Chapter 13 Operation and Maintenance of Water Supply and Sewerage Facilities

13.1 General

Present arrangements for the operation and maintenance (O&M) of water supply and sewerage facilities by BWSSB are as follows:

(1) Water supply: Kavery Zone is responsible for the O&M of major facilities including intake, water treatment, transmission facilities and GLRs. The procurement of materials and equipment required is also undertaken by the zone.

(2) Sewerage: Wastewater Management Zone is responsible for O&M of major sewerage facilities including larger size sewers with more than 400 mm dia., pumping stations and STPs. Required procurement of materials and equipment is also under the responsibility of this zone.

(3) Water distribution pipelines and smaller size sewers: Maintenance Zone is responsible for O&M of the facilities and Project Zone undertakes procurement of required materials and equipment.

Required design of the facilities in the O&M work is undertaken by respective zones. While, for large size facilities such as WTP and STP, as being practiced in BWSSP Phase 2 Project, the private sector undertakes O&M of facilities for about seven (7) years after construction work, as a part of contract in application of design-build-operate for the construction of facilities. For the O&M of planned facilities, present practices by BWSSB shall basically employed considering expansion of water supply and sewerage systems.

O&M cost required for JICA Survey Project (Stage V project and major sewerage facilities for 110 villages) is estimated based on the power and chemical requirements studied in the preliminary design of facilities. Cost estimate presented in DPR for 110 Villages water supply and sewerage project is also refereed to.

13.2 Water Supply

13.2.1 O&M of the Facilities to be Provided by Stage V Project

Required O&M of the water supply facilities is discussed by major facility.

(1) Intake facilities

Water intake gates and screens sometimes occlude caused by the inflow of floating impurities and inorganic substances, resulted in malfunctioning of intake facilities and poor raw water quality. Daily visual monitoring of these structures and conduct of regular cleaning are important to maintain them in good condition.

(2) Water treatment facilities

1) Flow Measurement

The intake water amount shall be less than the water privilege. In this regard, accurate measurement of inflow volume is necessary. In addition, it is also important to control treatment water volume and to provide proper dosing. Therefore, ultrasonic flowmeter and parshall flume are to be facilitated.

2) Flush Mixer

Flush Mixer is a facility for quick rapid agitation to uniformly diffuse the coagulant into the raw water. Using a typical flush mixer, mixing can be achieved by rotating at a proper peripheral speed. It is also possible to adjust the injection intensity by monitoring and controlling water and injection volume.

3) Flocculation Tank

Flocculation tank has a function to make small flocs into larger flocs by appropriate stirring to enable them to easily sediment. When the growth of the flocs is not sufficient enough, the quality of outflow from sedimentation tank is not good with higher turbidity, or in case of the reduction of the filtration duration, suspended matter flows out with the filtered water.

4) Sedimentation Tank

Sedimentation tank plays a role to separate and remove majority of the flocs formed in flocculation tank by sedimentation through gravity. In managing the sedimentation tank, it is necessary to pay special attention to water quality of outflow from the sedimentation tank, and therefore it is important that a target turbidity level is set for the outflow from sedimentation tank and water quality be monitored. The jar test should be carried out and appropriate chemical injection and equipment operation should be made based on the test result. Sludge withdraw from sedimentation tank should be monitored periodically.

5) Rapid Sand Filter

Filtration tank has a function to remove the contaminants from outflow of sedimentation tank by filtration. Washing of the sand filter shall be carried out, when the head loss reaches to a set value. Washing is performed providing a combination of backwashing and surface washing.

6) Clear Water Reservoir

Clear water reservoir is used to store treated water to take care of imbalance between the filtered water volume and water supply volume. Regular inspection of clear water reservoir is essentially required in terms of quality and hygiene.

7) Chemical Dosing Facility

a) Alum Dosing

Flocculants are used in the treatment process to facilitate formation of flocs and easy sedimentation of colloidal particles in the raw water. It is important to ensure an optimum injection rate and injection volume considering the quality and quantity of the raw water. Therefore, these parameters should be accurately measured, for which chemical injection equipment shall be properly maintained. Inspection and cleaning of the injection pipe should also be carried out regularly to avoid clogging of injection pipe by coagulant. In order to achieve the optimum effect of the flocculants, it is important to adjust the injection amount and agitation conditions.

b) Chlorination

Disinfection is necessary for the purpose of keeping the distributed water safe. Using chlorine as a disinfectant, a large amount of water can be easily disinfected with a longer effectiveness.

8) Sludge treatment facility

Back washed water and sludge from sedimentation tanks is collected either to balancing tanks, thickeners and centrifuges to separate solids from the liquid. The liquid is sent to raw water inflow channel for the treatment again. Generated sludge is disposed of in the BWSSB property.

9) Monitoring

Raw water and treated water quality are examined and reported. The monitoring items and their frequency are presented in Section 14.9.2, Chapter 14. Flow and operation conditions are monitored and recorded by SCADA system.

(3) Water Transmission Facilities

1) Transmission Pump and Pipeline

Treated water is transmitted through 70 km length of pipeline by means of three (3) staged pumping facilities. Pump units are operated using a daily average flow rate to fill the GLRs in Bengaluru city. To maintain a proper operation of pumping facilities, pump conditions are monitored and recorded by SCADA system. As a countermeasure against the failure of power supply, surge vessels and/or surge tanks are installed to avoid damage by water hammer. These facilities shall be properly maintained for the sound operation.

2) City Trunk Main and GLRs

It is necessary to maintain appropriate water level at GLRs and to ensure residual chlorine. The flow rates at the Inlet and outlet of GLRs and their water levels are monitored and recorded by SCADA system.

(4) Maintenance and Repair of Equipment

1) Daily/weekly inspection

Daily/ weekly inspection of the equipment is practiced including investigations, confirmation and recording of operating conditions of the equipment. It is necessary to analyze the differences comparing with the previous inspection results and evaluate whether or not the value matches to the standard value using the check sheet.

2) Periodical Maintenance

In case if any specific equipment indicates error in its original function during ordinary and periodic inspection, precise inspection and maintenance work should be carried out by skilled person having required expertise and knowledge. In particular, for large pumps and special equipment, the inspection shall be carried out by the manufacturer or its agents. Monitoring and Control of Water Supply System shall be undertaken in use of SCADA system.

13.2.2 O&M Cost for the Facilities Provided by Stage V Project

O&M cost is estimated including staff salary, power cost, chemical cost and repair cost, as shown below. For financial study, price escalation is considered setting the base year 2017.

(1) Personnel Cost

1) WTP

Number of O&M staff for the WTP is estimated referring to the plan employed in Stage IV Phase 2 as shown in Table 13.2.1.

Table 13.2.1 Number of O&M Staff at the WTP

No	Designation	Qualification	Experience	Shift-1	Shift- 2	Shift-3	Nos.
1	Plant Manager	Graduate Engineer (Civil / Env.)	10 years	General shift			1
2	Plant Supervisor	Graduate Engineer-Mech. /Elec./ Instrumentation	5 years	1	1	1	3
3	Shift-in-charge	Diploma (Elec./Mech.)	3 years	1	1	1	3 (2 Elec., 1Mech.)
4	Electrician	ITI (Elec.)	3 years	1	1	1	3
5	Chemist	B. Sc-Chemistry	3 years	1			1
6	Lab Assistant	Diploma in Lab Tech.	2 years	1	-	-	1
7	Helpers	8th pass	-	4	3	3	10
8	Security Guards	8th pass	2 years	2	2	2	6
9	Gardener	8th pass	2 years	2	-	-	2
	Total			13	7	7	30

Source: JICA Survey Team

2) Pump Station and Clear Water Reservoir

Number of O&M staff at a pump station is estimated referring to the plan in Stage IV Phase 2, as shown in Table 13.2.2.

Table 13.2.2 Number of O&M Staff at a Pump Station

No	Designation	Qualification	Experience	Shift-1	Shift-2	Shift-3	Nos.
1	Plant Supervi-sor	Graduate Engineer (Mech./Elec.)	10 years	General shift			1
2	Shift-in-charge	Graduate (Elec./Mech.) or Diploma (Elec./Mech.)	5 years 10 years	1	1	1	3
3	Electrician	ITI (Elec.)	5 years	1	1	1	3
4	Helpers	8th pass	-	4	3	3	10
5	Security Guards	8th pass	3 years	2	2	2	6
6	Gardener	8th pass	5 years	2	2	-	2
	Total			10	9	9	25

Source: JICA Survey Team

3) GLR

Number of O&M staff for a GLR is estimated as shown in Table 13.2.3.

Table 13.2.3 Number of O&M Staff for a GLR

No	Designation	Qualification	Experience	Shift-1	Shift-2	Shift-3	Nos.
1.	Plant Supervisor	Graduate Engineer (Mech./Elec.)	10 years	General shift			1
2	Operator	Mechanical Engineer	5 years	1	1	1	3
3	Security Guards	8th pass	3 years	1	1	1	3
	Total			2	2	2	7

Source: JICA Survey Team

4) City Trunk Main

Number of O&M staff for City Trunk Main is estimated as shown in Table 13.2.4.

Table 13.2.4 Number of O&M Staff for City Trunk Main

No	Designation	Qualification	Experience	Shift-1	Shift-2	Shift-3	Nos.
1.	Team Leader	Graduate Engineer (Civil/Mech./Elec.)	10 years	General shift			1
2	Inspection/repair	Civil Engineer	5 years	1	1	1	3
	Total			2	1	1	4

Source: JICA Survey Team

5) Rate of Salary by staff and overall salary requirements

To calculate overall personnel cost, annual average salary by concerned staff is assumed as shown in Table 13.2.5.

Table 13.2.5 Annual Average Salary by Concerned Staff for O&M of Stage V Facilities

No	Designation	Qualification	Experience	Nos.	Rate INR/M	Price INR/Y
1	Plant Manager	Graduate Engineer (Civil/ Env.)	10 years	1	50,000	600,000
2	Plant Supervisor	Graduate Engineer-Mech./Elec./ Instrumentation	5 years	3	40,000	1,440,000
3	Shift-in-charge	Diploma(Elec.2/Mech.1)	3 years	3	30,000	1,080,000
4	Electrician	ITI (Elec.)	3 years	3	20,000	720,000
5	Chemist	B. Sc-Chemistry	3 years	1	25,000	300,000
6	Lab Assistant	Diploma in Lab Tech.	2 years	1	18,000	216,000
7	Helpers	8th pass	-	10	12,000	1,440,000
8	Security Guards	8th pass	2 years	6	12,000	864,000
9	Gardener	8th pass	2 years	2	10,000	240,000
	Total			30		6,900,000

Note: 6,900,000 INR/ 30 Person = 230,000 INR/year (= 19,200 INR/month)
Source: JICA Survey Team

Using required number of staff by position as estimated from item 1) to 4) and salary rate in Table 13.2.5, annual average salary required is estimated at 230,000 INR/year.

(2) Power Cost

Power cost is calculated based on power consumption.

(3) Chemical Cost

Chemical cost is calculated based on chemical consumption. Present unit price is provided by BWSSB. (Liquid Chlorine, alum and polymer)

(4) Repair Cost

Repair cost is considered as 0.5 % of capital cost.

(5) Total Cost

Total cost is calculated summing up the items from item (1) to item (4), as shown in Table 13.2.6.

13.2.3 O&M for 110 Village Water Distribution and Revenue Collection

(1) Billing and Collection of Water Charges

The service connections for water supply to all consumers including domestic, non-domestic, industrial and others shall be metered. Billing frequency for all categories shall be once a month. The entire billing and collection is computerized with 24/7 collection system by bill payment through Kiosks installed at over 100 locations in the service area, which will enable the consumers to pay the bill any time convenient to them. The meter readers collect the consumption readings once a month and about 1,500-2,000 consumers shall be covered by each meter reader.

The readings are entered into the computer and each consumer bill is bar coded to facilitate payment through kiosks. The computer generated bills are to be collected by the meter reader and delivered to the consumer at the door step of the consumer. The operation and maintenance of the network of bill collection kiosk is out-sourced to a private operator who have installed the kiosks. The representative from private operator and BWSSB authorized staff collect the amount from the kiosks every day, which is verified and then remitted to BWSSB Bank account. Monthly billing is adopted for all customers and categories. Computerized monthly bills are to be issued to all consumers. Then the bill payment can be made conveniently by all consumers in provision of automatic Kiosks in the service area through 100 kiosks. In view of the above facility the ratio of collection to demand (billing/billable) can be expected with more than 90 %.

(2) Operation and Maintenance of Water Supply Facilities to be Provided by Stage V Project

The expansion of present arrangements for O&M of distribution systems by BWSSB staff with the support from lower categories outsourced from private agencies or by recruitment is recommended for the 110 Villages water supply. Likewise, the participation by private entity/community/NGO in meter reading, billing and collection along with operation and maintenance of distribution system is expected.

Table 13.2.6 O&M Cost for the Facilities provided by Stage V Project

			Unit	Q'ty	Rate	Price Million INR/year	Remarks
WTP TK Halli							
	Personnel		INR/year	30	230,000	6.9	0%
	Power		kWh/day	70,666	4.5	116.1	63%
	Chemicals						
		Alum	kg./day	10,400	7	26.6	15%
		Chlorine	kg./day	3,200	12	14.0	8%
		Polymer	kg./day	68.47	300	7.5	4%
	Repair		M INR/y	0.5%	2,412	12.1	7%
	Total					183.1	
Pump Station TK Halli							
	Personnel		INR/year	25	230,000	5.8	0%
	Power		kWh/day	336,346	4.5	552.4	97%
	Repair		M INR/y	0.5%	1,708	8.5	2%
	Total					566.7	
Pump Station Harohalli							
	Personnel		INR/year	25	230,000	5.8	0%
	Power		kWh/day	393,101	4.5	645.7	98%
	Repair		M INR/y	0.5%	1,708	8.5	1%
	Total					660.0	
Pump Station Tataguni							
	Personnel		INR/year	25	230,000	5.8	0%
	Power		kWh/day	387,960	4.5	637.2	98%
	Repair		M INR/y	0.5%	1,708	8.5	1%
	Total					651.5	
7 GLRs							
	Personnel		INR/year	49	230,000	11.3	1%
	Power		kWh/day	329	4.5	0.5	2%
	Chemicals			0			
		Chlorine	kg./day	775	12	3.4	10%
	Repair		M INR/y	0.5%	3842	19.2	56%
	Total					34.4	
Conveyance, Transmission & City Transmission							
	Personnel		INR/year	4	230,000	0.9	0%
	Power		kWh/day		4.5	0.0	0%
	Repair		M INR/y	0.50%	21,547	107.7	99%
	Total					108.7	
Total							
	Personnel		INR/year	158	230,000	36.3	2%
	Power		kWh/day	1,188,402	4.5	1,952.0	89%
	Chemicals					51.5	
		Alum	kg./day	10,400	7	26.6	1%
		Chlorine	kg./day	3,975	12	17.4	1%
		Polymer	kg./day	68	300	7.5	0%
	Repair		M INR/y		32,924	164.6	7%
	Total					**2,204.4**	

Source: JICA Survey Team

(3) O&M Cost for Water Distribution System for 110 Villages

For the O&M of the distribution system, adequate arrangements of required staff are necessary to ensure equitable distribution of water to all consumers. The major work pertains to valve operation and its monitoring, the water levels at the reservoirs, rectifying the leaks in the distribution pipe lines, feeder mains, and operation and maintenance of booster pump stations attending the consumer complaints.

The cost for the O&M work includes salaries and other benefits of the operating staff, energy charges for booster pump stations, replacement of valve spindles, glands, packing materials, pipes and specials, spares and consumables for pumps and motors, and other electrical equipment.

The area of operation of a subdivision is expected to cover about 20 to 25 thousand connections and each division shall comprise 3 to 4 subdivisions. The requirement of staff for one service station and sub divisional staff based on the norms prevailing in the Board is indicated as shown in Table 13.2.7.

Table 13.2.7 O&M Cost in the DPR for Providing Water Supply Facilities to 110 Villages

No.	Particulars	Unit	Qty. / Nos.	Rate (INR)	Amount per Month (INR)	Amount per Annum (INR)
A	**General Staff for maintenance of water Supply System**					
1	**Technical Staff**					*51,840,000*
a	Assistant Executive Engineer (A.E.E.)	No.	24	50,000	1,200,000	14,400,000
b	Assistant Engineer (A.E.)	No.	48	35,000	1,680,000	20,160,000
c	Work inspector	No.	96	15,000	1,440,000	17,280,000
2	**Revenue & Establishment Staff.**					*29,580,000*
a	Manager	No.	5	18,000	90,000	1,080,000
b	Cashier	No.	5	15,000	75,000	900,000
c	First Division Assistant	No.	10	15,000	150,000	1,800,000
d	Second Division Assistant	No.	20	12,000	240,000	2,880,000
e	Meter Reader	No.	125	12,000	1,500,000	18,000,000
f	Data Entry operator	No.	20	12,000	240,000	2,880,000
g	Telephone operator	No.	10	8,000	80,000	960,000
h	Watchman	No.	15	6,000	90,000	1,080,000
B	**O & M Staff for Water Supply Distribution**					
1	**Staff for Water Supply Feeder & Distribution Network (Based on CPHEEO Manual O & M Staff Pattern)**					***94,080,000***
a	Fitters	No.	210	12,000	2,520,000	30,240,000
b	Helpers	No.	210	10,000	2,100,000	25,200,000
c	Valve men	No.	322	10,000	3,220,000	38,640,000
2	**Staff for water Pumping Stations (Based on CPHEEO Manual O & M Staff Pattern)**					***27,648,000***
a	Pump operators	No.	72	12,000	864,000	10,368,000

No.	Particulars	Unit	Qty. / Nos.	Rate (INR)	Amount per Month (INR)	Amount per Annum (INR)
b	Electrician/Mechanic	No.	8	10,000	80,000	960,000
c	Helpers/Fitters	No.	8	8,000	64,000	768,000
d	Watchman	No.	216	6,000	1,296,000	15,552,000
3	**Water Supply Pumping machineries Energy Cost**					
	Average Pumping hours Per Day.	hrs	60			
	Total HP of pumps.	HP	5500			
	Total kWh	kWh	4103			
	Energy Charges	INR/ kWh	20			
	Energy Cost per day	INR	196,944			
	Energy Cost per year	INR				***71,884,560***
4	**Water Supply Feeder & Distribution System Repair & Replacement cost (0.50% of Project cost)**	L.S.		0		***79,235,920***

Note: General staff for maintenance work both for water supply and sewerage systems.

Source: BWSSB & JICA Survey Team

13.2.4 O&M Cost for the Facilities Related to Stage V and 110 Villages Distribution Systems

O&M cost for Stage V and 110 Villages water supply including revenue collection is summarized in Table 13.2.8. For the cost requirements by target year are calculated considering annual price escalation.

Table 13.2.8 O&M Cost for the Facilities Related to Stage V and 110 Villages Distribution Systems

Unit: Thousand INR/year

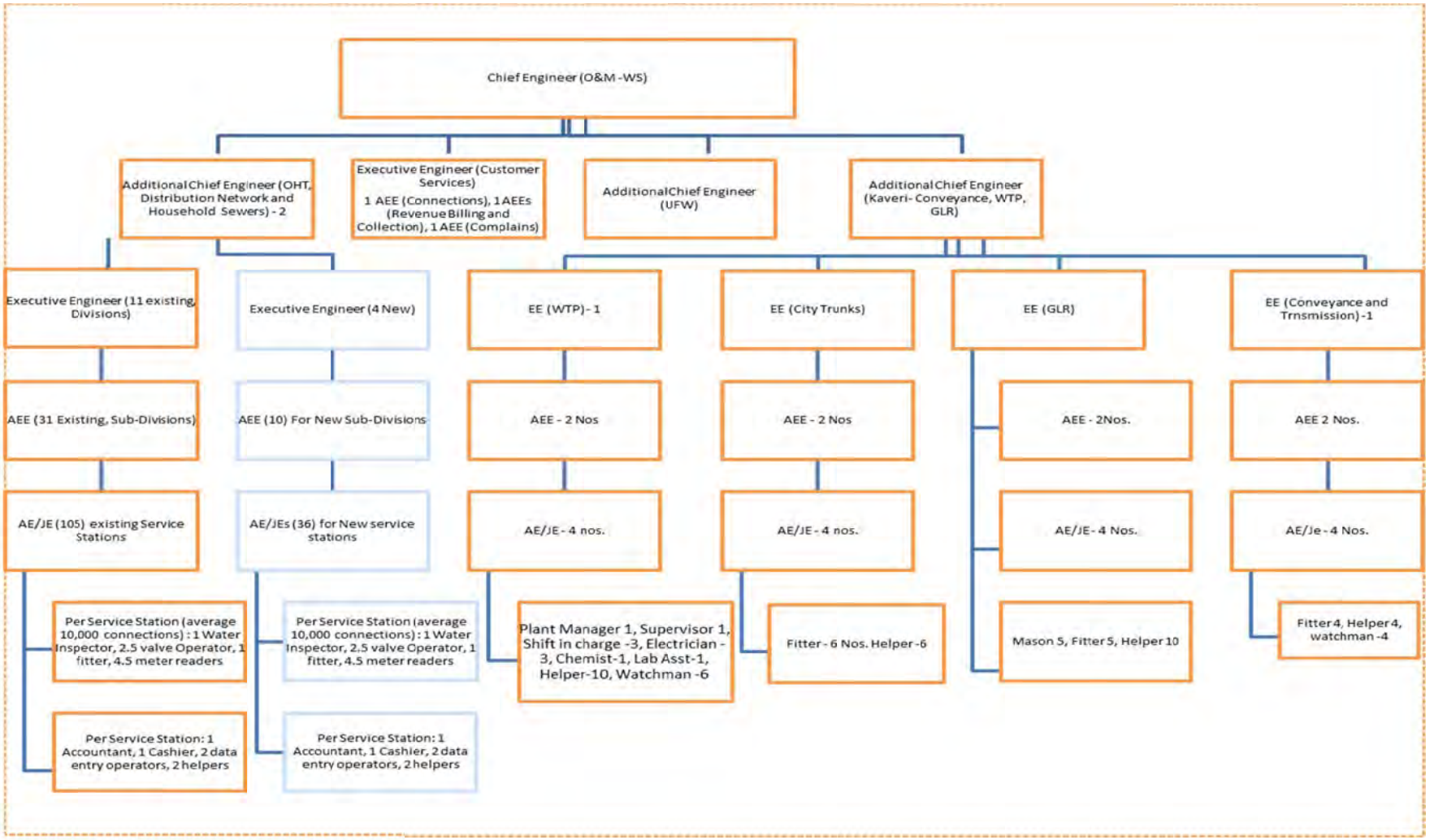
Price year				Base cost	Escalation	Future Price		Calculation Base
				2017		2024	2034	
Water Supply								
	Overhead	Personnel	Technical	51,840	5%	72,944	118,818	110 Village DPR
			Revenue	29,580	5%	41,622	67,798	110 Village DPR
		Sub-total		81,420	5%	114,566	186,616	
	Stage V	Personnel		36,340	5%	51,134	83,292	WTP, PS Capacity
		Power		1,951,950	5%	2,746,590	4,473,906	Water Production: 775 MLD
		Chemicals		51,480	5%	72,437	117,993	Water Production: 775MLD
		Repairs & maintenance		164,620	5%	231,637	377,312	0.5 % of Capital Cost
		Sub-total		2,204,390	5%	3,101,798	5,052,503	
	110 Village	Personnel	Network	94,080	5%	132,380	215,633	110 Village DPR
			Pump	27,648	5%	38,904	63,370	110 Village DPR
			Subtotal	121,728	5%	171,284	279,003	
		Power		71,884	5%	101,148	164,759	110 Village DPR
		Chemicals		0	5%	0	0	110 Village DPR
		Repairs & maintenance		79,235	5%	111,492	181,608	110 Village DPR
		Sub-total		272,847	5%	383,923	625,370	
	Total			**2,558,657**	**5%**	**3,600,288**	**5,864,489**	

Source: JICA Survey Team

13.2.5 Organizational Structure for O&M of Water Supply Facilities

Organizational structure for the O&M of the facilities by proposed projects is recommended as the expansion of existing organizational systems. Figure 13.2.1 presents organizational structure for O&M of facilities in combination of existing and expanded systems. In the figure the following abbreviations on the engineers are used.

EE: Executive Eng., AEE: Assistant Executive Eng., AE: Assistant Eng., JE: Junior Eng.



Source: BWSSB & JICA Survey Team

Figure 13.2.1 Organizational Structure for Water Supply

13.3 Sewerage Facilities

13.3.1 General

Sewerage facilities to be operated and maintained include sewers, intermediate sewage pumping stations (ISPSs) and sewage treatment plant (STPs). Presently, O&M work for existing ISPSs and STPs is undertaken by contractors with a minimal involvement by the BWSSB. On the other hand, there are some teams for O&M of sewers in BWSSB. The work for cleaning, investigations, countermeasures to consumer complaints, and replacement and/or repair of sewers are undertaken by BWSSB. However, some of such works are contracted out to the local contractors.

13.3.2 Sewers

Existing sewers are maintained by the two (2) separate divisions of BWSSB based on the size of the sewers: (1) main sewers (greater than or equal to 400 mm in Dia.) are maintained by Wastewater Management (WWM) division and (2) sewer networks (less than 400 mm in Dia.) including house connections are undertaken by Maintenance Division.

(1) O&M for Main Sewers

The main sewers in the BBMP area is managed by the WWM on a geographical basis i.e. for three (3) major valleys (V. Valley, K&C Valley and Hebbal).

Currently, WWM division does not have TV Camera for inspection of the internal parts of sewers. Therefore, it is recommended to procure three (3) units of TV Camera investigation equipment (See Figure 13.3.1) in this project for emergency inspection and evaluation of existing system before the connection of planned sewers.

WWM division already has eight (8) units of Hydro-jet (Sewer cleaning machine, see Figure 13.3.1) including one (1) water recycle type. The capacity is six (6) m^3 and the cost is about four (4) Million INR per machine. One (1) Hydro-jet can cover about 30 km of sewer lines.

Because of insufficient number of Hydro-jet, even to take care of existing main sewers, it is recommended to procure additional Hydro-jet with 8 m^3 capacity for the cleaning of main sewers (more than 300 mm in Dia.) in 110 Villages. The bigger size of Hydro-jet is costly with about five (5) Million INR per machine, which can cover about 40 km of sewer lines. Therefore, five (5) units of Hydro-jet procurement is recommended to cater for 200 km of main sewer lines.

	
TV Camera for Sewer Inspection http://kantool.co.jp/products/detail.php?ci=3&sci=11&i=184	Hydro-jet (Sewer Cleaning Machine) https://www.google.co.jp/search?q=sewer+cleaning+car+India

Figure 13.3.1 Images of TV Camera Investigation Car and Sewer Cleaning Car

(2) O&M for Sewer Networks (Lateral Sewers)

The sewer networks with less than 350 mm in Dia. are managed by Maintenance division of BWSSB, the activities of which entail the promotion of beneficiaries' participation on sewerage works including sewerage tariff. Currently, this division has 130 units of Hydro-jet (see Figure 13.3.1**)** for the maintenance of existing sewers.

The total length of lateral sewers for 110 Villages are planned by the DPR at about 2,300 km. Assuming that the coverage of sewer network would be 70 % (An existing service coverage is estimated at about 60-70 % in Core/ ULB area as analyzed in Chapter 8, thus, a similar achievement in 110 Villages is expected) in the year 2034, the total length of lateral sewers will be about 1,630 km. Therefore, 40 units of Hydro-jet with 8 m^3 capacity will be additionally required in 2034.

BWSSB also has 36 units of three (3) wheeler mounted manhole desilting machine, which is equipped by grab bucket mounted on a boom with cable type lifting mechanical arrangement (See Figure 13.3.2**)**. These machines can be used in narrow lanes, especially in old Bengaluru and slum areas. If the crane cannot be held steadily, there is a potential risk to cause damages to manholes, especially the frame and cover. This type of machine shall not be considered for 110 Villages, where the road is newly planned and constructed.

The pipe cleaning is usually undertaken by BWSSB using above mentioned machines, though some of maintenance work is out-sourced to the contractor. Nevertheless, it is necessary to conduct survey to confirm the status on the connection points of planned sewers to existing lateral sewers (The clogging of existing lateral sewers was confirmed in the field). The procurement of laser beam equipment is also recommended for inspection of new sewer lines as well as cleaned/repaired sewer lines (See Figure 13.3.2). Since BWSSB does not have such equipment at present, the procurement of four (4) units of laser beam equipment is recommended for the convenience of BWSSB considering subject O&M valley areas.

Pipe Laser
http://www.topcon.co.jp/positioning/products/product/laser/TP-L5_J.html

Three Wheelers Mounted Manhole Desilting Machine
http://www.thehindu.com/multimedia/dynamic/01146/17BGDESILTING_MACH_1146442e.jpg
https://www.indiamart.com/shubhamcorporation-vatva/construction-equipment.html#desilting-machine

Figure 13.3.2 Images of Pipe Razer and Sewer Cleaning Car

13.3.3 STP and ISPS

(1) Current Arrangement

Currently, O&M for the existing STPs and ISPSs is undertaken by the contractors who were awarded the Construction Contract (DBO: Design- Build- Operate). The contract period for O&M of the STPs and ISPSs is usually 7 to 10 years. Further extension of O&M period may be practical both for BWSSB and contractors.

Table 13.3.1 shows current O&M contract for existing 14 STPs. ISPSs are also included in the contract with connection STPs.

Table 13.3.1 Current O&M Contract and Cost for STPs (in 2016)

STP/ TTP TTP: Tertiary Treatment Plant	Location	Treatment Process	Plant Capacity MLD	Commis-sioning	Period of O & M Contract Years	O & M Cost per Annum in Thousand INR.	O & M Contractor
V Valley - Sec-ondary	Mysore Road	High Rate Trickling Filter	180	Jul-99	10	44,185	
V Valley - Ter-tiary		Trickling Filter, Densadeg, Flopac, Chlo-rination	60	May-03	10		Degremont
Kempmbudhi - Secondary	Chamaraj-pet	Activated Sludge Process (ASP)	1	May-01	10		
Mailsandra - Secondary	Mysore Road	Extended Aera-tion (EA)	75	Mar-06	10	22,847	UEM
Nagasandra - Secondary	Tumkur Road	E A	20	Mar-06	10	18,109	Manjunath
Sub Total			**276**			**85,143**	
K & C Valley - Secondary - Refurbished Plant	B. Na-gasandra	ASP	163	Sep-06	7	37,249	Vatech

STP/ TTP TTP: Tertiary Treatment Plant	**Location**	**Treatment Process**	**Plant Capacity MLD**	**Commis-sioning**	**Period of O & M Contract Years**	**O & M Cost per Annum in Thousand INR.**	**O & M Contractor**
K & C Valley - Secondary - New Module	B. Na-gasandra	ASP	55		7		
K & C Valley - Secondary - BWSSP Phase 1	B. Na-gasandra	E A	30	Dec-04	7	18,495	Degremont
Madivala - Reclamation	N S Palya	UASB: Upflow Anaerobic Sludge Blanket Reactor	4	Aug-00	7	1,267	Manjunatha
Kadabesanahal-li - Secondary	Ka-dabesanahal li	E A	50	Feb-06	7	20,478	Vatech
Lalbagh	Lalbagh	E A + RSF + UV	1.5		7	15,952	Degremont
Cubbun park	Cubbon Park	MBR	1.5		7		
Sub Total			**305**			**93,442**	
Hebbal - Sec-ondary	Vishwanath Nagenhalli	ASP	60	Jan-99	10	14,313	UEM
Yelahanka - Tertiary	New Town	ASP, Filtration, Chlorination	10	May-03	10	10,682	Nruthyaga-napathi
Jakkur - Sec-ondary	Yelahanka Jakkur Road	UASBR + E A	10	Jun-06	10	9,151	Nruthyaga-napathi
K. R. Purum - Secondary	K. R. Purum	UASBR + E A	20	Nov-06	10	11,016	UEM
Raja Canal - Secondary	Hennur Road	E A	40	Jul-05	10	16,343	Degremont
Sub Total			**140**			**61,508**	
Total			**721**			**240,094**	

Source: BWSSB

(2) Obligation of Contractor for O&M of STP and ISPS

It is recommended to obtain the following information from the contractor for this project, before commencement of O&M contracts with the Contractor/s after construction of STPs;

- An inventory of all civil, building, mechanical, electrical and other instrumentation works provided at STP/ISPSs with detailed specification
- Approved As-built drawings of all works submitted by the contractor in accordance with the contract
- All the test certificate, warranty certificates and contact details of contractors/suppliers
- An inventory of the entire laboratory equipment with detailed specification
- All spare parts details and the lists
- Approved O&M manuals including maintenance schedule for each equipment, a step by step operation instruction, charts for trouble shooting, check list of each equipment, log book of maintenance and so forth

- Flow diagram for wall-hanging of the plant showing hydraulic levels, name of units, process flow and capacity
- General layout plan for wall-hanging including all facility names, capacity, sizes, pipelines with diameter, roads, pathways, fund agency, contractor/s name and construction year
- Bird-view photos for wall-hanging of the plant (during and after the construction)

The Contractor's obligations for O&M of ISPSs and STPs including lift up pumping facilities are recommended as shown in Table 13.3.2.

Table 13.3.2 Recommended Contractor's Obligations for O&M of ISPS and STP

No.	Item	Contents	Paid by	Payment Term
1	Road works	Repair work	Contractor	Required basis
2	Landscaping	Maintenance, water for plants	ditto	Monthly basis
3	Civil/Structural	Modification/repair work	ditto	Required basis
4	Mechanical component	Periodical maintenance Repair work	ditto	As per O&M Manual schedule/ Required basis
5	Instrumentation system	ditto	ditto	ditto
6	Electrical System	ditto	ditto	ditto
7	SCADA System	ditto	ditto	ditto
8	Utility	Water, wastewater, gas, communication fee	ditto	Monthly basis
9	Ancillary Buildings	Periodical maintenance	ditto	Required basis
10	Diesel	Equivalent to the diesel for 60 hours* operation per month	Contractor	Monthly basis
		Diesel for any additional consumption exceed 60 hours* per month.	BWSSB	Required basis
11	Power Consumption	Guaranteed specific energy consumption	BWSSB	Monthly basis
		Exceed guaranteed power consumption	Contractor	Required basis
12	Dispose of the screenings, grit, and dewatered sludge cake	Collection, transport, and in full compliance with all applicable laws, rules, and regulations.	ditto	Required basis
13	Chemicals/ Consumables	Chemicals for sewage treatment	ditto	Monthly basis
14	Trouble shooting	Any trouble except force majeure	ditto	Required basis
15	Water quality analysis	Daily analysis of influent and effluent standard	ditto	Monthly basis
16	Overhead cost	Management cost	ditto	ditto
17	Effluent standard to be met the standard	Operation to meet stipulated design effluent standards	ditto	ditto
18	Weekly report	All above information	ditto	ditto

Note: Maximum diesel consumption 60 hours* shall be confirmed/agreed between BWSSB and the Contractor before the commencement of O&M. Normally, shut down time is considered as Average 2 hrs. per day on Monthly basis.
Source: JICA Survey Team

The Contractor should manage required work at his own expenses for plant operation personnel, chemicals usage, lubricants, diesel, spares, tools and tackles, routine maintenance, sampling and analysis, screenings and grit collection, transportation and disposal, and dewatered sludge disposal/sale, in coordination with BWSSB, Karnataka State Pollution Control Board (KSPCB), Karnataka Power Transmission Corporation Ltd. (KPTCL) authorities and any other authorities in full compliance with all applicable rules, regulations, laws, codes, effluent quality requirements and any other limitations.

The Contractor should submit a weekly report to the Employer on the O&M including the labour hours expended, Electrical Power Consumed, Chemicals and other Consumables consumed and any problems including trouble shooting faced and rectified. The report shall also include full details including photos and complete results of all sampling and analysis conducted. The items to be considered for water quality examination on inflow and effluent at STP is shown in Table 13.3.7.

(3) Functional Responsibilities of the Contractor

Recommended functional responsibilities of the contractor are described below;

1) The Contractor shall be responsible for effective O&M of the STPs. The scope of work includes treating sewage and disinfecting the effluent in conformity with the production capacity, consumption of chemicals and electricity, besides maintaining effluent quality requirements as shown in Chapter 10.

2) The Contractor shall maintain the laboratory (required as part of contract) and shall carry out the routine analysis of various indices following established frequencies shown in Table 13.3.7.

3) The Contractor shall operate the Plant through the day for a year in application of 3 shifts of 8 hours per shift, etc.

4) The Contractor shall organize a training course for O&M of the STP for all his staff and also for personnel nominated by BWSSB. The course content shall include brief introduction to technology used for sewage treatment, recycling and reuse of treated water, effective use of electricity and generation of electricity through biogas for savings, disinfection, preparation of chemical solution of required concentration and dosage, details of specific unit operations of the STP, maintenance schedule of all the plant equipment, maintenance of log books, preventive maintenance works to be carried out for major equipment etc. The course content and faculty shall be got concurred by Employer.

5) Operation of the STP shall be carried out using the recommended procedure for each unit treatment process as per the detailed O&M Manual. The Contractor is responsible for laboratory testing of the raw sewage and treated effluent in the plant laboratory as routine process measurements.

6) Minor and major repairs to equipment installed at the STP have to be carried out by the Contractor during the O&M period.

7) Besides individual log books, Contractor shall be responsible for providing input in the maintenance management system through "Asset Management plan" that is being implemented as part of project, in the computer shall also record the following:

Equipment wise records of;

- Date and details of Preventive maintenance
- Date and details Break downs
- Date and details Major repairs
- Details of service contract
- Servicing dates and preventive/remedial measures undertaken

8) The Contractor shall maintain separate registers showing the following details. Following registers shall be maintained by the head of the operating staff to be named by the Contractor in writing to the Employer.

a) Personnel: Name of the employees in each shift, their attendance records

b) Individual log book of each equipment, instrument etc.

- Daily Record of Operation
- Date and Details of Preventive maintenance (spares and consumables used)
- Break down and major reason thereof
- Dates and duration of out of operation hours
- Details of breakdown maintenance (date, spares, consumables etc.)
- Dates of calibration and results thereof

c) Separate Registers shall be maintained

- Shift wise use of Chemicals separately for treatment and disinfection showing the amount of chemicals used either in kg or liters of chemical solution (with strength).
- Equipment wise Fuel and other consumables used,
- Shift wise power use and Power Produced (if at the plant power generation is installed)
- Shift wise quantity of sewage pumped into the Plant and effluent discharged
- Daily Test results of effluent water quality
- Other registers required to be maintained as stipulated by the Government Regulations with regard to labor i.e. payment of EPF (Employee Provident Fund), ESI (Employee State Insurance), safety of workmen, accidents register etc.
- Calibration results of facilities (including reuse and power generation)

9) The Contractor's responsibility shall also include the safety and security of the works / plants during the course of O&M.

10) During Operation and Maintenance period, the Contractor is required to appoint a Plant In-Charge, Lead Operator and Laboratory Technician. In addition, the Contractor shall appoint suitable number of operators, fitters, electricians, helpers, gardeners, office peons, security guards, labourers as required for the operation and maintenance of the plants for three shifts and adequate other staff / supporting personnel

during general shift. Recommended minimum qualification and experience for key O&M personnel in STP and ISPS are shown in Table 13.3.3 and Table 13.3.4, respectively.

Table 13.3.3 Minimum Staff and Qualifications Requirements for STP during O&M Period

Sr. No.	Designation	Qualifications	Experience in Years	Total No. for each STP
1	Plant Manager	Graduate/ Post Graduate in Civil, Public Health, or Environmental Engineering with specialization in wastewater collection and treatment and having experience in STP and Sewage Pumping Stations Testing, Commissioning, Operation & Maintenance, Liaison with Government, Pollution Control Authorities. Shall have experience at least three (3) plants operation or equivalent.	8	1/2 (1 Manager for 2 plants)
2	Plant Supervisor/ Superintendent	Graduate in Civil, Public Health, or Environmental Engineering with specialization in wastewater collection and treatment. Shall have experience at least one plant operation or equivalent.	5	1
3	Shift-in-charge	Diploma in Civil Shall have experience at least one plant operation or equivalent.	5	1 (Night Shift only)
4	Operators for STP and Operators for TSPS	ITI certification or job oriented course or equivalent with experience at least one (1) STP. ITI certification or job oriented course or equivalent.	3	• 4 Mechanical • 4 Electrical • 2 Civil Total 10 numbers for < 10 MLD STP • Plus 2 numbers for 21 to 40 MLD < 20 MLD STP
5	Plant Chemist (Lab. Manager)	Graduate in Environmental Science / Chemistry having experience in Water/Wastewater (sampling / analysis)/ operation and maintenance.	3	1
6	Electrician	Experience in electrical Erection, Testing, Commissioning, Operation & Maintenance.	3	1/2
7	Instrumentation and Control Technician	Experience in Instrumentation and Control Engineering.	3	1/2
8	Fitter/Mechanic	ITI Certification in Mechanical Engineering with experience in STP & TSPS Erection, Testing, Commissioning, Operation & Maintenance.	3	2
9	Lab. Assistant	10^{th} Pass	2	1
10	Security Guards for STP	8^{th} Pass	3	3
11	Gardener	8^{th} Pass	1	1
12	Helpers	-	-	2

Source: JICA Survey Team

The Contractor shall furnish complete resumes/biodata for all personnel proposed two months before the start of Operation and Maintenance period to the Engineer for approval.

Table 13.3.4 Minimum Staff and Qualification Requirements for ISPS during O&M Period

S/N.	Designation	Qualifications	Experience in Years	Total No. for each STP
1	Electrician	Experience in electrical Erection, Testing, Commissioning, Operation & Maintenance.	3	1
2	Fitter/Mechanic	ITI Certification in Mechanical Engineering with experience in STP & TSPS Erection, Testing, Commissioning, Operation & Maintenance.	3	1 for Flow ≧ 2MLD
3	Helper	-	-	3 (Three Shifts, 1 for each shift) for Flow ≧ 2MLD
4	Security Guard	8th Pass	3	3 (Three Shifts, 1 for each shift)

Source: JICA Survey Team

13.3.4 Monitoring by SCADA System

Operators can monitor the ISPSs and STPs at SCADA HMI (Human-Machine Interface) provided in Operator Station to operate and maintain the plant load/equipment properly. The SCADA HMI may give the operators any plant information in a user friendly manner using graphical diagram and table format. There may be reports (daily, monthly and yearly) and alarms/events automatically generated on pre-set time schedule basis and/or event basis with date stamped by the SCADA system to assist operator activities and making decision in management level for operating and maintaining the plant suitably/properly. The reporting items are as follows;

- Power supply parameters such as power consumption (kWH), voltage (V), current (A), frequency (Hz), power factor (%),
- Plant load/equipment statuses such as run-time, full open position, full closed position, manual mode, automatic mode etc,
- Totalized flow rates, and real-time basis and historical trend basis flows for each flow meter such as inlet flow, RAS flow, WAS flow, MLR (Mixed Liquor Recycle) flow, air blower flow, alum dosing flow, de-chlorine flow, thickened sludge flow, centrifuge feed flow, centrifuge polymer dosing flow, effluent flow, filtrate flow etc.,
- Real-time basis and historical trend basis levels for each level meter such as level in inlet chamber, level in sewage pump wet well, level of pre and post screens, level in treated water tank, level in alum solution tank, level in de-chlorine tank, level in secondary sludge sump, level in thickened sludge sump, level in centrifuge sump, level in polyelectrolyte solution tank, level in filtrate sump,
- Real-time basis and historical trend basis of water quality such as DO in aeration tank, MLSS in aeration tank, residual chlorine in chlorine contact tank etc.,
- Alarms such as Low-Low and High-High levels in level meters, flow meters, pressure meters, water quality analyzers, etc.,
- Alarms such as electrical faults on power supply facilities, electrical faults on plant equipment, mechanical faults on plant equipment etc.

These reports may also be utilized for planning of equipment for preventive maintenance, planning of consumable procurement, asset management schedule/list for assisting planning of repairs and replacements of equipment.

13.3.5 Additional Facilities for Effluent Reuse at STPs

In this project, tertiary treatment is not considered except for No.2 Yelahankakere STP. However, it is recommended to add some effluent supply facility for all STPs to sell the effluent to recover O&M cost. For example, the water mixing with concrete materials for construction work does not require tertiary treatment to meet the standard as shown in Table 13.3.5.

Table 13.3.5 Water Quality Permissible Limit for Construction Use

Item	Standard	Target Quality from STPs	Remarks
Organic	Less than 200 mg/L	COD = 50mg/L	Considered as CODcr
Inorganic	Less than 3,000 mg/L	N.A.	Normally, not more than 2,000 mg/L in raw sewage
Sulphates (as SO_3)	Less than 400 mg/L	N.A.	Normally, not more than 300 mg/L in raw sewage
Chlorides (as Cl)	Less than 2,000 mg/L	N.A.	Normally, not more than 1,200 mg/L in raw sewage
pH	Not less than 6.0	pH= 6.0 to 8.0	Normally, pH is around 7.0
Suspended Matter	Less than 2,000 mg/L	SS = 10 mg/L	Considered as Suspended Solid (SS)

Source: JICA Survey Team, IS456, Water Reuse Guideline Document

The sewage from North-West part of Bengaluru city is collected and treated at existing Nagasandra STP (applying Extended Aeration Process) with an existing capacity of 20 MLD. Additional STP for the treatment of 20 MLD is under construction. The effluent from the STP is discharged into the nearby lake.

BWSSB commissioned a study in 2015 for demand assessment and willingness to use tertiary treated sewage from Tavarakere/ Nagasandra to Peenya Industrial Area for Non Potable Purposes (see Table 13.3.6). Peenya Industrial area and Dasarahalli Industrial areas are about 5 km away from Nagasandra STP.

Peenya and Dasarahalli Industrial areas mainly consist of knitting industries where water usage is limited. The majority of the industries have their own deep wells in their premises. The above mentioned industries are not much keen in taking tertiary treated sewage from BWSSB. As a result of the survey, the demand was projected at around 3 MLD with the willingness of about 38% of respondents to use tertiary treated sewage.

Table 13.3.6 Demand Assessment for Tertiary Treated Sewage

Location	Response with willingness to use Tertiary Treated Sewage (Nos.)			Projected Demand of Tertiary Treated Sewage
	Total Nos	Willing to Use	No response / No requirement / Not use	(m^3/day)
Peenya 2nd stage	30	22	8	198.40
Peenya 1st phase	20	14	6	370.00
Peenya 1st stage	2	1	1	100.00
Peenya phase II	64	34	30	1,416.83
Peenya phase III	54	30	24	370.33
Peenya phase IV	106	69	37	434.16
Grand Total	276	106	170	2,889.72

Source: BWSSB

13.3.6 Water Quality Examination for Inflow Sewage and Effluent at STP

(1) Operation by the Contractor

It is recommended that following measures shall be taken to ensure proper O&M of the STPs. During the first two (2) years of the O&M Contract (1 year of Defect Liability Period + 1 year of O&M), the raw sewage pumped into the Sewage Treatment Plant and disinfected effluent shall be sampled as scheduled in Table 13.3.7 and analyzed at the laboratory of the STPs.

