM <sub>10</sub> (µg/m <sup>3</sup> )		PM <sub>2.5</sub> (µg/m <sup>3</sup> )		CO (mg/m <sup>3</sup> )		NO <sub>2</sub> (µg/m <sup>3</sup> )		SO <sub>2</sub> (µg/m <sup>3</sup> )		Pb (µg/m <sup>3</sup> )	
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
AQ1	30.61	43.76	14.28	28.94	0.02	0.13	16.14	30.56	35.11	27.83	0.039	<0.001
AQ2	57.18	60.84	21.94	38.22	0.03	0.36	4.02	9.01	46.43	41.0	0.021	<0.001
AQ3	41.65	51.03	18.32	35.15	0.04	0.43	4.85	12.03	39.27	40.29	0.043	<0.001
AQ4	33.14	40.12	13.91	29.07	0.02	0.19	3.0	9.55	28.55	34.24	0.046	<0.001
Duration	24-hr		24-hr		8-hr		24-hr		24-hr		24-hr	

Source: Primary Monitoring (Wet season: 29.08.2022 – 01.09.2022 & Dry season: 04.12.2022-07.12.2022)

### 1.2 Water Quality

#### - Surface water

Location	Date	Temperature (°C)	pH	TDS (mg/L)	TSS (mg/L)	Coliform (total) (CFU/100 ml)	Oil and Grease (mg/L)	Frequency
		DO (mg/L)	BOD <sub>5</sub> (mg/L)	COD (mg/L)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	-	Monthly

Log Book: to be prepared and recorded by contractor(s) which is submitted to CWASA monthly.

### 1.3 Wastes

#### - Construction wastes and debris

Location (STP/Sewer Pipe)	Waste Composition	Waste Quantity (ton/month)	Transportation, Disposal/Treatment Methods (Specify: ex. Registered Service Provider, Officially final disposal site, registered treatment facility (or company))				Frequency
			Transport	Disposal	Treatment	Remarks	
	Construction Debris						Monthly
	Toxic and chemical Waste (if any)						
	Other (specify )						
	Excavated and Surplus soil management		Back filling	Designated Soil Disposal Site	Others (if any)	Remarks	

Log Book: to be prepared and recorded by contractor(s) which is submitted to CWASA monthly.

### 1.4 Soil Contamination

#### - Oil and Fuel leakage (spill)

Location (STP/Sewer Pipe)	Date	Type of Construction Vehicles/Equip ment	Fleet/Regi stration Number	Oil/Fuel Leakage Conditions				Frequenc y
	(Day, Month, Year)			Items	Yes	No	If Yes, Measures Taken	Daily
				Engine oil				
				Hydric power unit oil				
				Fuel				
				Others (Specify )				

Log Book: to be prepared and recorded by contractor(s) which is submitted to CWASA monthly.

If any problem arises, such vehicles and equipment to be sustained to use or be replaced by appropriate ones.

### 1.5 Noise and Vibration

#### - Noise/Vibration from Construction Vehicles and Equipment (Measurement)

Location	Date	Noise (L <sub>Aeq</sub> )		Vibration (dB)		Frequency
STP	(Day, Month, Year)					Monthly
Reference		Bangladesh Standard		Bangladesh Standard		
		Receptor	LAeq (dBA)	- (There is no standard)		
		Silent	50 (Day) 40 (Night)			
		Residential	55 (Day) 45 (Night)			
		IFC (EHS)		Japanese Request Limit <sup>1</sup> (dB)		
		Receptor	LAeq (dBA)	Receptor	(dB)	
	Residential	55 (Day) 45 (Night)	Residential, factory, and commercial facilities	65 (Day) 70 (Day)		

Japanese Request Limit<sup>1</sup>: Applied “Type 1: Residential Area”; The Vibration Regulation Law (Japan) (Law No.75 of 1995 (Not Environmental Standard but Request Limit Value on Vehicle Traffic Vibration stipulated by the Ministry of the Environment of Japan)

Log Book: to be prepared and recorded by contractor(s) which is submitted to CWASA monthly.

If any problem arises (parameters measured are more than the reference values), such vehicles and equipment to be sustained to use or be replaced by appropriate ones as well as necessary instruction and education on exhaust gases to drivers and operators.