Table 13.3.7 Recommended Sampling/Analysis Locations and Frequencies

Parameter	Sampling Frequency	Sampling Method	Sampling points/location
pH	1.Daily	Flow-weighted 24-hour composite	a) Raw Sewage b) Plant Effluent
	2. Three times per week	Grab	Aeration Basin Zones a) Anaerobic (if applicable) b) Anoxic c) Aerobic
COD	Daily	Flow-weighted 24-hour composite	a) Raw Sewage b) Plant Effluent
Rb COD	Weekly	Influent	Influent sewage
TSS	1. Daily	Flow-weighted 24-hour composite	a) Raw Sewage b) Plant Effluent
	2. Twice a week	Grab	Waste activated sludge (WAS)
VSS	1. Daily	Flow-weighted 24-hour composite	Raw Sewage
	2. Twice a week	Grab	Waste activated sludge (WAS)
Residual chlorine	1. Daily	Grab	Plant Effluent
	2. Continuous	On-line	Plant Effluent
BOD	Three times per week	Flow-weighted 24-hour composite	a) Raw Sewage Influent b) Plant Effluent

Parameter	Sampling Frequency	Sampling Method	Sampling points/location
TKN	Three times per week	Flow-weighted 24-hour composite	a) Raw Sewage b) Plant Effluent
Ammonia-N	1. Three times per week	Flow-weighted 24-hour composite	a) Raw Sewage b) Plant Effluent
	2. Three times per week	Grab	Aeration Basin Zones (as designed) a) Anaerobic (if applicable) b) Anoxic c) Aerobic
Nitrate-N	1. Three times per week	Flow-weighted 24-hour composite	a) Raw Sewage b) Plant Effluent
	2. Three times per week	Grab	Aeration Basin Zones a) Anaerobic (if applicable) b) Anoxic c) Aerobic
Alkalinity	1. Three times per week	Flow-weighted 24-hour composite	a) Raw Sewage b) Plant Effluent
	2. Three times per week	Grab	Aeration Basin Zones a) Anaerobic (if applicable) b) Anoxic c) Aerobic
Total phospho-rous	Three times per week	Flow-weighted 24-hour composite	Raw Sewage and Plant Effluent
Soluble phos-phorous	1. Three times per week	Flow-weighted 24-hour composite	Raw Sewage and Plant Effluent
	2. Three times per week	Grab	Aeration Basin Zones a) Anaerobic (if applicable) b) Anoxic c) Aerobic
Fecal coliform	Three times per week	Flow-weighted 24-hour composite	a) Raw Sewage b) Plant Effluent
VFAs	Three times per week	Grab	a) Raw Sewage b) Anaerobic zone (from Digester – if provided)
MLSS	Twice a week	Grab	Aerobic zone
MLVSS	Twice a week	Grab	Aerobic zone
Flow rate	Continuous	On-line flowmeter	a) Raw Sewage (Plant Effluent) b) Plant Effluent c) RAS d) WAS e) Sludge
Temperature	Daily	Flow-weighted 24-hour composite	a) Raw Sewage b) Plant Effluent
Specific gravity and concentra-tion	Three times per week	Grab	Chemicals Sludge for consistency
Volume	Three times per week	Grab	Chemicals/Screenings/Grit/ Gas genera-tion if applicable

Parameter	Sampling Frequency	Sampling Method	Sampling points/location
Electricity Generation	Daily	On-line	Gas Quality, Volume, Engine running and Electricity Generation.

Note: rb COD: readily biodegradable chemical oxygen demand
Source: JICA Survey Team
(Reference: Tender Document for Kengeri STP, BWSSP Phase 2)

For the subsequent four (4) years, the sampling and analysis shall be conducted (on 24 hours-composite sample) once a week and shall cover all the days of the week.

(2) Monitoring by Authorized Laboratory

In addition, the Contractor is required to validate its analysis on effluent samples up to four (4) times a month from an approved laboratory (by Bureau of India Standards), which is not connected to the Project. The validation sampling shall be randomly taken based on BWSSB decision and the cost of validation/analysis shall be borne by the Contractor.

During the entire operation and maintenance period, BWSSB shall nominate their official/counterparts for the inspection of specific STPs on a weekly basis. BWSSB shall also nominate a qualified person to carry out periodical inspection of the STPs and to conduct surprise checks, without prior notice to the Contractor. This policy is required for BWSSB to get best services from the Contractor(s) and to meet all the effluent quality requirement ensuring pollution abatement of the rivers. BWSSB shall check the effluent quality of the STP every day and request the Contractor to undertake appropriate remedial actions, if the performance of the plant is observed as not satisfactory.

It is further recommended that BWSSB shall engage an approved (or Bureau of Indian Standards Certified) laboratory for assessing the effluent water quality, for which the samples shall be jointly collected by the BWSSB and Contractor. The selection of sample locations and number of samples shall be determined during the first year of defect liability period.

During the Defect Liability Period, BWSSB shall carry out monthly, quarterly, half yearly and annual inspection of the treatment plant by its designated personnel with the assistance of project management consultants. BWSSB shall suggest necessary improvements to the Contractor for efficient O&M of the STP.

13.3.7 O&M Cost for Sewerage Facilities for the 110 Villages

The manner of cost estimate and unit cost for O&M of facilities are referred to the CPHEEO guidelines. The following are component items.

1) Staff cost (for all facilities: Sewer, ISPS and STP)
2) Power (Electricity/Fuel) cost (for all facilities)
3) Chemicals cost (only for STP)
4) Sludge disposal cost (only for STP)
5) Repair cost (for all facilities)

6) Others (for all facilities)

Required O&M cost was estimated for the target year 2034 based on unit cost in base year 2017. The cost in the year 2017 level was escalated up to the year 2034 using 5% of annual price escalation. The cost required for the year 2024 was also estimated, for the reference, in a simplified method using the percentage of water demand in 2024 to that in 2034 (refer to water balance study result in Chapter 6 Table 6.4.6).

Based on the study results on sewerage service coverage at present in Core and ULB area with 60-70 %, it is assumed that service coverage in 2034 would be 70% and in 2024, 50% of households in the planned sewerage service area (As completion year for the construction is planned in 2023, about half of service coverage is assumed). The following are calculation results on the above mentioned.

Sewage flow to be treated in 2034:

114 MLD (planned sewage in 2034) x 70% (assumed service coverage) = 79.8 MLD

Sewage flow to be treated in 2024:

114 MLD x (358 MLD/508 MLD; 70% water demand percentage - year 2024 against year 2034) x 50% (assumed service coverage) = 39.9 MLD

(1) O&M Cost in DPR

Table 13.3.8 shows O&M cost presented in the DPR. Annual O&M cost is estimated at about 154 Million INR (see Table 13.3.17). Issues for O&M cost in DPR are as follows;

- The O&M cost of STPs is not considered.
- The number of technical staff, revenue and establishment staff suggested in DPR needs to be reviewed. The number should also include additional number of Executive Engineers and some allocation for senior BWSSB staff.
- Only three (3) intermediate pumping stations are considered in the DPR. However, the number of pumping stations increased to seven (7). Accordingly, the staff numbers have to be revised.
- Energy charges considered at 20 INR/unit seem to be higher than current rates.

Table 13.3.8 O&M Cost by O&M Item in the DPR

No.	Particulars	Unit	Qty. / Nos.	Rate (INR)	Amount per Month (INR)	Amount per Year (INR)
A	**General Staff for maintenance of Sewerage System.**					
I	**Technical Staff**					
1	Assistant Executive Engineer (A.E.E)	No.	24	50,000	1,200,000	14,400,000
2	Assistant Engineer (A.E.)	No.	48	35,000	1,680,000	20,160,000
3	Work inspector	No.	96	15,000	1,440,000	17,280,000
II	**Revenue & Establishment Staff.**					

No.	Particulars	Unit	Qty. / Nos.	Rate (INR)	Amount per Month (INR)	Amount per Year (INR)
1	Manager	No.	5	18,000	900,00	1,080,000
2	Cashier	No.	5	15,000	75,000	900,000
3	First Division Assistant	No.	10	15,000	150,000	1,800,000
4	Second Division Assistant	No.	20	12,000	240,000	2,880,000
5	Meter Reader	No.	125	12,000	1,500,000	18,000,000
6	Data Entry operator	No.	20	12,000	240,000	2,880,000
7	Telephone operator	No.	10	8,000	80,000	960,000
8	Watchman	No.	15	6,000	90,000	1,080,000
B	**O & M Staff for Sewerage Collection System**					
I	**Staff for maintenance of Sewer Pipeline System**					
1	Supervisors	No.	28	10,000	280,000	3,360,000
2	Scavengers	No.	67	8,000	536,000	6,432,000
3	Helpers	No.	217	5,000	1,085,000	13,020,000
II	**Staff for Sewerage Pumping Stations**					
1	Pump operators (3 shifts per wet well & one reliever)	No.	48	15,000	720,000	8,640,000
2	Electrician/Mechanic	No.	24	12,000	288,000	3,456,000
3	Helpers/Fitters	No.	48	8,000	384,000	4,608,000
4	Watchman	No.	48	6,000	288,000	3,456,000
III	**Effluent Pumping machineries Energy Cost**					
1	Average Pumping hours Per Day	hrs	60			
2	Total HP of pump	HP	154			
3	Total power consumption	kWh/day	114.884			
4	Energy Charges	INR/unit	20			
5	Energy Cost per day	INR	5,514.43			
6	Energy Cost per year	INR	5,514.43 x 365days			2,012,767
IV	**Repair Cost**					
1	Sewerage System Repair & Replacement cost (0.25% of Project cost)	L.S.		0.25%		27,499,584
Miscellaneous and rounding off						15,648
	Total Cost of O&M Per year					**153,920,000**

Source: BWSSB (DPR for Sewerage Component of 110 Villages)

(2) General Staff

Table 13.3.9 shows estimated O&M cost of general staff for sewers and Table 13.3.10 shows that of STPs and ISPSs. Annual cost for general staff is estimated at approximately 23.6 + 39.5 = 63.1 Million INR.

Table 13.3.9 Estimated O&M Cost of General Staff for Sewers (BWSSB)

Item	Details at 2034	Calculation Basis	O&M Cost		
			2017 based	2024	2034
		(2017 based)	(INR/year)	(INR/year)	(INR/year)
EE	2 Nos of Executive Engineer	2 x 79,600 x 12months= 1,910,400	1,910,400	2,912,100	4,743,600
AEE	5 Nos of Assistance Executive Engineer	5 x 57,800 x 12months= 3,468,000	3,468,000	4,879,800	7,948,700
AE/JE	4 Nos of Assistance Engineer	4 x 51,700 x 12months= 2,481,600	4,779,600	6,725,400	10,954,900
	5 Nos of Junior Engineer	5 x 38,300 x 12months= 2,298,000			
	9 Nos in Total	4,779,600			
Total	EE+AEE+ AE/JE	10,158,000	10,158,000	14,517,300	23,647,200

Note: Price escalation is considered as 5%.
Source: BWSSB & JICA Survey Team

Table 13.3.10 Estimated Annual Cost for General Staff for STPs and ISPSs

Item	Details at 2034	Calculation Basis	O&M Cost		
			2017 based	2024	2034
		(2017 based)	(INR/year)	(INR/year)	(INR/year)
EE	2 Nos of Executive Engineer	2 x 79,600 x 12months= 1,910,400	1,910,400	2,912,100	4,743,600
AEE	9 Nos of Assistance Executive Engineer	9 x 57,800 x 12months= 6,242,400	6,242,400	8,783,700	14,307,700
AE/JE	7 Nos of Assistance Engineer	7 x 51,700 x 12months= 4,342,800	8,938,800	12,577,800	20,487,900
	10 Nos of Junior Engineer	10 x 38,300 x 12months= 4,596,000			
	17 Nos in Total	8,938,800			
Total	EE+AEE+ AE/JE	5,912,400	17,091,600	24,273,600	39,539,200

Note: * Price Escalation is considered as 5% per year
Source: JICA Survey Team

(3) Sewers

Table 13.3.11 and Table 13.3.12 show estimated O&M cost of proposed sewers. Annual repair cost of sewers is calculated as 0.25% of construction cost using same manner as DPR. Annual O&M cost for main sewers is estimated at approximately 17.1 Million INR, and lateral pipes and house connections are estimated at approximately 108.6 Million INR.

Table 13.3.11 Estimated O&M Cost of Proposed Main Sewers

Item	Details at 2034	Calculation Basis	O&M Cost		
			2017 based	2024	2034
		(2017 based)	(INR/year)	(INR/year)	(INR/year)
1) Staff Cost	Total 20 12months/year+1month bonus	(20x10,000+1x20,000) x 13months = 2,860,000	2,860,000	4,024,300	6,555,200
Inspector	1 nos.	20,000 x (1+5%)^ (2034-2017) = 45,840	Unit Cost 20,000	Unit Cost 28,142	Unit Cost 45,840
Main Sewer	(3 Staff +1 Driver) x 5 Hydro-jet = 20 nos.	10,000 x (1+5%)^ (2034-2017) = 22,920	Unit Cost 10,000	Unit Cost 14,070	Unit Cost 22,920
2) Power (Fuel) cost	Main Sewer 5 Hydro-jets Laterals 40 Hydro-jets Total 45 Hydro-jets at 2034	5 x 30L/day =150 L/day Working 200days/year 150x200x75 INR/L =2,250,000 INR/year	2,250,000	2,412,305	2,664,685
3) Repair Cost	0.25% of Construction Cost	Pipeline Construction Cost 2,370,000,000 x 0.0025 = 5,925,000	5,925,000	8,337,100	13,580,200
Sub-total			11,035,000	14,773,700	22,800,100
4) Others	Outsourcing etc.	5% of Above.	583,200	783,000	1,212,200
Total		-	**11,618,200**	**15,556,700**	**24,012,000**

Note: Fuel price is considered as 1% of escalation. Other price escalations are considered as 5% for all.

Source: JICA Survey Team

Table 13.3.12 Estimated O&M Cost of Lateral and House Connection Pipes (BWSSB Scope)

Item	Details at 2034	Calculation Basis	O&M Cost		
			2017 based	2024	2034
		(2017 based)	(INR/year)	(INR/year)	(INR/year)
1) Staff Cost	Total 160 12month/year + 1month bonus	(160x10,000+1x20,000) x 13months = 21,060,000	21,060,000	29,633,535	48,269,906
Inspector	1 nos.	20,000 x (1+5%)^ (2034-2017) = 45,840	Unit cost 20,000	Unit cost 28,142	Unit cost 45,840
Lateral Pipes	(3 Staff +1 Driver) x 40 Hydro-jet = 160 nos.	Ditto	Unit cost 10,000	Unit cost 14,070	Unit cost 22,920
2) Power (Fuel) cost	Laterals and House Connections (H.C.) 40 Hydro-jet	40 x 30L/day =1,200 L /day Working 200days/year 1,200 x 200 x 75 INR/L =18,000,000 INR/year	18,000,000	19,298,400	21,317,500

Item	Details at 2034	Calculation Basis	O&M Cost		
			2017 based	2024	2034
		(2017 based)	(INR/year)	(INR/year)	(INR/year)
3) Repair Cost	0.25% of Construc-tion Cost	Lateral & H.C. Pipeline Construction Cost 14,333,000,000 x 0.0025 = 35,832,500	35,832,500	50,419,900	82,128,700
Sub-total			74,892,500	99,351,800	151,716,100
4) Others	Outsourcing etc.	5% of Above	3,776,100	5,012,600	7,658,000
Total		-	**78,668,600**	**104,364,400**	**159,374,100**

Note: Fuel price is considered as 1% of escalation. Other price escalations are considered as 5% for all.

Source: JICA Survey Team

(4) Intermediate Pumping Stations

Annual O&M cost for ISPSs is calculated using following conditions referring to CPHEEO guidelines as adopted in the DPR.

- Staff work: CPHEEO guideline with price escalation in the DPR.
- Power work: Calculated based on power consumption with anticipated price escalation (same as DPR)
- Repair work: 2.0% of construction cost for mechanical works

Table 13.3.13 shows estimated annual O&M cost for ISPSs. Annual O&M cost for ISPSs is estimated at approximately 40.5 Million INR and for five (5) years cost is approximately 202.5 Million INR.

Table 13.3.13 Estimated O&M Cost of Proposed ISPSs

No	STP Name	Daily Average Flow	Manpower Cost	Power Cost	Repair/ Others	Price Escalation	Total			Unit Cost
							(2017 base)	2024	2034	
		MLD	INR/year	INR/year	INR/year	%	INR/year	INR/year	INR/year	INR/m^3
A-1	Bellahalli	0.9	650,000	246,391	269,878	5.0	1,166,300	1,641,100	2,673,200	2,970
B-1	Hagadur	15.0	1,300,000	2,826,770	752,636	5.0	4,879,400	6,865,800	11,183,700	746
C-1	Naganathapura	9.0	1,300,000	2,432,859	460,674	5.0	4,193,500	5,900,700	9,611,600	1,068
D-1	Arehalli 1	1.1	650,000	216,644	287,154	5.0	1,153,800	1,623,500	2,644,500	2,404
D-2	Hemigepura	1.6	650,000	302,912	277,169	5.0	1,230,100	1,730,900	2,819,400	1,762
E-1	Herohalli	0.5	650,000	67,906	249,539	5.0	967,400	1,361,200	2,217,300	4,435
E-2	Doddabidarakallu	8.1	1,300,000	2,072,231	690,917	5.0	4,063,100	5,717,200	9,312,700	1,150
Total		36	6,500,000	8,165,713	2,987,967	5.0	17,653,600	24,840,400	40,462,375	1,118

Note: * Price Escalation is considered as 5% per year

Source: JICA Survey Team

(5) Sewage Treatment Plant

Annual O&M cost for STPs is calculated based on the following conditions and shown in Table 13.3.14 to Table 13.3.16.

・Staff:	Calculated using unit cost of CPHEEO guidelines with anticipated price escalation
・Power:	Calculated based on power consumption unit cost with anticipated price escalation
・Chemical:	Calculated based on chemicals consumption, unit cost by BWSSB with anticipated price escalation (chlorine gas, sodium hypochlorite, alum and polymer)
・Sludge disposal:	Calculated based on dewatered sludge volume and transportation for 25 km each STP
・Repair works:	2.0% of construction cost for mechanical works

Table 13.3.14 Estimated O&M Cost of Proposed STPs (1)

No	STP Name	Daily Average Flow	Manpower Cost	Electricity Cost	Chemical Cost	Sludge Disposal Cost	Repair/ Others
		MLD	INR/year	INR/year	INR/year	INR/year	INR/year
1	Jakkur	7	7,020,000	8,752,472	2,916,609	2,168,283	1,627,156
2	Yelahankakere	6	7,020,000	7,568,102	2,537,100	1,858,398	1,500,687
3	Doddabettahalli	7	7,020,000	8,752,472	2,916,609	2,168,283	1,627,156
4	Bilishivalli	17	7,150,000	19,947,375	7,011,641	5,413,477	2,713,490
5	Varthur	15	7,150,000	17,556,323	6,234,061	4,839,170	2,486,345
7	Pillaganahalli	4	7,020,000	5,199,361	1,778,083	1,238,628	1,247,749
8	Talaghattapura	5	7,020,000	6,383,732	2,157,592	1,548,513	1,374,218
9	Somapura	8	7,020,000	9,936,843	3,296,118	2,478,168	1,753,626
10	Hemigepura	13	7,150,000	15,456,027	5,362,491	4,142,677	2,294,432
12	Nagasandra	9	7,020,000	11,121,213	3,675,627	2,788,053	1,880,095
13	Karivobanahalli	10	7,150,000	12,305,583	4,055,135	3,097,938	2,006,564
14	Herohalli	3	7,020,000	4,014,991	1,398,574	928,743	1,121,280
15	Hosahalli	6	7,020,000	7,568,102	2,537,100	1,858,398	1,500,687
16	Chikkabanavara-2	4	7,020,000	5,199,361	1,778,083	1,238,628	1,247,749
Total		114	98,800,000	139,761,957	47,654,824	35,767,352	24,381,233

Source: JICA Survey Team

Table 13.3.15 Estimated O&M Cost of Proposed STPs (2)

No	STP Name	Daily Average Flow	Price Esca-lation	Total			Unit Cost
				(2017 Base)	2024	2034	
		MLD	%	INR/year	INR/year	INR/year	INR/m^3
1	Jakkur	7	5.0	22,484,520	31,637,978	51,534,932	3,212
2	Yelahankakere	6	5.0	20,484,287	28,823,449	46,950,361	3,414
3	Doddabettahalli	7	5.0	22,484,520	31,637,978	51,534,932	3,212
4	Bilishivalli	17	5.0	42,235,983	59,430,270	96,805,647	2,484
5	Varthur	15	5.0	38,265,899	53,843,962	87,706,141	2,551
7	Pillaganahalli	4	5.0	16,483,821	23,194,391	37,781,219	4,121
8	Talaghattapura	5	5.0	18,484,054	26,008,920	42,365,790	3,697
9	Somapura	8	5.0	24,484,753	34,452,507	56,119,504	3,061
10	Hemigepura	13	5.0	34,405,627	48,412,173	78,858,328	2,647
12	Nagasandra	9	5.0	26,484,987	37,267,036	60,704,075	2,943
13	Karivobanahalli	10	5.0	28,615,220	40,264,488	65,586,608	2,862
14	Herohalli	3	5.0	14,483,587	20,379,862	33,196,647	4,828
15	Hosahalli	6	5.0	20,484,287	28,823,449	46,950,361	3,414
16	Chikkabanavara-2	4	5.0	16,483,821	23,194,391	37,781,219	4,121
Total		114	5.0	346,365,366	487,370,853	793,875,764	3,038

Note: * Price Escalation is considered as 5% per year
Source: JICA Survey Team

Table 13.3.16 Estimated O&M Cost

Unit: INR

Item	Year 2017	Year 2024	Year 2034
General Staff for Sewers	10,158,000	14,517,000	23,647,000
General Staff for STPs and ISPSs	17,092,000	24,274,000	39,539,000
Main Sewers	11,618,000	15,557,000	24,012,000
Lateral and House Connection Pipes	78,669,000	104,364,000	159,374,000
ISPS	17,654,000	24,840,000	40,462,000
STPs	346,365,000	487,371,000	793,876,000
Total	481,555,000	670,923,000	1,080,910,000

Source: JICA Survey Team

(6) Comparison of Annual O&M Cost between DPR and JICA Survey Results

Table 13.3.17 shows summary of O&M cost by JICA Survey results and DPR. According to JICA Survey, annual O&M cost for the sewage facilities in the year 2034, assuming 100% of sewage flow is treated, required cos arrived at 1,023 Million INR.

Table 13.3.17 Total O&M Cost of Sewage Facilities in 2034 by DPR and JICA Survey

Item	JICA Survey		DPR	
	Annual O&M Cost	**O&M Cost for 5 years** (Price escalation not considered)	**Annual O&M Cost**	**O&M Cost for 5 years** (Price escalation not considered)
	INR/year	**INR/year**	**INR/year**	**INR/year**
General Staff	63.1	315.5	81.4	407.1
Main Sewers	24.0	120.0	22.8	114.1
Laterals & Others	159.4	797.0		
ISPSs	40.5	202.5	22.2	110.9
STPs	793.9	3,969.5	Not Mentioned	Not Mentioned
Repairs & Miscellaneous	Included in each items above	Included in each items above	27.5	137.5
Total	**1,080.9**	**5,404.5**	**153.9**	**769.6**

Source: DPR and JICA Survey Team

Table 13.3.18 shows estimated annual O&M cost in the year 2024 and 2034 both for the treatment of 100% planned sewage flow and that under assumed service coverage.

Table 13.3.18 Annual O&M Cost by JICA Survey and DPR in the Year 2024 and 2034

Item		Year 2017	Year 2024	Year 2034
Flow (MLD)	Planned sewage flow (100%)	0	79.8	114
	Assumed sewage flow & service coverage	0	39.9 (50%)	79.8 (70%)
O&M Cost (Million INR)	Case 1: 100% of planned flow	(454.2)	632.4	1,023.2
	Case 2:Under assumed service coverage	0	316.2	716.2

Note: Cost in 2024 and 2034 is escalated from year 2017 with annual rate of 5 %. The figure in the parenthesis in O&M cost in 2017 shows the cost for planned sewage flow in 2034 on 2017 price level.
Source: JICA Survey Team

13.3.8 Organizational Structure and Technical Capacity Needs for BWSSB

BWSSB, since its inception is engaged in managing water supply and sewerage facilities. To undertake the O&M of water supply and sewerage facilities, it has a well-defined organizational structure.

For managing its sewerage facilities, BWSSB has an existing “Zone” for wastewater management under CE (WWM), which looks after STPs, Intermediate Pumping Stations (IPS) and sewers above 350 mm (trunk, mains, major laterals). The house connections (< 350 mm sewers) are managed by another Zone under CE (WS - Maintenance). The STPs and IPSs are operated and maintained by external contractors using Performance Based Management Contracts. The contracts are governed by a number of performance indicators. The Trunk, Mains and laterals above 350 mm are maintained by WMM zone. With topograph-

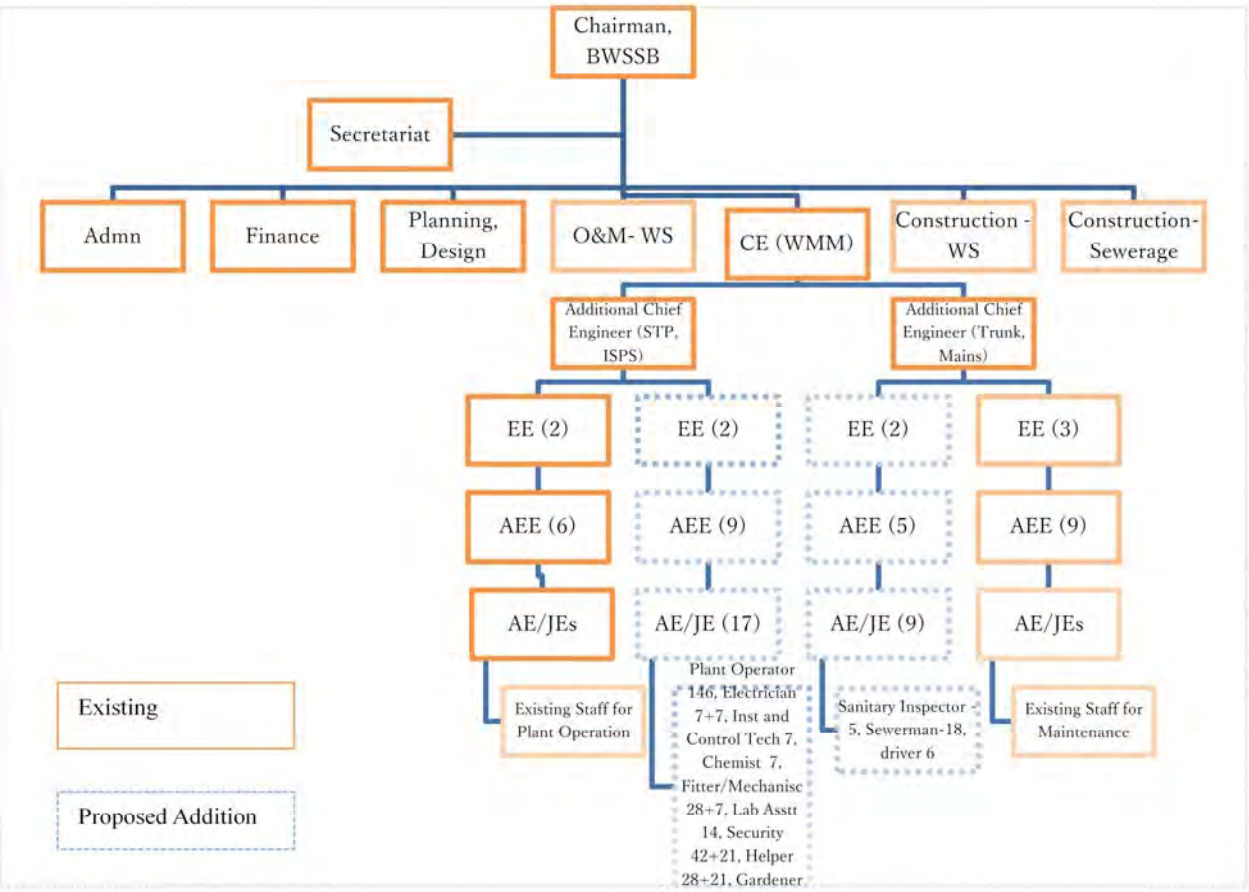
ical considerations, 3 EEs have been designated to look after O&M of existing sewers in different valleys (one for V. valley, One for K&C Valley and one for Hebbal valley). Since O&M of existing STPs and IPSs is out-sourced, only two divisions (headed by EE) have been designated to supervise and monitor their performance.

BWSSB has an ambitious plan to construct a large number of STPs and IPSs during next few years (by 2024). However, they also plan to continue the existing O&M strategy of using external contractors, wherein major role of BWSSB shall be supervision and monitoring only. Therefore, considering the expected work load, only two new divisions with required manpower for O&M of STPs and IPSs have been recommended.

Similarly a large number of new sewers (trunk, mains, laterals above 350 mm) are to be laid (+1,600 km by 2034) in 100 Villages. It is anticipated that more than half of that shall be laid by 2024. However, considering the spread, 3 additional divisions for maintenance of sewers have been suggested along with required manpower. The recommended organogram for O&M for sewerage management is presented as Figure 13.3.3.

For O&M of water supply, the entire area (comprising of Core area and ULBs) is covered by a network of divisions (headed by an EE), sub-divisions (headed by an AEE) and service stations (managed by AE/JEs). There are 11 existing divisions, 31 sub divisions and 105 operational (actual number is 112) service stations. However, with the planned projects, water supply shall be extended to 110 Villages by the year 2024. The major activities shall include construction works, provisioning of service connection and management of water supply facilities for quality service delivery. Overall, there shall be perpetual demand of manpower for O&M of water supply facilities. Considering the distribution of population in 2024 and associated service connections, coverage area, pipe length to be managed etc. it is recommended to have 4 new divisions, 11 sub-divisions and 36 service stations for operation and maintenance of WS component (including household level sewer connections). Using on-going norms, manpower requirements have also been calculated for O&M of WS facilities. The recommended organogram for O&M for water supply infrastructure is presented as Figure 13.3.4. Engineers considers are as follows:

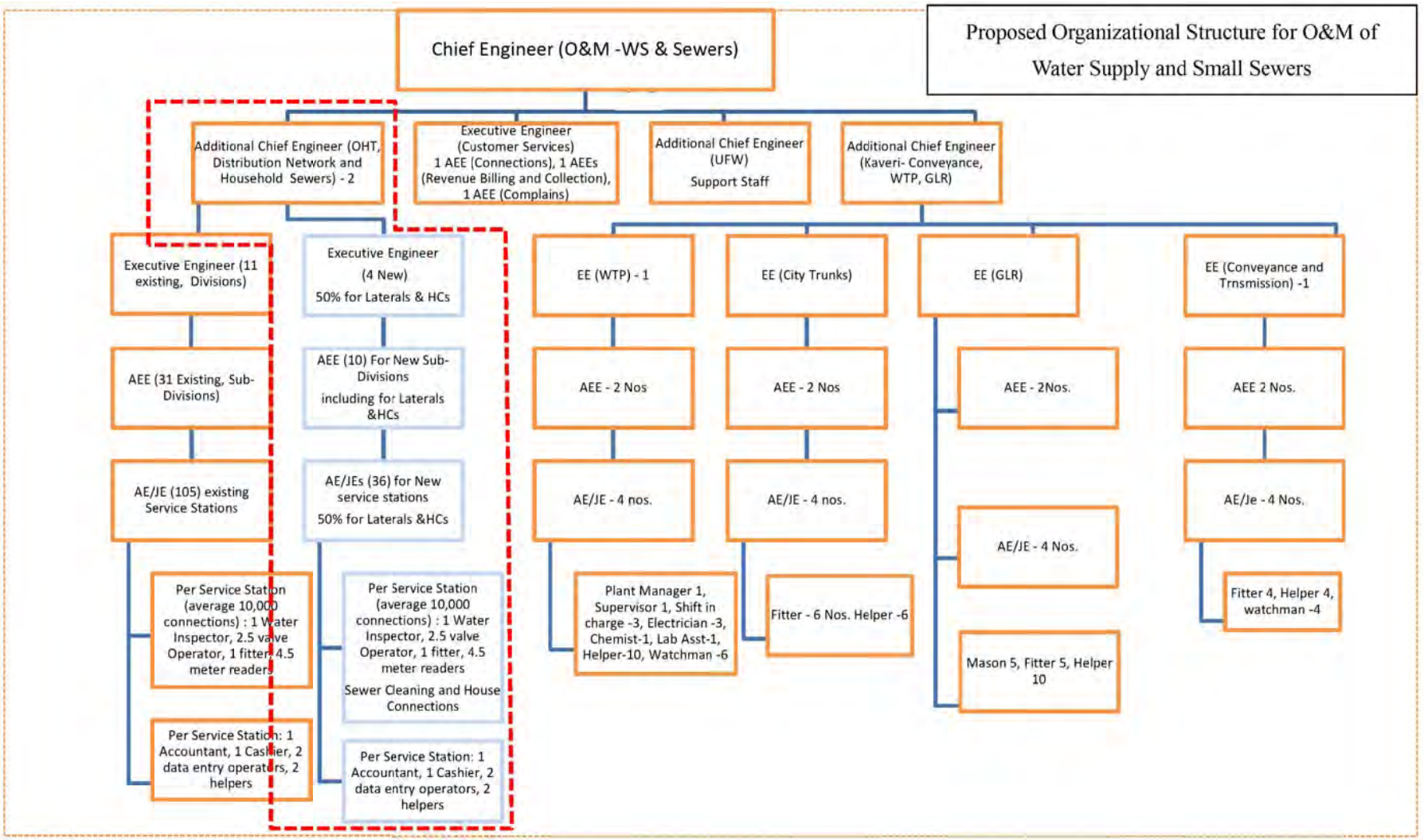
CE: Chief Eng., EE: Executive Eng., AEE: Assistant Executive Eng., AE: Assistant Eng., JE: Junior Eng.



Source: BWSSB & JICA Survey Team

Figure 13.3.3 Proposed Organizational Structure for O&M of STP, ISPS and Main Sewers

The operation of both water supply and sewerage infrastructure shall use SCADA system, which shall also facilitate their smooth monitoring. This shall require internal capacity building of concerned BWSSB staff. Similarly, new operators may require training in operation and maintenance of pumps. Overall, a comprehensive training needs would have to be undertaken to determine "competency gaps", which need to be bridged by BWSSB. Having done that, an elaborate Training Plan and its implementation shall be needed for required competency enhancement.



Source: BWSSB & JICA Survey Team

Figure 13.3.4 Proposed Organizational Structure for O&M of Lateral Sewers and House Connections

Chapter 14 Environmental and Social Considerations

14.1 Project Components for Environmental and Social Considerations

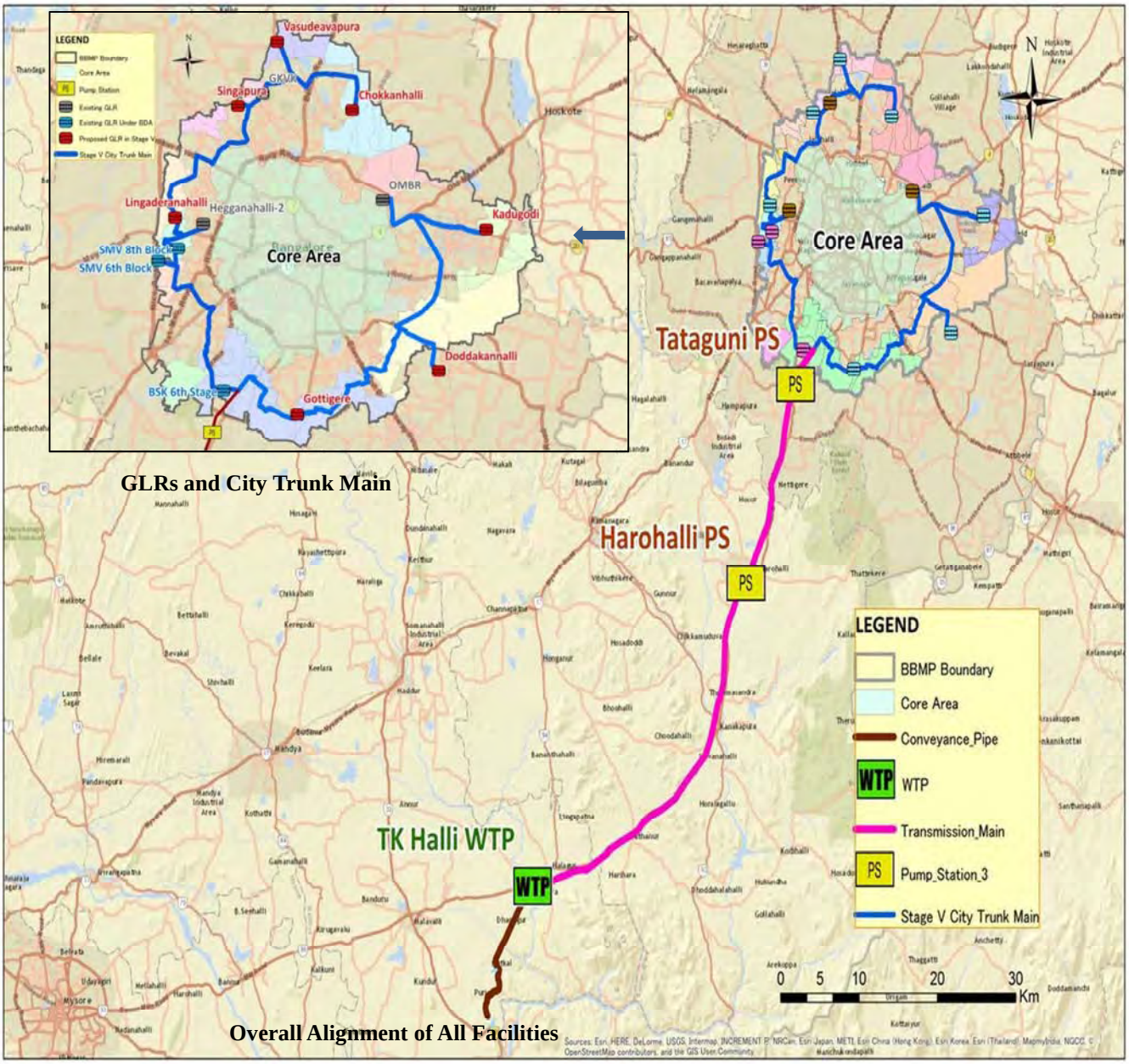
14.1.1 Stage V Water Supply Project (JICA Survey Project)

The components of Stage V Water Supply Project (categorized into JICA Survey Project) is shown in Table 14.1.1. The location of the project site is shown in Figure 14.1.1.

Table 14.1.1 Components of Stage V Water Supply Project

No.	Facility	Details of Facility	
		Capacity	Dimension
1	Intake & Conveyance pipeline	775 MLD	• Utilize existing facilities
2	Water Treatment Plant (WTP)	775 MLD	• Adjacent to existing WTP in TK Halli • Water Treatment: Rapid sand filtration • Disinfection: Liquid Chlorine • Sludge Treatment: Centrifuge
3	Transmission Facilities	775 MLD	• Transmission Pipe: Dia. 3,000 mm • Length: Approx. 70 km • Pump Station: 3 Nos.（Clear water reservoir, surge tank including） ・ TK Halli ・ Harohalli ・ Tataguni • One way surge tank: 1 Nos. • Diversion pipes with accessories at the Tataguni PS complex: ・Dia. 1,500 - 1,900 mm: 0.49 km
4	City Trunk Main	775 MLD	• Length: Approx.114 km • Dia. 500 mm - 3,000 mm
5	Ground Level Reservoirs (GLRs)	775 MLD	The following seven (7) GLRs with total capacity of 326,280 m^3 • Gottigere • Dokkanahalli • Kadugodi • Chokkanahalli • Vasudevapura • Singapura • Lingaderanalli

Source: JICA Survey Team



Source: JICA Survey Team

Figure 14.1.1 Location Map of Proposed Stage V Water Supply Project (JICA Survey Project)

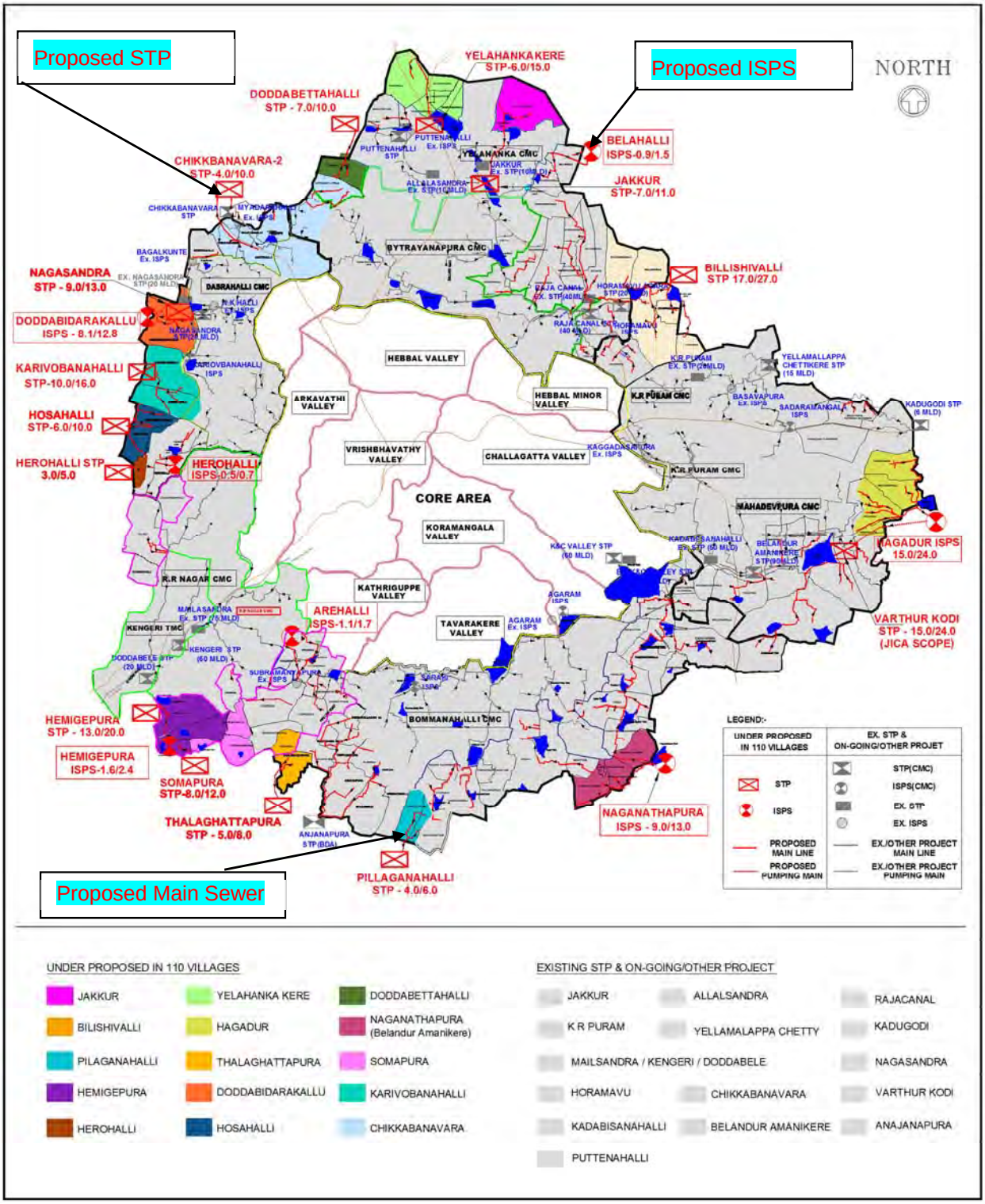
14.1.2 Sewerage Project for 110 Villages

The components of sewerage project for the 110 Villages is shown in Table 14.1.2. The locations of the facility sites are shown in Figure 14.1.2.

Table 14.1.2 Project Components of Sewerage Project for 110 Villages

No.	Facility	Details of Facility	
		Name	Capacity / Treatment Method
1	STPs (Sewage Treatment Plants)	Jakkur Yelahankakere Doddabettahalli: Bilishivalli: Varthur Pillaganahalli Talaghattapura Somapura Hemigepura: Nagasandra Karivobanahalli: Herohalli Hosahalli: Chikkabanavar-2	7 MLD / EA 6 MLD / EA 7 MLD / EA 17 MLD / EA 15 MLD / EA 4 MLD / EA 5 MLD / EA 8 MLD / EA 13 MLD / EA 9 MLD / EA 10 MLD / EA 3 MLD / EA 6 MLD / EA 4 MLD / EA
2	ISPS (Intermediate Sewage Pump Station)	Bellahalli Hagadur Naganathapura Arehalli Hemigepura Herohalli Daddabidarakallu	0.9 MLD / PS 15.0 MLD / PS 9.0 MLD / PS 1.1 MLD / PS 1.6 MLD / PS 0.5 MLD / PS 8.1 MLD / PS
3	Main Sewers	Bytrayanapura: Mahadevpura: Bommanahalli: R.R. Nagar: Dasarahalli:	ϕ 300 ~ ϕ 1,000, 50.3 km ϕ 300 ~ ϕ 800, 44.7 km ϕ 300 ~ ϕ 1,200, 65.0 km ϕ 300 ~ ϕ 500, 14.8 km ϕ 300 ~ ϕ 700, 27.5 km

Source: JICA Survey Team



Notes: Red characters show proposed projects while black characters show existing facilities
Source: JICA Survey Team

Figure 14.1.2 Location Map of Sewerage Facilities

14.1.3 Projects to be Implemented by Local Fund

The following projects will be implemented using local fund in India.

- Partial section of conveyance pipeline for Stage V
- Transmission pipelines to share water from Stage V Project to Core and ULB area (Branch Feeding Pipes)
- Water supply for the 110 Villages:
  1) Distribution pipelines and service connections
  2) Feeder pipes between GLR and OHTs, OHTs and Pumping facilities (for permanent distribution systems)
- The 110 Villages sewerage component project (Lateral sewers and house connections)
- UFW reduction and improvement of distribution systems

14.2 Environmental and Social Baseline in the Project Sites

Environmental and social study is made for the project components selected for JICA Survey to prepare preliminary design of facilities. Nevertheless, subject areas for the study are common to the areas for local funded projects.

14.2.1 Current Status on Environment

(1) Natural Environment

1) Metrological Situation

The past trend of the temperature (highest, lowest and average) and the rainfall (mm) in the Bengaluru city on a monthly basis for the last 10 years from 2006 to 2015 is shown in Table 14.2.1. The city has recorded the highest temperature in April and the lowest in January. An average rainfall is 891 mm. The records show that temperature is less than 5% to the average figure, while rainfall fluctuates up to 30% to the average figure.

Table 14.2.1 Meteorological Trend of Bengaluru City (2006 to 2015)

Monthly Temperature and Rainfall

	Jan.	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Average
T highest (ºC)	30.0	33.4	34.8	36.3	35.7	32.3	31.1	30.6	30.9	30.5	29.5	29.2	32.0
T lowest (ºC)	10.2	10.9	13.6	17.7	17.4	18.2	18.0	17.3	17.5	15.7	12.8	11.2	15.0
T ave. (ºC)	20.1	22.2	24.2	27.0	26.5	25.2	24.6	24.0	24.2	23.1	21.1	20.2	23.5
Rainfall (mm)	1.0	3.3	30.5	63.6	113.0	70.5	106.4	136.8	149.2	132.9	75.8	7.7	890.7

Annual Trend of Temperature and Rainfall

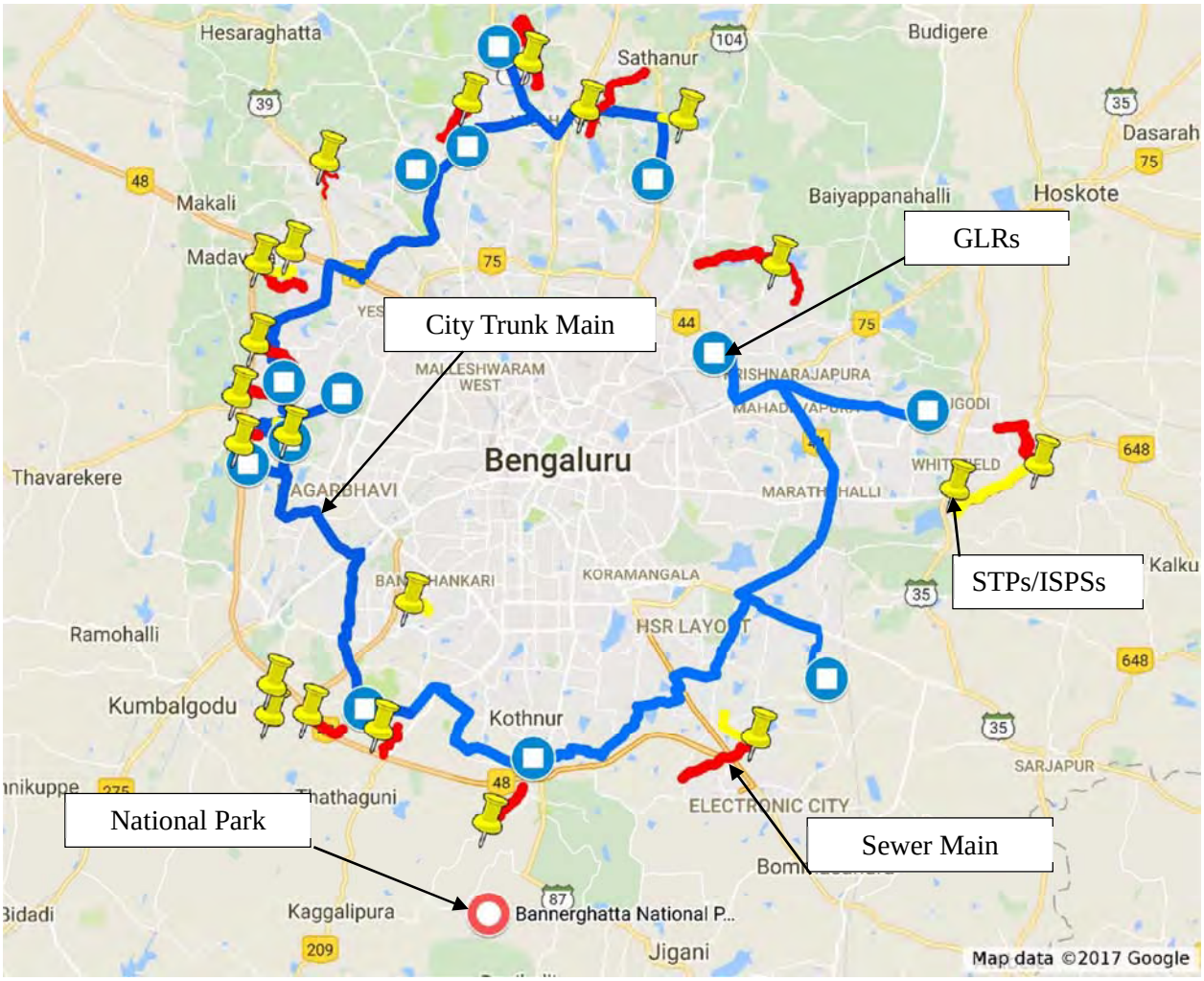
Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
T ave. (ºC)	23.67	23.2	22.63	23.45	23.88	22.35	24.03	23.67	24.16	24.24	23.5
Rainfall (mm)	708.8	790.3	1072.4	756.5	1027.2	804.5	578.9	847.5	994.5	1070.5	865.1

Source: Website of University of Agricultural Sciences, Bengaluru

2) National Parks and Nature Reserves

Most of the project sites are located in the built-up area and the sites do not encompass national parks or

nature reserves. Only one national park named Bannerghatta National Park is near to the project sites with a distance of about 4.0 km as shown in Figure 14.2.1.

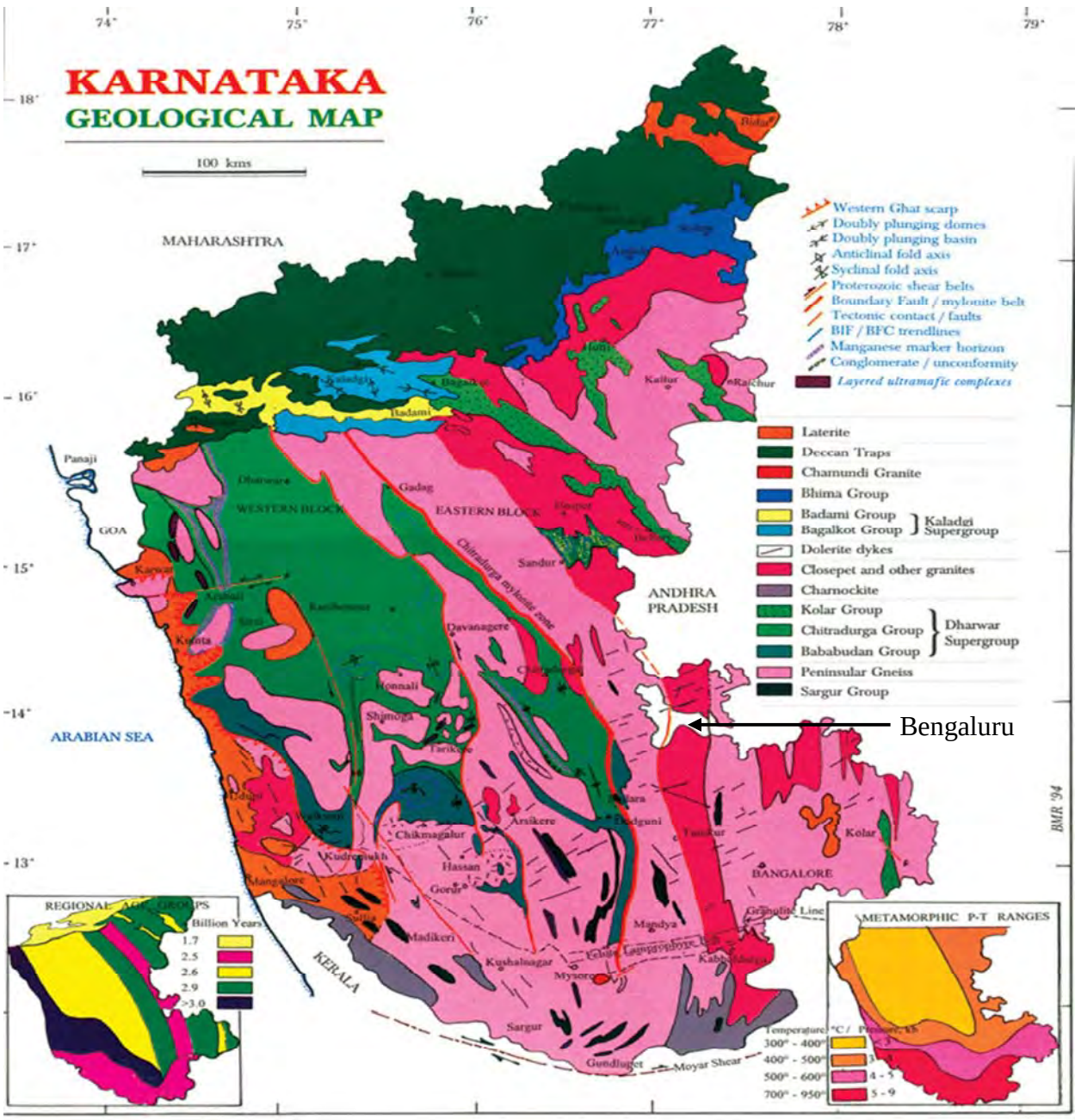


Source: JICA Survey Team

Figure 14.2.1 Location Map of National Park (Bannerghatta) near Facility Sites

3) Geological Condition

The Bengaluru district and its surrounding area which covers the project sites, is entirely underlain by Precambrian granite and gneiss of the Indian Precambrian Shield, which is a part of the peninsular granitic complex. Migmatites and gneiss are dominant, but there is a zone of granite and granodiorite with 20 km width trending in a north-northwest direction across the far western part of the district. Minor areas of charnokite occur in the far south western part of the district, and there are some small elongated bodies of amphibolite and schist aligned along a north-south trend through the central part. The geological map of Karnataka state is shown in Figure 14.2.2.



Source: http://geokarnataka.blogspot.in/2010/01/geological-map-of-karnataka.html?view=magazine

Figure 14.2.2 Geological Map of Karnataka State

(2) Pollution

1) Water Pollution

Cauvery River Water

There are five (5) monitoring stations for the water quality of the Cauvery River near the project sites. Table 14.2.2 shows the list of monitoring stations and Figure 14.2.3 shows the locations of the monitoring stations with indication of the project sites.

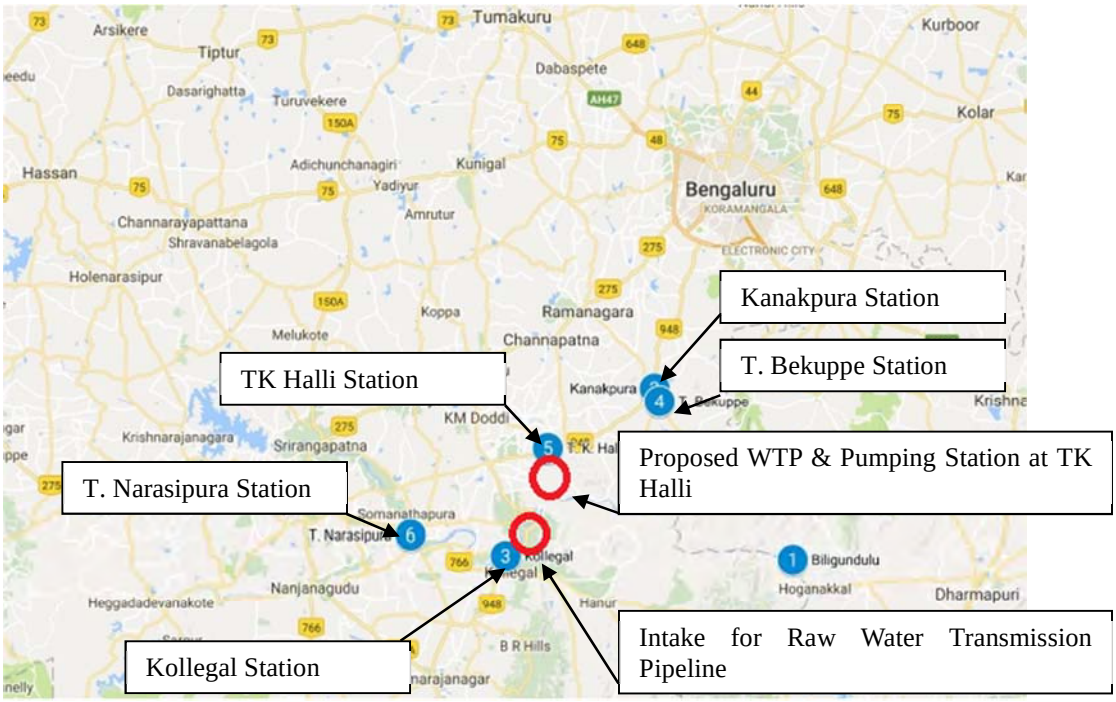
Table 14.2.3 shows the result of the water quality examination at Kollegal station which is the nearest to the intake point for the Stage V water supply project. The results of the water quality examination was

evaluated comparing with the Indian and Japanese environmental standards for drinking purpose. The results show that the water quality is within the allowable limits as a water source for drinking purpose. The figures of EC (Electric Conductivity) and chloride in dry season are larger than those in rainy season.

Table 14.2.2 List of Monitoring Stations for Water Quality of Cauvery River

No.	Monitoring Stations
1	Biligundulu
2	Kanakpura
3	Kollegal
4	T. Bekuppe
5	T. K. Halli
6	T. Narasipura

Source: JICA Survey Team



Source: JICA Survey Team

Figure 14.2.3 Location Map of Monitoring Stations for Water Quality of Cauvery River

Groundwater

There are twenty (20) water quality monitoring stations for the groundwater in the BBMP area, which are currently established by the CGWB (Central Ground Water Board) under Ministry of Water Resources. Table 14.2.4 shows the list of these monitoring stations, while **Figure 14.2.4** shows the locations of them, which indicates the geographical relationship with the proposed GLRs sites. Table 14.2.5 shows the results of the water quality examination in 2013 at the monitoring stations.

Table 14.2.3 Monitoring Results of Water Quality at Kollegal Station

Year	Quality Class	DO (mg/l)	pH	EC (umho/cm)	$NO_2^-+NO_3^-$ (mg N/l)	BOD (mg/l)	Total Hardness (mg-$CaCO_3$/l)	Ca Major Ions (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)	Cl^- (mg/l)	SO_4^{2-} (mg/l)	Total Coliforms (MPN/100ml)
2010														
Rainy Season (Avearage)		5.4	7.8	289.2	0.7	1.0	118.6	26.4	12.6	19.5	1.7	18.0	4.7	Nill
Dry Season (Average)		6.8	8.0	372.5	0.7	1.0	144.5	31.6	15.7	24.6	1.9	20.1	6.1	Nill
Full Year (Average)		6.1	7.9	334.6	0.7	1.0	131.6	29.0	14.2	22.0	1.8	19.0	5.4	Nill
2011														
Rainy Season (Avearage)		4.8	7.4	291.5	1.2	1.0	106.6	24.5	10.9	17.4	2.0	18.1	6.0	Nill
Dry Season (Average)		5.9	7.8	409.0	1.2	1.2	150.2	32.3	16.7	26.7	2.1	23.0	6.5	Nill
Full Year (Average)		5.3	7.6	350.3	1.2	1.0	128.4	28.4	13.8	22.1	2.0	20.6	6.2	Nill
2012														
Rainy Season (Avearage)		5.7	7.8	323.5	1.2	0.7	120.6	27.7	12.3	20.4	1.8	19.6	6.0	Nill
Dry Season (Average)		5.6	7.7	346.2	1.2	0.9	126.7	28.3	13.4	21.0	2.1	22.0	7.3	Nill
Full Year (Average)		6.1	7.8	362.9	1.3	0.8	136.1	30.4	14.4	22.8	1.9	21.3	6.2	Nill
2013														
Rainy Season (Avearage)		5.5	7.3	191.3	1.5	1.4	71.3	17.6	6.6	12.8	1.7	12.0	7.4	Nill
Dry Season (Average)		6.4	7.9	391.5	1.5	0.7	146.7	37.6	12.6	28.7	1.8	21.6	5.8	Nill
Full Year (Average)		5.9	7.6	291.4	1.5	1.1	109.0	27.6	9.6	20.7	1.7	16.8	6.6	Nill
2014														
Rainy Season (Avearage)		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Dry Season (Average)		5.8	7.9	407.8	1.3	1.5	134.7	30.8	13.9	33.1	6.8	22.3	8.9	Nill
Full Year (Average)		N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Indian Standards														
Standard for Surface Waters based on Designated Best Use by CPCB	Quality Class													
Drinking water source without conventional treatment	A	6 or more	6.5 to 8.5	NIL	-	2 or less	-	-	-	-	-	-	-	50
Outdoor bathing	B	5 or more	6.5 to 8.5	-	-	3 or less	-	-	-	-	-	-	-	500
Drinking water source with subsequent conventional treatment andd disinfection	C	4 or more	6.5 to 8.5	-	-	3 or less	-	-	-	-	-	-	-	5,000
Protection of ecosystem for wildlife and fisheries	D	4 or more	6.5 to 8.5	-	-	-	-	-	-	-	-	-	-	-
Irrigation, industrial cooling	E	-	6.5 to 8.5	2,250	-	-	-	-	-	-	-	-	-	-
Indian Drinking Water Standard (B25 10500: 2012)				-/600	45 (NO_3^-)		200/600	75/200	30/100	-/200	-/10	250/1000	200/400	Nill
Japan Water Act (No. 177 of 1957)					10 or less									

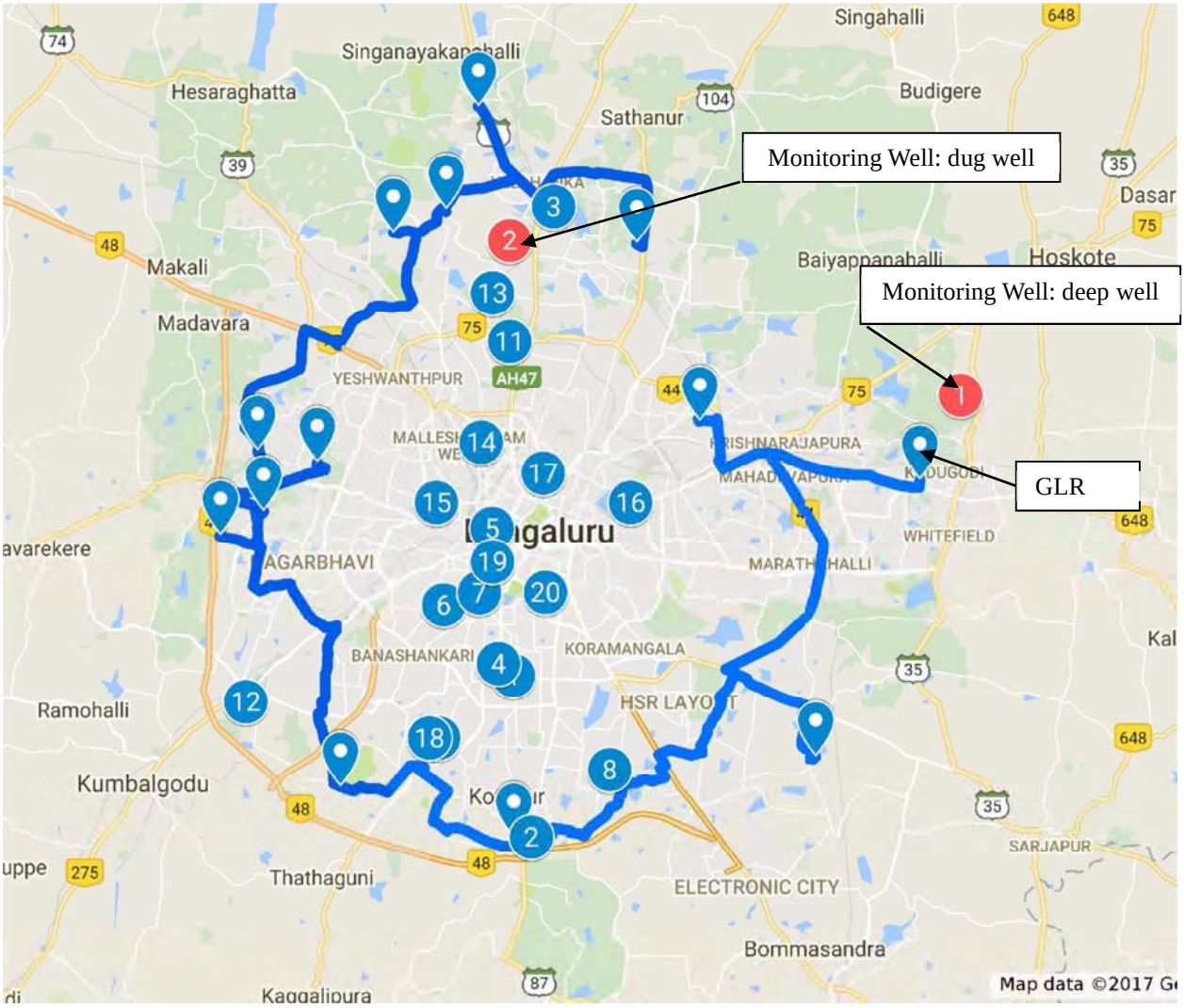
Rainy Season: May to October
Dry Season: November to April
Source: CWS (Central Water Commission), 2015

The results of the water quality examination in Table 14.2.5 were evaluated comparing with the Indian and Japanese environmental standards by the type of designated water use. Table 14.2.5 shows that results of the some samples show high concentration of EC, magnesium, nitrite/nitrate ion and total hardness, which mean that water pollution is underway in the some aquifers in BBMP area caused by human activities.

Table 14.2.4 List of Wells for Monitoring Groundwater Quality

No.	Name Dug Well	No.	Name Dug Well	No.	Name Deep Well
(1)	BENGALURU I	(11)	HEBBAL	(1)	Kannamangala
(2)	GOTTIGERE	(12)	KENGERI	(2)	Yelahanka
(3)	YELAHANKA	(13)	Kodigehalli		
(4)	BENGALURU II	(14)	Malleswaram		
(5)	BENGALURU-III	(15)	Rajajinagara		
(6)	BENGALURU-IV	(16)	Ulsoor		
(7)	Basavanagudi	(17)	Vasanthnagara		
(8)	Beguru	(18)	Vasanthpura		
(9)	Chennamankere Achkattu	(19)	Vijayanagar Hosahalli		
(10)	Gollahalli	(20)	Wilson Garden		

Source: CGWB (Central Ground Water Board), 2016



Source: JICA Survey Team

Figure 14.2.4 Locations of Monitoring Stations for Groundwater and Proposed GLRs

Table 14.2.5 Results of Water Quality Examination of Groundwater at Monitoring Stations in BBMP

Monitoring Well	Date of Sampling	B	Ca^{2+}	Cl^-	EC	F	K^+	Mg^{2+}	Na^+	NO_3^-	NO_3- + NO_2-	pH	SO_4^{2-}	TH
1. Results														
(1) Dug Wells														
Bangalore i	25-May-13	0.001	40	28	490	0.53	5.5	7.34	49	18	4.06	8	34	130
Gottigere A	25-May-13	0.35	44	227	1,370	0.27	5.6	65.7	135	145	32.74	8.1	100	380
Yelahanka1	25-May-13	0.2	36	107	710	0.3	1.1	38.94	45	30	6.77	8	62	250
Bangalore ii	25-May-13	0.5	24	71	430	0.2	5.5	2.46	61	48	10.84	9	18	70
Bangalore-iii	25-May-13	0.4	24	57	540	0.34	7.2	19.48	53	5	1.13	8.4	62	140
Bangalore-iv	25-May-13	0.18	8	64	430	0.49	1.7	4.87	70	1.5	0.34	8.9	20	40
Bangalore-iv	25-May-10		36	64	570	0.4	4.9	19	49	12	2.71	7.9	18	170
Basavanagudi	25-May-13	0.24	24	92	610	0.58	23.9	4.89	88	4.2	0.95	8.1	14	80
Begur	25-May-13	0.001	28	128	640	0.39	3.3	17.05	78	8	1.81	8.4	48	140
Chennamankere Ac	25-May-13	0.04	20	99	670	0.43	1.1	24.34	81	76	17.16	8.9	52	150
Gollahalli	25-May-13	0.38	28	341	1,540	0.43	2.3	70.54	184	39	8.81	7.8	68	360
Hebbal2	25-May-13	0.08	32	114	610	0.31	8.2	24.35	50	14.5	3.27	8.2	34	180
Kengeri1	25-May-13		24	199	1,300	0.24	16	82.69	101	5.6	1.26	8.53	52	400
Kodigehalli	25-May-13	0.02	32	334	1,920	0.38	22	126.47	150	96	21.68	8	202	600
Malleswaram	25-May-13	0.06	24	71	470	0.64	9.5	14.62	53	4.6	1.04	8.9	34	120
Rajajinagara	25-May-13	0.12	24	170	1,110	0.7	0.8	58.38	114	4.6	1.04	8.6	96	300
Ulsoor	25-May-13	0.001	12	57	380	1.56	28.4	4.88	46	2	0.45	9.2	20	50
Vasanthnagara	25-May-13	0.001	24	71	520	0.59	9.5	17.05	53	19	4.29	8.4	20	130
Vasanthpura	25-May-13	0.001	36	213	1,350	0.7	3.4	80.28	107	66	14.9	8.2	106	420
Vijayanagar Hosah	25-May-13	0.01	16	36	310	0.35	1.4	12.18	25	1	0.23	8.2	24	90
Wilson Garden	25-May-13	0.02	36	71	460	0.34	1.5	4.91	51	19	4.29	8.8	42	110
(1) Bore Wells														
Kannamangala	25-May-12			600	600	0.19		0		44	9.94	8.2		
Yelahanka1	25-May-10		44	71	510	0.2	11.8	12	36	12	2.71	6.8	28	160
2. Evaluation Criteria														
(1) Indian Standards														
1) Standard for Surface Waters based on Designated Best Use by CPCB	Quality Class													
- Drinking water source without conventional treatment	A	NIL	-	-	NIL		-	-	-	-	-	6.5 to 8.5	-	-
- Outdoor bathing	B	-	-	-	-		-	-	-	-	-	6.5 to 8.5	-	-
- Drinking water source with subsequent conventional treatment and disinfection	C	-	-	-	-		-	-	-	-	-	6.5 to 8.5	-	-
- Protection of ecosystem for wildlife and	D	-	-	-	-		-	-	-	-	-	6.5 to 8.5	-	-
- Irrigation, industrial cooling	E	2	-	-	2,250		-	-	-	-		6.5 to 8.5	-	-
2) Indian Drinking Water Standard (B25 10500: 2012)			75 / 200	250/ 1,000	-/600	1 / 1.5	-/10	30 / 100	- / 200	45 / 45	45 (NO_3^-)	6.5 to 8.5	200 / 400	200 / 600
(2) Japan Water Act (April, 2010)		1	300	200	-	0.8	-	300	200	-	10 or less	5.8 to 8.6	-	300

Source: CGWB (Central Ground Water Board), Ministry of Water Resources

Lakes

The results of water quality monitoring from eight lakes near proposed STP sites were obtained. Table 14.2.6 shows the lakes for regular monitoring of water quality and Figure 14.2.5 shows their locations.

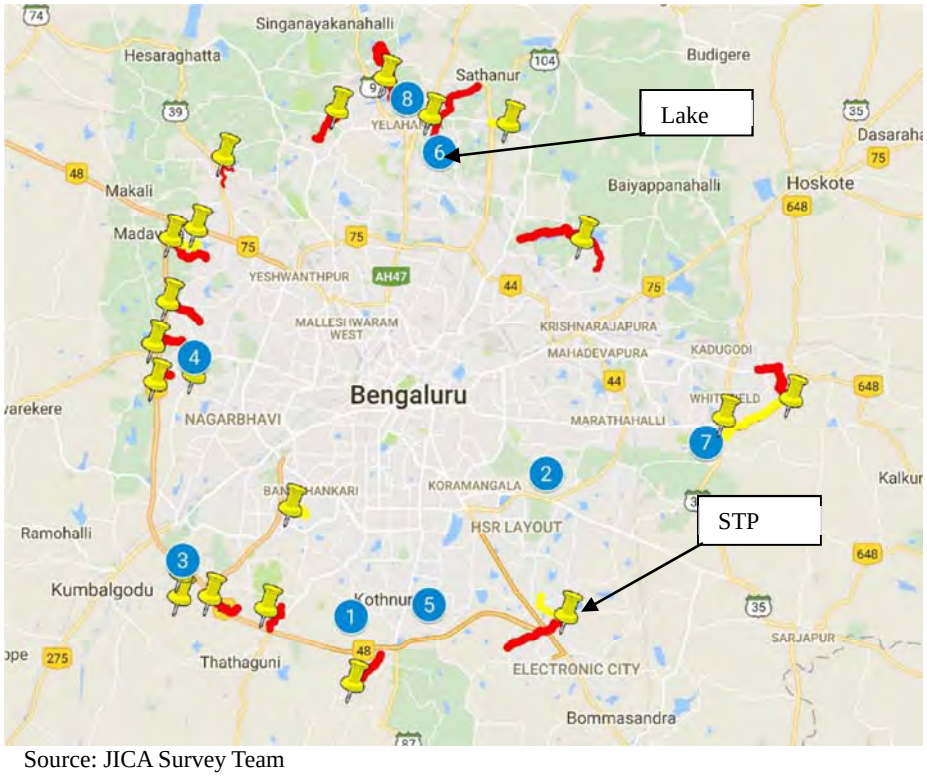
Table 14.2.7 shows the results of the water quality examination on the above lakes. The results were evaluated comparing the allowable level of the Indian and Japanese environmental standards for designated water use type.

It was concluded that the water quality of all lakes does not meet the allowable level in the parameters of PO-P (phosphoric acid), COD and zinc. Two lakes were found to be seriously contaminated with a considerable existence of total coliform. In this regard, the lakes in the BBMP area are heavily polluted as the final disposal waterbody of discharged wastewater. Improvement of the water quality of lakes can be expected in provision of sewerage systems in the 110 Villages.

Table 14.2.6 List of Lakes for Monitoring in BBMP

No.	Name of Lake
1	Anjanapura kere
2	Belandur Tank
3	Hemmilgepura kere
4	Herohalli kere
5	Hulimavu kere
6	Jakkur kere
7	Varturu Tank
8	Yelahanka kere

Source: NWMP (National Water Quality Monitoring Program)



Source: JICA Survey Team

Figure 14.2.5 Location Map of Monitoring Stations for Lakes in BBMP Area

Table 14.2.7 Results of Water Quality of Lakes in BBMP Area

Description			Chemical Constituents (mg/L except pH)								Heavy Metals (mg/L)		Coliform
Name of Lake	Extent in Ha	Sample Location	Cl^-	PO-P	TSS	DO	COD	NO_3^-	TH	pH	Zn	Pb	TC MPN/ 100 ml
Anjanapura kere	7.38	Inlet	190	0.2	67.5	6.2	40.00	4.715	224	8.12	0.17	Nil	
Belandur Tank	307.35	Inlet	109	5.05	498	Nil	96.00	9.73	208	7.51	0.19	Nil	
Hemmilgepura Kere	5.93	Outlet	87	0.1	12		19.20	3.09	184	8.47	0.05	Nil	
Herohalli Kere	12.26	Inlel	249	0.2	89	9.6	151	6.35	296	8.46	0.19	0.08	160,000
Hulimavu kere	44.26	Inlet	221	0.2	18	Nil	Nil	2.69	276	8.09	0.06	Nil	
Jakkur kere	58.97	Outlet	316	0.11	4.5	6.2		7.78	516	8.33	0.05	Nil	
Varturu Tank	I66.87	Inlet	137	2.5	12	3.8	56.64	8.02	276	8.13	0.14	Nil	
Yelahanka Kere	115.8	Middle	406	0.01	88		211.00	11.79	188	9.02	0.08	Nil	
Yelahanka Kere	- ditto -	Outlet	413	0.23	52		211.00	9.44	216	8.96	0.08	0.02	>1,600
Standards for Evaluation													
(1) Standard for Surface Waters based on Designated Best Use by CPCB		Quality Class											
- Drinking water source without conventional treatment		A	-			6 or more				6.5 to 8.5			50
- Outdoor bathing		B	-			5 or more				6.5 to 8.5			500
- Drinking water source with subsequent conventional treatment andd disinfection		C	-			4 or more				6.5 to 8.5			5,000
- Protection of ecosystem for wildlife and fisheries		D				4 or more				6.5 to 8.5			
- Irrigation, industrial cooling		E				-				6.5 to 8.5			
(2) Indian Drinking Water Standard (B25 10500: 2012)			250/1000		500/2000			45 (NO_3^-)	200/600	6.5 to 8.5		0.10	Nill
(3) Japanese Environmental Standards for Lake Water		Quality Class											
1) Standard A													
- For Water supply class 1, Fishery class 1		AA				7.5	1.0			6.5 to 8.5			50
- For Water supply class 2 and fishery class 2		A				7.5	3.0			6.5 to 8.5			1000
- For Fishery class 3		B				5	5.0			6.5 to 8.5			-
- For lakes and reservoirs, Industrial water class 2		C				2	8.0			6.5 to 8.5			-
2) Standard B													
- Conservation of natural environment		I		0.005 (T-P)				0.1 (T-N)					
- Water supply, class 1, 2 and 3, fishery class 1		II		0.01 (T-P)				0.2 (T-N)					
- Water supply, class 3		III		0.03 (T-P)				0.4 (T-N)					
- Fishery class 2		IV		0.05 (T-P)				0.6 (T-N)					
- Fishery class 3, industrial, irrigation water		V		0.1 (T-P)				1.0 (T-N)					
3) Standard C													
- Adaptability to Aquatic Life Habitat											0.03		
(4) Japanese Environmental Quality Standard for Human Health								10 (NO_2^- +NO_3^-)				0.01	

Source: NWMP (National Water Quality Monitoring Program)

An exploratory field survey of 105 lakes in Bengaluru was conducted during 2013, as mentioned in Chapter 8. Of these lakes, 25 lakes were fully covered with macrophytes. The physico - chemical characteristics of 80 lakes of 3 different valleys were monitored during all seasons for a period of 24 months. This report showed current status of the water pollution of the lakes as per water use classification established by CPCB of Table 14.2.8. Most of the lakes were categorized as Class E which can be applied for the irrigation use, but not for bathing nor domestic purpose including drinking.

The major cause of the pollution of the lakes is the urbanization including discharge of untreated sewage

and land use changes as shown in Table 14.2.9.

Table 14.2.8 Classification of Water by Type of Water Use

Designated Best Use	Class of Water
Drinking water source without conventional treatment but after disinfection	A
Outdoor bathing (Organized)	B
Drinking water source after conventional treatment and disinfection	C
Propagation of wild life and fisheries	D
Irrigation, Industrial Cooling, Controlled Waste disposal	E

Source: CPCB

Table 14.2.9 Major Cause of Water Pollution of Lakes

No.	Expected Causes	Potential Adverse Impacts
1	Discharge of untreated domestic sewage into water body	• Degradation of water quality • Nutrient accumulation • Dissolved oxygen depletion • Over growth of algae and aquatic macrophytes • Accumulation of silt and organic matter • Reduction in depth of lake • Contamination of ground water • Odour problems • Loss of aesthetic value
2	Encroachment of lake and construction activities in the lake catchment	• Reduction of catchment area of lakes • Reduction of ground water table as water recharge capacity goes down • Increased discharge of domestic sewage • Generation of building debris and solid wastes • Soil erosion, Silt accumulation • Cutting down of trees in that location • Affects bird population • Loss of interconnectivity among lakes
3	Land use changes	• Reduction of catchment area • Affects the hydrological regime • Affects climatic condition
4	Unplanned urbanization	• Loss of wetland and green spaces • Increased frequency of floods • Decline in groundwater table • Heat island • Increased carbon footprint
5	Threat to ecological balance	Aquatic biodiversity is affected (fish, birds, flora and fauna that are dependent on lake system)
6	Decline of Ecosystem goods and services	Affects economic growth and livelihood of local people

No.	Expected Causes	Potential Adverse Impacts
7	Removal of shoreline riparian vegetation	• Causes soil erosion • Effects the habitat of aquatic organisms
8	Dumping of municipal solid waste and building debris	• Affects human health • Breeding of disease vectors and pathogens

Source: " WETLAND: TREASURE OF BENGALURU", Energy & Wetland Research Group, Centre for Ecological Sciences, January, 2016

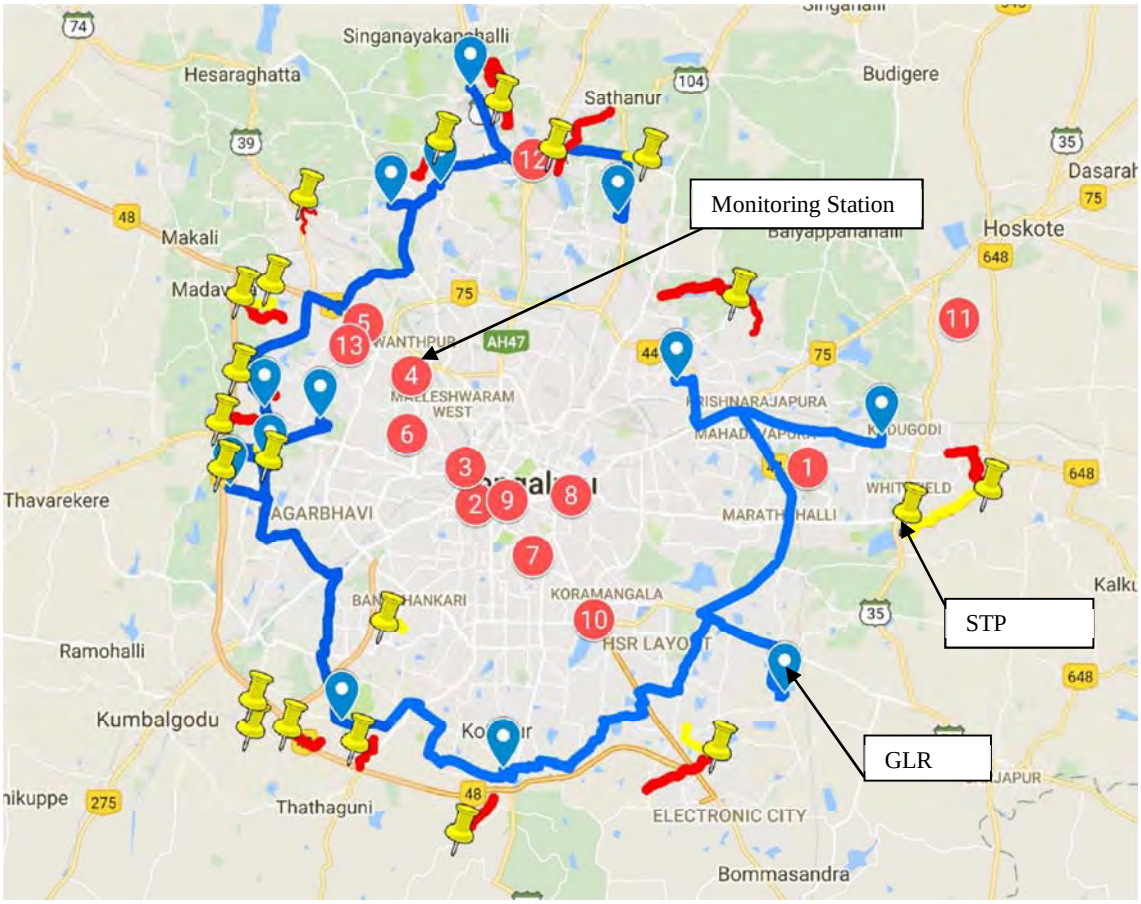
2) Air Pollution

Thirteen (13) stations for air quality monitoring are located in BBMP area as shown in Table 14.2.10 and Figure 14.2.6. Table 14.2.11 the results of air quality monitoring of above stations that were evaluated comparing with the allowable level of Indian national standards for parameters of ambient air quality of SO_2, NO_2 and RSPM (Respirable Suspended Particulate Matter). The results in Table 14.2.11 show that the concentration of RSPM exceeded the national standard at almost all stations, while those of SO_2 and NO_2 were within the standard level.

Table 14.2.10 List of Monitoring Stations for Air Quality Examination

No.	Name of Monitoring Stations	Remarks
1	Export Promotional Park ITPL(Graphite India)	Industrial Zone
2	Victoria Hospital	Sensitive Zone
3	City Railway Station	Continuous Monitoring
4	Yeshwanthpura Police Station	Mixed Urban Zone
5	Peenya Industrial area	Industrial Zone
6	Saneguruvanahalli (SG Halli)	Residential Area
7	Indira Gandhi Children Care Institute (NIMANHS)	-
8	DTDC House, Victoria Road	-
9	AMCO Batteries, Mysore Road	Mixed Urban Zone
10	Central Silk board, Hosur Road	-
11	Kajisonnenahalli	-
12	KHB Industrial Area, Yelahanka	Industrial Zone
13	Swan Silk Industrial area, Peenya	-

Source: Karnataka State Pollution Control Board



Source: JICA Survey Team

Figure 14.2.6 Locations of Air Quality Monitoring Stations in BBMP Area

Table 14.2.11 Results of Monitoring of Air Quality in BBMP Area (Measured in 2015)

Sl. No.	Name of the Station	Average for three months April -June-2015			Average for three months July- Sept 2015			For the Month of Oct-2015			For the Month of Nov-2015		
		SO2 µg/m3	NO2 µg/m3	RSPM µg/m3	SO2 µg/m3	NO2 µg/m3	RSPM µg/m3	SO2 µg/m3	NO2 µg/m3	RSPM µg/m3	SO2 µg/m3	NO2 µg/m3	RSPM µg/m3
1	Export promotional park ITPL, White field, premises of Graphite India Ltd, Bangalore	5.9	20.0	**189.0**	5.3	14.5	**124.0**	2.2	12.9	**169.0**	2.0	21.4	**140.0**
2	KHB Industrial Area, Yelahanka	5.15	12.1	79.0	5.3	14.4	**124.0**	2.0	11.3	**145.0**	2.3	14.8	**146.0**
3	Peenya Industrial Area (RO)	5.8	19.0	**149.0**	5.8	15.2	**126.0**	2.0	14.5	**122.0**	2.0	17.9	87.0
4	Yeshwanthpura Police Station	6.0	22.1	**131.0**	5.1	13.8	86.0	2.0	14.0	**105**	2.3	20.4	82.0
5	AMCO Batteries, Mysore Road	6.3	17.4	**137.0**	5.3	14.5	**104.0**	2.2	12.8	98.0	3.2	19.7	78.0
6	Central Silk Board , Hosur Road	5.8	17.7	**169**	5.6	15.9	**145**	2.2	13.2	**182**	2.7	21.7	**170**
7	DTDC House , Victoria Road	5.5	13.7	**158**	5.2	14.3	**119**	2.0	13.1	**117**	2.2	18.8	85
8	Kajisonnenahalli,	5.2	11.7	61.3	4.9	13.1	66.0	2.0	11.3	94.0	2.6	12.5	57.0
9	Victoria Hospital	6.4	23.0	**114.0**	5.2	14.6	71.0	2.0	13.7	85.0	2.5	25.4	74.0
10	Indira Gandhi Children Care Institute (NIMANHS)	5.7	14.7	97.0	5.0	12.8	**138.0**	1.8	10.9	**100.0**	3.0	19.4	69.0
11	CAAQM City Railway Station	6.6	28.8	93.0	3.3	45.4	81.0	4.2	67.3	**152.0**	6.6	41.4	74.0
12	CAAQM SG Halli	1.7	11.6	36.0	2.6	13.4	52.0	2.4	28.6	77.0	3.5	21.0	47.0
	Standards/National limits	**80.0**	**80.0**	**100.0**	**80.0**	**80.0**	**100.0**	**80.0**	**80.0**	**100.0**	**80.0**	**80.0**	**100.0**

Note: The Board has monitored the ambient air quality of Bangalore city at 12 locations including two Continuous Ambient Air Quality Monitoring Stations under National Ambient Air Quality Monitoring Programme (NAMP) covering Industrial Area, Mixed Urban Area and Sensitive Area. Monitoring is being carried out on twice a week 24 hourly at uniform intervals for RSPM, SO2 and NO2 pollutants, RSPM values have exceeded the national limit (60.0 µg/M3) in 8 places and at Domalur are within the national limit. SO2 and NO2 values are within the national limits in all measured places during the period 2015-16.

Source: Karnataka State Pollution Control Board

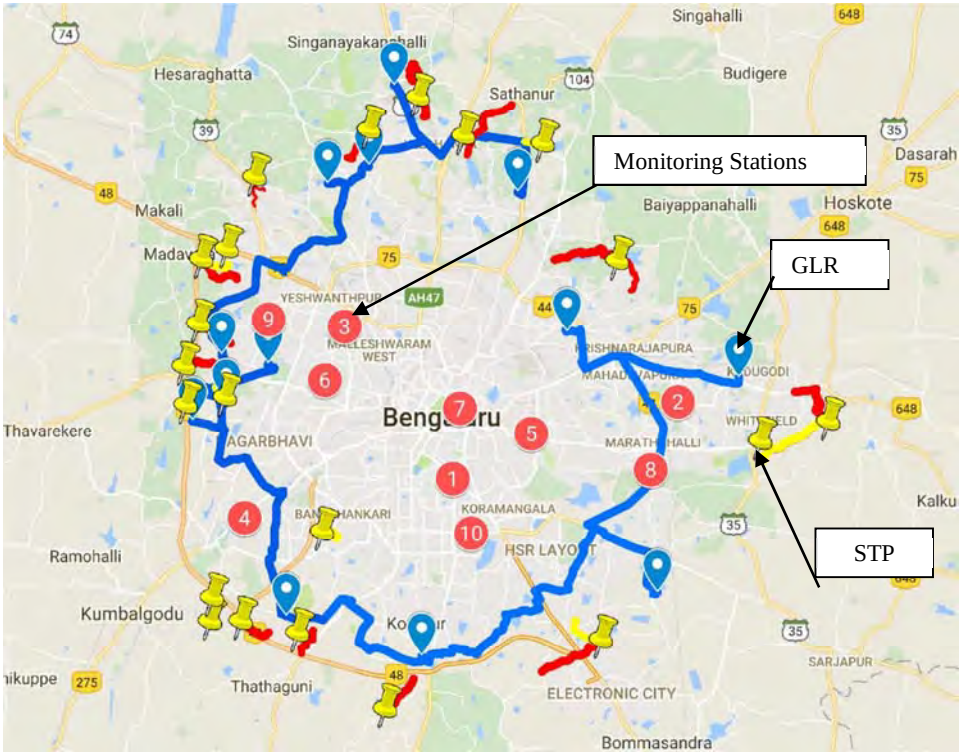
3) Noise

Ten (10) stations for monitoring of ambient noise in BBMP area were established as shown in Table 14.2.12 and Figure 14.2.7. Table 14.2.13 shows the results of the noise monitoring at above mentioned stations and the results were evaluated comparing allowable level of the Indian national standards for noise. The results in Table 14.2.13 show that most of the measurement results exceeded the national standards.