<b>Baseline (Noise)</b>			
<b>Location</b>	<b>Average Noise level [dB(A)]</b>		<b>Location Setting</b>
	<b>Leq<sub>day</sub></b>	<b>Leq<sub>night</sub></b>	
NL1	47.80	44.90	Residential
NL2	52.60	49.80	Silent
NL3	47.72	45.90	Residential
NL4	51.00	47.20	Residential
NL5	52.80	44.81	Residential
NL6	51.70	49.60	Residential
NL7	54.50	49.35	Residential

Source: Field Survey by EQMS (August 2022)

<b>Baseline (Vibration)</b>		
<b>Location</b>	<b>Average Vibration (ppv, mm/s)</b>	<b>Vibration velocity level in decibels (VdB)</b>
VL1	0.10	59.86
VL2	0.04	51.90
VL3	0.07	56.76
VL4	0.12	61.45
VL5	0.02	45.88
VL6	0.05	53.84
VL7	0.05	53.84

Source: Field Survey by EQMS (August 2022)

### 1.6 **Pre-Construction Phase** Land Acquisition/Resettlement (Transfer of CWASA Staff in STP)

Location	Transfer Budget		Transfer schedule		Grievances		Frequency
	Allocation	Use	Preparation	Transferred	Specify	Countermeasures	
STP	%	%	HHs	HHs	-	-	Weekly
					-	-	

HHs: Households

### 1.7 Existing Social Infrastructure and Services

#### - Meeting with surrounding Communities/Business Establishments/Public Service Entities

Location (STP/Sewer Pipe)	Date	Community	Meeting Venue	Number of Participants	Agenda	Opinions Requests	Countermeasures	Frequency
	(Day, Month, Year)			Community ( )				Before construction and where necessary
				Officials ( )				
				Others (Specify )				
				Total ( )				

Log Book/ Minutes of Meeting: to be prepared and recorded by contractor(s) which is submitted to CWASA monthly.

Participant list and meeting minutes shall be attached

### 1.9 Risks of Infectious diseases such as HIV/AIDS

#### - Health and Sanitation Education

Date	Venue	Agenda	Lecturer	Number of Participants	Frequency
(Day, Month, Year)				Community ( )	Monthly
				Worker/Labor ( )	
				Others (Specify )	
				Total ( )	

Log Book: to be prepared and recorded by contractor(s) which is submitted to CWASA monthly.

Participant list and educational materials shall be attached

#### - Infection case

Date	Symptomatic state	Treatment	Name	Frequency
(Day, Month, Year)				Monthly

Log Book: to be prepared and recorded by contractor(s) which is submitted to CWASA monthly.

**1.10 Occupational health and safety**

**- Occupational health and safety Education**

Date	Venue	Agenda	Lecturer	Number of Participants	Frequency
(Day, Month, Year)				Community ( )	Monthly
				Worker/Labor ( )	
				Others (Specify )	
				Total ( )	

Log Book: to be prepared and recorded by contractor(s) which is submitted to CWASA monthly.

Participant list and educational materials shall be attached

**- Personnel Protective Equipment (PPE)**

Location (STP/Sewer Pipe)	Date	Monitoring Item	If any problems, measures taken	Frequency
	(Day, Month, Year)	PPE: such as Helmet, Gloves, Masks, shoes, safe belts and etc. (specify ).)		Daily

Log Book: to be prepared and recorded by contractor(s) which is submitted to CWASA monthly.

**- Safety patrol**

Date	Checked point	Result	Measures (If any)	Frequency
(Day, Month, Year)				Monthly

Log Book: to be prepared and recorded by contractor(s) which is submitted to CWASA monthly.

**Occupational health and safety Problem**

Sl. No	Date and Time	Accident/Incident Locations	Types of works	Types of Accident/ Incidents	Descriptions	Corrective Action Plan (CAP)



**1.11 Accidents**

**- Traffic and Safety Educational Meetings**

Location (STP/Sewer Pipe)	Date	Venue	Agenda	Lecturer	Number of Participants	Materials paraded	Frequency
	(Day, Month, Year)				Community ( )		Once/Two Months
					Worker/Labor ( )		
					Others (Specify )		
					Total ( )		

Log Book/ Minutes of Meeting: to be prepared and recorded by contractor(s) which is submitted to CWASA monthly.

Participant list and meeting minutes shall be attached

**- Accident case**

Sl. No	Date and Time	Accident/Incident Locations	Types of works	Types of Accident/ Incidents	Descriptions	Corrective Action Plan (CAP)

Log Book: to be prepared and recorded by contractor(s) which is submitted to CWASA.

## 2. Operation Phase

The latest results of the below monitoring items shall be submitted to JICA on biannual basis for the first three years of operation phase.