Table 14.2.12 List of Monitoring Stations for Ambient Noise

No.	Name
1	NIMHANS IGH Care
2	Graphite India (White field Industrial Area)
3	Yeshwanthpur Police Station
4	RVCE, Mysore Road
5	TERI Office, Domlur
6	KSPCB Building, Nisarga Bhavana
7	KSPCB, Parisara Bhavan
8	CAAQMS at BWSSB Site, Kadabeesanahalli
9	CAAQMS of CPCB at ACE manufacturing system, Peenya
10	BTM Layout

Source: Karnataka State Pollution Control Board



Source: Karnataka State Pollution Control Board

Figure 14.2.7 Location Map of Monitoring Stations for Ambient Noise

Table 14.2.13 Results of Noise Level Monitoring Stations in BBMP Area for the year 2015-16

No.	Name of the Station	Limit dB(A) L_{eq}	L_{eq}	L_{min}	L_{max}	Increase (%)	Limit dB(A) L_{eq}	L_{eq}	L_{min}	L_{max}	Increase (%)
1	NIMHANS IGH Care	50	60.9	48.8	87.2	21.80%	40	54.4	40.8	78.8	36.00%
2	Graphite India (White field Industrial Area)	75	65.9	58.4	83.9	Within LIMIT	70	60.6	50.7	74.1	Within LIMIT
3	Yeshwanthpur Police Station	65	71.3	64.7	82.4	9.70%	55	63.4	54.4	73.8	15.30%
4	RVCE, Mysore Road	50	59.7	53.2	78.2	19.40%	40	53.9	47.6	67.6	34.80%
5	TERI Office, Domlur	55	63.2	48	61.6	14.90%	45	54.8	38.9	71.9	21.70%
6	KSPCB Building, Nisarga Bhavana	55	58.2	47.3	81.3	5.80%	45	49.7	41.2	71.4	10.40%
7	KSPCB, Parisara Bhavan	65	66.2	54.7	76.7	1.90%	55	59.1	49.2	72.9	7.60%
8	CAAQMS at BWSSB Site, Kadabeesanahalli	65	58.2	52.8	71.7	Within LIMIT	55	56.7	52.6	66.6	3.1%
9	CAAQMS of CPCB at ACE manufacturing system, Peenya	75	58.8	50	71.9	Within LIMIT	70	55.6	49.9	73.1	Within LIMIT
10	BTM Layout	55	65.8	57	86.4	19.60%	45	58.9	46.9	72.4	30.80%

Notes:
- Day time shall mean from 6.00 AM to 10.00 PM
- Night time shall mean from 10.00 PM to 6.00 AM
- Silence zone is an area comprising not less than 100 meters around Hospitals, Educational Institutions, Courts, Religious places or any other which is declared as such by the competent authority.
- dB(A) Leq denotes the time weighted average of the level of sound decibels on scale ‘‘A” which is relatable to human hearing.
- ‘‘A” decibel is a unit in which noise is measured.
- ‘‘A” in dB(A) Leq, denotes the frequency weighting in the measurements of noise and corresponds to frequency response characteristics of the human ear.
- “Leq’’ it is energy mean of the noise level over a specific period.

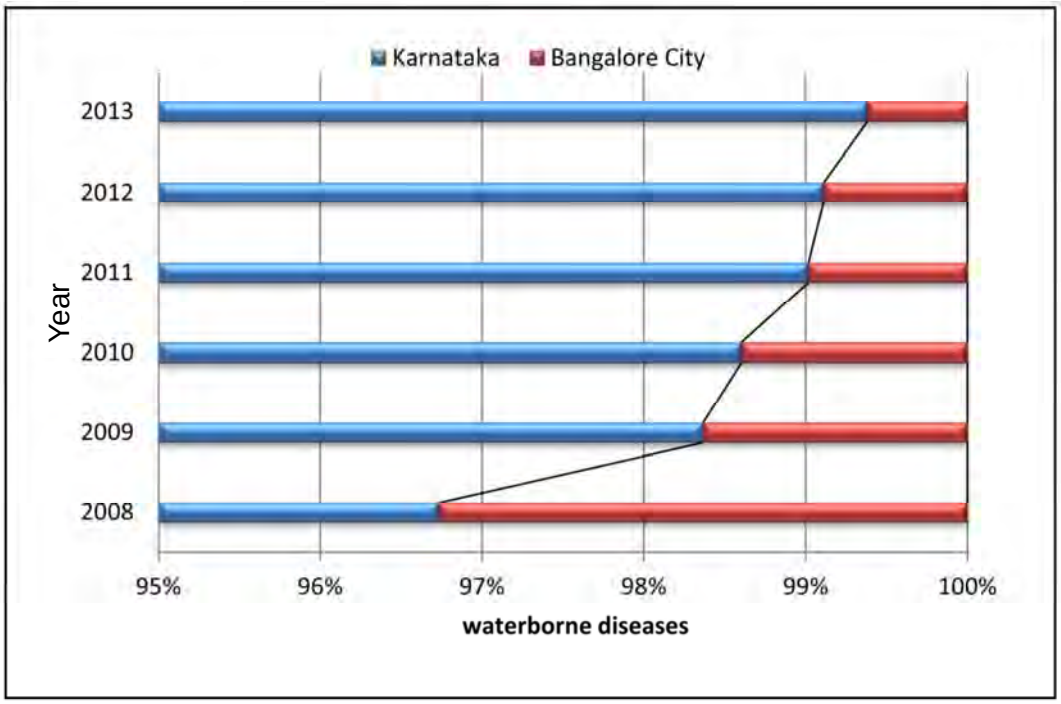
Source: Karnataka State Pollution Control Board

(3) Social Environment

1) Public Health

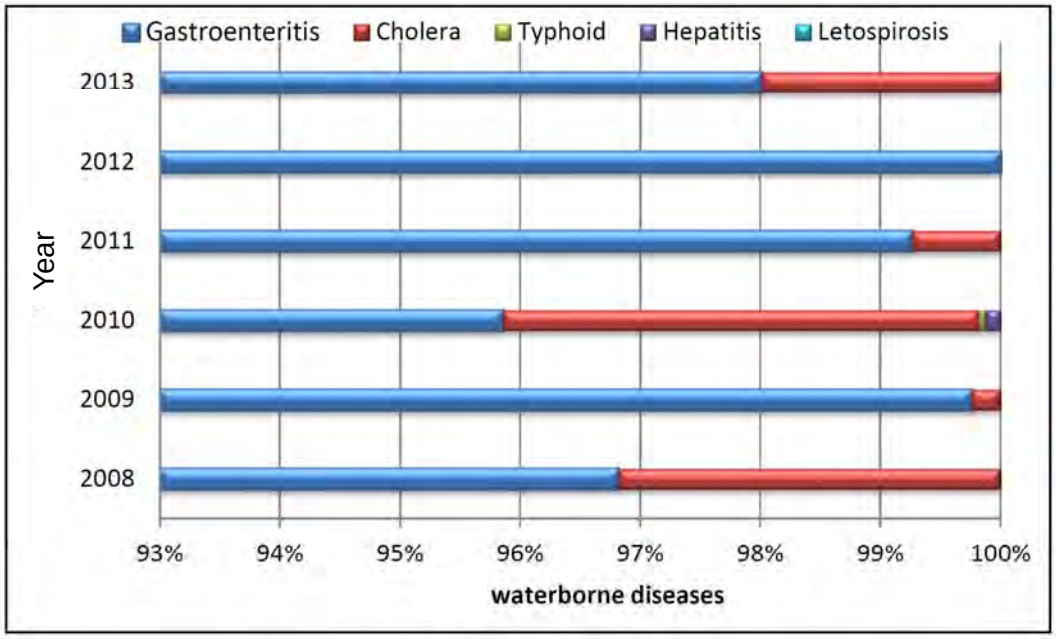
Waterborne diseases are caused by pathogenic microorganisms that are commonly transmitted through the consumption of contaminated potable water. Many infections are transmitted by microbes that may accidentally enter the water supply system. Figure 14.2.8 shows the waterborne diseases outbreak in Karnataka and Bengaluru from year 2008 to 2013. The geographical figure reveals that waterborne diseases outbreak in Bengaluru have decreased between years 2008 and 2013.

The common waterborne communicable diseases outbreak in Bengaluru is gastroenteritis, cholera, typhoid, hepatitis and leptospirosis. The type of the waterborne diseases is shown in Figure 14.2.8, Figure 14.2.9 and Figure 14.2.10. Gastroenteritis was the most occurring dominant disease in Bengaluru City with an occurrence rate more than 95% in the last five years from 2008 and 2013, followed by cholera, hepatitis and typhoid. The occurrence of cholera was quite high in the years of 2008, 2010 and 2013, while hepatitis and typhoid occurrences were very rare and there was no occurrence of leptospirosis in the last five years. This shows that the quality of drinking water has been improved and number of people adopting BWSSB’s tap water has been increased.



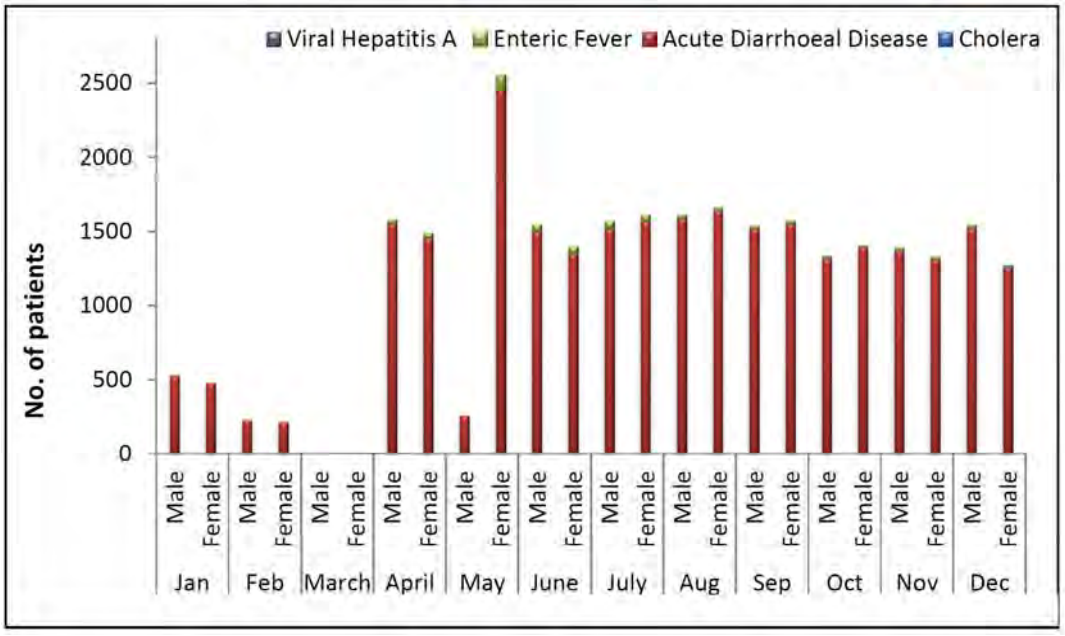
Source: BBMP

Figure 14.2.8 Occurrence of Waterborne Diseases in Karnataka State and Bengaluru City



Source: BBMP

Figure 14.2.9 Status of Waterborne Communicable Diseases in Bengaluru

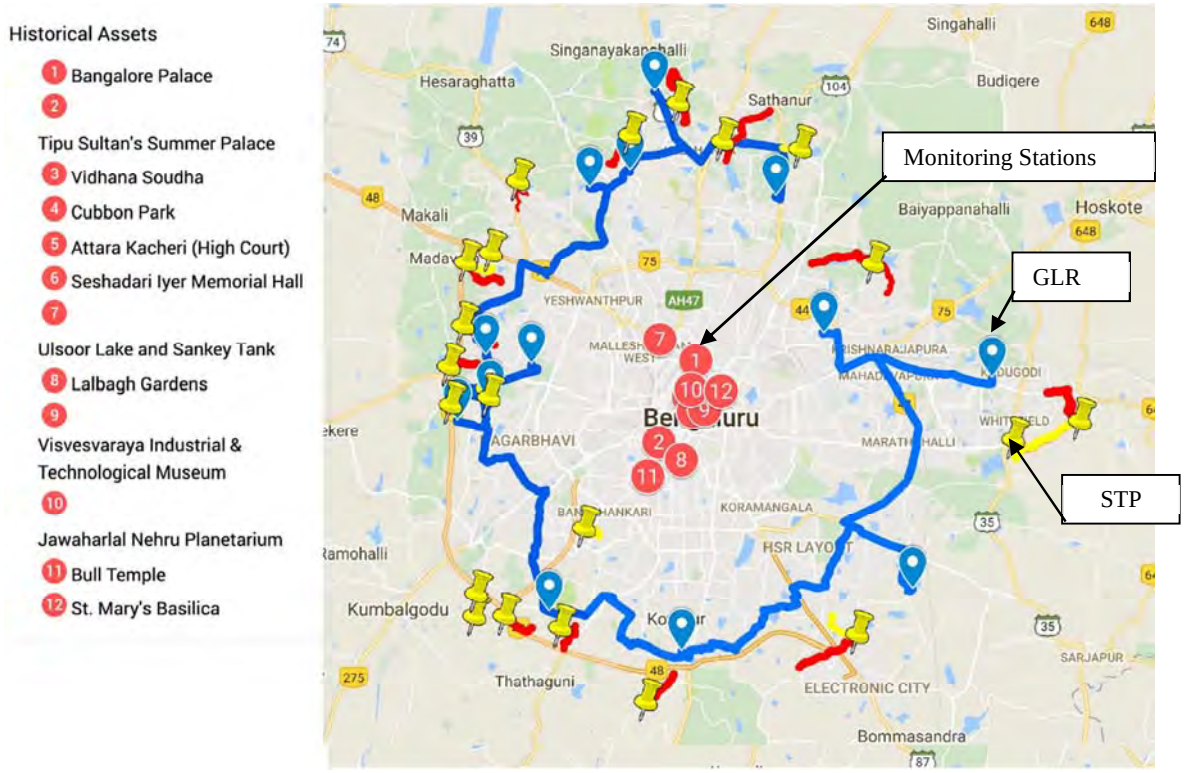


Source: BBMP

Figure 14.2.10 Frequency of Waterborne Diseases Occurrence in Bengaluru Urban

2) Historical and Cultural Assets

The location of the historical and cultural assets is shown in Figure 14.2.11. These assets are located at the city center, and separated apart from the public roads.



Source: JICA Survey Team

Figure 14.2.11 Location Map of Historical and Cultural Assets

3) Public Awareness toward Water Supply and Sewerage Service

a) Source of Data / Information

"Assessment of BWSSB Services" which was prepared in 2016 by PAC (Public Affairs Centre) in association with BWSSB was mainly utilized for acquisition of the public awareness toward the water supply and sewerage services. In addition, the results of the social condition survey which was carried out in the JICA survey was used to complement some information such as the awareness focusing on the households of the 110 Villages and business establishments, willingness and affordability to pay for the future improved services to be provided by the projects and awareness toward environmental conservation and saving water. The detailed results of the social condition survey are included in the Data Report on Social Condition Survey.

b) Methodology and Approach

The survey of "Assessment of BWSSB Services" involved interviews with 2,617 consumers covering the jurisdiction of BWSSB. The consumers' samples were selected from all divisions of BWSSB based on random sampling method from the database of the list of consumers provided by BWSSB.

The survey was carried out based on the procedure shown as below.

- Initial discussions with BWSSB officials
- Development of data collection instruments
- Field work and quality assurance
- Data entry, analysis and report writing

Meanwhile, the social condition survey, which was conducted by the JICA survey, had the following sample numbers for household and business establishments as shown in Table 14.2.14.

Table 14.2.14 Summary of Samples Surveyed in Social Condition Survey

No.	Name of Area	Nos. of Households	Nos. of Establishments	Survey Date	
				From	To
1	110 Villages	200	20	25/11/2016	3/12/2016
2	ULBs	75	15	27/11/2016	6/12/2016
3	Core Area	75	15	5/12/2016	7/12/2016
	Total	350	50		

Source: JICA Survey Team

c) Survey Results for Households

i. Profile of Respondents

Majority of the consumers (41.5%) were aged above 51 years and were men (72.5%). While more than half were self-occupation, 42% reported that they use their houses for own use and rental purpose. Most of them lived in houses constructed on a site size ranging from 1,001 to 1,250 sq. ft (93.0 to 116.1 m^2). It was observed that 41% of the users were having only ground floor houses, one-third with ground and first floor and a little less than a quarter with ground and two floors. A slight variation was identified in the number of floors and kitchens. The percentage of people who reported one kitchen (57%) is more than those having ground floor house (41%). Table 14.2.15 shows number of floors.

With regard to occupation, one-fourth of the consumers reported that they are in charge of either

self-occupation or private service. Another 13-14% composed of retired persons and laborers. Education levels varied from secondary to graduation. There were 3.5% postgraduates. Average of family size is consisted of five (5) members with three (3) males and two (2) females.

Table 14.2.15 Number of Floors in Households Surveyed

Number of Floors	Percentage, %	Respondent Number
Ground	40.7	837
Ground + 1st Floor	31.1	639
Ground + 2nd Floor	24.1	495
Multi Storied	4.2	86
Total	100.0	2,057

Source: "Assessment of BWSSB Services", Public Affairs Centre, 2016

ii. Household Income

Assessment of BWSSB Services surveyed by PAC: Against an average monthly income of 20,800 INR per household, the average monthly expenditure was found to be approximately 10,300 INR.

Social Condition Service by the JICA Survey: Fifty five percent (55%) of the respondents were not willing to disclose their monthly income. Based on available data from the remaining 45% respondents, 16,522 INR was obtained as an overall average monthly income per household. In 110 Village areas, average household monthly income reached to 13,182 INR, in ULB area at 16,489 INR and in Core Area at 25,000 INR.

iii. Current Status of Water Source

The PAC study showed that Cauvery water was the main source of water or for the majority of the households (58%), while nearly 20% reported public taps apart whose water source is not Cauvery water. The rest use hand pumps, deep wells, mini water supply and tankers (see Table 14.2.16).

Table 14.2.16 Source of Water Supply

Source of Water	Percentage, %
Public tap	17.4
Public hand pump / deep well	8.4
Deep well water connection through tap near home	5.9
Public mini water supply scheme	5.2
Tanker supply (free of charge)	0.9
Tanker supply (with payment)	3.6
BWSSB's Cauvery Water	57.7
Others	0.8
Total	100.0

Source: "Assessment of BWSSB Services", Public Affairs Centre, 2016, with correction and revision

iv. Water Consumption and Cost

According to the social condition survey (conducted in the Preparatory Survey) regarding water consumption in 110 Villages, the households consumed piped water of 7,600 liters as a monthly average which is supplied by local administration through deep wells under maintenance by BWSSB. Monthly average consumption from different water sources and the expenditure on water consumption in 110 Village areas, ULB area, and Core area is shown in Table 14.2.17.

Table 14.2.17 Monthly Water Consumption and Expenditure

No.	Area	Average Monthly Consumption (Liters)				Average Monthly Expenditure on Water Consumption (INR)			
		BWSSB	Tankers	Bottled Water	Other Source	BWSSB	Tankers	Bottled Water	Other Source
1	110 Villages	7,600	4,600	600	2,500	400	1,300	600	500
2	ULBs	5,300	3,000	400	-	350	1,250	600	-
3	Core Area	5,000	-	-	-	400	-	-	-

Source: JICA Survey Team

v. Satisfaction Level of BWSSB Piped Water Service

Overall Satisfaction Level

The PAC study as shown in Table 14.2.18 revealed that 81% of the consumers were completely satisfied taking into account all aspects of services provided by BWSSB. While 18% were partially satisfied, one (1) percent of the users expressed dissatisfaction.

Table 14.2.18 Overall Satisfaction toward BWSSB's Service

Satisfaction Level for BWSSB's Services	Percentage, %	Respondent Number
Completely satisfied	80.9	1,665
Partially satisfied	18.1	373
Dissatisfied	0.9	19
Total	100.0	2,057

Source: "Assessment of BWSSB Services", Public Affairs Centre, 2016

Irregularity of Water Supply

Two (2) percent responded that the water supply is irregular. While 22% reported that the supply was sometimes irregular, 75.5% of the consumers reported regularity in its supply. This result is shown in Table 14.2.19.

Table 14.2.19 Irregularity of Water Supply

Irregular Water Supply	Percentage, %	Respondent Number
Yes, most of the time	2.3	48
Yes, sometimes	22.1	455
No irregularities	75.5	1,554
Total	100.0	2,057

Source: "Assessment of BWSSB Services", Public Affairs Centre, 2016

Frequency / Duration of Water Supply

More than half of the consumers (54%) conveyed that they get water once in two (2) days and one-third reported to be getting once in three days (Table 14.2.20). Nearly 10% of the users reported getting water once in 4-5 days. Most of them conveyed that the duration of supply was 1-5 hours with 48% reporting 2-3 hours on the day of supply (Table 14.2.21).

Table 14.2.20 Frequency of Water Supply

Frequency of Water Supply	Percentage, %	Respondent Number
Once a day	1.5	31
Once in 2 days	54.0	1,111
Once in 3 days	33.1	680
Once in 4 - 5 days	9.6	198
Irregular	1.8	37
Total	100.0	2,057

Source: "Assessment of BWSSB Services", Public Affairs Centre, 2016

Table 14.2.21 Duration of Water Supply

Duration of Water Supply	Percentage, %	Respondent Number
Less than one (1) hour	3.1	64
One (1) to two (2) hours	20.4	420
Two (2) to three (3) hours	48.2	992
Three (3) to five (5) hours	16.6	341
Over fine (5) hours	9.7	200
Don't know	1.9	40
Total	100.0	2,057

Source: "Assessment of BWSSB Services", Public Affairs Centre, 2016

Pressure of Water Supply

The awareness toward water pressure is shown in Table 14.2.22. Most of the respondents (61.4 %) reported that the water pressure is medium, while 28.8 % responded that the water pressure is high and remaining (9.7 %) reported that the water pressure is low.

Table 14.2.22 Pressure of Water Supply

Water Pressure	Percentage, %	Respondent Number
High	28.8	593
Medium	61.4	1,264
Low	9.7	199
Others	0.0	1
Total	100.0	2,057

Source: "Assessment of BWSSB Services", Public Affairs Centre, 2016

vi. Willingness and Affordability to Pay

According to the social condition survey in the JICA survey, 95.5% of the households are ready to pay if BWSSB provides good quality and reliable piped water for 24 hours a day and even if they can increase the tariff to recover the future increased O&M cost.

With regards to connection fee for piped water supply, 77.5% of the households were ready to pay below 500 INR, while 21.6% of the households ready to pay 500 to 1,000 INR. Remaining households were ready to pay the connection fee over 1,000 INR. In terms of connection fee for sewerage service, 85.7% of the households were ready to pay below 300 INR and the remaining (14.3 %) households were ready to pay over 300 INR.

vii. Awareness toward Water Conservation, Environment, Re-use of Treated Sewage and Public Health

The social condition survey in the JICA survey shows the following results.

Water Conservation

With regards to the future potential on water depletion in Bengaluru city, 84% of the respondents were aware that Bengaluru city will face water shortage in the future. Ninety point six percent (90.6 %) of the respondents were ready to use the water preciously and practice a water conservation at any time in their daily life.

Environment

With regards to final discharge of waste from kitchen, bath rooms and toilets, 39% of the households responded that the sewage is discharged finally to the nallahs (channels), 22.3% responded that the sewage is discharged to the lakes and the remaining were not aware where it is finally discharged. In terms of awareness toward water pollution, 74.3% responded that surrounding water bodies such as lakes and nallahs are severely polluted, and 22.6% responded that they are slightly polluted and the remaining were not aware of the water pollution. In terms of reasons of such water pollution, 71% responded that about 50 to 80% of the water pollution is caused by the discharge of the untreated sewage.

Re-use / Recycling of Treated Sewage

Most of the households were not aware about the fact that treated sewage can be a potential water source in urban area. Eight percent (8%) of the households think it will be a good idea to use advanced treated sewage for flushing of toilets and gardening purposes so that problem of water shortage should be improved. Further, 14% of respondents were aware of sewage recycling or water re-use as an alternative solution to solve the potential water shortage in Bengaluru.

With regards to usage of treated sewerage, 96% of the households were ready to use for gardening purposes and 2% of the households were ready to use for toilet flushing. Eighty one percent (81%) responded that some risks are involved in sewage recycling, while 14% responded that they do not know about the risks. In addition, 54% out of 81% of the respondent think that the contamination will be a main risk in sewage recycling.

Public Health

Thirty five percent (35%) of the respondents responded that the quality of water will cause Malaria-Dengue fever, 19% responded that the bad quality of the water will cause skin diseases, and the remaining

responded that it will cause typhoid or cholera. The survey identified that about 60% of the households had not faced any illness due to bad water quality in their family in the last twelve (12) months. Out of the remaining 40% of the respondents, 20.3% of their family members were affected by typhoid and cholera, and 13% of the family members were affected by malaria or dengue fever.

d) Business Establishments

i. Profile of Business Establishments

A total of 50 samples were collected from business establishments including factories, IT companies, hotels etc. With regard to employment number, 67% of the samples are 2 to 10 employees, 25% are 11 to 50 and the remaining are over 50.

ii. Current Status of Water Supply Service

Eighteen percent (18%) of the business establishments were connected to existing BWSSB water supply system. Sixty percent (60%) of the business establishments responded that the main reason of not connecting to the water supply systems is that there is no distribution systems in their areas. The remaining establishments utilize different water sources other than Cauvery River.

iii. Current Water Source

With respect to present water sources for business activities, 12 to 18% of the business establishments use piped water for drinking and washing purpose, 20 to 46% use tanker water, 34% use own well and the remaining use neighbor's well water & bottled water.

iv. Current Sanitation Status

With regards to present sanitation status, 68% of the business establishments have one toilet, 10% have two toilets and 22% have more than two toilets in their premises. At present about 56% of the business establishments are connected to public sewerage systems and 44% are not connected. Fifty two percent (52%) out of 56% of the business establishments connected to public sewerage systems do not satisfy with present services due to sewer blockages.

v. Water Consumption and Cost

The business establishments connected to BWSSB water supply systems paid monthly tariff between 500 and 1,100 INR. The monthly water consumption ranged from 15,000 to 25,000 liters. The business establishments which are not connected to BWSSB water supply systems spend monthly 500 to 22,500 INR for the purchase of Tanker water and 200 to 15,000 INR for bottled water. The monthly consumption of the tanker varied from 1,000 to 30,000 liters while bottled water from 200 to 6,000 liters.

vi. Satisfaction Level of BWSSB Water Supply Services

With regards to the satisfaction level of BWSSB water supply services, 14% of the business establishments out of 18% connected to BWSSB water supply systems do not satisfy the services. The main reason of the dissatisfaction is caused by intermittent water supply.

In terms of water source availability, 14% out of 20% business establishments connect to BWSSB water supply systems responded that daily water supply service is limited to less than 6 hours, thus all the business establishments installed water storage tanks on their roof top. They also explained that water pressure always fluctuates requiring installation of a pump unit. Regarding quality of water, they have not experienced any bad taste or odor, but they usually boil the water before drinking.

vii. Willingness and Affordability to Pay

All the business establishment expect that the new project will bring safe, clean, reliable piped water supply and decrease the river pollution resulted in the improvement of the environment. All the business establishments are ready to connect to the new water supply and sewerage systems, even the monthly tariff may increase. Twenty four percent (24%) of them are ready to pay 500 INR per month for good quality and reliable piped water supply and 54% of them are ready to pay 500 to 3,000 INR per month for sewerage service.

viii. Awareness towards Water Conservation, Environment, Sewage Re-use and Public Health

Water Conservation

Eighty percent (80%) of the business establishments responded that water shortages in Bengaluru city may occur in the future. Ninety (90%) of them responded that they will practice water conservation measures at any time.

Environment

Forty six percent (46%) of the business establishments responded that the sewage is discharged finally to nallahs. Eighteen percent (18%) of them responded that sewage is discharged to lakes and the remaining was not aware of the destination. Eighty four percent (84%) of the business establishment responded that 50 to 80% of the surrounding water bodied such as lakes, rivers and nallahs are severely polluted due to discharge of sewage and 16% responded that it is slightly polluted.

Re-use of Treated Sewage

Six percent (6%) of the respondents expressed that reuse of sewage should be promoted more to solve the water shortage and 94% of the respondents expressed that they are not aware of the fact that most of the treated sewage can be a potential water source in urban area. Only 6% of the respondents agreed that it will be a good idea for the improvement of the water shortage problem to use the advanced treated sewage as flushing water for toilets or watering plants at gardens. Twenty two percent (22%) responded that sewage recycling or water reuse are alternative solutions to solve the water shortages.

Eighty eight percent (88%) of the respondents expressed that they are very supportive to sewage recycling as a means of increasing the amount of water available. They informed that, treated sewage use is acceptable for gardening and flushing of toilets. Eighty six percent (86%) of the respondents think that risks are involved in sewage recycling while 14% reported that they are not aware of the risks. In addition, 54% out of 86% of the respondents think that contamination will be main risk in sewage recycling, while 32% out of 86% think that health risks will be a main risk in sewage recycling.

(4) Site Description

1) Stage V Water Supply Project

a) Raw Water Conveyance Pipeline to be connected to TK Halli WTP

Most of the proposed sites are located in the existing facility areas of BWSSB, public roads and crossing points of rivers. The surrounding environment is pipeline roads, agricultural land as cotton fields. No national parks or sanctuaries are located in this project site. The situation of the project sites is shown in Photo 14.2.1.

Photo 14.2.1 Conveyance Pipeline (1)　Conveyance Pipeline crossing Shimsha River (2)

b) TK Halli WTP / Pump Station

The project site of the proposed WTP at TK Halli is located in the existing WTP facility area. The surrounding environment is the main and auxiliary facilities of the existing water treatment plant. There are several residential houses near the project site. The project site is shown in Photo 14.2.2.

Photo 14.2.2 TK Halli WTP with Pump Station

c) Pump Stations with Clear Water Reservoir at Harohalli and Tataguni

The project sites of the proposed pump stations at Harohalli and Tataguni are located in the facility area of existing pump stations. The surrounding situation is the main and auxiliary facilities and the existing pump stations. The project site at Harohalli is shown in Photo 14.2.3.

Photo 14.2.3 Pump Stations at Harohalli

d) Transmission Facilities

The proposed transmission pipeline will be located along the existing pipelines which are BWSSB's facility areas of maintenance roads. The pipeline will cross some roads such as village roads and Bengaluru - Dingdigul Highway (NH-209). Most of the surrounding area is agricultural land. The project site is shown in Photo 14.2.4.

Photo 14.2.4 Proposed Site for Transmission Pipeline

e) GLRs (Ground Level Reservoirs)

Seven (7) GLR sites are proposed at the north, south, east and west parts of the 110 Villages. Most of the proposed sites are located in the built-up area and no national parks and sanctuaries are located. Kadugodi GLR site is located in a forest, which is under jurisdiction of Department of Forest and Environment, and Chokkanahalli GLR site is located in a Eucalypt forest. These project sites are shown in Photo 14.2.5. The site situation of the proposed GLR sites is shown in Table 14.2.23.

Photo 14.2.5 Proposed Site of GLRs (Left: Chokkanahalli GLR, Right: Kadugoti GLR)

Table 14.2.23 Site Situation of Proposed GLR Sites

No.	Name of GLRs	Site Situation
1	Gottigere	The site is a vacant area which is located in a hilly area partially with shrubs which has higher elevation compared to its surrounding area. Currently, a small Hindu temple is located inside the facility area. Rocks are outcropping in the road side.
2	Doddakanahalli	The project site is a vacant land which is located at a distance of 170 m from Sarjapura Main Road. The current surrounding land use is farm land. There is one school named *Prakriya* Green Wisdom School and Bengaluru Technical Institute near the site.
3	Kadugodi	The project site is facing ITPL main road and currently its land use is a forest area which is in jurisdiction of Department of Forest and Environment of Karnataka state. The current surrounding land use is forest, techno park and industrial area. The plants with local names of Honge (*Pongamia Pinnat*a), Nerale (*Syzgium cumini*), Sissoo (*Dalbergia sissoo*), Peltophorum (*Peltophorum pterocarpum*) are planted. However, Eucalypt which is commonly identified in the city is planted at the project site.
4	Chokkanahalli	The project site is a vacant land covered with shrubs which is located in the west side of Thanisandra main road. The current surrounding land use is a forest of Eucalypt and residential areas.
5	Vasudevapura	The project site is a vacant land covered with shrubs. The site is facing Doddaballapur road. There is few residential houses near the site.
6	Singapura	The project site is a vacant land covered with shrubs. The site has less houses in its surrounding areas. However, additional housing areas are under development.
7	Lingaderanahalli	The project site is a vacant land. There are several houses near the site. One Hindu temple is located inside the facility area.

Source: JICA Survey Team

f) City Trunk Main

The proposed sites for the city trunk main are located in the road areas as shown in Table 14.2.24, which shows the current traffic condition of the roads.

Table 14.2.24 Site Situation of Proposed City Trunk Main

No.	City Trunk Main	Name of Roads for Construction	Current Traffic Condition
1	Tataguni PS - Vajarahalli Junction	• Pipeline Road	The proposed site is located in existing BWSSB's pipeline road and it has no traffic.
2	Vajarahalli Junction - Gottigere GLR	• Gubbala Main Road • Kanakapura Road • 80 Feet Road • Gottigere – Kembathahalli Road	Kanakapura Road and 80 Feet Road currently have heavy traffic. Other roads have less traffic compared to these roads.
3	Gottigere GLR - Doddakannali GLR	• Bannerghatta Main Road • Begur Road • Doddakannali – Chikkakannali Road • Sarjapura Road	Bannerghatta Main Road, Begur and Sarjapura Road have heavy traffic. Other roads have less or no traffic.
4	Vajarahalli Junction - BDA SMV 6th Block	• Vajarahalli Road • Technology Road • Kenchana Halli Road • Mysore Road • 60 Feet Road	Mysore and Kenchana Halli Road has heavy or medium traffic. Other roads have less traffic or no traffic.
5	Vajarahalli Junction - BSK Tapping	• Vajarahalli Road	This road has medium traffic.
6	Doddakanahalli tapping - Kadugodi tapping	• Outer Ring Road	This road has heavy traffic.
7	Kadugoti GLR - OMBR GLR	• ITPL Main Road • Old Madras Road • Service Road • 3rd Main Road	These road have heavy traffic.
8	BDA SMV 6th Block - Lingaderanahalli GLR	• Kuvempu Road • Dwarakavasa Road • Magad Main Road	Magad Main Road has heavy traffic. Other roads have medium traffic.
9	Lingaderanahalli GLR - Singapura GLR	• Andrahalli Main Road • AB Road • Vidyaranyapura Nanjangad Road • Yelahanka Road	These roads have heavy traffic except Andrahalli Main Road.
10	Singapura GLR - Vasudevapura GLR	• Yelahanka Road • Doddaballapur Road	These roads have heavy traffic.
11	Yelahanka junction - Chokkanahalli GLR	• Doddaballapur Road • Kogilu Road • Thanisandra Main Road • Chokkanahalli Road	These roads have heavy traffic.

Source: JICA Survey Team

2) Sewerage Projects for 110 Villages

a) STP Sites

The site situation at the proposed STP sites is shown in Table 14.2.25. The project sites are located in the built-up area near lakes which are currently final receiving water bodies of the untreated sewage. Photo 14.2.6 presents situation of some STP sites.

Table 14.2.25 Site Situation of Proposed STP Sites

No.	Name of STP Sites	Site Situation
1	Jakkur	The proposed site is located in the drying bed of sludge of existing STP facility area. Several houses are built up in front of the existing STP facilities.
2	Yelahankakere	The project site is a vacant land adjacent to Yelahankakere Lake at a distance of 150 m. The surrounding land use is a built-up area of a substation and railway facility area. Residential areas are located at a distance of 200 m from the proposed site
3	Doddabetahalli	The project site is a vacant land of the government land (BDA) and the surrounding land use is a built-up area partially with farm land. The collected sewage by gravity by sewer mains will be treated at this STP and its treated effluent will be discharged to Attur Lake near the site.
4	Bilishivale	The project site is almost flat and built-up area adjacent to Rampura Lake. The surrounding area is currently illegal dumping site of solid waste.
5	Varthur	The site is a vacant land which was already acquired by BWSSB. The surrounding land is open land or agricultural land. The residential area is identified at 200 m from the site boundary.
6	Pillaganahalli	The project site is a vacant land adjacent to Gottigere Lake, NICE ring road and Bannerghatta main road. The surrounding land use is a highway, factory yard and high school.
7	Talaghattapura	The project site is a vacant land adjacent to existing Coca-Cola factory. The surrounding land use is a factory and residential area under construction at a distance of 80 m.
8	Somapura	The project site is a vacant land and located at the existing interchange of two highways of NICE Bengaluru Mysore Expressway and NICE ring road. The surrounding land use is a built-up area. Two (2) graves were identified within the project site.
9	Hemigepura	The project site is a vacant land which is close to NICE road and a river. The surrounding land use is farm land. The project site is covered with construction wastes and distribution of shrubs. The land is already transferred to BWSSB. Ambient noise level which originates in NICE ring road is quite high.
10	Nagasandra	The proposed site is located in a vacant land of the existing BWSSB's STP's facility area. The surrounding land use is the existing STP and nallah.
11	Karivobanahalli	The project site is a low land with a swamp which is close to NICE ring road. The surrounding land use is a vacant land covered with shrubs.
12	Herohalli	The project site is located in a vacant land close to NICE ring road. The site is a vacant land with shrubs. A nallah where untreated sewage is flowing from upstream residential areas was identified.
13	Hosahalli	The project site is a vacant area covered with coconut trees adjacent to village roads. One residential house was identified near the site.
14	Chikkabanavara-2	The project site is a vacant land which is adjacent to Chikkabanavara Lake. The surrounding land use is farm land.

Source: JICA Survey Team

Jakkur STP Site

Doddabettahalli STP Site

Hemigepura STP Site

Herohhali STP Site

Photo 14.2.6 Site Situation of Proposed STP Sites

b) ISPS Sites

The site situation of the proposed ISPS sites is shown in Table 14.2.26. As same as STP sites, the current land use of the proposed sites of ISPSs are located in the built-up area.

Table 14.2.26 Site Situation of Proposed ISPS Sites

No.	Name of ISPS Sites	Site Situation
1	Bellahalli	The project site is a vacant land which is close to a quarry site. The surrounding land use is a quarry site and farm land.
2	Hagadur	The project site is a vacant land which is located at the low land area. The surrounding land use is a river and farm land.
3	Naganathapura	The project site is a vacant land. The surrounding land use is a built-up area near Raisandra Lake.
4	Arehalli	The project site is a vacant land which is located at the south part of a stream. The surrounding land use is vacant land and residential area at a distance of 30 m.
5	Hemigepura	The project site is a vacant land which is located close to NICE ring road and a river. The surrounding land use is farm land and residential areas.
6	Herohalli	The project site is located at west side of NICE ring road and is currently a

No.	Name of ISPS Sites	Site Situation
		vacant land. The surrounding land use is farm land.
7	Doddabidarakallu	The project site is a vacant land which is located at the south part side of Anchepalya Lake. The surrounding land use is farm land.

Source: JICA Survey Team

c) Main Sewers

The site situation of the proposed STPs is shown in Table 14.2.27. The proposed main sewers are developed along existing streets in the residential area, nallahs and a railway. Of the planed roads, several roads have heavy traffic.

Table 14.2.27 Site Situation of Proposed Main Sewers

No.	Zones for Main Sewers	Site Situation
1	Bytrayanapura	The proposed sewer mains are located in the built-up area and will run the following major roads which have currently heavy traffic and a railway line. • Kogilu Road • Bengaluru – Hyderabad Highway (NH-7) in a flyover bridge • Doddaballapur Road • Railway
2	Mahadevpura	Most of the proposed sewer mains will run existing nallahs and convey the collected sewage at Hagadur ISPS to Varthur STP. The main sewer will be constructed at an existing road named Chanasandra Main Road which has not so much traffic.
3	Bommanahalli	The proposed main sewers are located in two areas of Naganathapura and Pillaganahalli. <u>Naganathapura area:</u> The proposed main sewer runs through a vacant area from Naganathapura ISPS, crosses two major roads of Chennai – Bengaluru Highway currently in a flyover structure and NICE ring road which have heavy traffic, and runs along Chikka Togur Lake up to Neeladri Road. <u>Pillaganahalli</u> The proposed main sewer runs through a vacant land at Pillaganahalli district between two residential areas up to Pillaganahalli STP. The main sewer does not cross major roads.
4	R.R. Nagar	The proposed main sewers are located in three areas of Talaghattapura, Somapura and Hemmigepura districts. <u>Talaghattapura</u> The proposed Hosahalli main sewer runs through or crosses BWSSB's pipeline road , runs along Talaghattapura Lake and streets in residential areas up to Talaghattapura STP. <u>Somapura</u> The proposed main sewer runs through a vacant area, NICE Ring Road up to Somapura STP. NICE Ring Road has currently has heavy traffic. <u>Hemigepura</u> The proposed main sewer runs through streets in residential areas.

No.	Zones for Main Sewers	Site Situation
5	Dasarahalli	The proposed main sewers are located in three areas of Daddabidarakallu, Karivobanahalli, Herohalli and Hosahalli districts. Daddabidarakallu: The proposed main sewer runs through existing streets in residential areas up to Daddabidarakallu ISPS. From Daddabidarakallu ISPS, another main sewer runs Daddabidarakallu residential area. Karivobanahalli: The proposed Handrahalli main sewer runs through existing nallah in a residential area up to Kariobanahalli STP. Herohalli: The proposed Herohalli main sewer runs through several streets in a residential area and a nallah up to Herohalli STP. Hosahalli : The proposed Hosahalli main sewer runs through a nallah and crosses NICE Ring Road up Hosahalli STP.

Source: JICA Survey Team

3) Projects to be implemented using Local Fund

The project sites are situated in the build-up area of the ULBs/Core areas and the 110 Villages in BBMP except for Stage V conveyance pipeline project, which is planned to be implemented at existing BWSSB's facility areas before reaching TK Halli WTP site. There are no national parks nor natural reserves in the project sites. The project sites are existing public road areas where the future pipelines are planned to be laid or existing pipelines have already been laid. The project sites for UFW Reduction Project are located in the public roads in the Core area with higher traffic comparing with those for Water Supply and sewerage Project (lateral sewers and house connections) in the 110 Villages.

14.3 Legal and Institutional Framework for Environmental and Social Considerations

14.3.1 Environmental Clearance

(1) Legal Basis for Environmental Clearance

EIA Notification 2006 is a legal basis, which stipulates environmental clearance for development of projects. There are following four (4) stages in the environmental clearance process as per the notification.

- Stage 1: Screening
- Stage 2: Scoping
- Stage 3: Public Consultation
- Stage 4: Appraisal

1) Stage 1: Screening

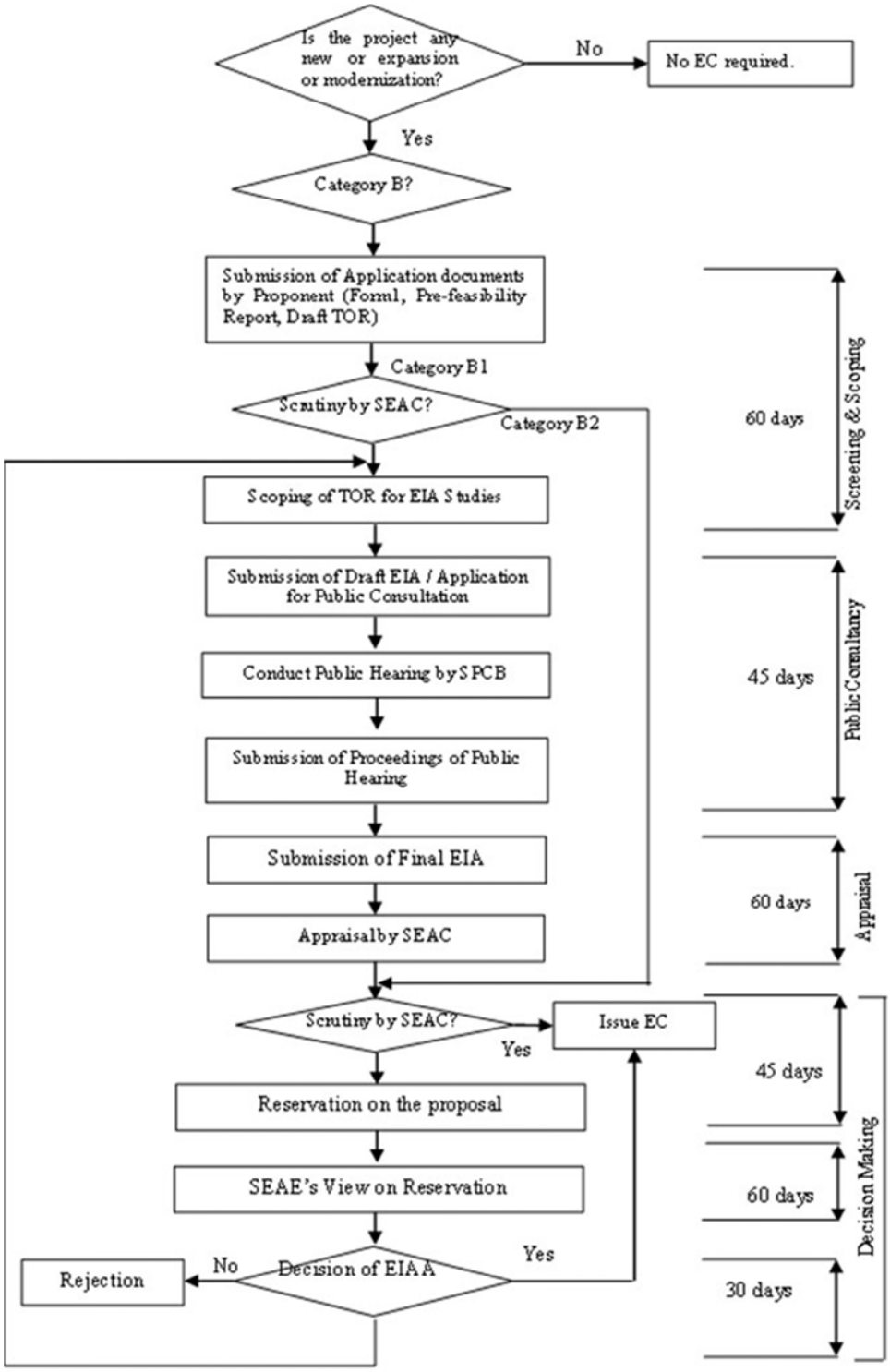
According to the notification, projects are classified either Category A or Category B depending on the types, scales of the projects and potential impact level to be caused by them. For Category A projects which have large scales and cause potential significant impact, EC (Environmental Clearance) shall be obtained from the EAC (Expert Appraisal Committee) of MoEF (Ministry of the Environment and Forests). For Category B project which have less scales comparing to category-A projects and may have less impact level, on one hand, an EC shall be obtained from the SEAC (State Level Expert Appraisal Committee).

In the case of Category B projects, this stage will entail the scrutiny of an application seeing prior environmental clearance made in Form 1 by the concerned State level Expert Appraisal Committee (SEAC) for determining whether or not the project requires further environmental studies for preparation of an Environmental Impact Assessment (EIA).

Projects requiring an EIA report shall be termed Category B1. Projects of Category B2 are not required to prepare an EIA report. In projects of Category B, Category B is applied only for the project of “Townships and Area Development projects”, while other projects are categorized as B2.

The process flow of EC for Category B projects is shown in Figure 14.3.1. Source: Centre for Science and Environment, New Delhi, India

Figure 14.3.1



Source: Centre for Science and Environment, New Delhi, India

Figure 14.3.1 Environmental Clearance Flow for Category B Projects

2) Scoping

Scoping refers to the process by which a review is undertaken by the EAC (Expert Appraisal Committee) in the case of Category A projects, and SEAC (State level Expert Appraisal Committee) in the case of Category B1 projects. All projects of Category B require scoping. The projects for construction, township, commercial complex and housing including sewerage projects shall not require scoping and will be appraised on the basis of Form 1and a conceptual plan.

3) Public Consultation

Public Consultation refers to the process by which the concerns of local affected persons and others who have a plausible stake in the environmental impacts of the projects are ascertained with a view to taking into account all the material concerns regarding the project or activity design as appropriate. All Category A and Category B1 projects or activities shall undertake public consultation, except a) Irrigation projects, b) all projects located within industrial estates or parks, c) expansion of roads, d) all building / construction projects, e) all projects as determined by the Central Government.

4) Appraisal

Applicants shall submit the final EIA report and outcome of the public consultations including public hearing proceedings to the regulatory authority concerned (EAC or SEAC) for obtaining the EC. The appraisal of all projects which are not required to submit an Environmental Impact Assessment report shall be carried out on the basis of the prescribed application Form 1 and Form 1A as applicable. After the final EIA report is received by the EAC or SEAC, it takes 60 days to approve the report.

5) EIA Requirement for Proposed Projects

According to EIA Notification 2006, the proposed water supply and sewerage projects do not require EC for implementing EIA (Environmental Impact Assessment).

(2) Comparison of India EIA System and JICA Guideline

The comparison on the requirements in between Indian EIA system and JICA guideline (JICA Guideline for Environmental and social Considerations 2010) is summarized in Table 14.3.1. In Indian EIA system, the requirement of information disclosure and public consultation are essential for the projects which may affect significant impacts on environment.

Table 14.3.1 Comparison between India EIA System and JICA Guideline

JICA Guideline	Indian EIA System as per EIA Notification 2006 or other Relevant Legislation / Regulation
1. Information Disclosure	
• Important Principles, 5. JICA discloses information: JICA itself discloses information on environmental and social considerations in collaboration with project proponents etc., in order to ensure accountability and to promote the participation of various stakeholders.	• The approved TOR (Terms of Reference) by the Expert Appraisal Committee or State Level Expert Appraisal Committee for EIA study shall be published on the website of the Ministry of Environment and Forests and the concerned State Level Environment Impact Assessment Authority.

JICA Guideline	Indian EIA System as per EIA Notification 2006 or other Relevant Legislation / Regulation
• 2.1 Information Disclosure: In principle, project proponents etc. disclose information about the environmental and social considerations of their projects. JICA assists project proponents etc. by implementing cooperation projects as needed.	• For obtaining responses in writing from other concerned persons having a plausible stake in the environmental aspects of the project or activity, the concerned regulatory authority and the State Pollution Control Board (SPCB) or the Union territory Pollution Control Committee (UTPCC) shall invite responses from concerned persons by publishing draft Summary EIA report on their websites.
2. Screening	
JICA classifies projects into four (4) categories according to the extent of environmental and social impacts, taking into account an outline of project, scale, site condition, etc. • Category A: Proposed projects which are likely to have significant adverse impacts on the environment and society. • Category B: Proposed projects whose potential adverse impacts on the environment and society are less adverse than those of Category A projects. • Category C: Proposed projects which are likely to have minimal or little adverse impact on the environment and society. • Category FI: Proposed projects which satisfy the following requirements: - JICA's funding of projects is provided to a financial intermediary or executing agency - the selection and appraisal of the sub-projects is substantially undertaken by such an institution only after JICA's approval of the funding, so that the sub-projects cannot be specified prior to JICA's approval of funding (or project appraisal) - those sub-projects are expected to have a potential impact on the environment	• All projects and activities are broadly categorized into two categories - Category A and Category B based on the spatial extent of potential impacts and potential impacts on human health and natural and man-made resources. • The projects requiring an Environmental Impact Assessment report shall be termed Category 'B1' and remaining projects shall be termed Category 'B2' and will not require an Environment Impact Assessment report.
3. Environmental and social Elements to be Assessed	
• 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. • 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	• Land environment • Water environment • Vegetation • Fauna • Air environment • Aesthetics • Socio-economic aspects

JICA Guideline	Indian EIA System as per EIA Notification 2006 or other Relevant Legislation / Regulation
working conditions including occupational safety.	
4. Consultation with Local Stakeholders	
• In principle, project proponents etc. consult with local stakeholders through means that induce broad public participation to a reasonable extent, in order to take into consideration the environmental and social factors in a way that is most suitable to local situations, and in order to reach an appropriate consensus. • Category A projects, JICA encourages project proponents etc. to consult with local stakeholders about their understanding of development needs, the likely adverse impacts on the environment and society, and the analysis of alternatives at an early stage of the project, and assists project proponents as needed.	All Category 'A' and Category B1 projects or activities shall under take public consultation, except the following: • Modernization of irrigation projects • All projects or activities located within industrial estates or parks approved by the concerned authorities • Expansion of roads and highways) which do not involve any further acquisition of land • All building / construction projects/ area development projects and townships • All Category 'B2' projects and activities. • All projects or activities concerning national defense and security or involving other strategic considerations as determined by the Central Government.
5. Others (Involuntary Resettlement)	
• Involuntary Resettlement: Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. • 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.	EIA Notification does not mention involuntary resettlement. However, in case of the project which includes resettlement or land acquisition of private land including compensation or rehabilitation measures, the project shall follow the provisions of the LARR (Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act), 2013 which provides fair compensation policies for PAPs (Project Affected Persons) corresponding to the requirements of international cooperation agencies.

Source: JICA Survey Team

14.3.2 Relevant Clearance / Permissions other than Environmental Clearance

The relevant clearances other than EC (Environmental Clearance) for implementation of the proposed projects and relevant information regarding the process details are shown in Table 14.3.2.

Table 14.3.2 Relevant Clearance / Permissions other than Environmental Clearance

No.	Action by Project	Authority for Granting Permission	Period from application to approval	Initiation By BWSSB
1	Crossing of Nallahs	BBMP	1 month	The BBMP will be approached for approval on start of project and completion of design. This process will be completed before tendering.
2	Crossing of Rivers	Irrigation Department and PWD of Karnataka State	1 month	The irrigation department and PWD will be approached for approval for crossing of Rivers on start of project. This process will be completed before tendering.

No.	Action by Project	Authority for Granting Permission	Period from application to approval	Initiation By BWSSB
3	Crossing of Railways	Southern Railway -Indian Railways	4 months	The Southern Railway will be approached for approval for crossing of Railways on start of project This process will be completed before tendering.
4	Excavation of underground road area	BBMP BDA	1 month	The BBMP/BDA will be approached for approval for excavation on start of project. This process will be completed before tendering.
5	Tollway (Public)	NHAI (National Highways Authority of India)	4 months	The NHAI will be approached for approval for crossing of highway on start of project. This process will be completed before tendering.
6	Tollway (Private)	NICE Limited	1 month	The Nice Ltd. will be approached for approval for crossing of highway on start of project. This process will be completed before tendering.
7	Discharge of treated wastewater	KSPCB	1 month	The KSPCB will be approached on start of the project for release of treated sewage to the water body. This process will be completed before tendering.
8	Permission for tree cutting	BBMP Forest Department (GoK)	2 months at maximum	On start of project and completion of design of all components. This process will be completed before tendering.
9	Power	BESCOM (Bengaluru Electricity Supply Company Limited) KPTCL (Karnataka Power Transmission Corporation Limited)	4 months	Already initiated discussion is under progress. This process will be completed before tendering.
10	Crossing gas pipelines	GAIL (Gas Authority of India Limited) BBMP	4 months	On start of project and completion of design of all components. This process will be completed before tendering.
11	Crossing telecommunication cables	BSNL (Bharat Sanchar Nigam Limited) Telecom Companies	4 months	On start of project and completion of design of all components. This process will be completed before tendering.

Source: JICA

14.3.3 Legislative Framework for Environmental and Social Considerations

(1) National Policy and Plans in Environmental Sector

National Environment Policy 2006 is an India's national commitment to a clean environment which is mandated in the Constitution in Articles 48 A and 51 A (g), (DPSP) strengthened by judicial interpretation of Article 21. It is recognized that the maintenance of the healthy environment is the responsibility of not only the state but also those of every citizen and that a necessity of partnership should be realized through the environment management.

The following summarizes the objectives, strategies and actions.

Objectives of the Policy

- Intra-generational Equity: Livelihood Security for the Poor
- Conservation of Critical Environmental Resources
- Inter-generational Equity
- Integration of Environmental Concerns in Economic and Social Development
- Efficiency in Environmental Resource Use
- Environmental Governance Enhancement of Resources for Environmental Conservation

Strategies and Actions

- "Polluter Pays" principle: The National Environment Policy promotes the internalization of environmental costs, including through the use of incentives based policy instruments, taking into account the approach that the polluter should, in principle, bear the cost of pollution, with due regard to the public interest, and without distorting international trade and investment.
- Legal Liabilities in the Policy: The policy adopts the civil liability for environmental damage that would deter environmentally harmful actions, and compensate the victims of environmental damage.
- Legislative Reforms: The policy calls for identification of the emerging areas for new legislation, due to better scientific understanding, economic and social development, and development of multilateral environmental regimes, in line with the National Environment Policy. It also calls for review the body of existing legislation in order to develop synergies among relevant statutes and regulations.
- Environment Impact Assessment: The policy focuses on encouraging the regulatory authorities to institutionalize regional and cumulative environmental impact assessments to ensure that environmental concerns are identified and addressed at the planning stage itself.
- Wetland: The policy aims at setting up a legally enforceable regulatory mechanism for identified valuable wetland, to prevent their degradation and enhance their conservation. Develop a national inventory of these wetland.

(2) Laws and Regulations Relating to Environmental Conservation

The Environment (Protection) Act, 1986, 2004 (amended)

The Environment (Protection) Act was conceived as an "umbrella legislation" seeking to supplement the

existing laws on the control of pollution (the water Act and the Air Act) by enacting a general legislation for environment protection and to fill the gaps in regulation of major environmental hazards.

- Section 3 (1) of the Act empowers the Centre to "take all such measures as it deems necessary or expedient for the purpose of protecting and improving the quality of the environment and preventing, controlling and abating environmental pollution".
- It also authorizes the government to make rules on any aspect related to environment protection.
- No industries can discharge any solid, liquid or gaseous substances beyond the permissible limit as laid down by the GOI on its behalf.
- Comply with the directions issued in writing by the GOI within a specified time as mentioned in the order.
- Furnish information to the prescribed agencies of any accident or unforeseen event, in which environmental pollutants occurred in excess of the prescribed standards are being discharged, of are likely to be discharged in the environment.

The key environmental laws and regulations relating to implementation of the projects other than above Environmental Protection Act are shown in Table 14.3.3.

Table 14.3.3 Laws and Regulations for Environmental and Social Considerations

No.	Act/Rules	Purpose	Conditions for Applicability
1	Environmental Impact Assessment Notification, 14th Sep-2006	To conduct environmental clearance for EIA (Environmental Impact Assessment) to new development activities in accordance with project types, their magnitude and their project sites in environmentally sensitive areas.	This notification is applicable only to the identified 29 projects that are listed in the notification.
3	The Forest (Conservation) Act 1980, its amendment in 1988	The Central Government enacted The Forest (Conservation) Act in 1980 to stop large-scale diversion of forestland for non-forest use. As amended in 1988, the Act requires the approval of the Central Government before a State "de-reserves" a reserved forest, uses forestland for non-forest purposes, assigns forestland to a private person or corporation, or clears forests land for the purpose of reforestation. Such diversion is generally allowed on the advice of an Advisory Committee constituted under the Act. In case of such diversion of forest land, compensatory afforestation has been made mandatory.	This act is applicable if there is diversion of forest land for non-forest activities for any of the projects.
4	MoEF circular (1998) on linear plantation on roadside, canals and railway lines modifying	Protection/planting roadside strip as avenue/strip plantation	This act will be applicable if sewers are to be laid along roadside, wherein roadside tree plantation exists, irrespective of whether tree felling is involved or not.
5	Wild Life Protection Act 1972	To protect wildlife through certain of National Parks and Sanctuaries	This act will be applicable, if there are any points of wildlife crossings in proximity to project locations.

No.	Act/Rules	Purpose	Conditions for Applicability
6	Air (Prevention and Control of Pollution) Act, 1981	To control air pollution from transport and controlling emission of air pollutants as per prescribed standards	This act will be applicable during construction stage of the proposed projects.
7	Water Prevention and Control of Pollution Act, 1974	To control water pollution by controlling discharge of pollutants as per prescribed standards through delegation of the power to state government. A State Government has a power: To inspect sewage or trade effluents, works and plants for the treatment of sewage and trade effluents and to review plans, specifications or other data relating to plant set up for the treatment of water, works for the purification thereof and the system for the disposal of sewage or trade effluents or in connection with the grant of any consent as required by this act.	This act will be applicable for the SPCB's inspection of the water quality of the effluent of sewerage facilities.
8	Noise Pollution (Regulation Control) Rules, 2000	The standards for noise for day and night have been promulgated by MoEF for various land uses.	This act will be applicable for all construction equipment deployed at the worksite.
9	Ancient Monuments and Archaeological Sites and Remains Act, 1958	The Ancient Monuments and Archaeological Sites and Remains Act (or AMASR Act) is an act of parliament of the government of India that provides for the preservation of ancient and historical monuments and archaeological sites and remains of national importance, for the regulation of archaeological excavations and for the protection of sculptures, carvings and other like objects.	This act will be applicable if any of the projects is in proximity to any ancient monuments, declared protected under the act. Areas within the radii of 100m and 300m from the "protected property" are designated as "protected areas" and "controlled areas" respectively. No development activity (including building, mining, excavating, blasting) is permitted in the "protected areas". Development activities likely to damage the protected property are not permitted in the "controlled areas" without prior permission from the Archaeological Survey of India (ASI) if the site/remains/ monuments are protected by ASI or the State Directorate of Archaeology.
10	Child Labor (Prohibition and Regulation) Act 1986	This act prohibits the employment of children under 14 in certain specified hazardous processes, including construction work.	This act will be applicable for the construction and operation works of the projects.
11	Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996	Indian construction industry is subject to certain health and safety rules to set out health, safety and welfare requirements of this act. This includes a requirement to register the construction business with the relevant authorities, to appoint a safety officer and establish a safety committee where 500 workers or more are employed.	This act will be applicable for construction works for construction companies ("establishments") employing 10 or more workers on projects costing more than 1.0 Million INR (approximately ¥1.7 Million JPY).

No.	Act/Rules	Purpose	Conditions for Applicability
12	Building and Other Construction Workers' Welfare Cess Act 1996	This act allows state governments and Union Territories to impose a 1% levy (cess) on construction projects with costing more than 1.0 Million INR to fund state welfare schemes providing financial assistance to workers and their families in the event of accidents.	This act will be applicable for the construction works of the projects.
13	Public Liability Insurance Act, 1991	This act provides for public liability insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling any hazardous substance and for matters connected therewith or incidental thereto and also provides occupational diseases benefit.	The accidents, handling and transportation of hazardous substances by vehicle use during construction and operation stages of the proposed projects will follow this act.
14	The Manufacture, Storage and Import of Hazardous Chemical Rules, 1989	This act provides employers in charge of factories, mines, plantations, construction work, "mechanically propelled vehicles" and other hazardous occupations must pay compensation to employees and their dependents in the case of work-related fatalities and serious injuries and certain occupational accidents.	This act will be applicable for the handling hazardous matters such as chlorine gas at construction and operation stages of the projects.
15	IS 11768: 1986, Recommendations for disposal of asbestos waste material	This standard provides the recommendations on disposal of asbestos waste material.	This standard relates to demolition works including deteriorated asbestos pipes at construction stage.
16	Central Motor Vehicle Act 1988 and Central Motor Vehicle Rules 1989	To check vehicular air and noise pollution	This rule will be applicable to vehicles deployed for construction activities and construction machinery.
17	National Forest Policy 1952, National Forest Policy (Revised) 1988	To maintain ecological stability through preservation and restoration of biological diversity	This policy will be applicable if any eco-sensitive feature exists in and around the projects.
18	Land Acquisition, Rehabilitation and Resettlement Act, 2013 (LARR)	This Act was replaced with the previous Land Acquisition Act 1984.The LARR Act 2013 focuses on providing not only compensation to the land owners, but also extend rehabilitation and resettlement benefits to livelihood looser from the land, which shall be in addition to the minimum compensation.	The applicability of this act should be examined for the land acquisition process for the proposed projects instead of the old act as mentioned before.
19	Water Bodies Lakes Bengaluru NGT (National Green Tribunal) Order dated 07th May, 2016	The order stipulates buffer zones to be maintained as greenbelt for conservation of water bodies such as lakes and wetland.	As a meeting with Lake Development Authority and other authorities concerned such as BDA and BBMP, STPs can be constructed exceptionally.
20	Karnataka Act No. 10 of 2015 (The Karnataka Lake Conservation and Development Authority Act, 2014)	This act was established to protect, conserve, reclaim, regenerate and restore lakes to facilitate recharge of depleting ground water by promoting integrated approach with the assistance of concerned Government departments, local and other authorities.	A construction of commercial or industrial facilities within a distance to be notified by the Government is prohibited by this law. The construction of STPs or ISPS is not applicable for this law.

Source: JICA Survey Team

(3) Ambient Air Quality Standards

CPCB has notified the National Ambient Air Quality Standards (NAAQS) in Schedule VII of these Rules, which are reproduced in Table 14.3.4.

Table 14.3.4 National Ambient Air Quality Standards

Pollutant	Time weighted	Concentration in ambient air (μg/m^3)			Method of Measurement
	Average	Industrial	Residential	Sensitive	
SO_2	Annual*	80	60	15	Improved West & Gaeke method
	24 hrs**	120	80	30	Ultra violet fluorescence
NO_x	Annual	80	60	15	Jacob & Hochheiser modified (Na-Arsenite) method
	24 hrs	120	80	30	Gas phase chemi-luminescence
SPM	Annual	360	140	70	Average flow rate not less than
	24 hrs	500	200	100	1.1 m^3/minute
RPM	Annual	120	60	50	
	24 hrs	150	100	75	
Pb	Annual	1.00	0.75	0.50	AAS method after sampling using
	24 hrs	1.50	1.00	0.75	EPM 2000 or equivalent paper
CO***	8 hrs	5	2	1	Non dispersive infrared spectroscopy
	1 hour	10	4	2	

Note*: Annual arithmetic mean of minimum 104 measurements in a year taken twice a week 24 hourly at uniform intervals.
Note**: 24 hourly /8 hourly values to be met 98% of the time in a year. However, 2% of the time, it may exceed but not on two consecutive days.
Note***: Values in mg/m^3
Source: JICA Survey Team

(4) Ambient Noise Standards

The standards for ambient air quality in respect of noise are given in Schedule III under the rules and are reproduced in Table 14.3.5.

Table 14.3.5 Ambient Noise Standard

Area code	Category of area	Limits in dB (A)	
		Day time	Night time
A	Industrial	75	70
B	Commercial	65	55
C	Residential	55	45
D	Silence zone	50	40

Note 1: Daytime is reckoned in between 6 a.m. to 10 p.m.
Note 2: Night time is reckoned in between 10 p.m. to 6 a.m.
Note 3: Silence zone is defined as areas up to 100 meters around such premises as hospitals, educational institutions and courts. The silence zones are to be declared by the Competent Authority. Use of vehicular horns, loud speakers and bursting of crackers shall be banned in these zones.
Note 4: Mixed categories of areas should be declared as one of the four above-mentioned categories by the Competent Authority and the corresponding standards shall apply.
Source : JICA Survey Team

(5) Water Quality Standards

The Indian water quality standard for drinking water purpose and the effluent discharge standards for sewage treatment plant which are mentioned in Chapter 2.2.4 is applied for the project.

14.4 Project Alternative Study

14.4.1 Stage V Water Supply Project

(1) Location and Alignment of Facilities

The proposed facilities including WTP, transmission pipeline and pump stations are planned to be constructed in the existing BWSSB's facility areas, thus there is no need to acquire private land. The project sites for GLRs were selected taking into consideration of the water service area, hydraulic condition and land availability in public land. All project sites for GLRs are owned by the government or BWSSB without requiring land acquisition of private land. In case of the utilization of private land, compensation and resettlement may be necessary. In case of zero option (without the project), the required water to meet the future demand in the 110 Villages would not be supplied, which causes another risk of social unrest.

(2) Water Treatment Method

1) Water Treatment

A rapid sand filtration method with the processes of aeration and pre-chlorination (Option 1) was selected after alternative study as shown in Table 14.4.1. The major reasons on the application of the method are: 1) to avoid algae growth in the raw water, 2) to avoid DO decrease in the underground pipeline and 3) BWSSB projects have adopted the method with successful experience.

Table 14.4.1 Selection of Treatment Method

Item	Option-1	Option-2	Option-3
Process Type	Conventional Rapid Filtration Process	Plain Disinfection by Chlorination	Plain Sedimentation followed by Slow Sand Filtration and Disinfection
Applicability	For highly polluted raw water with algae or other microorganism growing	For the raw water with turbidity below 10 NTU and free from odor and color	For the raw water with turbidity not exceeding 50 NTU and with a condition that sufficient land area is available
Conditions for application	a) There is a possibility of algae growing. b) DO consumption is projected in the underground pipeline with 16 km. c) BWSSB has sufficient experience on conventional rapid filtration process.	This process cannot treat the raw water with algae.	The large area is necessary for this process, but land acquisition seems to be difficult.
Selection	Adopted	Not Adopted	Not Adopted

Source: JICA Survey Team

2) Treatment Method of Wastewater Generated by Backwashing

Since the direct discharge of wastewater generated through water treatment into the Shimsha River is prohibited, some wastewater is planned to treat. In this regard, the thickening of combined sludge collected from the process of backwashing and sedimentation is planned. Then, treated wastewater is recycled returning to the treatment process and generated sludge after the treatment is disposed of.

(3) Number of Transmission Pump Units at the Three (3) Intermediate Pump Stations

Two (2) options on the number of pump units (12 and 9) including stand-by units were studied. A total of 9 units including 3 units of stand-by pump was adopted in view of economy and pumping efficiency.

14.4.2 Sewerage Project for 110 Villages

(1) Location and Alignment of Facilities

The location of the proposed sewerage facilities should be selected taking into account of the following requirements.

1) Main Sewers should be located close to the sewage collection area.

2) A gravity sewer should be planned to connect to STPs as much extent as possible in consideration of topographical conditions.

The conditions on the discharge of effluent, land acquisition giving priority to public land to avoid social impacts on private owners or resettlement problem were also considered. In case of Zero option (without the project), untreated sewage will continuously cause water pollution in the surrounding water bodies.

(2) Sewage Treatment Method

Sewage Treatment:

Technical options on Advanced OD, SBR, EA, MBR, A2O and MBR were studied for the selection of sewage treatment method considering nitrogen removal, treatment effectiveness, performance, capital cost, and easiness of O&M with required cost. EA and SBR methods were screened as applicable methods for this project. Then, further study was made in view of their biological treatment process. EA was finally selected to apply for all STPs, due to its good performance in India and easiness of maintenance.

Sludge Treatment:

Presently, BWSSB use mechanical thickening, digestion and mechanical dewatering for sludge treatment. In consideration of the required countermeasures against potential problems including odor and noise, the combined treatment of TH (Thickener) and DW (Mechanical Dewatering) was recommended. In case of small -size STPs, TH can be omitted.

Zero Option:

Without implementation of the sewage project, water pollution in the public water bodies will not be improved.

14.5 Scoping

14.5.1 Stage V Water Supply Project

(1) Rating for Scoping

The following ratings were applied for the assessment of the scoping;

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

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

C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)

D: No impact is expected.

(2) Scoping Results

The scoping for the proposed Stage V Water Supply project was made as shown in Table 14.5.1 based on the site condition, interview results and literature data. The environmental and social elements to be assessed are shown below.

- At construction phase: social infrastructure, infectious diseases, occupational health and safety, air pollution, waste, noise and accidents
- At operation phase: poverty, landscape, occupational health and safety, water pollution, waste, noise, accident, climate change

Table 14.5.1 Scoping Results for Stage V Water Supply Project

Type	No.	Elements to be Assessed	Rating		Reason for Evaluation
			Const.	O&M	
Natural Environment	1	Protected Area	D	D	The project site and surrounding area is not located in any national parks or nature reserves.
	2	Ecosystem	D	D	Most of the project sites are located in the existing BWSSB's facility areas or the urban built-up area.
	3	Hydrology	D	D	At Construction stage: The construction works of the water pipe bridge is not large scaled and it will not affect the change of the river flow or river bed. At Operation stage: The downstream water use and maintenance flow has already been secured for Cauvery river.
	4	Topography / Geology	D	D	The project does not include large scaled excavation works.
Social Environment	5	Resettlement / Land Issue	D	D	The project sites do not include residential area nor compensation problems since the project sites to be acquired are all public land, not private land.
	6	Poverty	D	B-	At Operation stage: The increase of water tariff may affect the household economy of low income level.
	7	Ethic Minority	D	D	There are no ethnic minorities nor indigenous people at the project sites.
	8	Employment	B+	D	At Construction stage:

Type	No.	Elements to be Assessed	Rating		Reason for Evaluation
			Const.	O&M	
		, sustenance and regional economy			An opportunity for employment of local residents is expected by the construction works and may contribute to local economy.
	9	Land Use / Regional Resource	D	D	The project sites at the BWSSB's facility areas, public road areas and the vacant area in the built-up area will not affect the local land use nor regional resources.
	10	Water Use	D	D	The downstream water use and maintenance flow in Cauvery river will be secured.
	11	Social Infrastructure / Service	B-	D	The construction works of the water pipelines at road areas and GLRs may affect the traffic flow and existing underground utilities.
	12	Local society for decision making	D	D	The project is to implement a public works by the government which aim to bring public benefit and will not affect local society.
	13	Unbalance of damages and benefits	D	D	The project is to develop water supply facilities of safe water to the 110 Villages which are currently not served by BWSSB's water service and not bring unbalance damage and benefit.
	14	Local Conflicts of Interests	D	D	The project does not supply water to specific people or structure, and it will not bring local conflicts.
	15	Heritage or Cultural Assets	D	D	The project sites do not encompass such historical or cultural assets.
	16	Landscape	D	B-	The appearance of new facilities of GLRs may affect surrounding landscape.
	17	Gender	D	D	Currently, there is no distinguishing practice that the housewives take water from existing water source.
	18	Right of Children	D	D	The project is not related to the issue of right of children. Child labor will be prohibited for implementation of the project by compliance with national laws or international guidelines.
	19	Infectious Diseases (e.g. HIV / AIDS)	B-	D	The inflow of construction workers may generate or expand infection diseases. At operation phase, safe water treated at the proposed WTP will be supplied.
	20	Occupational Health and Safety	B-	B-	<u>At Construction stage</u>: Care should be taken for the working environment of the construction workers. <u>At Operation stage</u>: Care should be taken for the handling of the chlorine gas at the disinfection process.
Pollution	21	Air Pollution	B-	D	The construction vehicles and equipment at construction stage will generate dust.
	22	Water	D	B-	<u>At Construction stage</u>:

Type	No.	Elements to be Assessed	Rating		Reason for Evaluation
			Const.	O&M	
		Pollution			Turbid water will not be generated by the generation of underground water at excavation works due to the low table of the groundwater. At Operation stage: The wastewater by the backwashing at flocculation and sedimentation process will be recycled at the WTP. However, inappropriate operation or system dysfunction may cause water quality pollution of the produced water.
	23	Waste	B-	B-	At Construction stage: Construction debris, excavation soil and the garbage at construction camps will be generated. At Operation stage: Sludge will be generated at the water treatment process.
	24	Soil Contamination	D	D	The hazardous matter causing soil contamination will not be generated.
	25	Noise / Vibration	B-	B-	At Construction stage: Noise will be generated by the operation of construction vehicles and equipment. At Operation stage: Noise will be generated by the operation of pumping equipment.
	26	Ground Subsidence	D	D	The project does not extract groundwater.
	27	Odour	D	D	The project does not include the activities which generates odour.
	28	Sediments	D	D	The scale of the pipe support bridges is not large and will not affect the sediments of the river bed.
Others	29	Accident	B-	B-	At Construction stage: Care should be taken for the accidents which are estimated at the construction works. At Operation stage: Care should be taken for the accidents which are estimated at the operation and maintenance works.
	30	Climate Change	D	B-	At Operation stage: The operation of the equipment such as pumping units at WTP and pump stations will consume electricity and generate GHGs.

Notes: A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
D: No impact is expected.

Source: JICA Survey Team

14.5.2 Sewerage Project for 110 Villages

(1) Rating for Scoping

The same method for rating in the case of sewerage project for the 110 Villages was applied.

(2) Scoping Results

The scoping for the proposed sewerage project for the 110 Villages was made as shown in Table 14.5.2 based on the site condition, interview results and literature data. The environmental elements to be assessed are shown below.

- At construction phase: social infrastructure, infectious diseases, occupational health and safety, air pollution, waste, noise and accidents
- At operation phase: poverty, landscape, occupational health and safety, water pollution, waste, soil contamination, noise, odour, accident, climate change

Table 14.5.2 Scoping Results for Sewerage Project for 110 Villages

Type	No.	Impact to be Assessed	Rating		Reason for Evaluation
			Const.	O&M	
Natural Environment	1	Protected Area	D	D	The project site and surrounding area is not located in any national parks or nature reserves.
	2	Ecosystem	D	D	Most of the project sites are planned at built-up area.
	3	Hydrology	D	D	At Construction stage: The drainage at construction sites is temporary and minor. At Operation stage: The current sewage discharge in nallah will be taken into the proposed sewerage system.
	4	Topography / Geology	D	D	The project does not include large-scaled excavation works.
Social Environment	5	Resettlement / Land Issue	D	D	The project sites does not include residential area nor compensation problems since the project sites to be acquired are all public land, not private land.
	6	Poverty	D	B-	At Operation stage: The increase of sewage tariff may affect the low income households.
	7	Ethic Minority	D	D	There are no ethnic minorities nor indigenous people at the project sites.
	8	Employment, sustenance and regional economy	B+	D	At Construction stage: An opportunity for employment of local residents is expected by the construction works and may contribute to local economy.
	9	Land Use / Regional Resource	D	D	The project sites are the vacant areas in the built-up area and the public road.
	10	Water Use	D	D	The project does not relate to water use.
	11	Social	B-	D	The construction works of the main sewers at public

Type	No.	Impact to be Assessed	Rating		Reason for Evaluation
			Const.	O&M	
		Infrastructure / Service			road areas may affect the traffic flow and existing underground utilities.
	12	Local society for decision making	D	D	The project is to implement a public works by the government which aim to bring public benefit and will not affect local society.
	13	Unbalance of damages and benefits	D	D	The project is to develop sanitation facilities of environmental improvement to the 110 Villages which are currently not served by BWSSB and not bring unbalance damage and benefit.
	14	Local Conflicts of Interests	D	D	The project does not provide the improved service to specific people or structure, and it will not bring local conflicts.
	15	Heritage or Cultural Assets	D	D	The project sites do not encompass such historical or cultural assets.
	16	Landscape	D	B-	New appearance of facilities may affect surrounding landscape.
	17	Gender	D	D	The project is not related to gender issue.
	18	Right of Children	D	D	The project is not related to the issue of right of children. Child labor will be prohibited for implementation of the project by compliance with national laws or international guidelines.
	19	Infectious Diseases (e.g. HIV / AIDS)	B-	D	The inflow of construction workers may generate or expand infection diseases.
	20	Occupational Health and Safety	B-	B-	<u>At Construction stage</u>: Care should be taken for the working environment of the construction workers. <u>At Operation stage</u>: Care should be taken for the maintenance works of main sewers or handling of the chlorine gas at the disinfection process.
Pollution	21	Air Pollution	B-	D	The construction vehicles and equipment at construction stage will generate dust.
	22	Water Pollution	D	B-	<u>At Construction stage</u>: Turbid water will not be generated by the generation of underground water at excavation works due to the low table of groundwater. <u>At Operation stage</u>: Inappropriate operation or system dysfunction may cause water quality pollution.
	23	Waste	B-	B-	<u>At Construction stage</u>: Construction debris, excavation soil and the garbage at construction camps will be generated. <u>At Operation stage</u>: Sludge will be generated at the sewage treatment process.

Type	No.	Impact to be Assessed	Rating		Reason for Evaluation
			Const.	O&M	
	24	Soil Contamination	D	B-	The leakage of sewage at the main sewers may affect the surrounding ground.
	25	Noise / Vibration	B-	B-	At Construction stage: Noise will be generated by the operation of construction vehicles and equipment. At Operation stage: Noise will be generated by the operation of pumping equipment and blower.
	26	Ground Subsidence	D	D	The project does not extract groundwater.
	27	Odour	D	B-	The project may generate odour at the treatment process of sludge.
	28	Sediments	D	D	The project does not include the activities which affect the sediments of the river bed.
Others	29	Accident	B-	B-	At Construction stage: Care should be taken for the accidents which are estimated at the construction works. At Operation stage: Care should be taken for the accidents which are estimated at the operation and maintenance works.
	30	Climate Change	D	B-	At Operation stage: The operation of the equipment such as pumping units and blower at STPs and ISPSs will consume electricity and generate treated sludge which may cause GHGs.

Notes: A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
D: No impact is expected.

Source: JICA Survey Team

14.5.3 Projects to be Implemented Using Local Funds

The details on the scoping results are included in the Supporting Report. The environmental and social elements were selected including poverty, social infrastructure/ service, infectious diseases, occupational health and safety, air pollution, waste, noise and accident.

14.6 TOR for Environmental and Social Considerations at IEE Level

14.6.1 Stage V Water Supply Project

The TOR (Terms of References) for the environmental and social considerations for the proposed Stage V Water Supply project is shown in Table 14.6.1.

Table 14.6.1 TOR for Stage V Water Supply Project

No.	Environmental and Social Elements	Items to be Examined	Methods for Examination
1	Poverty	• Current tariff system • Awareness of beneficiaries	• Literature survey • Interview • Social Condition Survey • Future tariff system for the urban poor
2	Social infrastructure/ service	• Traffic volume • Status of underground utilities	• Literature survey • Interview • Construction plan • Relevant clearances for the construction at road areas
3	Landscape	• Appearance of facility buildings	• Surrounding land use • Facility design of GRLs or their landscaping plan
4	Infectious Diseases (e.g. HIV / AIDS)	• Health program or training at construction	• Construction plan
5	Occupational Health and Safety	• Safety measures at construction and operation stage	• Construction plan • Operation and maintenance method
6	Air Pollution	• National standards • Surrounding land use • Dust control at construction stage	• Literature survey • Interview • Site reconnaissance
7	Water pollution	• National standards • Control measures for turbid water at construction • Emergency measures for the events of dysfunction operation	• Construction plan • Facility design • Operation and maintenance method
8	Waste	• Handling, discharge and treatment method of garbage, excavation soil and construction debris • National standards on sludge treatment and disposal	• Literature survey • Construction plan • Sludge treatment and disposal method Practice in other projects
9	Noise / Vibration	• National standards • Surrounding land use • Noise level to be generated by equipment	• Literature survey • Site reconnaissance • Construction plan • Facility design • Operation and maintenance method
10	Accident	• Safety measures at construction and operation stage	• Construction plan • Operation and maintenance method
11	Climate Change	• Electricity consumption • Type of equipment	• Equipment plan of WTP and pumping stations • Carbon emission factor for grid electricity in Karnataka state in India

Source: JICA Survey Team

14.6.2 Sewerage Project for 110 Villages

The TOR (Terms of References) for the environmental and social considerations for the proposed sewerage projects for the 110 Villages is shown in Table 14.6.2.

Table 14.6.2 TOR for Sewerage Projects for 110 Villages

No.	Environmental and Social Elements	Items to be Examined	Methods for Examination
1	Poverty	• Current tariff system • Awareness of beneficiaries	• Literature survey • Interview • Social Condition Survey • Future tariff system for the urban poor
2	Social infrastructure / service	• Traffic volume • Status of underground utilities	• Literature survey • Interview • Construction plan • Relevant clearances for the construction at road areas
3	Landscape	• Appearance of facility buildings	• Surrounding land use • Facility plan of STPs and ISPSs
4	Infectious Diseases (e.g. HIV / AIDS)	• Health program or training at construction	• Construction plan
5	Occupational Health and Safety	• Safety measures at construction and operation stage	• Construction plan • Operation and maintenance plan
6	Air Pollution	• National standards • Surrounding land use • Dust control at construction stage	• Literature survey • Interview • Site reconnaissance
7	Water pollution	• National standards • Control measures for turbid water at construction • Emergency measures for the events of dysfunction operation	• Construction plan • Facility plan • Operation and maintenance method
8	Waste	• Handling, discharge and treatment method of garbage, excavation soil and construction debris • National standards on sludge treatment and disposal	• Literature survey • Construction plan • Sludge treatment and disposal method • Practice in other projects
9	Soil contamination	• Measures for control of leakage of sewage	• Operation and maintenance plan • Emergency response plan
10	Noise / Vibration	• National standards • Surrounding land use • Noise level to be generated by equipment	• Literature survey • Site reconnaissance • Construction plan • Facility plan • Operation and maintenance method

No.	Environmental and Social Elements	Items to be Examined	Methods for Examination
11	Odour	• National standards • Surrounding land use • Control measures for generation of odour	• Literature survey • Site reconnaissance • Construction plan • Facility plan • Operation and maintenance method
12	Accident	• Safety measures at construction and operation stage	• Construction plan • Operation and maintenance method
13	Climate Change	• Electricity consumption • Type of equipment	• Equipment plan of STPs and ISPSs • Carbon emission factor for grid electricity in Karnataka state in India • Operation and maintenance method

Source: JICA Survey Team

14.7 Estimation of Environmental and Social Impacts

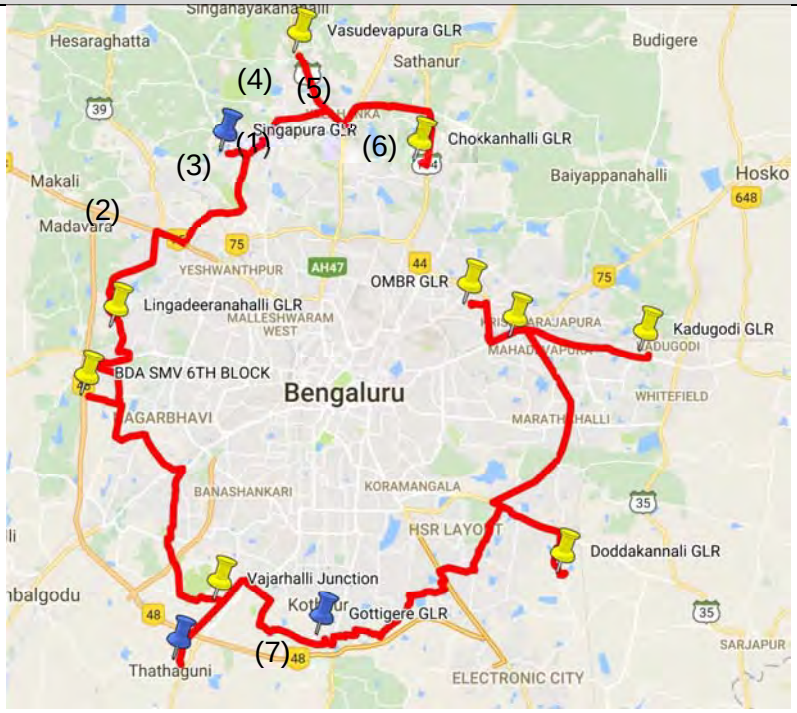
14.7.1 Estimation of Potential Adverse Impacts at IEE Level

(1) Stage V Water Supply Project

The potential impact by the project of Stage V Water Supply project is shown in Table 14.7.1.

Table 14.7.1 Potential Adverse Impacts by Stage V Water Supply Project

No.	Environmental And Social Elements	Potential Adverse Impacts
1	Poverty (At Operation Phase)	At Operation phase: At the operation phase after the construction of the water supply facilities, the water tariff will be increased to recover the future increase of the operation and maintenance cost. According to the social condition survey which was carried out in the study, most of the households (77.5% of the respondents) were ready to pay below 500 INR as a connection fee for piped water supply if BWSSB provides good quality and reliable piped water to their residential area 24 hours a day, while only remaining 22.5 % responded to pay over 500 INR. Therefore, future increase of water tariff may affect the household economy of the urban poor.
2	Social infrastructure / service (At construction phase)	At Construction phase: The construction works of the proposed city trunk mains may affect the traffic of the following roads in the urban BBMP area which have currently heavy traffic; • NH-4 / Tumkur main Road (1) • Subrato Mukerjee Road (2) • Major Sandeep Unnikrishnan Road (3) • Doddaballapur Road (4) • Kogilu Main Road (connected to Chokkanahalli GLR) (5) • Thanisandra Main Road (connected to Chokkanahalli GLR) (6) • Bannerghatta Main Road (7)

No.	Environmental And Social Elements	Potential Adverse Impacts
		
3	Landscape	At Operation phase: The appearance of new facilities of GLRs may affect the city scape of the project sites. However, the height of the proposed GLRs which will be below 10 m will not damage the surround environment.
4	Infectious Diseases (e.g. HIV / AIDS)	At Construction phase: According to National AIDS Control Organization of India, the prevalence of AIDS in India in 2013 was 0.27%, while they estimated that 2.39 Million people live with HIV/AIDS in India in 2008-09, and the British Medical Journal (2010) estimates the population to be between 1.4-1.6 Million people. And also, Karnataka state is one of the states with high HIV prevalence as shown that Manipur (1.40%), Andhra Pradesh (0.90%), Mizoram (0.81%), Nagaland (0.78%), Karnataka (0.63%) and Maharashtra (0.55%). During the construction phase, risk of infectious diseases such as HIV/AIDS infection may increase among construction workers around construction sites.
5	Occupational Health and Safety	At Construction phase: During construction stage, the adverse impacts on construction workers, surrounding residents is estimated. At Operation phase: Handling of chlorine may affect the safety and health risk of the operation and maintenance staffs.
6	Air Pollution	At Construction phase: At the construction phase, dust will be generated by the operation of construction vehicles and construction equipment at construction sites and surrounding areas. Some adverse impact is estimated.
7	Water Pollution	At Construction phase: The groundwater table at the project site is low. Therefore, turbid water will not be generated. This impact is estimated be little.

No.	Environmental And Social Elements	Potential Adverse Impacts
		At Operation phase: At operation stage, some impact on water pollution due to the malfunction or dysfunction of the WTP process or defect of the maintenance works is estimated.
8	Waste	At Construction phase: The excavation works or demolition works at the proposed raw water main, WTP, pump stations, Clearwater main, GLRs and city trunk main will generate excavated soil and demolition waste by the construction works. And also, domestic garbage will be generated at the construction camps. The impact due to treatment and the final disposal of such waste is estimated. At Operation phase: Sludge will be generated by the WTP process. Some impact is estimated relating to the disposal of the sludge.
9	Noise / Vibration	At Construction phase: Some residential areas are close to the proposed project sites, especially for the following facilities; • Gottigere GLR • Singapura GLR • Lingaderanahalli GLR Some impact of noise on the surrounding residential area by the construction works. At Operation phase: All the GLRs will supply the clear water by gravity and they will not install pumping units. However, the following facilities will equip pumping equipment. • TK Halli WTP • Harohalli Pumping Station • Tataguni Pumping Station Some impact of noise on the surrounding residential area by the operation of pump units.
10	Accident	At Construction phase: The increase of vehicles for the construction works may cause traffic congestions on the local road network, and increase the risk of traffic accidents around the construction sites. A part of roads around the project sites may be temporarily blocked and cause traffic congestion at some sections. Traffic may be encroached due to the arrangement of the works such as scaffold, material yard and operation of construction equipment. The vehicles carrying the materials, wastes to and from the construction area may drop spoil or soil on the road surface which cause slippery condition and increases the risk of unsafe traffic. At Operation phase: Handling of chlorine and other operation and maintenance works may cause the safety and health risk of the operation and maintenance staffs.

No.	Environmental And Social Elements	Potential Adverse Impacts
11	Climate Change	At Operation phase: The following electricity will be generated at minimum at each facilities; • WTP: 78,037 kwh/day • Pump station at TK Halli: 335,422 kwh/day for 11 KV + 924 kwh/day for 415 V = 336,346 kwh/day • Pump station at Harohalli: 392,185 kwh/day for 11 KV + 916 kwh/day for 415 V = 393,101 kwh/day • Pump station at Tataguni: 387,025 kwh/day for 11 KV + 935 kwh/day for 415 V = 387,960 kwh/day • City Reservoir: 329 kwh/day Total 1,195,773 kwh/day (= 436,457 MWh/year) The estimated GHGs generation amount as converted CO_2 is as below; 0.99 tCO_2e/Mwh* x 436,457 Mwh/year = 432,092 tCO_2e/year Therefore, 432,092 ton GHGs amount converted as CO_2 equivalent is estimated as an impact level of global warming due to GHGs emission by the project. Note*: "CO_2 Baseline Database for the Indian Power Sector, User Guide Version 10.0, December 2014", Central Electricity Authority, India

Source: JICA Survey Team

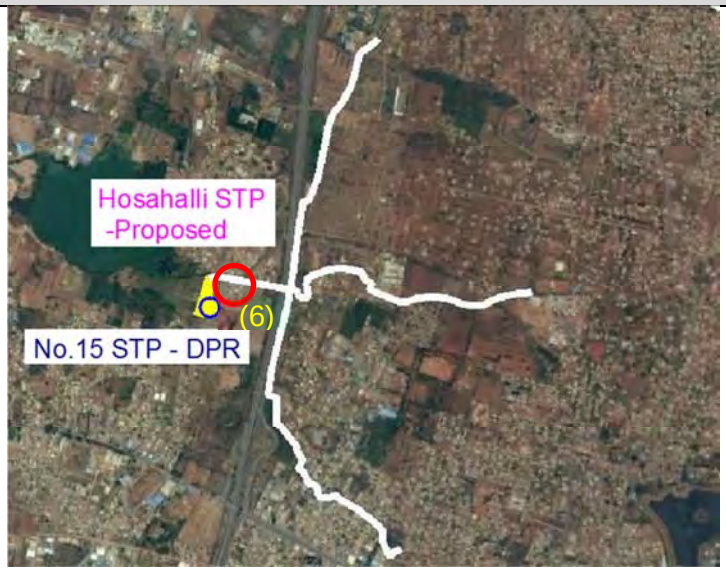
(2) Sewerage Project for 110 Villages

The potential adverse impact by the sewerage project for the 110 Villages is shown in Table 14.7.2.