### 2.1 Water Quality

#### - Surface water

Location	Date	Temperature (°C)	pH	TDS (mg/L)	TSS (mg/L)	Coliform (total) (CFU/100 ml)	Oil and Grease (mg/L)	Frequency
								Monthly
		DO (mg/L)	BOD5 (mg/L)	COD (mg/L)	Total Phosphorus (mg/L)	Total Nitrogen (mg/L)	-	

### 2.3 Occupational health and safety

#### - Occupational health and safety Education

Date	Venue	Agenda	Lecturer	Number of Participants	Frequency
(Day, Month, Year)				Community ( )	Monthly
				Worker/Labor ( )	
				Others (Specify )	
				Total ( )	

#### - Safety patrol

Date	Checked point	Result	Measures (If any)	Frequency
(Day, Month, Year)				Monthly

#### Occupational health and safety Problem

Sl. No	Date and Time	Accident/Incident Locations	Types of works	Types of Accident/ Incidents	Descriptions	Corrective Action Plan (CAP)

**2.4 Accidents**

**- Traffic and Safety Educational Meetings**

Location	Date	Venue	Agenda	Lecturer	Number of Participants	Materials paraded	Frequency
STP	(Day, Month, Year)				Community ( )		Two Times/Year
					Worker/Labor ( )		
					Others (Specify )		
					Total ( )		

Participant list and education materials shall be attached

**- Accident case**

Sl. No	Date and Time	Accident/Incident Locations	Types of works	Types of Accident/ Incidents	Descriptions	Corrective Action Plan (CAP)

### Location of Baseline Data\*

Station Code	Geographic Location	Sampling Station	Location Setting
Air quality			
AQ1	22°22'15.6"N 91°51'52.3"E	Kodal kata Pakkar Dokan, Moju Fokirer Bari, Chandgaon, Chattogram	South side of the project boundary
AQ2	22°22'16.9"N 91°51'36.3"E	Sanowara Govt. Primary School, Khulapara, Chandgaon, Chattogram	East side of the project boundary
AQ3	22°22'29.7"N 91°51'38.3"E	Nazir bari School, Contractor Bari, Chandgaon, Chattogram	Northwest side of the project boundary
AQ4	23°36'32.06" N 90°32'47.28" E	Kalabagh Jame Mosque, Shabdi, Bandor	North side of the project boundary
Noise and Vibration			
NL1/ VL-1	22°22'16.7"N 91 °51'52.6"E	Kodal kata Pakkar Dokan, Moju Fokir's house, Chandgaon, Chattogram	Residential
NL 2/ VL-2	22°22'16.4"N 91 °51'35.1"E	Sanowara Govt. Primary School, Khulapara, Chandgaon, Chattogram	Silent (Noise) Residential (Vibration)
NL 3/ VL-3	22°22'12.1"N 91 °51'44.4"E	Kodal kata Monar Bari, Chandgaon, Chattogram	Residential
NL 4/ VL-4	22°22'14.7"N 91 °52'3.3"E	Kodal kata Khal, Morshed Alom house, Chandgaon, Chattogram	Residential
NL 5/ VL-5	22°22'29.6"N 91 °51'37.5"E	Nazir bari School, Contractor Bari, Chandgaon, Chattogram	Residential
NL 6/ VL-6	22°22'36.0"N 91 °51'44.2"E	Sri Sri Jogadhatri Mondir, Daspara, Chandgaon, Chattogram	Residential
NL 7/ VL-7	22°22'20.4"N 91 °51'33.4"E	Khulapara Masjid Road, Chandgaon, Chattogram	Residential

## RAP Monitoring Form

### (1) Pre-Construction Stage

#### Transfer of CWASA Staff in STP (Pre-Construction Stage)

Location	Transfer Budget		Transfer schedule		Grievances		Frequency
	Allocation	Use	Preparation	Transferred	Specify	Countermeasures	
STP	%	%	HHs	HHs	- - -	- - -	Weekly

HHs: Households

### (2) After Transfer and Operation Stage

#### Transfer of CWASA Staff in STP (After Transfer and Operation Stage)

Location	CWASA Assistance for Staff Commutes			Living Standard				Grievances		Frequency
	Full Traffic Expense	Provide Transportation (such as bus)	Others (Specify)	Good	Fair	Bad	Others (Specify)	Specify	Countermeasures	
STP	HHs	HHs	%	HHs	HHs	HHs		- - -	- - -	Monthly

HHs: Households