Table 14.7.2 Potential Adverse Impacts by Sewerage Project for 110 Villages

No.	Environmental and Social Elements	Potential Adverse Impacts
1	Poverty (At Operation Phase)	At Operation phase: At the operation phase after the construction of the sewerage facilities, the sewage tariff will be increased to recover the future increase of the operation and maintenance cost. According to the social condition survey which was carried out in the study, the majority of the samples (78% of the respondents) were ready to pay the sewerage fee below 300 INR, while their remaining were willing to pay over 300 INR for the sewerage service. Therefore, future increase of sewage tariff may affect the household economy of the urban poor.

No.	Environmental and Social Elements	Potential Adverse Impacts
2	Social infrastructure / service (At construction phase)	At Construction phase: Impacts on existing infrastructures of roads and railways are estimated especially at the following project sites which are close to such infrastructures; • Main sewer between Jakkur ISPS and Yelahnkakere STP: Crossing (1) Bengaluru – Hyderabad Highway, crossing (2) existing railway line and construction on(3)Doddallapura road which has currently has heavy traffic • Main sewer between Nagthanapura STP and Chika Togur Lake: Crossing (4) NH-7 (National Highway -7) and (5) NICE Ring Road • Main sewer to Hosahlli STP: Crossing (6) NICE Ring Road  Main Sewer from Jakkur ISPS to Yelahankakere STP  Main Sewer between Nagthanapura STP and Chika Togur Lake

No.	Environmental and Social Elements	Potential Adverse Impacts
		 Main Sewer to Hosahalli STP
3	Landscape	At Operation phase: The appearance of new facilities of STPs may affect the city scape of the project sites. However, the height of the proposed STPs which will be below 10 m may affect not damage the existing landscape.
4	Infectious Diseases (e.g. HIV / AIDS)	At Construction phase: As same as the case for the Stage V Water Supply project, during the construction phase, risk of HIV/AIDS infection may increase among construction workers around construction sites.
5	Occupational Health and Safety	At Construction phase: During construction stage, the adverse impacts on construction workers, surrounding residents is estimated. At Operation phase: The sewers may generate hazardous gas H_2S (Hydrogen Sulfide) and CH_4 (Methane) at the maintenance works. In addition, the operation works of STPs will have to handle the hazardous gas of CH4 and Chlorine gas. These O and M works may cause adverse impact on occupational health and safety.
6	Air Pollution	At Construction phase: At the construction phase, dust will be generated by the operation of construction vehicles and construction equipment at construction sites and surrounding areas. Some adverse impact is estimated.
7	Water Pollution	At Construction phase: At construction sites, turbid water is estimated by the excavation and construction works at especially monsoon seasons. Some impact is estimated by the generation of the turbid water. At Operation phase: At operation stage, some impact on water pollution due to the malfunction or dysfunction of the STP process or defect of the maintenance works is estimated.
8	Waste	At Construction phase: The excavation works or demolition works at the proposed sewer main, STPs and ISPSs will generate excavated soil and demolition waste by the construction works. And also, domestic

No.	Environmental and Social Elements	Potential Adverse Impacts
		garbage will be generated at the construction camps. The impact due to treatment and the final disposal of such waste is estimated. At Operation phase: Screen residues and sludge will be generated by the STP process. Some impact is estimated relating to the disposal of the sludge.
9	Soil Contamination	At Operation phase: Potential leakage of the sewage at the main sewer may cause a risk of soil contamination of the surrounding ground at the operation and the maintenance stage.
10	Noise / Vibration	At Construction phase: Some residential areas are close to the proposed project sites, especially for the following facilities; • Herohhali STP • Hosahalli STP • Doddabettahalli STP • Chikkabanavara STP Some impact of noise on the surrounding residential area by the construction works. At Operation phase: Currently, BWSSB has not received any complaints of noise from surrounding residents. However, pumping unit, blower, emergency generator and dewatering centrifuge will be source of generating noise at the STPs and ISPSs especially on the following sites which are close to residential area. • Herohhali STP • Hosahalli STP • Doddabettahalli STP • Chikkabanavara -2 STP Some impact of noise by the operation of these equipment may affect the surrounding residential area by the operation of pump units.
11	Odour	At Operation phase: Odour may be generated at the sludge treatment at the proposed STPs or due to dysfunction of the operation of STPs. Some impact of odour on surrounding areas is estimated.
12	Accident	At Construction phase: The increase of vehicles for the construction works may cause traffic congestions on the local road network, and increase the risk of traffic accidents around the construction sites. A part of roads around the project sites may be temporarily blocked and cause traffic congestion at some sections. Traffic may be encroached due to the arrangement of the works such as scaffold, material yard and operation of construction equipment. The vehicles carrying the materials, wastes to and from the construction area may drop spoil or soil on the road surface which cause slippery condition and increases the risk of unsafe traffic. At Operation phase: The sewers may generate hazardous gas H_2S (Hydrogen Sulfide) and CH_4 (Methane) at the maintenance works. In addition, the operation works of STPs will have to handle the hazardous gas of CH4 and Chlorine gas. These O and M works may cause adverse impact on occupational health and safety.

No.	Environmental and Social Elements	Potential Adverse Impacts
13	Climate Change	At Operation phase: 1) GHGs Emission due to Power Consumption The following electricity will be generated at minimum by the operation of equipment at each STP and ISPS; STP • Jakkur : 5,329 kwh/day • Yelahankakere : 4,608 kwh/day • Doddabettahalli : 5,329 kwh/day • Bilishivalli : 13,145 kwh/day • Varthur : 10,689 kwh/day • Pillaganahalli : 3,166 kwh/day • Talaghattapura : 3,887 kwh/day • Somapura : 6,050 kwh/day • Hemigepura : 4,608 kwh/day • Nagasandra : 6,771 kwh/day • Karivobanahalli : 7,492 kwh/day • Herohalli : 2,444 kwh/day • Hosahalli: : 4,608 kwh/day • Chikkabanavara-2 : 3,166 kwh/day Total 81,292 kwh/day (= 29,672 Mwh/year) • Jakkur: The estimated GHGs generation amount as converted CO_2 is as below; 0.99 tCO_2e/Mwh* x 29,672 Mwh/year = 29,375 tCO_2e/year 29,375 ton GHGs amount converted as CO_2 equivalent is estimated per year. Therefore, 29,375 ton GHGs amount converted as CO_2 equivalent is estimated as an impact level of global warming due to GHGs emission by the project. Note*: "CO_2 Baseline Database for the Indian Power Sector, User Guide Version 10.0, December 2014", Central Electricity Authority, India ISPS Herohalli ISPS : 41 kwh/day Bellahalli ISPS : 150 kwh/day Arehalli ISPS : 132 kwh/day Hemigepura ISPS : 184 kwh/day Daddabidarakallu ISPS : 1,262 kwh/day Naganathapuray : 1,481 kwh/day Hagadur ISPS : 1,721 kwh/day Total 4,971 kwh/day (= 1,814 MWh/year) The estimated GHGs generated as converted CO_2 is as below; 0.99 tCO_2e/MWH x 1,814 MWh/year = 1,796 tCO_2e/year Therefore, 31,171 ton GHGs amount converted as CO_2 equivalent is estimated per year due to power consumption. 2) GHGs Emission due to generation of sludge At Treatment process Total generation of sludge in dry base: 279.98 m^3/day CH_4 generation: 0.00088 t-CH_4*/10^3m^3 x 279.98 m^3/day = 0.0899 t-CH_4/year CH_4 converted to CO_2: 25 x 0.0899 tCO_2e/year = 2.25 tCO_2e/year N_2O generation: 0.00016 t-N_2O*/10^3m^3 x 279.98 m^3/day = 0.0164 t-N_2O/year N_2O converted to CO_2: 298 x 0.0164 tCO_2e/year = 4.9 tCO_2e/year

No.	Environmental and Social Elements	Potential Adverse Impacts
		Therefore, total of GHGs amount of 7.2 tCO_2e/year is estimated at the treatment process. Notes*: Ministry of Land, Infrastructure, Transport and Tourism, Government of Japan At Disposal of treated sludge The treated sludge is finally filled as a soil conditioner. 0.0667 t- CH_4/ds-t is assumed as the emission factor for filling of sludge in semi-aerobic state.** 0.0667 x 279.98 m^3/day x 0.8 t/m^3 = 14.9 t-CH_4/day (= 5,438.5 t-CH_4/year) CH_4 converted to CO_2: 25 x 5,438.5 tCO_2e/year = 135,962.5 tCO_2e/year Total of GHGs due to sludge treatment and disposal Therefore, total of GHGs amount of tCO_2e/year is estimated by the final disposal. Total generation of GHGs due to sludge The total amount of GHGs as converted to CO_2 equivalent amount is estimated as 170,969.7 tCO_2e/year due to sludge. 3) Total generation of GHGs Total generation of GHGs is estimated as 165,345 t- tCO_2e/year Notes; **: Ministry of Land, Infrastructure, Transport and Tourism, Government of Japan

Source: JICA Survey Team

(3) Projects to be Implemented by Local Fund

The potential adverse environmental and social impacts are described in the Supporting report.

14.7.2 Summary of Assessment Results at Scoping and IEE Examination

(1) Stage V Water Supply Project

The comparison of the assessment on the impacts at the scoping and IEE is shown in Table 14.7.3.

Table 14.7.3 Comparison Table of Assessment at Scoping and IEE

Type	No.	Element to be Assessed	Rating at Scoping		Rating at IEE		Reasons for Assessment
			Const.	O&M	Const.	O&M	
Natural Environment	1	Protected Area	D	D	N/A	N/A	The project site and surrounding area is not located in any national parks or nature reserves.
	2	Ecosystem	D	D	N/A	N/A	Most of the project sites are located in the existing BWSSB's facility areas or the urban built-up area.
	3	Hydrology	D	D	N/A	N/A	At Construction phase: The construction works of the water pipe bridge is not large scaled and it will not affect the change of the river flow or river bed. At Operation phase: The downstream water use and maintenance flow has already been secured for Cauvery river.

Type	No.	Element to be Assessed	Rating at Scoping		Rating at IEE		Reasons for Assessment
			Const.	O&M	Const.	O&M	
	4	Topography / Geology	D	D	N/A	N/A	The project does not include large scaled excavation works.
Social Environment	5	Resettlement / Land Issue	D	D	N/A	N/A	The project sites does not include residential area nor compensation problems since the project sites to be acquired are all public land.
	6	Poverty	D	B-	N/A	B-	At Operation phase: The future increase of water tariff may affect the household economy of the urban poor.
	7	Ethic Minority	D	D	N/A	N/A	There are no ethnic minorities nor indigenous people at the project sites.
	8	Employment, sustenance and regional economy	B+	D	N/A	N/A	An opportunity for employment of local residents is expected by the construction works and may contribute to local economy.
	9	Land Use / Regional Resource	D	D	N/A	N/A	The project sites at the BWSSB's facility areas, public road areas and the vacant area in the built-up area will not affect the local land use nor regional resources.
	10	Water Use	D	D	N/A	N/A	The downstream water use and maintenance flow in Cauvery river will be secured.
	11	Social Infrastructure / Service	B-	D	B-	N/A	The construction works of the main sewers at public road areas may affect the traffic flow and existing underground utilities.
	12	Local society for decision making	D	D	N/A	N/A	The project is to implement a public works by the government which aim to bring public benefit and will not affect local society.
	13	Unbalance of damages and benefits	D	D	N/A	N/A	The project is to develop water supply facilities of safe water to the 110 Villages which are currently not served by BWSSB's water service and not bring unbalance damage and benefit.
	14	Local Conflicts of Interests	D	D	N/A	N/A	The project does not supply water to specific people or structure, and it will not cause local conflicts.
	15	Heritage or Cultural Assets	D	D	N/A	N/A	The project sites do not encompass such historical or cultural assets.
	16	Landscap	D	B-	N/A	D	The height of the proposed GLRs which will be

Type	No.	Element to be Assessed	Rating at Scoping		Rating at IEE		Reasons for Assessment
			Const.	O&M	Const.	O&M	
		e					below 10 m will not damage the surround environment.
	17	Gender	D	D	N/A	N/A	Currently, there is no distinguishing practice that the housewives take water from existing water source.
	18	Right of Children	D	D	N/A	N/A	The project is not related to the issue of right of children. Child labor will be prohibited for implementation of the project by compliance with national laws or international guidelines.
	19	Infectious Diseases (e.g. HIV / AIDS)	B-	D	B-	N/A	During the construction phase, risk of HIV/AIDS infection may increase among construction workers around construction sites.
	20	Occupational Health and Safety	B-	B-	B-	B-	At Construction phase: During construction stage, the adverse impacts on construction workers, surrounding residents is estimated. At Operation phase: Handling of chlorine may affect the safety and health risk of the operation and maintenance staffs.
Pollution	21	Air Pollution	B-	D	B-	N/A	At Construction phase: At the construction phase, dust will be generated by the operation of construction vehicles and construction equipment at construction sites and surrounding areas. Some adverse impact is estimated.
	22	Water Pollution	B-	B-	D	B-	At Construction phase: The groundwater table at the project site is low. Therefore, turbid water will not be generated. This impact is estimated be little. At Operation phase: At operation stage, some impact on water pollution due to the malfunction or dysfunction of the WTP process or defect of the maintenance works is estimated.
	23	Waste	B-	B-	B-	B-	At Construction phase: The excavation works or demolition works will generate excavated soil and demolition waste by the construction works. At Operation phase: Sludge will be generated by the WTP process. Some impact is estimated relating to the disposal of the sludge.
	24	Soil Contami	D	D	N/A	N/A	The hazardous matter causing soil contamination will not be generated.

Type	No.	Element to be Assessed	Rating at Scoping		Rating at IEE		Reasons for Assessment
			Const.	O&M	Const.	O&M	
		nation					
	25	Noise / Vibration	B-	B-	B-	B-	At Construction phase: Some impact of noise on the surrounding residential area by the construction works at GLRs is estimated. At Operation phase: Some impact of noise on the surrounding residential area by the operation of pump units is estimated at the WTPs and pumping stations.
	26	Ground Subsidence	D	D	N/A	N/A	The project does not extract groundwater.
	27	Odour	D	D	N/A	N/A	The project does not include the activities which generates odour.
	28	Sediments	D	D	N/A	N/A	The scale of the pipe support bridges is not large and will not affect the sediments of the river bed.
Others	29	Accident	B-	B-	B-	B-	At Construction phase: The increase of vehicles for the construction works may cause the risk of traffic accidents around the construction sites. At Operation phase: Handling of chlorine and other operation and maintenance works may cause the safety and health risk.
	30	Climate Change	D	B-	N/A	B-	432,092 ton GHGs amount converted as CO_2 equivalent is estimated per year by the electricity consumption at WTP and pump stations.

Source: JICA Survey Team

Notes: A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
D: No impact is expected.
N/A: Not Applicable

(2) Sewerage Project for 110 Villages

The comparison of the assessment on the impacts at the scoping and IEE is shown in Table 14.7.4.

Table 14.7.4 Comparison Table of Assessment at Scoping and IEE

Type	No.	Element to be Assessed	Rating at Scoping		Rating at IEE		Reasons for Assessment
			Const.	O&M	Const.	O&M	
Natural Environment	1	Protected Area	D	D	N/A	N/A	The project site and surrounding area is not located in any national parks or nature reserves.
	2	Ecosystem	D	D	N/A	N/A	Most of the project sites are planned at built-up area.
	3	Hydrology	D	D	N/A	N/A	At Construction stage: The construction works of the water pipe bridge is not large scaled and it will not affect the change of the river flow or river bed. At Operation stage: The downstream water use and maintenance flow has already been secured for Cauvery river.
	4	Topography / Geology	D	D	N/A	N/A	The project does not include large-scaled excavation works.
Social Environment	5	Resettlement / Land Issue	D	D	N/A	N/A	The project sites does not include residential area nor compensation problems since the project sites to be acquired are all public land, not private land.
	6	Poverty	D	B-	N/A	B-	At Operation phase: Future increase of sewage tariff may affect the household economy of the urban poor.
	7	Ethic Minority	D	D	N/A	N/A	There are no ethnic minorities nor indigenous people at the project sites.
	8	Employment, sustenance and regional economy	B+	D	N/A	N/A	An opportunity for employment of local residents is expected by the construction works and may contribute to local economy.
	9	Land Use / Regional Resource	D	D	N/A	N/A	The project sites are the vacant areas in the built-up area and the public road.
	10	Water Use	D	D	N/A	N/A	The project does not relates to water use.
	11	Social Infrastructure / Service	B-	D	B-	N/A	The construction works of the water pipelines at road areas and GLRs may affect the traffic flow and existing underground utilities.
	12	Local society for	D	D	N/A	N/A	The project is to implement a public works by the government which aim to bring public

Type	No.	Element to be Assessed	Rating at Scoping		Rating at IEE		Reasons for Assessment
			Const.	O&M	Const.	O&M	
		decision making					benefit and will not affect local society.
	13	Unbalance of damages and benefits	D	D	N/A	N/A	The project is to develop water supply facilities of safe water to the 110 Villages which are currently not served by BWSSB's water service and not bring unbalance damage and benefit.
	14	Local Conflicts of Interests	D	D	N/A	N/A	The project does not supply water to specific people or structure, and it will not bring local conflicts.
	15	Heritage or Cultural Assets	D	D	N/A	N/A	The project sites do not encompass such historical or cultural assets.
	16	Landscape	D	B-	N/A	D	The height of the proposed STPs which will be below 10 m may affect not damage the existing landscape.
	17	Gender	D	D	N/A	N/A	The project is not related to gender issue.
	18	Right of Children	D	D	N/A	N/A	Child labor will be prohibited for the implementation of the project.
	19	Infectious Diseases (e.g. HIV / AIDS)	B-	D	B-	N/A	At Construction phase: A risk of HIV/AIDS infection may increase among construction workers around construction sites.
	20	Occupational Health and Safety	B-	B-	B-	B-	At Construction phase: Adverse impacts on construction workers, surrounding residents is estimated. At Operation phase: Potential generation of hazardous gas H_2S and CH_4 may cause adverse impact on occupational health and safety.
Pollution	21	Air Pollution	B-	D	B-	N/A	At Construction phase: Dust will be generated by the operation of construction vehicles and construction equipment at construction sites and surrounding areas.
	22	Water Pollution	B-	B-	D	B-	At Construction phase: The groundwater table at the project site is low. Therefore, turbid water will not be generated. This impact is estimated be little. At Operation phase: Some impact on water pollution due to the malfunction or dysfunction of the STP process or defect of the maintenance works is estimated.
	23	Waste	B-	B-	B-	B-	At Construction phase:

Type	No.	Element to be Assessed	Rating at Scoping		Rating at IEE		Reasons for Assessment
			Const.	O&M	Const.	O&M	
							The excavation works or demolition works at the proposed sewer main, STPs and ISPSs will generate excavated soil and demolition waste by the construction works. At Operation phase: Screen residues and sludge will be generated by the STP process. Some impact is estimated.
	24	Soil Contamination	D	B-	N/A	B-	At Operation phase: Potential leakage of the sewage at the main sewer may cause a risk of soil contamination of the surrounding ground.
	25	Noise / Vibration	B-	B-	B-	B-	At Construction phase: Some impact of noise on the surrounding residential area by the construction works at the areas close to residential areas. At Operation phase: Some impact of noise by the operation of these equipment may affect the surrounding residential area by the operation of pump units.
	26	Ground Subsidence	D	D	N/A	N/A	The project does not extract groundwater.
	27	Odour	D	B-	N/A	B-	At Operation phase: Odour may be generated at the sludge treatment at the proposed STPs.
	28	Sediments	D	D	N/A	N/A	
Others	29	Accident	B-	B-	B-	B-	At Construction phase: The increase of vehicles for the construction works may increase the risk of traffic accidents around the construction sites. At Operation phase: The sewers may generate hazardous gas H_2S (Hydrogen Sulfide) and CH_4(Methane) at the maintenance works. In addition, the operation works of STPs will have to handle the hazardous gas of CH_4 and Chlorine gas.
	30	Climate Change	D	B-	N/A	B-	At Operation phase: 165,345 ton GHGs amount converted as CO_2 equivalent is estimated per year by the consumption of electricity.

Notes:
A+/-: Significant positive/negative impact is expected.
B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
D: No impact is expected
Source: JICA Survey Team

14.8 Recommended Mitigation Measures

14.8.1 Stage V Water Supply Project

Recommended mitigation measures on the potential adverse impacts are shown in Table 14.8.1.

Table 14.8.1 Mitigation Measures for Potential Adverse Impacts

At Construction Phase

No.	Elements	Proposed Mitigation Measures	Actor for Mitigation Measures	Regulatory authority	Budget / Cost
1	Social Infrastructure / Service	• Prior notice to traffic police before the construction works • Placement of traffic guides at each end of construction sections for smooth inducement of traffic • Careful examination of construction schedule • Setting detouring route if necessary. • Sufficient information disclosure such as construction period or work section to media such as television, radio, newspapers, etc. as well as utilization of internet media • Socialization activity to local residents including distribution of leaflet or announcement letters, or holding meetings if required • Implementation of underground utility survey for existing water pipes, power lines, telephone lines and gas pipes not to cause damage on these utilities • Adoption of trenchless method at crossing points of roads with heavy traffic • Incorporation of mitigation measures including indemnification into bidding and contract documents	Contractor	KPCB/BWSSB/Consultant	Project Cost
2	Infectious Diseases (e.g. HIV / AIDS)	• Preparation of appropriate working health plan • Training of construction workers • Incorporation of above measures into bidding and contract documents	Contractor	NACO/KSAPS/BWSSB/Consultant	Project Cost
3	Occupational Health and Safety	• Preparation of construction plan • Training of construction workers • Protection equipment (PPE) such as hard hats, earpiece, safety shoes, and others; • Conduct explanation meetings on safety issues for local communities • Install warning signs whereas the	Contractor	BWSSB/Consultant	Project Cost

No.	Elements	Proposed Mitigation Measures	Actor for Mitigation Measures	Regulatory authority	Budget / Cost
		potential dangers are expected • Erect temporary fence around high risk areas to control public access and light them at night if that is on the regular roads used by the locals; • Assign construction staffs on or near places where construction vehicles are crowded to ensure safety • Incorporation of above measures into bidding and contract documents			
4	Air Pollution	• Preparation of construction plan for control dust • Training of construction workers • Provide construction workers with sufficient personal • Examination of Contractor's construction plan • Monitoring of Contractor's dust control • Incorporation of above measures into bidding and contract documents	Contractor	KPCB/BWSSB/Consultant	Project Cost
5	Waste	• Preparation of construction plan for excavated soil and demolition waste • Examination of Contractor's construction plan • Monitoring of Contractor's management of excavated soil, construction debris • Incorporation of above measures into bidding and contract documents	Contractor	KPCB/BWSSB/Consultant	Project Cost
6	Noise / Vibration	• Utilization of low-noise type construction machineries if applicable. • Temporary enclosure of the site during the construction works if necessary • Instructing the contractors to examine low noise/vibration construction methods • Encouragement of idling reduction to the workers • To avoid works at night and early morning at the sites close to residential areas, schools and hospitals • Monitoring of noise level at facility boundaries • Incorporation of above measures into bidding and contract documents	Contractor	KPCB/BWSSB/Consultant	Project Cost

No.	Elements	Proposed Mitigation Measures	Actor for Mitigation Measures	Regulatory authority	Budget / Cost
7	Accident	• Preparation of appropriate construction vehicle operation plan to avoid concentration of machinery and vehicles in limited roads • Allotment of traffic guide for proper control of traffic in order to minimize disruption to traffic flows • The construction site should be enclosed with temporary fence to provide a visual barrier between the construction site and adjacent traffic • Contractor's advance notification to communities in case of blocking traffic for transport of heavy equipment the contractor • Incorporation of above measures into bidding and contract documents • Environmental monitoring	Project Cost / Contract Amount	Police/BWSSB/Consultant	Project Cost

At Operation Phase

No.	Elements	Proposed Mitigation Measures	Actor for Mitigation Measures	Regulatory authority	Budget / Cost
1	Poverty	• Establishment of appropriate tariff collection system for urban poor • Implementation of public awareness survey	BWSSB	GOK/BWSSB/ Consultant	O&M Cost
2	Occupational Health and Safety	• Facility design for prevention of leakage of chlorine gas at detail design • Preparation of appropriate O&M manual for handling of chlorine gas • Preparation of emergency safety plan • Incorporation of above measures into bidding and contract documents	Contractor	KPCB/BWSSB/ Consultant	O&M Cost
3	Water Pollution	• Facility design for water treatment • Preparation of appropriate O&M manual for WTP and GLRs • Regular monitoring of water quality at WTP and GLRs • Incorporation of above measures into bidding and contract documents	Contractor	KPCB/BWSSB/ Consultant	O&M Cost
4	Waste	• Facility design for sludge treatment • Preparation of appropriate O&M manual for STPs • Preparation of manifest system of treatment, transport and disposal of	Contractor	KPCB/BWSSB/ Consultant	O&M Cost

No.	Elements	Proposed Mitigation Measures	Actor for Mitigation Measures	Regulatory authority	Budget / Cost
4		sludge • Monitoring of sludge treatment and disposal • Incorporation of above measures into bidding and contract documents			
5	Noise / Vibration	• Equipment layout / configuration plan at detail design • Monitoring of noise at facility boundary at WTP and pump stations • Installation of sound proof wall if necessary • Incorporation of above measures into bidding and contract documents	Contractor	KPCB/BWSSB/ Consultant	O&M Cost
6	Accident	• Facility design for prevention of leakage of chlorine gas at detail design • Preparation of appropriate O and M manual for handling of chlorine gas • Preparation of emergency safety plan • Environmental monitoring • Incorporation of above measures into bidding and contract documents • Environmental monitoring	Contractor	Police/BWSSB/ Consultant	O&M Cost
7	Climate Change	• Facility design for pump units and motor with high efficiency to consume electricity efficiently • Decision of the diameter of pipelines by taking electricity consumption into account • Regular maintenance • Incorporation of above measures into bidding and contract documents	Contractor	KPCB/BWSSB/ Consultant	O&M Cost

Source: JICA Survey Team

14.8.2 Sewerage Project for 110 Villages

The recommended mitigation measures on the potential adverse impacts are shown in Table 14.8.2.

Table 14.8.2 Mitigation Measures for Potential Adverse Impacts

At Construction Phase

No.	Impacts	Proposed Mitigation Measures	Actor for Mitigation Measures	Regulatory Authority	Budget / Cost
1	Social Infrastructure / Service	• Prior notice to traffic police before the construction works • Placement of traffic guides at each end of construction sections for smooth	Contractor	KPCB/Police/BWSSB/Consultant	Project Cost

No.	Impacts	Proposed Mitigation Measures	Actor for Mitigation Measures	Regulatory Authority	Budget / Cost
		inducement of traffic • Careful examination of Contractor's construction plan and schedule • Setting detouring route if necessary • Sufficient information disclosure such as construction period or work section to media such as television, radio, newspapers, etc. as well as utilization of internet media • Socialization activity to local residents including distribution of leaflet or announcement letters, or holding meetings if required • Implementation of underground utility survey for existing water pipes, power lines, telephone lines and gas pipes not to cause damage on these utilities • Adoption of trenchless method at crossing points of roads with heavy traffic • Incorporation of above measures including indemnification into bidding and contract documents			
2	Infectious Diseases (e.g. HIV / AIDS)	• Preparation of appropriate working health plan • Training of working health for construction workers • Incorporation of above measures into bidding and contract documents	Contractor	NACO/KSAPS /BWSSB/Consultant	Project Cost
3	Occupational Health and Safety	• Preparation of construction plan • Training of construction workers • Provide construction workers with sufficient personal • Protection equipment such as hard hats, earpiece, safety shoes, and others; • Conduct explanation meetings on safety issues for local communities • Install warning signs whereas the potential dangers are expected • Erect temporary fence around high risk areas to control public access and light them at night if that is on the regular roads used by the locals; • Assign construction staffs on or near places where construction vehicles are crowded to ensure safety • Incorporation of above measures into bidding and contract documents	Contractor	KPCB/BWSSB/ Consultant	Project Cost
4	Air Pollution	• Preparation of construction plan for control dust	Contractor	KPCB/BWSSB/ Consultant	Project Cost

No.	Impacts	Proposed Mitigation Measures	Actor for Mitigation Measures	Regulatory Authority	Budget / Cost
4		• Examination of Contractor's construction plan especially on dust control • Monitoring of Contractor's dust control • Incorporation of above measures into bidding and contract documents			
5	Waste	• Preparation of construction plan for excavated soil and demolition waste • Examination of Contractor's construction plan • Monitoring of Contractor's management of excavated soil, construction debris • Incorporation of above measures into bidding and contract documents	Contractor	KPCB/BWSSB/ Consultant	Project Cost
6	Noise / Vibration	• Utilization of low-noise type construction machineries if applicable • Temporary enclosure of the site during the construction works if necessary • Instructing the contractors to examine low noise/vibration construction methods • Encouragement of idling reduction to the workers • To avoid works at night and early morning at the sites close to residential areas, schools and hospitals • Monitoring of noise level at facility boundaries • Incorporation of above measures into bidding and contract documents	Contractor	KPCB/BWSSB/ Consultant	Project Cost
7	Accident	• Preparation of appropriate construction vehicle operation plan to avoid concentration of machinery and vehicles in limited roads • Allotment of traffic guide for proper control of traffic in order to minimize disruption to traffic flows • The construction site should be enclosed with temporary fence to provide a visual barrier between the construction site and adjacent traffic • Contractor's advance notification to communities in case of blocking traffic for transport of heavy equipment the contractor • Incorporation of above measures into bidding and contract documents • Environmental monitoring	Contractor	Police/BWSSB/ Consultant	Project Cost

Source: JICA Survey Team

At Operation Phase

No.	Impacts	Proposed Mitigation Measures	Actor for Mitigation Measures	Regulatory authority	Budget/Cost
1	Poverty	• Establishment of appropriate tariff collection system for urban poor • Implementation of public awareness survey	BWSSB	GOK	O&M Cost
2	Occupational Health and Safety	• Facility design for prevention of leakage of chlorine gas at detail design • Preparation of appropriate O &M manual for handling of chlorine gas • Preparation of emergency safety plan • Incorporation of above measures into bidding and contract documents	Contractor	KPCB / BWSSB / Consultant	O&M Cost
3	Water Pollution	• Facility design for sewage treatment • Preparation of appropriate O &M manual for STPs • Regular monitoring of water quality at STPs and surrounding water bodies • Incorporation of above measures into bidding and contract documents	Contractor	KPCB / BWSSB / Consultant	O&M Cost
4	Waste	• Preparation of manifest system of sludge for treatment, transport and final disposal • Agreement among relevant authorities such as BWSSB, contractors and farmers • Monitoring of manifest of generation, transport and disposal of treated sludge • Incorporation of above measures into bidding and contract documents	Contractor	KPCB / BWSSB / Consultant	O&M Cost
5	Soil Contamination	• Preparation of appropriate maintenance plan of the facilities for prevention of damage • Early detection of occurrence of leakage of sewage at main sewers • Visual and odor inspection as regular maintenance • Quick response to the local residents' information relating to occurrence of odor and detection of leakage of sewage	BWSSB	KPCB / Consultant	O&M Cost

No.	Impacts	Proposed Mitigation Measures	Actor for Mitigation Measures	Regulatory authority	Budget/Cost
6	Noise / Vibration	• Equipment layout/configuration plan at detail design • Facility design on the materials with high sound absorption and insulation effects • Monitoring of noise level at the facility boundaries of the STPs and IPSs • Installation of sound proof wall if necessary • Incorporation of above measures into bidding and contract documents	Contractor	KPCB / BWSSB / Consultant	O&M Cost
7	Odour	• Facility design for reduction of odour generation • Monitoring of odor level at the facility boundaries of the STP sites • Establishment of handling complaints of the residents and quick response to take measures • Incorporation of above measures into bidding and contract documents	Contractor	KPCB / BWSSB / Consultant	O&M Cost
8	Accident	• Preparation of appropriate construction vehicle operation plan to avoid concentration of machinery and vehicles in limited roads • Allotment of traffic guide for proper control of traffic in order to minimize disruption to traffic flows • The construction site should be enclosed with temporary fence to provide a visual barrier between the construction site and adjacent traffic • Contractor's advance notification to communities in case of blocking traffic for transport of heavy equipment the contractor • Incorporation of above measures into bidding and contract documents • Environmental monitoring	BWSSB/Contractor	Police/BWSSB/ Consultant	O&M Cost
9	Climate Change	• Facility design of pump units and blower with high efficiency, inverter type air blower • Optimum operation of pump in accordance with process flow rate	Contractor	KPCB / BWSSB / Consultant	O&M Cost

No.	Impacts	Proposed Mitigation Measures	Actor for Mitigation Measures	Regulatory authority	Budget/Cost
		• Recovery of GHGs in treatment process in STPs through installing a biogas power generation or an incineration to reduce the generation of GHGs in disposal sites of treated sludge • Incorporation of above measures into bidding and contract documents			

Source: JICA Survey Team

14.8.3 Projects to be Implemented by Local Fund

The recommended mitigation measures are included in the Supporting Report.

14.9 Environmental Monitoring Plan

14.9.1 Implementing Structure on Environmental Monitoring

The implementation structure for the environmental monitoring is shown in Figure 14.9.1. The main actor of the environmental monitoring will be each contractor which should undertake each project component of water supply and sewerage scheme at the project phase of construction and operation (In BWSSB's previous projects, the contractor for construction works has undertaken its operation and maintenance activities in the contract years). The consultant and BWSSB will inspect and supervise the contractors' mitigation measures.

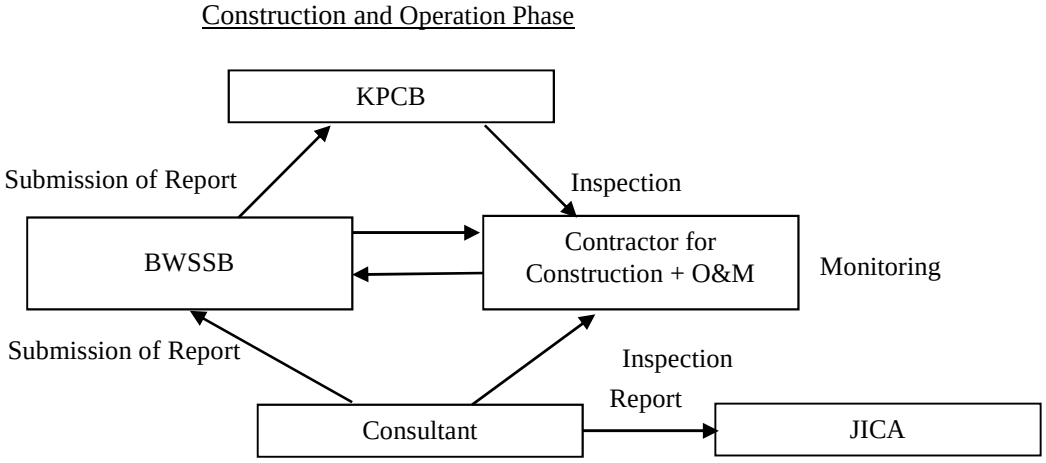


Figure 14.9.1 Monitoring Structure for Environmental Monitoring

14.9.2 Environmental Monitoring Plan

(1) Stage V Water Supply Project

The proposed environmental monitoring plan is shown in Table 14.9.1.

Table 14.9.1 Environmental Monitoring Plan

Construction Phase

No.	Item	Proposed Location	Parameters	Method	Frequency	Implementing Agency
1	Air Pollution	Facility boundaries at construction sites	Dust	Visual inspection	Monthly	Contractor
2	Waste	• Construction sites for excavation works • Construction sites for Backfill • Final disposal site of construction debris	• Type of construction debris • Amount of construction debris • Amount of excavated soil	• Visual inspection • Examination of daily or monthly report	Monthly	Contractor
3	Noise / Vibration	Facility boundaries at construction sites of the following GLRs close to residential area; • Gottigere GLR • Singapura GLR • Lingaderanahalli GLR	Noise level	Measurement of noise level by sound level meter	Monthly	Contractor
4	Accident	Construction sites	Safety measures Construction practice	• Visual inspection • Examination of daily or monthly report	Daily	Contractor

Source: JICA Survey Team

Operation Phase

No.	Item	Proposed Location	Parameters	Method	Frequency	Implementing Agency
1	Water Quality	• WTP at TK Halli (Raw water, treated water) • Vasudevapura GLR (Treated water) • Singapura GLR (Treated water) • Chokkanahalli GLR (Treated water) • Lingaderanahalli GLR (Treated water) • Gottigere GLR (Treated water) • Doddakanahalli GLR (Treated water) • Kadugodi GLR (Treated water)	Raw water: • Turbidity • pH • Alkalinity • Total hardness • Total dissolved solids • Electrical conductivity • Calcium • Iron • Magnesium • Total Coliforms • Temperature Treated water: • Turbidity • Al • pH • Color • Iron	The methods which are regulated in Indian Drinking Standards, WHO standards or other international are applied.	Daily	Contractor

No.	Item	Proposed Location	Parameters	Method	Frequency	Implementing Agency
			• Fecal coliforms • Total Coliforms • Residual chlorine			
2	Waste	• WTP at TK Halli • Final disposal site	• Generation amount of treated sludge • Location of final disposal site • Final disposed amount of sludge	• Visual inspection • Examination of daily or monthly report	Monthly	Contractor
3	Noise / Vibration	Facility boundaries of the following facilities; • TK Halli WTP • Harohalli Pumping Station • Tataguni Pumping Station	Noise level	Measurement of noise level by sound level meter	Monthly	Contractor
4	Accident	The following facilities and surrounding road areas; • TK Halli WTP • Harohalli Pumping Station • Tataguni Pumping Station	Operation and maintenance practice	• Visual inspection • Examination of daily or monthly report	Monthly	Contractor

Source: JICA Survey Team

(2) Sewerage Project for 110 Villages

The proposed environmental monitoring plan is shown in Table 14.9.2 and Environmental Monitoring Form is included in Supporting Report 14.9.2.

Table 14.9.2 Environmental Monitoring Plan

Construction Phase

No.	Item	Location	Parameters	Method	Frequency	Implementing Agency
1	Air Pollution	Facility boundaries at construction sites	Dust	Visual inspection	Monthly	Contractor
2	Waste	• Construction sites for excavation works • Construction sites for Backfill • Final disposal site of construction debris	• Type of construction debris • Amount of construction debris • Amount of excavated soil	• Visual inspection • Examination of daily or monthly report	Monthly	Contractor
3	Noise / Vibration	Facility boundaries at the following facilities; • Herohhali STP • Hosahalli STP • Doddabettahalli STP • Chikkabanavara STP	Noise level	Measurement of noise level by sound level meter	Monthly	Contractor
4	Accident	Construction sites	• Safety	• Visual	Monthly	Contractor

No.	Item	Location	Parameters	Method	Frequency	Implementing Agency
			measures • Construction practice	inspection • Examination of daily or monthly report		

Source: JICA Survey Team

Operation Phase

No.	Item	Location	Parameters	Method	Frequency	Implementing Agency
1	Water Quality	The following STPs (Raw sewage, Effluent); • Jakkur • Yelahankakere • Doddabettahalli • Bilishivalli • Varthur • Pillaganahalli • Talaghattapura • Somapura • Hemigepura • Nagasandra • Karivobanahalli • Herohalli • Hosahalli • Chikkabanavara-2	• pH • BOD5 • COD • TSS • NH4-N • T-N • T-P • fecal Coliforms	As per the methods of Indian standards	Daily	Contractor
2	Waste	The following STPs (Raw sewage, Effluent); • Jakkur • Yelahankakere • Doddabettahalli • Bilishivalli • Varthur • Pillaganahalli • Talaghattapura • Somapura • Hemigepura • Nagasandra • Karivobanahalli • Herohalli • Hosahalli • Chikkabanavara-2 Final disposal sites	• Generation amount of treated sludge • Location of final disposal site • Final disposed amount of sludge	• Visual inspection • Examination of daily or monthly report	Monthly	Contractor
3	Noise / Vibration	Facility boundaries at the following STPs; • Herohhali STP • Hosahalli STP • Doddabettahalli STP	Noise level	Measurement of noise level by sound level meter	Monthly	Contractor

No.	Item	Location	Parameters	Method	Frequency	Implementing Agency
		• Chikkabanavara -2 STP				
4	Odour	Facility boundaries at the following STPs; • Herohhali STP • Hosahalli STP • Doddabettahalli STP • Chikkabanavara -2 STP	Odour level of the following chemical substances as odour source; • Ammonia • Methyl mercaptan • Hydrogen sulfide • Methyl sulfide • Styrene	Measurement method which is regulated in Japanese Offensive Odor Control Law (Law No. 91 of 1971, Latest Amendment by Law No. 71 of 1995)	Monthly	Contractor
5	Accident	• All STP sites and surrounding areas • All ISPS sites and surrounding areas	Operation and maintenance practice	• Visual inspection • Examination of daily or monthly report	Monthly	Contractor

Source: JICA Survey Team

14.9.3 Environmental Monitoring Cost

(1) Stage V Water Supply Project

The estimated cost for environmental monitoring is shown in Table 14.9.3.

Table 14.9.3 Estimated Cost for Environmental Monitoring

Construction Phase

No.	Item for Monitoring	Implementing Agency	Estimated Cost
1	Air Pollution	Contractor	To be covered in the project cost.
2	Waste	Contractor	To be covered in the project cost.
3	Noise / Vibration	Contractor	Measurement of noise level for the following sites; • Gottigere GLR • Singapura GLR • Lingaderanahalli GLR 5,000 INR/parameter x 3 points = 15,000 INR/month Therefore, 15,000 INR/month is estimated for noise measurement.
4	Accident	Contractor	To be covered in the project cost.

Source: JICA Survey Team

Operation Phase

No.	Item for Monitoring	Implementing Agency	Estimated Cost
1	Water Quality	Contractor	At TK Halli WTP: The following staffs of the operation contractor will conduct the monitoring. 1 Chemist: 27,500 INR/month 1 Assistant: 16,500 INR/month 27,500 + 16,500 = 44,000 INR/month Therefore, 44,000 INR/month is estimated. At 7 GLRs: 1 Chemist and 1 Assistant for 7 GLRs. 44,000 x 7 = 308,000 INR/month Therefore, 308,000 INR/month is estimated. Therefore, total of 352,000 INR/month is estimated.
2	Waste	Contractor	To be covered in the project cost.
3	Noise / Vibration	Contractor	Measurement of noise level for the following sites; • TK Halli WTP • Harohalli Pumping Station • Tataguni Pumping Station 5,000 INR/parameter x 3 points = 15,000 INR/month Therefore, 15,000 INR/month*2 is estimated for noise measurement. Notes *2; Actual contract price of monitoring per 1 parameter as of 2016 in Bengaluru
4	Accident	Contractor	To be covered in the project cost.

Source: JICA Survey Team

(2) Sewerage Project for 110 Villages

The estimated cost for environmental monitoring is shown in Table 14.9.4.

Table 14.9.4 Estimated Cost for Environmental Monitoring

Construction Phase

No.	Item for Monitoring	Implementing Agency	Estimated Cost
1	Air Pollution	Contractor	To be covered in the project cost.
2	Waste	Contractor	To be covered in the project cost.
3	Noise / Vibration	Contractor	Measurement of noise level for the following sites; • Herohhali STP • Hosahalli STP • Doddabettahalli STP • Chikkabanavara STP 5,000 INR/parameter x 4 points = 20,000 INR/month Therefore, 20,000 INR/month*2 is estimated for noise measurement.
4	Accident	Contractor	To be covered in the project cost.

Operation Phase

No.	Item for Monitoring	Implementing Agency	Estimated Cost
1	Water Quality	Contractor	1 Chemist + 1 Assistant for 14 STPs 1 Chemist: 27,500 INR/month 1 Assistant: 16,500 INR/month Therefore, (27,500 + 16,500) x 14 = 616,000 INR/month Total of 616,000 INR/month is expected.
2	Waste	Contractor	To be covered in the project cost.
3	Noise / Vibration	Contractor	Total samples for the following STP sites; • Herohhali STP • Hosahalli STP • Doddabettahalli STP • Chikkabanavara -2 STP 5,000 INR/parameter x 4 points = 20,000 INR/month Therefore, 20,000 INR/month is estimated for noise measurement.
4	Odour	Contractor	5 samples for the following STP sites; • Herohhali STP • Hosahalli STP • Doddabettahalli STP • Chikkabanavara -2 STP 5 samples x 4 STPs = 20 samples 5,000 INR/parameter*4 x 20 points = 100,000 INR/month Notes *4; Actual contract price of monitoring per 1 parameter as of 2016 in Bengaluru
5	Accident	Contractor	To be covered in the project cost.

Source: JICA Survey Team

14.10 Land Acquisition and Resettlement Plan

14.10.1 Necessity on Land Acquisition and Resettlement

Stage V Water Supply Project

All of the project sites are planned to be constructed at existing BWSSB's facility areas or public land owned by GoK (Government of Karnataka), BDA and BBMP without including private land. The current status on the necessity of the land acquisition for the project sites is shown in Table 14.10.1. The project sites of GLRs at Doddakanahalli, Kadugodi, Chokkanahalli and Vasudevapura should be acquired from GoK.

Sewerage Project for 110 Villages

As shown in Table 14.10.1, the STP sites at Yelahankakere, Doddabettahalli, Bilishivalli, Varthur, Pillaganahalli, Talaghattapura, Somapura, Karivobanahalli, Herohalli, Chikkabanavara-2 and all ISPS sites should be acquired from relevant agencies of BBMP, GOK, BDA and PWD.

Table 14.10.1 Land Acquisition Required for the Project

Stage V Water Supply Project

No.	Facility	Required Area / Length	Necessity of Land Acquisition	Land Ownership as of February, 2017
1	Raw Water Conveyance Line	6.3 km	Not Necessary	BWSSB
2	TK Halli WTP	8.7 ha	Not Necessary	BWSSB
3	Transmission Facility			
3-1	Transmission Pipe	68 km	Not Necessary	BWSSB
3-2	Surge Tank at JK Doddi	-	Not Necessary	BWSSB
3-3	Clear Water Reservoir at Harohalli	3.24 ha	Not Necessary	BWSSB
3-4	Clear Water Reservoir at Tataguni	4.46 ha	Not Necessary	BWSSB
4	Power Receiving Facility			
4-1	Switch Yard at TK Halli WTP	0.25 ha	Not Necessary	BWSSB
4-2	Switch Yard at Tataguni Pump Station	0.38 ha	Not Necessary	BWSSB
5	GLRs			
5-1	Gottigere GLR	3.30 ha	Not Necessary	BWSSB
5-2	Doddakanahalli GLR	2.43 ha	Necessary	GOK*1
5-3	Kadugodi GLR	2.45 ha	Necessary	GOK*2
5-4	Chokkanahalli GLR	2.97 ha	Necessary	GOK*1
5-5	Vasudevapura GLR	0.81 ha	Necessary	GOK
5-6	Singapura GLR	1.40 ha	Not Necessary	BWSSB
5-7	Lingaderanahalli GLR	0.62 ha	Not Necessary	BWSSB

Notes
*1: Deputy Commissioner of Government of Karnataka state
*2: Forest Department of Government of Karnataka state
Source: JICA Survey Team

Sewerage Project for 110 Villages

No.	Facility	Required Area in ha	Necessity of Land Acquisition	Land Ownership as of February, 2017
1	STPs			
1-1	Jakkur	-	Not Necessary	BWSSB
1-2	Yelahankakere	2.0	Necessary	BBMP
1-3	Doddabettahalli	1.0	Necessary	BBMP
1-4	Bilishivalli	4.5	Necessary	GOK (Revenue Department)
1-5	Varthur	-	Not Necessary	BWSSB
1-6	Pillaganahalli	2.4	Necessary	GOK (Revenue Department)

No.	Facility	Required Area in ha	Necessity of Land Acquisition	Land Ownership as of February, 2017
1-7	Talaghattapura	2.6	Necessary	BDA
1-8	Somapura	2.4	Necessary	BDA
1-9	Hemigepura	-	Not Necessary	BWSSB
1-10	Nagasandra	-	Not Necessary	BWSSB
1-11	Karivobanahalli	1.7	Necessary	BDA
1-12	Herohalli	3.7	Necessary	GOK (Revenue Department)
1-13	Hosahalli	0.9	Not Necessary	BWSSB
1-14	Chikkabanavara-2	1.2	Necessary	GOK (Revenue Department)
2	ISPS			
2-1	Belahalli	0.4	Necessary	GOK (Revenue Department)
2-2	Hagadur	0.5	Necessary	GOK (Revenue Department)
2-3	Naganathapura	0.2	Necessary	BDA
2-4	Arehalli 1	0.1	Necessary	GOK (Revenue Department)
2-5	Herohalli	0.1	Necessary	GOK (Revenue Department)
2-6	Hemigepura	0.2	Necessary	PWD*1 (Lake)
2-7	Doddabidarakallu	0.2	Necessary	BDA

Note:
*1: PWD: Public Works Department
Source: JICA Survey Team

14.10.2 Legal Framework on Land Acquisition

The RFCT in LARR (Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act), 2013 is applicable to land acquisition in all states of India (Except the state of Jammu and Kashmir). This Act lays down procedures for estimating fair compensation of the affected families (and not just the titleholders) due to land acquisition, rehabilitation and resettlement. The step wise silent features of the LARR, 2013 are shown below.

Preliminary Investigations/Preparation of SIA/SIMP

It is mandatory under the Act to conduct a Social Impact Assessment (SIA) and prepare Social Impact Management Plan (SIMP). No land acquisition shall be initiated unless SIA/SIMP is approved by an expert group. The SIA shall also be conducted in a participatory manner and with all necessary public hearings, dissemination etc. duly followed.

Preliminary Notification, Objections and Hearing

Under the Act, Preliminary Notification shall be issued only after the approval of SIA and within twelve (12) months from the date of SIA approval, failing which a fresh SIA/SIMP will be prepared. Preliminary Notification shall allow appropriate Government to undertake various surveys and update records, which

needs to be compulsorily completed within two (2) months. Within this period, all affected landowners/families shall be given right to raise objections in writing to the District Collector (DC) and shall obtain an opportunity to be heard individually.

Preparation of Rehabilitation and Resettlement Scheme and its Declaration

Following Preliminary Notification, an administrator appointed for rehabilitation and resettlement shall conduct a survey, census of the affected families and prepare a draft Rehabilitation and Resettlement Scheme (RRS). An Administrator first submits RSS to the DC and DC then to the Commissioner-Rehabilitation and Resettlement who approves the RSS in the last. The DC shall publish a summary of RSS along with Declaration under the hand and seal of Secretory to such Government or any other official duly authorized. Declaration shall be published only after the Requiring Body deposits amount towards the cost of land acquisition. RSS summary and Declaration shall be compulsorily made within the twelve months after the issue of Preliminary Notification. If not complied, such notification shall be considered rescinded unless land acquisition was held up on account of any stay or injunction by the order of Court.

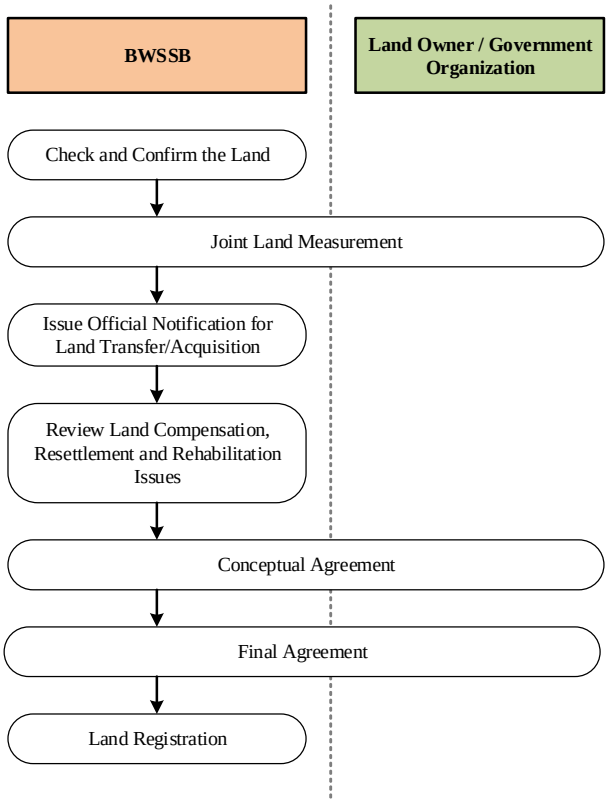
Public Notice and Award

Following above Declaration, the DC shall issue a public notice and hear objections (if any) within six (6) months from the date of its issue. The DC shall make an award within a period of twelve (12) months from the date of publication of the Declaration and if award is not made within that period, the entire proceedings of the acquisition of the landhall lapse.

Most of the project sites to be acquired are public land whose land tenures are currently transferred to GOK, BBMP and BDA. In case of such government land, several corresponds through issuing official letters and a survey for joint land measurement are conducted by the both parties of BWSSB and the relevant government agencies. A transfer of land tenure is a final process from the relevant agencies of original land owner to BWSSB. In case of government land, ISA, SIMP and public hearings are not required. Figure 14.10.1 shows the simplified process flow of the land acquisition.

14.10.3 Scope of Land Acquisition

The project sites to be acquired are currently the government owned land by GOK, BBMP and BDA. The compensation or rehabilitation measures which are required for private land as a scope of land acquisition is not required for the project. Figure 14.10.1 shows procedural flow for land transfer.



Source: JICA Survey Team

Figure 14.10.1 Simplified Process Flow of Land Transfer/Acquisition

14.10.4 Implementation Structure for Land Acquisition

The implementation structure for land acquisition of the project sites is shown in Figure 14.10.2. The project proponent (BWSSB) and the relevant government agencies of GOK, BBMP and BDA which have the current land tenure are responsible parties for the land acquisition.

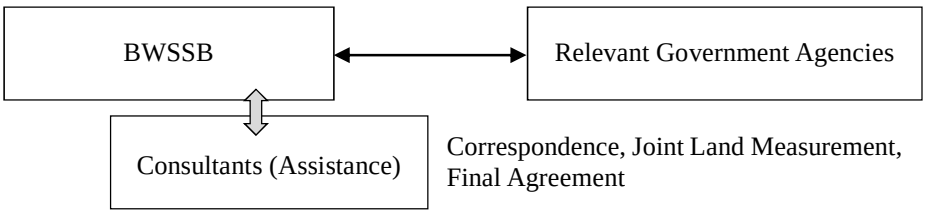


Figure 14.10.2 Implementation Structure for Land Acquisition

14.10.5 Cost and Budgeting for Land Acquisition

Basically, the cost for land acquisition such as compensation for private land owners or other PAPs (Project Affected Persons) whose livelihood might be affected by projects will not arise for the project case, since all the project sites are BWSSB's facility areas or government land. However, some expenditure such as preparation of official documents or joint site survey to be required for the process for the land transfer to BWSSB will be necessary. This cost should be borne by the BWSSB's budget.

14.10.6 Current Status / Future Schedule of Land Acquisition

As of February, 2017, BWSSB has submitted letters to relevant government agencies for application of land transfer. Further events of joint site survey and mutual agreement up to final land transfer will follow the submission of the letters as shown in Table 14.10.2. About ten (10) months is required for the final transfer to BWSSB from the submission of the letter.

Table 14.10.2 Tentative Schedule of Land Acquisition

S/N	Description	2016			2017									
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct
1	Identification Land for ISPS / STPS / GLRs	100 Days												
2	Joint meeting conducted by Chief Secretary (Urban Development) with BWSSB and Land Owners *1				○									
3	Request Letters from BWSSB to Land Owners *2				48 Days									
4	Site Inspection with Land Owners						30 Days							
5	Collection of Maps, Tippans *3, Akarband *4							30 Days						
6	Collection of RTC *5 from Taluk offices *6								30 Days					
7	Topo- Survey by Total Station								45 Days					
8	Preparation of Individual case files									45 Days				
9	Follow up action with DC, TDR, RI, ADLR *7										75 Days			
10	Possession Certificate (Transfer of Land Title)											90 Days		

Note;
*1: Meeting held on 11.01.2017
*2: Letter dated 08.02.2017 and 13.02.2017 to relevant agencies
*3: Tippans :- The map which indicates survey number and dimensions not to scale
*4: Akarband :– A register showing the area and rate of assessment of Properties
*5: RTC:– Records of Rights, Tenancy and Crops
*6: Taluk Offices :– Sub-District offices
*7: DC :– Deputy Commissioner of GoK (Revenue) TDR – Taluk Revenue Officer (Tehsildar) RI – Revenue Inspector
ADLR – Assistant Director Land Records

14.11 Environmental Checklist

The environmental checklist of Stage V Water Supply project and Sewerage Project for the 110 Villages is summarized in Table 14.11.1 and Table 14.11.2, respectively.

Table 14.11.1 Environmental Checklist for Stage V Water Supply Project

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
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?	(a) N (b) N (c) N (d) N	(a) EIA and a preparation of EIA reports is not required for the proposed project as per the Indian Environmental Notification 2006 and its revision in 2009. (b) - Ditto - (c) - Ditto - (d) - Ditto -

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
1 Permits and Explanation		(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?		
	(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) N (b) N	(a) Public consultation meeting is not required for the project as per EIA notification 2006. (b) - Ditto -
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) The alternative plans were studied especially on the viewpoint of availability of public land and treatment methods.
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that chlorine from chlorine storage facilities and chlorine injection facilities will cause air pollution? Are any mitigating measures taken? (b) Do chlorine concentrations within the working environments comply with the country's occupational health and safety standards?	(a) Y (b) Y	(a) Appropriate facility plan for the chlorination room will be examined at the design stage. (b) Appropriate safety and health management plan will be prepared to comply with the national or international standards.
	(2) Water Quality	(a) Do pollutants, such as SS, BOD, COD contained in effluents discharged by the facility operations comply with the country's effluent standards?	(a) N/A	(a) The water for the utilization of process at the proposed WTP will be recycled at the facility and will not discharge effluent.
	(3) Wastes	(a) Are wastes, such as sludge generated by the facility operations properly treated and disposed in accordance with the country's regulations?	(a) Y	(a) The treated sludge will be disposed of at final landfill site of solid waste.
	(4) Noise and Vibration	(a) Do noise and vibrations generated from the facilities, such as pumping stations comply with the country's standards?	(a) Y	(a) For the design of the facility with pumping system, mitigation measures for reducing noise will be taken into account at the design stage. In addition, environmental monitoring will be carried out.
	(5) Subsidence	(a) In the case of extraction of a large volume of groundwater, is there a possibility that the extraction of groundwater will cause subsidence?	(a) N	(a) The project does not extract groundwater.
3 Natural Environment	(1) Protected Areas	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) The project sites are not located in protected areas.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site or discharge area encompass the protected habitats of endangered species designated by the	(a) N (b) N (c) N (d) N	(a) The project sites will not encompass such forests. However, appropriate process will be taken in case of tree cutting inside the project sites as per the State regulation. (b) - Ditto –

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
3 Natural Environment		country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce the impacts on aquatic environments, such as aquatic organisms?		(c) - Ditto – (d) The maintenance flow to the downstream has already been taken into consideration.
	(3) Hydrology	(a) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect surface water and groundwater flows?	(a) N	(a) The maintenance flow to the downstream has already been taken into consideration. The project does not extract groundwater.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N (b) N (c) N (d) N (e) N (f) N (g) N (h) N/A (i) N/A (j) N/A	(a) Most of the project sites are government vacant land (state land) without residential housings. In addition, pipelines will be laid down at public spaces of road areas. (b) - Ditto - (c) - Ditto - (d) - Ditto - (e) - Ditto - (f) - Ditto - (g) - Ditto - (h) Resettlement is not required. (i) – Ditto - (j) – Ditto -
	(2) Living and Livelihood	(a) Is there a possibility that the project will adversely affect the living conditions of inhabitants? Are adequate measures considered to reduce the impacts, if necessary? (b) Is there a possibility that the amount of water used (e.g., surface water, groundwater) by the project will adversely affect the existing water uses	(a) N (b) N	(a) The proposed projects are planned in open or vacant area not to affect the surrounding environment. (b) In case of sites located close to residential area, environmental monitoring will be carried out for the potential adverse impacts to be caused by noise or odor.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
		and water area uses?		
	(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) There is no local archeological, historical, cultural, and religious heritage in and around the project sites.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) There is no area with aesthetic value in and around the project sites. The height of the proposed facilities are below 10 m.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N (b) N	(a) The project does not relate to such ethnic minorities nor indigenous people. However, some consideration will be made for planning public water hydrants for the socially vulnerable such as the residents at slum areas. (b) The project does not relate to such ethnic minorities nor indigenous people.
4 Social Environment	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) N (b) N (c) N (d) N	(a) The construction works will follow Indian laws and regulations regarding working environment. (b) Mitigation measures will be made to control the safety and health environment at the construction stage. (c) A consideration will be taken for the safety and health management at the tender and construction stage. (d) A consideration will be taken for the safety and health management at the tender and construction stage.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts? (d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a) Y (b) Y (c) Y (d) Y	(a) Environmental monitoring will be made for the examination of the contractor's activities to mitigate these impacts. (b) - Ditto - (c) Explanation of the construction works will be notified for the residents near the construction lots. (d) A mitigation measures for reducing such impacts such as allocating of traffic guides to reduce the impact of traffic congestion in cooperation with the traffic police of Bengaluru city.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b) N/A (c) Y (d) Y	(a) Environmental management and monitoring plan will be established. (b) The items, methods and frequencies for environmental monitoring will be examined at the study. (c) Monitoring framework will be studied at the study and examined by BWSSB. (d) The format and frequencies of the monitoring report will follow Indian regulations or international guidelines.
6 Note	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Dam and River Projects checklist should also be checked.	(a) N	(a) The proposed project does not contain development of a dam nor dam reservoir.
	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) Y	(a) The operation of pump units will consume power electricity which may cause GHGs. Mitigation measures will be taken by considering high efficiency of pump units.

1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made. In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.
Source: JICA Survey Team

Table 14.11.2 Environmental Checklist for Sewerage Project for 110 Villages

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
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 (d) N	(a) EIA and a preparation of EIA reports is not required for the proposed project as per the Indian Environmental Notification 2006 and its revision in 2009. (b) - Ditto - (c) - Ditto - (d) - Ditto -
	(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	(a) N (b) N	(a) Public consultation meeting is not required for the project as per EIA notification 2006. (b) - Ditto -

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
		project design?		
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) The alternative plans were studied especially on the viewpoint of availability of public land and treatment methods.
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) Y	(a) The design for the proposed STPs will be carried out to be in compliance with the national effluent standards. (b) The proposed STPs will accept the domestic sewage not industrial wastewater. Thus the untreated sewage will 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) There is no standard for the disposal of treated sludge. The treated sludge at the STPs will be used at farm land.
	(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) Y	(a) The proposed STPs will not accept industrial waste water which may 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) Appropriate design for the facilities and equipment will be conducted to be in compliance with the national standards. In addition, environmental monitoring will be carried out for the compliance at the operation stage.
	(5) Odor	(a) Are adequate control measures taken for odor sources, such as sludge treatment facilities?	(a) Y	(a) Odor control will be examined at the design stage of the proposed project. In addition, environmental monitoring will be carried out for the compliance at the operation stage.
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 is no protected area in and around the project site.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Is there a possibility that the project will adversely affect aquatic environments, such as rivers? Are adequate measures taken to reduce	(a) N (b) N (c) N (d) N	(a) The project sites will not such forests. However, some appropriate process will be taken in case of tree cutting inside the project sites as per the State regulation. (b) - Ditto - (c) - Ditto - (d) The proposed sewerage project will improve the water quality environment. The treated effluent of improved water quality will be discharged into the lakes

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
		the impacts on aquatic environments, such as aquatic organisms?		nearby area. Then, the improvement of the lake water is expected in the future.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement given to affected people prior to resettlement? (c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement? (d) Is the compensations going to be paid prior to the resettlement? (e) Is the compensation policies prepared in document? (f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples? (g) Are agreements with the affected people obtained prior to resettlement? (h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan? (i) Are any plans developed to monitor the impacts of resettlement? (j) Is the grievance redress mechanism established?	(a) N (b) N (c) N (d) N (e) N (f) N (g) N (h) N/A (i) N/A (j) N/A	(a) Most of the project sites are government vacant land (state land) without residential housings. In addition, sewer main and sub main will be laid down at public spaces of road areas. (b) - Ditto - (c) - Ditto - (d) - Ditto - (e) - Ditto - (f) - Ditto - (g) - Ditto - (h) Resettlement will not be expected. (i) Resettlement is not expected. However, in case of land acquisition, BWSSB will make a monitoring for the process of land acquisition. (j) Resettlement is not expected. However, in case of land acquisition, BWSSB will establish a rehabilitation mechanism for potential affected land owners.
	(2) Living and Livelihood	(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? (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?	(a) N (b) N	(a) The proposed projects are planned in open or vacant area not to affect the surrounding environment. (b) In case of sites located close to residential area, environmental monitoring will be carried out for the potential adverse impacts to be caused by noise or odor.
	(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) There is no local archeological, historical, cultural, and religious heritage in and around the project sites.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) There is no area with aesthetic value in and around the project sites. The height of the proposed facilities are below 10 m.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N (b) N	(a) The project does not relate to such ethnic minorities nor indigenous people. However, some consideration will be made for planning public toilets for

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
				the socially vulnerable such as the residents at slum areas. (b) The project does not relate to such ethnic minorities nor indigenous people.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(a) N (b) Y (c) Y (d) Y	(a) The construction works will follow Indian laws and regulations regarding working environment. (b) Mitigation measures will be made to control the safety and health environment at the construction stage. (c) A consideration will be taken for the safety and health management at the tender and construction stage. (d) A consideration will be taken for the safety and health management at the tender and construction stage.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)?(b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts?(c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?(d) If the construction activities might cause traffic congestion, are adequate measures considered to reduce such impacts?	(a) Y (b) Y (c) Y (d) Y	(a) Environmental monitoring will be made for the examination of the contractor's activities to mitigate these impacts. (b) - Ditto - (c) Explanation of the construction works will be notified for the residents near the construction lots. (d) A mitigation measures for reducing such impacts such as allocating of traffic guides to reduce the impact of traffic congestion in cooperation with the traffic police of Bengaluru city.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	(a) Y (b) N/A (c) Y (d) Y	(a) Environmental management and monitoring plan will be established. (b) The items, methods and frequencies for environmental monitoring will be examined at the study. (c) Monitoring framework will be studied at the study and examined by BWSSB. (d) The format and frequencies of the monitoring report will follow Indian regulations or international guidelines.
6 Note	Note on Using Environmental	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the	(a) Y	(a) The consumption of electricity and disposal of

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
	Checklist	project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).		treated sludge may generate GHGs at operation phased. However, mitigation measures will be taken for that.

Note;

1) Regarding the term "Country's Standards" mentioned in the above table, in the event that environmental standards in the country where the project is located diverge significantly from international standards, appropriate environmental considerations are required to be made. In cases where local environmental regulations are yet to be established in some areas, considerations should be made based on comparisons with appropriate standards of other countries (including Japan's experience).
2) Environmental checklist provides general environmental items to be checked. It may be necessary to add or delete an item taking into account the characteristics of the project and the particular circumstances of the country and locality in which the project is located.

Source: JICA Survey Team

14.12 Stakeholders' Meeting

BWSSB held stakeholders' meeting on August 22, 2017 for planned Water Supply and Sewerage Project for the 110 Villages. The number of the participants was 125 persons which were consisted of concerned authorities (BDA, BBMP, Pollution Control Board, etc.) and representatives from the 110 Villages. In the meeting BWSSB explained the outline of the projects and implementation plan. Required contributions by the beneficiaries were also refereed to including land acquisition for facility sites and right of way for pipeline laying. The participants welcomed the projects to realize as soon as possible and promised to cooperate for the implementation of the projects. Relevant documents for the meeting are included in Supporting Report (Minutes of Meeting for Stakeholder Meeting, 22nd August, 2017).

Chapter 15 Implementation Plan and Construction Cost Estimates

15.1 General

Implementation plan for the safe and stable water supply and the improvement of sanitary environment in the BBMP area as well as contribution for the promotion of industry was prepared in this chapter. The project covers construction of water supply and sewerage facilities, and consulting services to ensure successful project implementation.

The proposed project components are categorized into the two groups: JICA Survey Projects and those to be undertaken by Indian side using local fund. Implementation plan covers all project components to confirm interrelationship for adequate and timely implementation of the project components as a part of the requirements to achieve overall purposes. Under this context, the plan for JICA Survey Projects are prepared based on preliminary design in Chapter 12, while the plan for the projects to be undertaken by Indian side is referred to updated information obtained from BWSSB including on-going bidding documents, original/updated DPRs and other related information. The following two component projects related to Stage V water supply project and 110 Villages water supply project are finally included in Indian side undertaking project.

- Transmission facilities required (Branch Feeding Pipes) to share water to be transmitted by Stage V Project to Core/ULB areas
- Water distribution facilities from planned GLRs to OHTs for 110 Villages water supply to complete permanent distribution systems

Issues and problems experienced in India and BBMP area are the basis to come up with recommendations on the countermeasures for timely completion of the projects from bidding to construction and O&M stages. Preliminary cost was estimated based on preliminary design of water supply and sewerage facilities for JICA Survey Projects. The cost includes the requirements as a project assisted by Japanese ODA loan. Aside from the cost required for JICA Survey Projects, an overall cost required for all proposed projects is presented in combination of proposed cost by BWSSB for the projects to be undertaken by Indian side.

15.2 Conditions and Assumptions for Preparation of Implementation Plan

The implementation Plan for the project components, especially for JICA Survey Projects shall be established referring to the lessons from Stage IV Phase 2 Project and the similar projects in India, as summarized below, and particular conditions and assumptions to be considered for the projects.

(1) Needs for the improvement in the project implementation based on the experiences on the similar projects in BBMP area and other areas in India.

1) Change of Scope of the Projects

a) Site conditions in terms of topographical and geotechnical conditions shall be confirmed before commencement of construction work (D/D stage and prior to construction by the contractor)

2) Delay in land acquisition and statutory permissions

a) Agreement on the land use shall be exchanged between BWSSB and land owner/s before Loan

Agreement (L/A).

b) If there is a need of relocation in the planed facility site, required action shall be started in early stage together with legislative countermeasures.

3) Procedural delays in obtaining concurrence

a) Selection of Consultants: BWSSB shall prepare to complete selection procedure in shortest period by procurement specialist. In this regard, the approval process for the selection of the Consultants shall be simplified in the GoK.

b) Selection of Contractors: Conditions on the qualifications and experience of the bidders shall be stricter with a requirement to submit comprehensive and complete documents to show clearly evidence of experience of procurement of larger diameter pipes and equipment to be imported, especially for Stage V Project. The required qualifications shall include certificate from the clients on the experienced projects. On-the-job training by the Consultants specialist shall be provided for the procurement specialist of BWSSB before and during bidding stage for the selection of contractors.

c) Reduction in the duration of approval process in GoK shall be studied to find a short cut way in the approval process for the procurement.

d) Reduction in the duration of approval process in GoK shall be sought to find a short cut way in the approval process for the procurement. The following shall be considered.

- Establishment of approval committee to simplify approval process
- Utilization of simplified format in documentation by different purpose of required approval (technical, administrative and accounting)
- Training of procurement specialist of BWSSB upon commencement of consulting services by general consultants

4) Poor responsiveness to biddings

a) Potential contractors for undertaking the Project shall be studied both in BBMP and nationwide markets in consideration of scope of work.

b) For the bidding announcement various kind of media shall be used.

5) PQ conditions on the company's experience and quality and experience of Project Manager (P/M) and engineers for construction work

a) Eligibility of bidders for JICA Survey Project: The prime contractor shall be selected through International Competitive Bidding (ICB). However, local sub-contractors may be used for civil/architectural work.

b) The bidders for construction of STPs shall have experiences on small to medium-size projects or large-size STP projects to ensure quality of the construction work. The bidders shall also have the experience on O&M of WTP and STPs.

c) Quality and experience of staff: Conditions on the qualifications and experience of the P/M and engineers of the bidders shall include communication capability in English. The PQ and bid documents shall request bidders to submit comprehensive and complete documents including pictures at the project sites on experienced similar projects and certificates of completed project by the clients in the similar scope of work of this Project, in order to show clearly the evidence of the capability of the P/M and engineers, as well as experience of the bidder on similar project(s) in Asian countries.

(2) Special conditions to be considered for the Project

1) Weather conditions in BBMP area shall be considered to assume working period/months, especially for the construction of main sewers.

2) Following present procurement practices used by BWSSB, a manner of bidding shall be determined by water supply facility (pipeline, WTP, PS and GLR) and sewerage facility (main sewer, ISPS and STP).

3) General conditions for the contract: for the Stage IV Phase 2 Project, the following are applied. This Stage V Project shall adopt the same manner.

a) FIDIC - Conditions of Contract for Construction Contract for construction; For Building and Engineering Works Designed by the Employer, First Edition 1999.

b) FIDIC – Conditions of Contract for Plant and Design Build, First Edition 1999.

15.3 Scope of Work and Project Packaging for the Overall Project

15.3.1 Scope of Work for the Overall Project

Scope of work for water supply and sewerage component projects is summarized by JICA Survey Project and Indian side undertaking Project as shown in Table 15.3.1. The table also shows component facilities by project component with details (specifications). The project for reduction of UFW, which was included in the project to be undertaken by Indian side in Chapter 11 is omitted from this JICA assisted Project. The project will be managed by BWSSB individually aside from this Project.

Table 15.3.1 Scope of Work for Overall Proposed Project by Implementation Group

Project Group	Project Component	Facilities	Details (Specifications)	
JICA Survey Project	Stage V	WTP	775 MLD	Adjacent to existing WTP in TK Halli Water Treatment: Rapid sand filtration Disinfection: Liquid Chlorine Sludge Treatment: Centrifuge
		Transmission Facilities	775 MLD	Transmission Pipe: Dia. 3,000 mm, Approx. 70 km from T.K Halli WTP to Vajarahalli junction Pump Station: 3 Nos.（including Clear water reservoir and surge tank） ・TK Halli, ・Harohalli, ・Tataguni
		City Trunk Main	775 MLD	Dia. 500 mm - 3,000 mm, Length Approx. 114 km
		GLR	775 MLD	7 Nos.: Total Capacity 326 ML
		Central SCADA	—	Monitoring Water Supply and Sewerage Facilities
	110 Villages major Sewerage Facilities	Bytrayanapura Zone	Main Sewer Pressure Main ISPS STP	Dia. 300 mm -1,000 mm, 50.3 km Dia. 250 mm, 1.4 km 1 No. 4 Nos.
		Mahadevpura Zone	Main Sewer Pressure Main ISPS STP	Dia. 300 mm - 800 mm, 44.7 km Dia. 800 mm, 5.3 km 1 No. 1 No.
		Bommanahalli Zone	Main Sewer Pressure Main	Dia. 300 mm - 1,200 mm, 65.0 km Dia. 600 mm, 3.0 km

Project Group	Project Component	Facilities	Details (Specifications)	
			ISPS STP	1 No. 2 Nos.
		R.R. Nagar Zone	Main Sewer Pressure Main ISPS STP	Dia. 300 mm - 500 mm, 14.8 km Dia. 250 - 400 mm, 2.2 km 2 Nos. 2 Nos.
		Dasarahalli Zone	Main Sewer Pressure Main ISPS STP	Dia. 300 mm - 700 mm, 27.5 km Dia. 200 - 600 mm, 3.4 km 2 Nos. 5 Nos.
Indian Side Under-taken Project	110 Villages Water Supply	Distribution pipe-line and Service connections	Feeder main (for temporary systems) Distribution pipe-lines	Dia. 100 mm - 762 mm; Length Approx. 3,000 km Booster pumps for temporary systems.
		Distribution facil-ities between GLRs and OHTs for permanent systems	Feeder Pipes be-tween GLRs and OHTs	Dia. 150 mm - 1,750 mm Length: Approx. 200 km
			OHT	135 Nos.
			Pump, Pump House and water sump	61 Nos.
	110 Villages Sewerage	Lateral sewer and House connec-tions	Lateral Sewer	Dia. 230 mm, Approx. 2,300 km House Connections
	Stage V	Conveyance pipe-line	Valve Chamber to TK Halli WTP	Dia. 2,750 mm, Length 9.95 km; (construction contract was awarded)
		Branch Feeding Pipes	Interconnection pipes with existing Mains/GLRs	Dia. 600 mm - 1,400 mm, Length: 28.9 km;

Source: JICA Survey Team

15.3.2 Project Packaging for the Overall Project

(1) JICA Survey Project

There are two (2) project components for JICA Survey Project. Referring to the experience in Stage IV Phase 2 Project for the BBMP area, major components are planned as follows:

1) Stage V Water Supply Project

There are seven major component facilities with one (1) to three (3) packages each, as shown in Table 15.3.2. The packages are planned considering the magnitude of the required work and cost. Centralized SCADA Centre is also considered both for water supply and sewerage component projects.

Table 15.3.2 Component and Packages

Component Facilities	No. of Package
1.Water Treatment Plant at TK Halli (WTP)	1 (1 WTP)
2.Transmission Facilities at TK Halli, Harohalli and Tataguni (Clear Water Reservoir, Pump Station and Air Chamber)	3 (3 Pumping Stations)
3.Procurement of MS Plates	1 (For pipes from TK Halli to Vajarahalli)

Component Facilities	No. of Package
4.Transmission pipeline with accessories	2 (2 sections from TK Halli to Harohalli and from Harohalli to Vajarahalli)
5.City Trunk Main	2 (east and west lines from Vajarahalli junction)
6.Ground Level Reservoir (GLR)	2 (east and west lines from Vajarahalli junction)
7. Centralized SCADA	1 (for both water supply and sewerage component projects)

2) Sewerage Project for Major Sewerage Facilities for 110 Villages:

The construction of sewerage major facilities is planned including main sewers, ISPSs and STPs covering 5 administrative zones.

The three major component facilities (main sewer, ISPS and STP) are divided into two groups; (1) STP and ISPs, and (2) Main sewer and Pressure main. Each group consists of five packages considering five administrative zones.

3) Consulting Services

Consulting services will be procured for the two kinds of construction components of the Project; design-bid-construction for water transmission/distribution pipelines, GLRs and sewers; and design-build-operate for WTP, transmission PSs (Pumping Stations), ISPSs, STPs; and design-build for Centralized SCADA System. The service covers TOR preparation for selection of the contractors, bidding assistance and supervision of the contractors.

(2) Project to be Undertaken by Indian Side

1) Stage V related project

An individual package for raw water conveyance pipeline from Valve Chamber to TK Halli WTP is considered. In addition, another package is recommended for Branch Feeding Pipes to expand City Trunk Main of Stage V up to existing Mains/Reservoirs.

2) 110 Villages Water Supply Facilities

Distribution facilities are divided into two categories; (1) facilities between GLRs and OHTs and (2) distribution pipe networks in each village. Facilities between GLRs and OHTs include feeder pipes between GLRs and OHTs, OHTs and Pump facilities. Each category has five packages considering five administrative zones.

3) 110 Villages Sewerage Project

Five packages are considered for the construction of lateral sewers for the five (5) zones. House connections shall also be constructed, though owners will pay for the required cost.

(3) Packaging Components for All Projects to be Implemented

The following are the required packages by component for the Project.

- Package 1: Raw Water Conveyance pipeline from Valve Chamber to TK Halli WTP (BWSSB)
- Package 2: Water Treatment Plant at TK Halli (include O&M: JICA)
- Package 3: Transmission Facilities at TK Halli (include O&M: JICA)
- Package 4: Transmission Facilities at Harohalli (include O&M: JICA)
- Package 5: Transmission Facilities at Tataguni (include O&M: JICA)
- Package 6: Procurement of MS Plates (JICA)
- Package 7: Transmission Facilities from TK Halli to Harohalli (JICA)
- Package 8: Transmission Facilities from Harohalli to Vajarahalli (JICA)
- Package 9: City Trunk Main along eastern Route (JICA)
- Package 10: City Trunk Main along Western Route (JICA)
- Package 11: Branch Feeding Pipes (BWSSB)
- Package 12: Ground Level Reservoir along Eastern Route (JICA)
- Package 13: Ground Level Reservoir along Western Route (JICA)
- Package 14: 110 Villages Water Supply Facilities in Bytrayanapura Zone (BWSSB)
- Package 15: 110 Villages Water Supply Facilities in Mahadevpura Zone (BWSSB)
- Package 16: 110 Villages Water Supply Facilities in Bommanahalli Zone (BWSSB)
- Package 17: 110 Villages Water Supply Facilities in R.R. Nagar Zone (BWSSB)
- Package 18: 110 Villages Water Supply Facilities in Dasarahalli Zone (BWSSB)
- Package 19: 110 Villages Distribution Pipe Networks in Bytrayanapura Zone (BWSSB)
- Package 20: 110 Villages Distribution Pipe Networks in Mahadevpura Zone (BWSSB)
- Package 21: 110 Villages Distribution Pipe Networks in Bommanahalli Zone (BWSSB)
- Package 22: 110 Villages Distribution Pipe Networks in R.R. Nagar Zone (BWSSB)
- Package 23: 110 Villages Distribution Pipe Networks in Dasarahalli Zone (BWSSB)
- Package 24: Centralized SCADA System for both Water Supply and Sewerage Facilities (JICA)
- Package 25: 110 Villages STP and ISPS in Bytrayanapura Zone (include O&M: JICA)
- Package 26: 110 Villages STP and ISPS in Mahadevpura Zone (include O&M: JICA)
- Package 27: 110 Villages STP and ISPS in Bommanahalli Zone (include O&M: JICA)
- Package 28: 110 Villages STP and ISPS in R.R. Nagar Zone (include O&M: JICA)
- Package 29: 110 Villages STP and ISPS in Dasarahalli Zone (include O&M: JICA)
- Package 30: 110 Villages Main Sewer in Bytrayanapura Zone (JICA)
- Package 31: 110 Villages Main Sewer in Mahadevpura Zone (JICA)
- Package 32: 110 Villages Main Sewer in Bommanahalli Zone (JICA)
- Package 33: 110 Villages Main Sewer in R.R. Nagar Zone (JICA)
- Package 34: 110 Villages STP and ISPS in Dasarahalli Zone (JICA)
- Package 35: 110 Villages Lateral Sewer in Bytrayanapura Zone (BWSSB)
- Package 36: 110 Villages Lateral Sewer in Mahadevpura Zone (BWSSB)
- Package 37: 110 Villages Lateral Sewer in Bommanahalli Zone (BWSSB)

- Package 38: 110 Villages Lateral Sewer in R.R. Nagar Zone (BWSSB)
- Package 39: 110 Villages lateral Sewer in Dasarahalli Zone (BWSSB)
- Package 40: Consulting Services (JICA)

The contractors' work for Packages 2 to 5, and 25 to 29 will include O&M of facilities for seven years after construction/installation of the facilities.

15.4 Implementation Plan for JICA Survey Project

15.4.1 Procurement Method for the Implementation of the Project

(1) Manner of Contract for the Construction of Water Supply and Sewerage Facilities

All packages may be implemented by application of the method used for Japanese loan projects. However, for the construction work for WTP, transmission PSs, STPs, and ISPSs, Design-Build-Operate method is recommended following current practices in the similar projects in India and BWSSB projects and Design-Build method is for Construction of Centralized SCADA System. While, for the construction of pipelines and sewers, Design-Bid-Construction method shall be adopted, since this work needs to adjust/arrange right of way for pipe laying and house connections with beneficiaries.

(2) Possibility of Local Bidding

With regard to the manner of bidding for construction work, generally, Local Competitive Bidding (LCB) is more advantageous than International Competitive Bidding (ICB) in terms of the time required from the start of bidding to contract award. However, it seems to be difficult to adopt LCB for the Project, because of the technical expertise required for the construction of WTP, Transmission Pumping Stations, sewers and STPs as well as limited experience on larger scale water supply projects and sewerage projects by local contractors. Therefore, ICB shall be used for packages to maintain the quality of the required facilities and timely completion of construction works, although LCB may be applied depended on their requirements.

(3) Procurement Methods

In application of ICB, normal procurement procedure is recommended for all packages except GLR and sewers based on the discussions in the above sub-sections. Table 15.4.1 summarizes the procurement methods both for consultants and contractors.

Table 15.4.1 Procurement Method

Procurement	Scope of Work	Manner of Procurement with required process/ events
Consultants	One consultancy package: (1) D/D, Assistance for Bidding and C/S for water supply pipeline including transmission pipeline for sharing water from Stage V Project to Core/ULBs (Branch Feeder Pipes), distribution facilities from GLRs to OHTs for 110 Villages water supply, GLRs and sewer packages of work, and (2) Basic Design, Assistance for Bidding and C/S for WTP, transmission PSs, ISPSs & STPs and Centralized SCADA Sys-	ICB (Short list, QCBS)

Procurement	Scope of Work	Manner of Procurement with required process/ events
	tem	
Contractor	Construction of water supply pipelines, Design-bid-Build	ICB (PQ, Single stage with two envelopes)
Contractor	Construction of WTP, transmission PSs, ISPSs and STPs: Design-Build-Operate	ICB (PQ, Single stage with two envelopes)
Contractor	Construction of Centralized SCADA System: Design-Build	ICB (PQ, Single stage with two envelopes)
Contractor	Procurement of MS Pipe, Construction of GLRs and sewers: Design-bid-Build	LCB (PQ, Single stage with two envelopes)

There are sufficient number of potential contractors for the implementation of the Project. Table 15.4.2 shows potential contractors for the implementation of water supply and sewerage projects, and SCADA system in India through ICB. For the implementation of WTP, transmission PSs, ISPSs and STPs, they have experience on the similar ODA projects in India (financially sound with annual income of more than 500 Million INR at present). For the construction of conveyance pipeline, clear water transmission pipeline, city trunk mains and sewers, Indian contractors have experiences including the construction of more than 10 km pipelines. The contractors shown with an asterisk in Table 15.4.2 were awarded for Stage VI Phase-II Project.

Table 15.4.2 Potential Contractors for the Implementation of the Project

Facility Category	Potential Contractors
Conveyance, transmission pipeline, city trunk main and sewer	1. L&T *(Larsen & Toubro), 2. Nagarjuna Construction Company, 3. SPML* (Subhash Project and Marketing Ltd), 4. SMC Infrastructure, 5. Megha Engineering, 6. HCC (Hindustan Construction Company), all 1. to 5. companies are from India
WTP and Transmission Pumping Stations, GLR, ISPS and STP	1. Degremont (France)*, 2. Enviro Control (India), 3. SMC Infrastructure (India), 4. KEC (India), 5. VA Tech Wabag*, 6. Toshiba-UEM (Japan-India), 7. Toyo Engineering (Japan), 8. Passavant (Germany), 9. Triveni Engineering (India), 10. Thermax Ltd (India), 11. Lon Exchange Ltd (India), 12. Waterleau (Belgium)*, 13. Kirloskar Brothers Limited (India)*
SCADA System	1. Yokogawa India*, 2. Mitsubishi Electric India*, 3. Siemens India*, 4. Schneider Electric India*

Note: Companies with (*) are awarded for the Stage IV Phase-II Project.

(4) Conditions for the Procurement of Contractor for Specific Works

In consideration of system operation and maintenance for water supply and sewerage systems under specific features of the project with a very large size of scope of work, the following conditions for some items shall be adopted.

1) Water Treatment Plant

・Bidders shall have experience of at least one (1) water supply project including O&M of constructed facilities with contract amount of more than one (1) Billion INR in the last 10 years.

・Bidders shall have experience on a water supply project (either whole plant construction or part of the plant construction such as electrical, mechanical and civil works) with more than 350 MLD in the last 15 years.

・Bidders shall have a qualification on ISO 9001 for Engineering, Installation and Commissioning.

2) Transmission Pump Station

・Bidders shall have experience on the delivery of the same type of pump unit (single stage double suction type volute pump) as planned for this project with a larger size capacity than the requirements (capacity; 5,000 m^3/hr. and water head; 120 m) in this project.

・Bidders shall have more than 20 years production experience for the similar type of pump unit.

・Bidders shall have a qualification on ISO 9001 for Engineering, Installation and Commissioning.

・Bidders shall have the knowledge on water hammer.

3) Centralized SCADA System for CP-24

・Bidders shall have experience on the delivery of electronically integrated SCADA system for at least one (1) comprehensive water supply project with a capacity of more than 350 MLD in the last 10 years.

・Bidders shall have experience on the delivery of SCADA system for at least one (1) sewerage project with a total capacity of more than 100 MLD in the last 10 years.

・Bidders shall have experience on the establishment of more than 15points of remote stations for the water supply project or sewerage project.

・Bidders shall have a qualification on ISO9001 for Engineering, Installation and Commissioning.

4) Sewage Treatment Plant / Intermediate Sewage Pump Station

・Bidders shall have experience of at least 1 (one) sewerage project including O&M of constructed facilities with contract amount of more than one (1) Billion INR in the last 10 years.

・Bidders shall have experience on a sewerage treatment plant (either whole plant construction or part of the plant construction such as electrical, mechanical and civil works) with more than 50 MLD including BNR (Biological Nutrient Removal) sewage treatment plant in the last 10 years.

・Bidders shall have experience on establishment of an intermediate sewerage pump station with more than 20 MLD in the last 10 years.

・Bidders shall have a qualification on ISO 9001 for Engineering, Installation and Commissioning.

15.4.2 Implementation Schedule by Major Component /Procurement Case

(1) Conditions of Implementation Schedule for the Project

Appraisal of the Project and Exchange of Notes (E/N) between GoI and GoJ, and Loan Agreement (L/A) are assumed to be completed before December 2017.

Table 15.4.3 shows the required months for the implementation of the Project under the following site conditions and assumptions.

- Monsoon season from May to June and a series of national holidays usually affect the civil works in

the BBMP area. In this regard, annual working months are assumed to be 10 months in consideration of non-working months.

- Considering planned schedule of DPR and experience of stage IV phase II project, 30 months are necessary for each package of construction.
- Shop inspection for procurement of materials/equipment is included in the construction period.

Table 15.4.3 Construction Packages and Periods for JICA Survey Project

Items	Original
L/A signing	**September, 2017**
Consulting Services	
Selection of Project Management Consultant	September 2017 to August 2018
Consulting Service	September 2018 to February 2026
CP-2 : Water Treatment Plant (JICA)	
Conceptual Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	None
CP-3 : Reservoir and Pump Station at TK Halli (JICA)	
Conceptual Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	None
CP-4 : Reservoir and Pump Station at Harohalli (JICA)	
Conceptual Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	None
CP-5 : Reservoir and Pump Station at Tataguni (JICA)	
Conceptual Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	None
CP-6 : Procurement of MS Plates (JICA)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	June 2023 to May 2024

Items	Original
CP-7 : Transmission Pipeline From TK Halli to Harohalli (JICA)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	June 2023 to May 2024
CP-8 : Transmission Pipeline From Harohalli to Vajarahalli (JICA)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	June 2023 to May 2024
CP-9 : City Trunk Main along Eastern Route (JICA)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	June 2023 to May 2024
CP-10 : Construction of City Trunk Main along Western Route (JICA)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	June 2023 to May 2024
CP-12 : Ground Level Reservoir along Eastern Route (JICA)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	June 2023 to May 2024
CP-13 : Ground Level Reservoir along Western Route (JICA)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	June 2023 to May 2024
CP-24 : Centralized SCADA System for Both Water Supply and Sewerage Facilities (JICA)	
Conceptual Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	June 2023 to May 2024
CP-25 : 110 Village STP and ISPS in Bytrayanapura Zone (JICA)	

Items	Original
Conceptual Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract (by BWSSB)	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	None
CP-26 : 110 Village STP and ISPS in Mahadevpura Zone (JICA)	
Conceptual Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract (by BWSSB)	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	None
CP-27 : 110 Village STP and ISPS in Bommanahalli Zone (JICA)	
Conceptual Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract (by BWSSB)	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	None
CP-28 : 110 Village STP and ISPS in R.R. Nagar Zone (JICA)	
Conceptual Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract (by BWSSB)	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	None
CP-29 : 110 Village STP and ISPS in Dasarahalli Zone (JICA)	
Conceptual Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract (by BWSSB)	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	None
CP-30 : 110 Village Main Sewer in Bytrayanapura Zone (JICA)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract (by BWSSB)	December 2019 to November 2020
Construction	December 2020 to November 2024
Defect Liability Period	December 2024 to November 2025
CP-31 : 110 Village Main Sewer in Mahadevpura Zone (JICA)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract (by BWSSB)	December 2019 to November 2020
Construction	December 2020 to November 2024
Defect Liability Period	December 2024 to November 2025
CP-32 : 110 Village Main Sewer in Bommanahalli Zone (JICA)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019

Items	Original
Tendering, Evaluation of Bids and Awarding the Contract (by BWSSB)	December 2019 to November 2020
Construction	December 2020 to November 2024
Defect Liability Period	December 2024 to November 2025
CP-33 : 110 Village Main Sewer in R.R. Nagar Zone (JICA)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the	December 2019 to November 2020
Contract (by BWSSB)	
Construction	December 2020 to November 2024
Defect Liability Period	December 2024 to November 2025
CP-34 : 110 Village Main Sewer in Dasarahalli Zone (JICA)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract (by BWSSB)	December 2019 to November 2020
Construction	December 2020 to November 2024
Defect Liability Period	December 2024 to November 2025
Project Completion Date	**November 2024**

Work-flow of bidding procedure to select contractors (Two-Envelope Bidding under JICA Procedure) and required time by major work is summarized below.

- P/Q; 3 months
- Preparation of Bidding Document including JICA concurrence; 3 months
- Submission of Bid; 3 months
- Technical Evaluation/Price Evaluation including JICA concurrence; 5 months
- Negotiation to L/C; 3 months

15.4.3 Implementation Schedule for JICA Survey Project

Figure 15.4.1 shows the implementation schedule for the Project in consideration of required periods in a series of procedures. If the period for the procedure before construction work would be shorten, the completion year for the project may be earlier than proposed plan. The construction work is planned to be completed by the end of year 2024 followed by O&M period for the facilities.

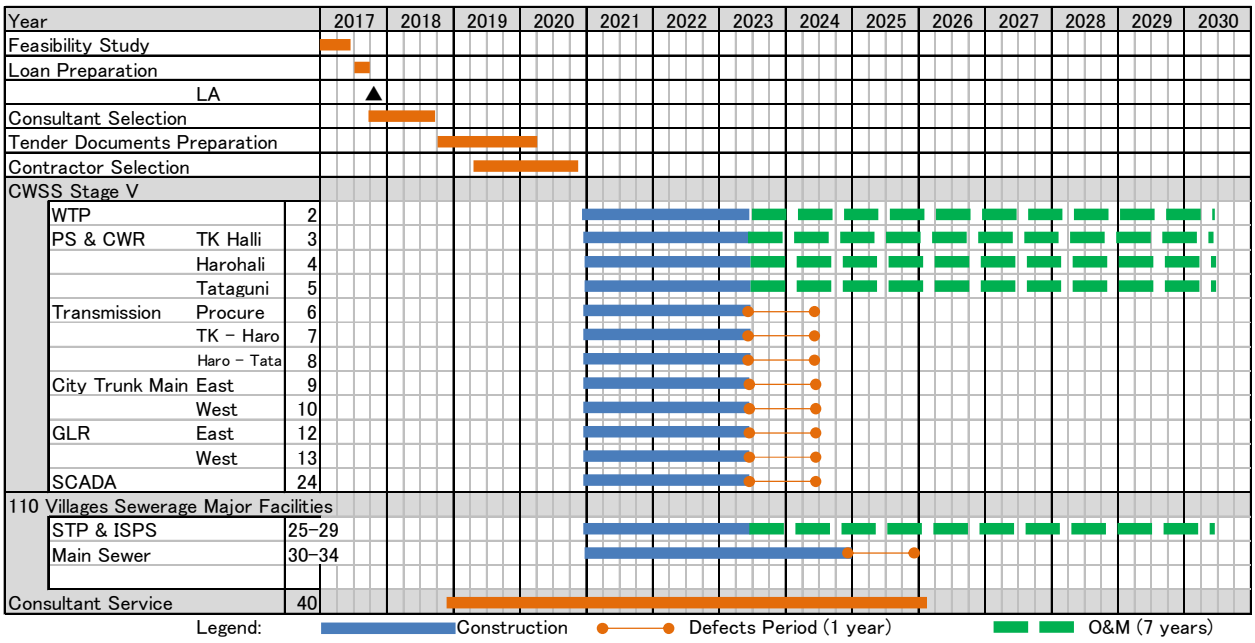


Figure 15.4.1 Implementation Schedule for JICA Survey Project

15.5 Implementation Plan for the Project to be Undertaken by Indian Side

15.5.1 Required Implementation Period

Table 15.5.1 shows the required months for the implementation of the Project reflecting current development as of June, 2017.

Table 15.5.1 Package and Construction Periods for the Project to be Undertaken by Indian Side

No	Project	Funding Source	Implementation Period	Detailed information
1	110 Villages Water Supply	GOK (67%) + BWSSB (33%)	24 Months	GBWASP funds Feeder Mains are temporary.
		BWSSB	24 Months	Permanent distribution facilities: Feeder pipes between GLRs and OHTs, OHTs and Pumping facilities
2	110 Villages Sewerage: Lateral sewers and House connections	BWSSB	Lateral sewers – 48 Months	BCC funds Cost for house connection is paid by the customer.
3.	Stage V related Project - Conveyance pipeline - Branch Feeding pipes	BWSSB	24 Months	Conveyance pipeline : Already awarded
		BWSSB	30 Months	Branch Feeding pipes (interconnection pipes with existing Mains/Reservoirs

Table 15.5.2 Construction Packages and Periods for Indian Side Project

Items	Original
CP-1 : Raw Water Conveyance Pipeline From Valve Chamber to TK Halli WTP (BWSSB)	
Detailed Design	done

Items	Original
Preparation of Tender Documents	done
Tendering, Evaluation of Bids and Awarding the Contract	done
Construction	June 2017 to May 2019
Defect Liability Period	June 2019 to May 2020
CP-11 : Branch Feeding Pipes (BWSSB)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	June 2023 to May 2024
CP-14 : 110 Village Water Supply Facilities in Bytrayanapura Zone (BWSSB)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	June 2023 to May 2024
CP-15 : 110 Village Water Supply Facilities in Mahadevpura Zone (BWSSB)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	June 2023 to May 2024
CP-16 : 110 Village Water Supply Facilities in Bommanahalli Zone (BWSSB)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	June 2023 to May 2024
CP-17 : 110 Village Water Supply Facilities in R.R. Nagar Zone (BWSSB)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	June 2023 to May 2024
CP-18 : 110 Village Water Supply Facilities in Dasarahalli Zone (BWSSB)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract	December 2019 to November 2020
Construction	December 2020 to May 2023
Defect Liability Period	June 2023 to May 2024
CP-19 : 110 Village Distribution Pipe Networks in Bytrayanapura Zone (BWSSB)	
Detailed Design	done
Preparation of Tender Documents	done
Tendering, Evaluation of Bids and Awarding the Contract	done
Construction	June 2017 to May 2019
Defect Liability Period	June 2019 to May 2020

Items	Original
CP-20 : 110 Village Distribution Pipe Networks in Mahadevpura Zone (BWSSB)	
Detailed Design	done
Preparation of Tender Documents	done
Tendering, Evaluation of Bids and Awarding the Contract	done
Construction	June 2017 to May 2019
Defect Liability Period	June 2019 to May 2020
CP-21 : 110 Village Distribution Pipe Networks in Bommanahalli Zone (BWSSB)	
Detailed Design	done
Preparation of Tender Documents	done
Tendering, Evaluation of Bids and Awarding the Contract	done
Construction	June 2017 to May 2019
Defect Liability Period	June 2019 to May 2020
CP-22 : 110 Village Distribution Pipe Networks in R.R. Nagar Zone (BWSSB)	
Detailed Design	done
Preparation of Tender Documents	done
Tendering, Evaluation of Bids and Awarding the Contract	done
Construction	June 2017 to May 2019
Defect Liability Period	June 2019 to May 2020
CP-23 : 110 Village Distribution Pipe Networks in Dasarahalli Zone (BWSSB)	
Detailed Design	done
Preparation of Tender Documents	done
Tendering, Evaluation of Bids and Awarding the Contract	done
Construction	June 2017 to May 2019
Defect Liability Period	June 2019 to May 2020
CP-35 : 110 Village Lateral Sewer in Bytrayanapura Zone (BWSSB)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract (by BWSSB)	December 2019 to November 2020
Construction	December 2020 to November 2024
Defect Liability Period	December 2024 to November 2025
CP-36 : 110 Village Lateral Sewer in Mahadevpura Zone (BWSSB)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract (by BWSSB)	December 2019 to November 2020
Construction	December 2020 to November 2024
Defect Liability Period	December 2024 to November 2025
CP-37 : 110 Village Lateral Sewer in Bommanahalli Zone (BWSSB)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract (by BWSSB)	December 2019 to November 2020
Construction	December 2020 to November 2024
Defect Liability Period	December 2024 to November 2025
CP-38 : 110 Village Lateral Sewer in R.R. Nagar Zone (BWSSB)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract (by BWSSB)	December 2019 to November 2020

Items	Original
Construction	December 2020 to November 2024
Defect Liability Period	December 2024 to November 2025
CP-39 : 110 Village Lateral Sewer in Dasarahalli Zone (BWSSB)	
Detailed Design	September 2018 to August 2019
Preparation of Tender Documents	August 2019 to November 2019
Tendering, Evaluation of Bids and Awarding the Contract (by BWSSB)	December 2019 to November 2020
Construction	December 2020 to November 2024
Defect Liability Period	December 2024 to November 2025

15.5.2 Procurement Method for the Implementation of the Project

(1) Manner of Contract

For the construction of water pipelines, GLRs/OHTs with pumping facilities and sewers, Design-Bid-Construction method shall be adopted, since this work needs to adjust/arrange right of way for pipe laying and house connections with beneficiaries. BWSSB practices same manner as mentioned above for the implementation of the subject woks.

(2) Possibility of Local Bidding

Local Competitive Bidding (LCB) will be employed for the projects as experienced by BWSSB in the implementation of similar projects.

15.5.3 Implementation Schedule

The information on the implementation schedule for the projects to be implemented by Indian side was collected and shown in Figure 15.5.1. The on-going projects are planned to complete by the middle of year 2020, while for the water supply facilities, branch feeding pipes and lateral sewer are planned to complete by year 2024.

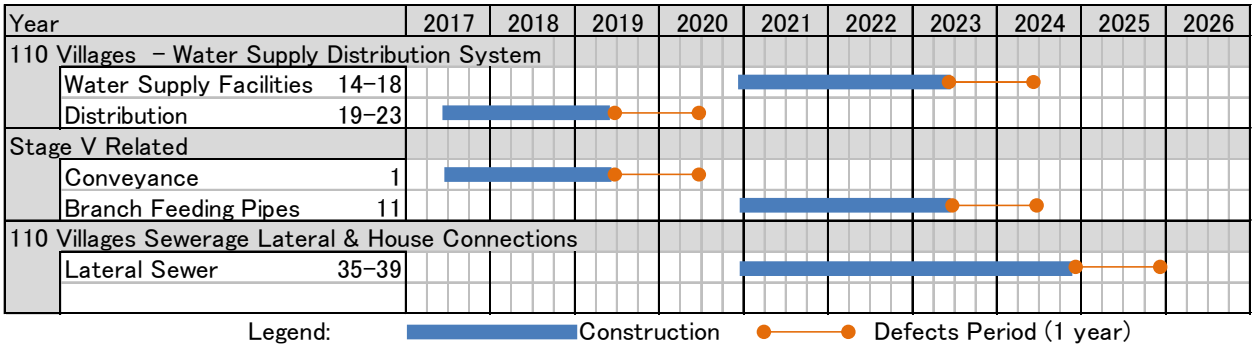


Figure 15.5.1 Implementation Schedule for the Project to be Undertaken by Indian Side

15.6 Project Implementation Unit for the Implementation of JICA Survey Project

15.6.1 Organizational Structure, and Roles and Responsibilities of the PIU

BWSSB has successfully managed water supply and sewerage projects through Stage I to Stage IV including administration and financial arrangements. They have Financial Advisors and Chief Accountants

Office in the head quarter, as shown in Figure 17.1.1 Organizational Chart of BWSSB. These staff will be utilized for the project implementation. For the implementation of this project, BWSSB will establish an expert team including specialists in the fields of procurement, contract and accounting among them, as described below. The Project Implementing Unit (PIU) of BWSSB shall serve as the technical arm in managing, supervising and controlling project activities, including the work of the consultants and contractors. This shall involve activities such as project planning, procurement of works, goods and services; construction supervision, environmental management, project monitoring and control, fund management including disbursements, preparation of reports and liaison with funding agency (JICA).

15.6.2 General Guidelines Governing PIU

(1) PIU of BWSSB

BWSSB shall organize an office to be designated as the office of Project Implementation Unit (PIU) for the Project. It should be set-up as an independent office with its own personnel attached to and under the Office of the Chairman, BWSSB. The following shall be the guidelines in setting up the PIU:

a) The PIU shall be set up as an adjunct/separate office attached to and directly under the Chairman, BWSSB with one of the Chief Engineer (CE - Projects) serving as the de facto Project Director. At the moment, there is no specific office within BWSSB, which could be transformed into and can take-up the responsibilities of a PIU.

b) As much as practicable, the positions for the PIU shall be filled from among the qualified BWSSB staff. Positions that cannot be filled from the existing ranks, shall be hired on a contractual basis for the duration of the Project. Recruitment and selection, however, will follow the State government regulations on hiring based on the required qualifications and experience for the positions. Table 15.6.1 provides the summary of positions and number of personnel required to manage the PIU. Figure 15.6.1 presents organizational Structure of the PIU.

Table 15.6.1 Positions and Number of Personnel Required for PIU

No	PIU Position	Equivalent Level /Position in BWSSB	Number Required
1	Project Director	Chairman	1
2	Project Manager	Chief Engineer	2
3	Assistant Project Manager	Additional Chief Engineer	2
4	Project Engineer	Executive Engineer	10
5	Environmental / Social Specialist	Assistant Executive Engineer	1
6	Assistant Project Engineer	Assistant Executive Engineer	15
7	Contract/ Procurement / Quantity Surveyor	Assistant Engineer	4
8	CAD/GIS Operator	Junior Engineer	1
9	Assistant Accounts Officer	Assistant Accounts Officer	1
10	Accounts cum Audit Assistant	Senior Assistant	2

No	PIU Position	Equivalent Level /Position in BWSSB	Number Required
11	Secretary	Secretary/Senior Clerk	2
12	Driver	Driver	2
13	Support Staff	Helper	2
	Total		45

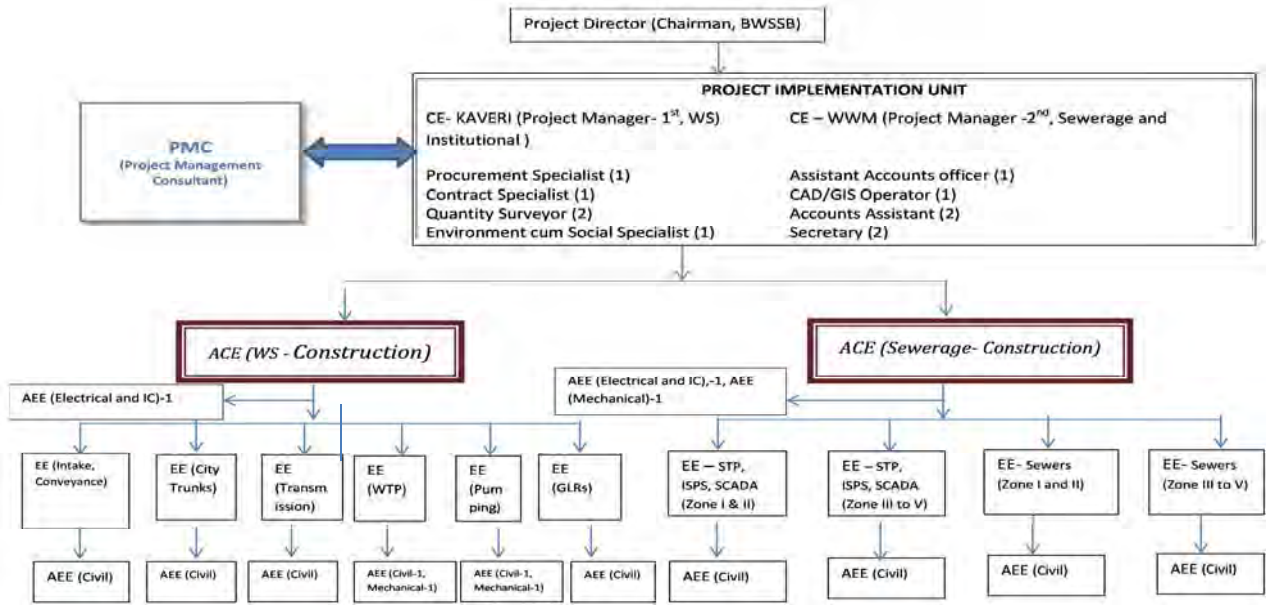


Figure 15.6.1 Organizational Chart of PIU

Chairman of BWSSB shall be the Project Director. Two (2) of the CE (CE- Kavery/Wastewater Management, BWSSB) shall be the Project Manager. The Project Manager will be supported by ten (10) assistant project managers – six (6) to supervise the water supply package and four (4) for sewerage works. Likewise, the assistant project managers will each be supported by 15 project engineers consist of civil mechanical and electrical. Considering the importance of environmental management and low negative social impacts, need for an environmental cum social professional has been considered. Although the PMC shall be engaged for preparation of tender documents, evaluation etc., yet two (2) quantity surveyors and one (1) CAD/GIS operator (draftsman) have been considered to assist the Project Manager.

(2) Responsibilities of BWSSB in Project Implementation

On the strategic level, the Chairman, BWSSB should ensure that objectives/targets of the Project are achieved efficiently and effectively according to the plan. On the monitoring level, Chairman shall attend regular meetings with JICA representative and DEA on the implementation of this ODA project and bring to its attention urgent issues for immediate resolution.

One of the Chief Engineer shall be the over-all in-charge of project implementation and policy coordination activities. Because of the magnitude of the project, the CE shall have direct supervision and authority over the PIU as its de facto Project Director. As such, he/she shall (i) Approve/ endorse all official docu-

ments and communications from the PIU through the Chairman for inter-governmental and external offices; (ii) Approve technical studies and matters related to the detailed design of the new treatment plant, the distribution network, reservoirs, STPs and facilities for the project, including construction management activities; (iii) Bring to the attention of the Chairman (and JICA), about important implementation issues (legal, financial, and policy) that need immediate resolution and/or coordination on the level of the State/GOI. He/She shall ensure that the project is implemented in accordance with the schedules, plans and procedures agreed upon by BWSSB, JICA, GoK and GOI.

(3) Roles, Functions and Responsibilities of the PIU Staff

The PM is a position that requires ad hoc adjustments, based on moment-to-moment assessments of current conditions, within the context of a comprehensive plan created using sound and consistent methods from relevant past experience. This position also requires collaborative efforts among project stakeholders (JICA, GOI, GoK, BBMP, project beneficiaries etc.). The PM for the PIU is expected to perform the following tasks/responsibilities:

a) Provides direction and guidance to the key personnel of the PIU.
- Reviews and confirms the scope of work of the Consultants for the approval of the Chairman, BWSSB;

  ⇒ Defines the roles and responsibilities of each PIU team member and secure their respective commitments

  ⇒ Defines the outputs, resource constraints, timelines and quality expectations for the submission of the outputs by each team member
- Develops the work and financial plans of the project for approval of the Chairman and determines the resource and logistical constraints to complete the objectives of the project.

b) Develops systems, policies/rules and procedures to manage and monitor the implementation of the project components that should include.
- Monitoring benchmarks to evaluate the progress of the project;
- Monitoring the progress of the Consultant and Contractors in terms of scope, time and budget using the appropriate software;
- Database and monitoring system that will enable quick and accurate online downloading of information on the progress of the project;
- Development and implementation of standards, guidelines and regulations.

c) Ensures the timeliness and quality of outputs of the Consultants, contractors and suppliers.
- Reviews all reports of the Consultant and recommends the appropriate action, where necessary;
- Recommends to the Chairman on coordination and inspection;
- Reviews field reports and identify issues with the necessary recommendations for submission/approval of Chairman;
- Reviews and recommend invoices, including certification of work completion/acceptance of Consultant and contractors/suppliers for billing purposes.

d) Manages and monitors all pertinent activities, like work flow and records management; administrative coordination and financial transactions.

e) Reviews and manages the monitoring plan for the natural and social environment, and other social considerations.
f) Provides regular progress and performance evaluation reports and to the Principal Secretary, the Chief Engineer, the concerned State and Central government authorities, and JICA.

The Assistant Project Manager (APM) will report directly to the PM, and will be responsible for supervising the assigned technical projects/ construction package and related activities of the PIU, developing various systems and procedures for the smooth implementation of the project, installing and/or developing project management processes for the PIU. The specific tasks of the APM are the following:

- Assists the PM in his responsibility for the management and supervision of technical studies to be undertaken;
- Directly oversees and supervises the implementation of field-level activities, particularly in civil works construction;
- Certifies the completion of work and payments of suppliers;
- Develops and undertakes planning activities, such as but not limited to, the work (technical) and financial plans and undertake the implementation of the approved work plan;
- Monitors project activities and accomplishments, using in part, the monitoring system designed for ODA projects;
- Prepares supporting reports on the progress of the project for the concerned offices of the State and the Central Governments, and the JICA;
- Reviews monitoring report of consultants and contractor's work and submits this to through the PIU's chain of command.

The Project Engineer/s (PE) will report directly to the APM and will have the following functions:

- Responsible for the field-level implementation and management by providing direction for the effective and efficient field implementation of the different components of the assigned project / package, while also monitoring the performance of the contractor and the field experts of the Consultant;
- Validates the progress of implementation of each activity in the work plan;
- Assists in monitoring the activities and accomplishments of the project;
- Assists in preparing regular supporting reports for various users;
- Facilitates the preparation of the work (technical) and financial plan;
- Reports and/or find solutions to problems encountered in the field.

The Assistant Project Engineer/s (Asst. PE) will report directly to the PE for tasks on the field-level / technical side of the Project. The specific field functions are:

- Assists in monitoring the performance of the contractor and the field experts of the Consultant;
- Prepares regular field inspection reports;
- Reports any deviations and problems to the PE.

However, all delegated administrative and financial functions at the level of the project manager shall also

be the responsibility of PE, such as:

- Project administration functions:
  - ⇒ Develops, maintains and manages the Project's records system, project office documents and communications system, as well as physical facilities and supplies;
  - ⇒ Coordinates and processes procurement of goods and services for the PIU;
  - ⇒ Processes request for payments from suppliers and reviews compliance with GOI, GoK and JICA procedures;
  - ⇒ Prepares request for payment for suppliers, contractors and consultants based on the field-level disbursement procedures.
- Project finance functions:
  - ⇒ Prepares the financial portion of the WIP (works in progress);
  - ⇒ Keeps all project accounts up-to-date while assists in maintaining project book of accounts;
  - ⇒ Ensures timely preparation of report of disbursements and periodic accounting reports of the Project;
  - ⇒ Processes vouchers and documents for disbursement of project funds.

The Environmental Engineer and Social Specialist will report directly to the PM. Working as a team, their functions are the following:

- ⇒ Review the contractor's EMP (Environmental Management Plan) and Social Impact Reduction Plan (especially involving large construction works)
- ⇒ Review the E&S monitoring report;
- ⇒ Review the contractor's concrete environmental management and social impact reduction plans;
- ⇒ Provide instruction on environmental management to Consultants and Contractors; Inspect environmental management conditions at construction site with consultant/contractors; and
- ⇒ Submit necessary reports and documents to the relating agencies for environmental and social consideration.

The Contract Quantity Surveyor shall report directly to the PM, whose functions and responsibilities will be the following: (i) Draw up the bill of quantities and their breakdown; (ii) Prepare the tender documents for the project; and (iii) Manage cost control in terms of schedule and budget for the project.

The Accounts Officer shall be under the direction of the PM, who will be responsible for procurement work financial documentation for the project. The Accountant shall assist him/her in maintaining proper records.

The Secretary shall be under the direction of the APM and will be responsible for administrative works. He/She shall also assist the Account Officer.

The Support Staff/Driver shall be under the APM and will ensure the safe transport of staff and goods within the project sites. The drivers will also perform daily maintenance works on the vehicles assigned to

them. The expected qualifications and experience requirements of PIU staff are provided in Table 15.6.2.

Table 15.6.2 Proposed Qualifications of the Staff for PIU

Positions	Qualifications and Experience	
Project Manager (1 for water supply, 1 for wastewater)	Academic	Essential: • Graduate in Civil Engineering Desirable: • Master Degree in Civil Engineering (Public Health, Water Supply, Waste Water) - an advantage • Project Management Professional (PMP) Certification also an advantage
	Experience	At least 15 year experience of managing water supply and/or sewerage projects At least 10 year experience of managing construction projects of water supply and/or sewerage projects At least 5 year experience (in the grade of EE or higher) as project manager (contract management) of water supply/waste water projects of a substantial scale (>100 crores in 5 years)
Assistant Project Manager (6 for water supply, 4 for wastewater)	Academic	Essential: • Graduate in Civil/Mechanical/Electrical Engineering Desirable: • Master's Degree in Civil Engineering (Public Health, Water Supply, Waste Water) - an advantage • Project Management Certification an advantage
	Experience	At least 12 year experience of managing water supply and/or sewerage projects At least 8 year experience of managing construction projects of water supply and/or sewerage projects At least 4 year experience (in the grade of EE or higher) as project manager (contract management) of water supply/waste water projects of a substantial scale (>75 crores in 4 years)
Project Engineer	Academic	Graduate in Civil, Mechanical or Electrical Engineering
	Experience	At least 10 year experience as Project Engineer or Assistant Project Engineer (in AEE or higher level) of water supply and/or sewerage projects
Environmental Engineer	Academic	Graduate in Environmental Engineering or Graduate in Civil Engineering with Masters in Public Health Engineering
	Experience	At least 10 years experiences as environmental specialist/engineer on water supply and/or sewerage projects
Contract/Quantity Surveyor	Academic	Diploma in Civil, Mechanical or Electrical Engineering Degree in Civil/Mechanical Engineering to be preferred
	Experience	At least 5 year experience as materials estimator and /or contract/quantity surveyor for major water supply and/or sewerage construction projects
CAD/GIS Operator	Academic	Trade Certificate (ITI) in Draftsmanship (civil/mechanical) Degree or Diploma in Civil, Mechanical Engineering
	Experience	At least 5 years of experience in use of AutoCAD for Civil works including 2 years for water supply or sewerage projects
Assistant Accounts Officer	Academic	University graduate in Commerce (or Accountancy) Relevant course in accountancy (at least one year) from a reputed university/college
	Experience	At least 10 year experience as accountant, Able to proficiently use computers and IT Good working experience on common accounting Software (ex. Tally)
Accounts and Audit	Academic	University graduate in Commerce (or Accountancy)

Positions	Qualifications and Experience	
Assistant	Experience	At least 5 years of experience as accounting/audit assistant (or clerk) , Able to proficiently use computers and IT Good working experience on common accounting Software (ex. Tally)
Secretary/Data Entry Operators*	Academic	Relevant Secretarial Diploma Course (at least two years) from any reputable university/college
	Experience	At least five years of experience as office clerk/assistant Extensive experience in computer operation, file management etc. Proficiency in English
Driver*	Academic	High School Certificate (Standard X) or equivalent
	Experience	At least three years of experience of driving LCVs with a reputed organization Valid professional driving License Good knowledge of Kannada with ability to converse in common English
Support Staff* (2)	Academic	High School Certificate (Standard X) or equivalent
	Experience	At least three (3) years' work experience in an office Good knowledge of Kannada with ability to converse in common English

*): With existing ban on recruitment, services of Data Entry Operators, Driver and Support Staff may be outsourced.

15.7 Consulting Services

15.7.1 Terms of Reference

BWSSB will procure consulting services through ICB for the construction of transmission pipelines, WTP, transmission PSs, CWRs, GLRs, Main Sewers, STPs, ISPSs and Centralized SCADA System. In addition, construction by BWSSB including 110 Villages water supply facilities, branch feeding pipes, lateral sewers, will be covered in the Consulting services.

The consultants' team shall consist of international and local professional, and supporting staff. Consultants will be selected through a short list method to avoid lowering of quality and in accordance with the "Guidelines for the Employment of Consultants under Japanese ODA Loans".

The scope of work in the Terms of Reference (TOR) for the consulting services includes the requirements under different manner of biddings for the water supply and sewerage facilities; one for design-bid-construction and the other design-build (- operate) method.

For the former method, detailed design will be conducted including preparation of tender documents for the packages for the construction of transmission pipelines, city transmission, GLRs and main sewers. For the latter method, basic design of WTP, transmission pump stations, STPs, ISPSs, and Central SCADA System is included as well as assistance for bidding and construction supervision.

The TOR is prepared considering requirements discussed in the previous sub-sections. Draft TOR is included in Supporting Report 15.7.1.

15.7.2 Cost Estimates for Consulting Services

The scope of work for the consulting services includes preparation of Detailed Design (D/D) / Basic Design (B/D), assistance for bidding and construction supervision, and procurement of equipment for this project.

A total of 678 man-months of foreign, 2,233 man-months of local engineers and 2,036 man-months of supporting staff are considered.

Under the above conditions total cost for the consulting services is estimated at approximately 4.8 Billion JPY (Foreign portion: 2.5 Billion JPY, Local portion: 1.3 Billion INR equivalent to 2.3 Billion JPY). The detailed cost estimate for the consulting services is shown in Table 15.7.1.

Table 15.7.1 Estimated Cost for Consulting Services

Item	Unit	Qty.	Foreign Portion		Local Portion		Combined Total
			Rate	Amount	Rate	Amount	
			JPY	Mil JPY	INR	Mil INR	Mil JPY
A Remuneration							
1 Professional (A)	M/M	678	3,153,000	2,138	0	0	2,138
2 Professional (B)	M/M	2,233	0	0	334,207	765	1,331
3 Supporting Staffs	M/M	2,036	0	0	60,000	122	213
Subtotal of A				2,138		887	3,681
B Direct Cost							
1 International Airfare	trip	226	250,000	57	0	0	57
2 Domestic Airfare	trip	970	0	0	18,000	17	30
3 Domestic Travel	trip	2,036	0	0	3,000	6	11
4 Accommodation Allowance (a)	Month	678	400,000	271	0	0	271
(b)	Month	2,233	0	0	80,000	179	311
(c)	Month	2,036	0	0	30,000	61	106
5 Vehicle Rental	Month	970	0	0	55,000	53	93
6 Office Rental	Month	144	0	0	200,000	29	50
7 International Communications	Month	144	0	0	25,000	4	6
8 Domestic Communications	Month	144	0	0	20,000	3	5
9 Office Supply	Month	144	0	0	20,000	3	5
10 Office Furniture and Equipment	set	1	0	0	3,000,000	4	6
11 Report Preparation	Month	1	0	0	150,000	0	1
12 Topo-survey	km	5,900	0	0	10,000	58	101
13 Soil survey	Nos.	400	0	0	50,000	20	35
14 Computer, software	set	1	0	0	10,000,000	12	21
Soft Component							
15 Overseas Training							
16 Air fare	trip	20	250,000	5	0	0	5
17 Per diem	day	280	27,000	8	0	0	8
18 Program	set	1	1,000,000	1	0	0	1
Subtotal of B				341		449	1,122
Total（A+B）				**2,479**		**1,336**	**4,803**

15.8 Preliminary Cost Estimates

15.8.1 Conditions and Assumptions for Cost Estimate for JICA Survey Project

Proposed projects are divided into two groups; JICA Survey Project and projects to be undertaken by Indian side using local fund. Required costs for the JICA Survey project are estimated basically referring to those in the concerned DPRs with modifications, and updating unit prices. While, for the projects to be undertaken by Indian side, updated costs for the final scope of work are referred to for the study of overall implementation program on the proposed projects by the BWSSB. Table 15.8.1 and Table 15.8.2 summarize manner of cost estimates by above mentioned project group.

Table 15.8.1 Summary of Cost Estimation Method for Direct Cost

Direct Construction Cost			
Group and Projects		**Facility**	**Manner of Cost Estimates**
JICA Survey Project	Stage V	All Facilities	Basically the manner of cost estimates used in the DPRs is applied with following modifications and updating. - Unit material price for civil and architectural work will be replaced from 2014-2015 to 2017 price level. - Unit price for mechanical and electrical facilities for major facilities will be investigated through the inquiries to some manufacturers. - The change of BOQ and specifications of the facilities in the Basic Design will be reflected in the cost estimates.
		Conveyance line from SBR to NBR	- Same manner as that in DPR
		Water Treatment Plant	- Same manner as that in DPR - Use updated unit price and BOQ after conducting design calculation, layout and profile study.
		Clear Water Reservoir and Pumping Station	- Same manner as that in DPR - Use updated unit price for major facilities including transmission pump.
		Clear Water Transmission Main	- Same manner as that in DPR
		City Trunk Mains	- Same manner as that in DPR - Use updated unit price and BOQ after conducting design calculation, layout and profile study.
		City Reservoirs（GLRs)	- Same manner as that in DPR - Use updated unit price and BOQ after conducting design calculation, layout and profile study.
	110 Villages Sewerage (major facilities)	All Facilities	Basically, the manner of cost estimates used in the DPRs is applied with following modifications and updating. - Unit material price for civil and architectural work will be replaced from 2014-2015 to 2017 price level. - Unit price for mechanical and electrical facilities for major facilities will be investigated through the inquiries to some manufacturers - The change of BOQ and specifications of the facilities in the Basic Design will be reflected in the cost estimates.
	110 Villages Sewerage (major facilities)	STP	- Preliminary design was conducted for four (4) different capacity STPs (3MLD, 10MLD, 15MLD, 24MLD). Rough BOQ was prepared based on dimension and specification after conducting design calculation, layout and profile study. Then each STP cost was estimated following DPR manner. - Cost function was prepared based on the result of above cost estimation. The cost function was examined by the awarded price of Stage V Phase-II.
JICA Survey Project		ISPS	- Cost function was prepared after model study using data from the DPR and the experience in Stage IV Phase-II project.
		Force main (D.I. pipe)	- Unit construction cost per meter by pipe diameter was pre-

Direct Construction Cost			
Group and Projects		**Facility**	**Manner of Cost Estimates**
			pared referring to those in DPR and experience in Stage IV Phase-II project.
		Main Sewer	【Open Cut】 - Unit construction cost by pipe diameter and excavation depth will be prepared using data from DPR. - Additional cost considered in the DPR (extended pipeline) will not be counted.
			【Trenchless】 - Cost base was changed from pipe ramming method used in the DPR to Micro Tunnel method due to the soil and site condition.
		Main Sewer Road Restoration	- Required cost was adjusted to meet planned length of main sewers in the basic design.
	110 Villages water supply	Distribution facilities from GLRs to OHTs	Adopt DPR cost after updating scope of work and considering price escalation, if any.
Undertaken by Indian side	110 Villages Water Supply	All Facilities	Adopt DPR cost after updating scope of work and considering price escalation, if any.
	UFW Reduction	3 areas in Core area	-Ditto-
	110 Villages Sewerage	Lateral Sewer, House Connections, Lateral Sewer Road Restoration	-Ditto-
	Additional facilities to share Stage V water to Core/ULB	Transmission pipeline from new GLRs to existing GLRs/OHTs in Core/ULB areas	-Ditto- M/P Consultants will prepare the requirements by Feb. 14, 2017.

Table 15.8.2 Summary of Cost Estimation Method for Indirect Cost

Indirect Construction Cost		
Group	**Project**	**Manner of Cost Estimates**
JICA Survey Project	Stage V	The following are to be considered for the application of Japanese ODA loan. 【Eligible Items】
		- Consulting services fee - Price escalation for the cost of construction and consulting services - Physical contingency for the construction and consulting services - Interest during construction period for the construction and consulting services 【Non-eligible Items】 - Land acquisition cost - Customs Duty and tax - Administration cost - Interest during other period of the construction work - O&M cost after project completion - Front End fee

Indirect Construction Cost		
Group	**Project**	**Manner of Cost Estimates**
	110 Villages Sewerage (major facilities)	Same as those in Stage V
Undertaken by Indian side	110 Villages WS	Comply with those in the DPR
	UFW Reduction	-Ditto-
	110 Villages Sewerage (lateral/House connections)	-Ditto-
	Additional facilities to share Stage V water to Core/ULB	-Ditto-

The followings are detailed countermeasures for the estimation of direct construction cost in the Preliminary Design utilizing the results of cost estimate in the concerned DPRs.

(1) Water Supply: CWSS Stage V Project

1) Composition of major facilities

Major facilities for the Stage V Project consist of the following six items, as categorized in the DPR.

- Conveyance Pipeline from SBR to NBR
- Water Treatment Plant at TK Halli
- Clear Water Reservoirs and Pumping Stations at TK Halli, Harohalli and Tataguni
- Transmission Main
- City Trunk Mains
- City Reservoirs

2) Manner of Cost Estimates

The construction cost for the facilities in the DPR is estimated using BOQ and unit prices by facility. In this survey, the same manner is applied, however, in case that the design of facilities are modified/ changed, cost is estimated using BOQ for planed facilities and unit prices for the required items. The following are updated and provided additional measures from those in the DPR.

a) Unit price for civil work used in the DPR (2014-2015 price level) is replaced by that in 2017.

- BWSSB SOR DPR unit price (2014-2015) × 1.04 (4% of price escalation); Refer to BWSSB MEMORANDUM 8927
- PWD SOR DPR unit price (2014-2015→2015-2016) × 1.02 (2% of price escalation); While, if there are unit prices which are inquired from manufacturers and/or experienced, the prices are used.

b) Major mechanical and electrical equipment are updated through inquires to manufacturers.

(2) Sewerage: Major Sewerage Facilities for 110 Villages

1) Sewage Treatment Plant (STP)

a) Manner of cost estimate

The construction cost for the STPs in the DPR is estimated based on the assumption that a uniform cost of 20 thousand INR/m^3 can be adopted for all STPs. However, there is no calculation basis on the cost and according to the experience in Stage IV-Phase 2 sewerage project, the cost ranges from 19 to 55 thousand INR/m^3. In consideration of the facts on the cost estimates, a cost function for unit treatment volume is to be studied for civil and architectural work. Four cases of construction cost of the STPs under the same treatment method are studied including those with three (3) MLD, 10 MLD, 15 MLD, 24 MLD applying the manner of unit price basis for construction requirements.

b) Conditions and Assumptions for Cost Estimates

- The required cost for pile foundation or soil improvement for the construction of foundation, shall be added, as required at respective STPs.
- For civil work, BOQ for a series of work is estimated and present unit price (same as those used in CWSS Stage V Project) is adopted to come up with the construction cost, while for architectural work, a unit price per m^2 (referring to the experience in Stage IV Phase 2 Project) is applied. The required cost for mechanical and electrical facilities is estimated based on the data collected through the inquiries to the manufacturers.

2) ISPS and Force Main Pipeline

The construction cost for the ISPS in the DPR is estimated using BOQ and unit prices. Since planned flow for the ISPS was changed as a result of review work and new ISPSs are planned, the construction cost for the ISPS is estimated applying the following conditions.

- A cost function for civil and architectural work is prepared using the experience in Stage IV Phase 2 project.
- The cost for mechanical and electrical facilities is estimated based on the experience at the existing facilities.

The required cost for the force main is estimated using a cost function to be prepared using the plan in the DPR and experience in the Stage IV Phase 2 project.

3) Main Sewer

a) Utilization of the cost estimates in the DPR

- The cost for main sewers in the DPR is estimated using BOQ and unit prices for the construction requirement. The cost can't be utilized directly for this preliminary design because of the change of STP locations and design conditions of the main sewer lines (route, diameter and inert level resulted in the changes of length and excavation volume) as a result of field study. Thus, unit cost per meter by diameter and by depth (invert level) will be estimated utilizing the data in the DPR

b) Change and Addition from those in the DPR

- Updating of unit price will be made in the same manner adopted for CWSS Stage V Project.
- Construction cost for effluent pipes at the STP is estimated, although the cost for effluent pies is not considered in the DPR.
- The construction method for the crossing of railways, roads and rivers is changed from Pipe Ramming method in the DPR to Micro Tunnel method from the realistic view point.
- The cost for the restoration of storm water drains and roads is shown as a different item from sewer construction cost in the DPR. The restoration cost for sewer construction will include force main and effluent pipes, aside from common main sewers. The cost estimate for the sewers will be made in use of base information on the cost estimate for sewers in the DPR. While, the cost for the restoration of storm water drainage is maintained in a separate item of the overall cost, as it is negligible small.
- The cost required for main sewers in the DPR is estimated considering allowances for the future land development by zone (different sewer length between design and BOQ for cost estimate). In this preliminary design, the cost required for the main sewers will be estimated for those coinciding to the design length.

(2) Conditions and Assumptions for the Estimation of Indirect Cost for the Projects

Conditions and assumptions to estimate indirect cost for the surveyed projects (in case of the application of JICA loan) are summarized below.

i. Price escalation; FC 1.7 % and LC 3.92% annually
ii. Physical contingency; 5 %
iii. PMC (Project Management Consultant) fee; 5 % of direct cost
iv. Front end fee; 0.2 % of direct cost

15.9 Project Implementation Plan for Overall Projects

15.9.1 Detailed Project Scope and Construction Costs

Detailed project scope by package for JICA Survey Project and that to be undertaken by Indian side is shown in Table 15.9.1. Required cost for each package is summarized in Table 15.9.2.

Table 15.9.1 Detailed Project Scope

No.	Facility Name	Quantity	Capacity	Type Remarks
CP-1 : Raw Water Conveyance Pipeline - from Valve Chamber to TK Halli WTP (BWSSB)				
1	Intake Facility at Shiva Balancing Reservoir	-	-	Utilize Existing Facility
2	Conveyance Pipeline From Intake to Valve Chamber	-	-	Utilize Existing Facility
3	Conveyance Pipeline From Valve Chamber to TK Halli WTP	Length: 9.95 km	Dia. 2,750 mm	Pipe Material: MS Bridges for River Crossing: 2 sites
CP-2 : Water Treatment Plant - TK Halli WTP - (JICA)				
1	Cascade Aerator	1 Unit	775 MLD	

No.	Facility Name	Quantity	Capacity	Type Remarks
2	Parshall Flume	2 Units	775 MLD	
3	Rapid Mixing Basin	4 Units	775 MLD	Flash Mixer
4	Flocculation Basin	32 Units	775 MLD	Vertical Flocculator
5	Sedimentation Basin	16 Units	775 MLD	Up- Flow, Tube Settler
6	Rapid Sand Filter	36 Units	775 MLD	Gravity Sand Filter
7	Backwash Water Recovery Basin	2 Units		
8	Sludge Balancing Basin	2 Units		
9	Primary Sludge Thickener	4 Units		
10	Secondary Sludge Thickener	1 Unit		
11	Supernatant Basin	1 Unit		
12	Centrifuge Building	1 Unit		
13	Chemical Building	1 Unit		Alum
14	Chlorination Building for Pre and Post-Chlorination	1 Unit		Liquid Chlorine, Neutralization System
15	Administration Facility	1 Unit		Central Administration Building, Laboratory, Control Room etc.
16	Filter Annex Building	1 Unit		
17	Electrical Switch Yard	1 Unit		
18	Electrical Sub Station	1 Unit		11 kV Power Receiving,
CP-3 : Transmission Facilities at TK Halli (JICA)				
1	Clear Water Reservoir at TK Halli	1 Unit (2 Basins)	68,000 m^3	2 Hour of Output Amount
2	Pump Station at TK Halli	Pump Unit: 9 Nos. (6 operation + 3 stand-by)	5,390 m^3/hr x H 130 m x 2,700 kW	Double Suction Volute Pump with single stage impeller
3	Air Chamber at TK Halli	9 Units	each 100 m^3	
CP-4 : Transmission Facilities at Harohalli (JICA)				
1	Clear Water Reservoir at Harohalli	1 Unit (2 Basins)	34,000 m^3	1 Hour of Output Amount
2	Pump Station at Harohalli	Pump Unit: 9 Nos. (6 operation + 3 stand-by)	5,390 m^3/hr x H 152 m x 3,400 kW	Double Suction Volute Pump with single stage impeller
3	Air Chamber at Harohalli	4 Units	each 100 m^3	
CP-5 : Transmission Facilities at Tataguni (JICA)				
1	Clear Water Reservoir at Tataguni	1 Unit (2 Basins)	34,000 m^3	1 Hour of Output Amount
2	Pump Station at Tataguni	Pump Unit: 9 Nos. (6 operation + 3 stand-by)	5,390 m^3/hr x H 150 m x 3,300 kW	Double Suction Volute Pump with single stage impeller
3	Air Chamber at Tataguni	11 Units	each 100 m^3	
CP-6 : Procurement of MS Plates (JICA)				
1	Procurement of MS Plates for CP-7 and CP-8	1 LS		Pipe Material: MS

No.	Facility Name	Quantity	Capacity	Type Remarks
CP-7 : Transmission Facilities From TK Halli to Harohalli (JICA)				
1	Transmission Pipe From TK Halli to Harohalli	Length: 43.9 km	Dia. 3,000 mm	Pipe Material: MS
2	One-way Surge Tank at JK Doddi	1 Unit (2,200 m^3)	20 m Dia. x 7m High	
CP-8 : Transmission Facilities From Harohalli to Vajarahalli (JICA)				
1	Transmission Pipe From TK Harohalli to Tataguni	Length: 21.5 km	Dia. 3,000 mm	Pipe Material: MS
2	Connection and Branch Pipe at Tataguni	Length: 0.49 km	Dia. 1,500 - 1,900 mm	Pipe Material: MS
3	Transmission Pipe From Tataguni to Vajarahalli	Length: 4.05 km	Dia. 3,000 mm	Pipe Material: MS
CP-9 : City Trunk Main along Eastern Route (JICA)				
1	City Trunk Main	Length: 69.513 km	Dia. 500 - 3,000 mm	Pipe Material: DIP & MS
2	Trenchless Crossing	12 Nos.	Dia. 800 - 2,200 mm	
3	Pipe Bridge	1 No.	Dia. 1,200 mm	
CP-10 : City Trunk Main along Western Route (JICA)				
1	City Trunk Main	Length: 44.949 km	Dia. 800 - 1,600 mm	Pipe Material: DIP & MS
2	Trenchless Crossing	9 Nos.	Dia. 1,300 - 2,000 mm	
3	Pipe Bridge	1 No.	Dia. 1,600 mm	
CP-11 : Branch Feeding Pipes (BWSSB)				
1	Interconnection Pipes with Existing Mains/Reservoirs	Length: 28.9 km	Dia. 600 - 1,400 mm	Pipe Material: DIP & MS
CP-12 : Ground Level Reservoir along Eastern Route (JICA)				
1	Chokkanahalli GLR	1 Unit (2 Basins)	64,800 m^3	
2	Vasudevapura GLR	1 Unit (2 Basins)	10,800 m^3	
3	Singapura GLR	1 Unit (2 Basins)	24,000 m^3	
4	Lingaderanahalli GLR	1 Unit (1 Basin)	17,784 m^3	
5	Disinfection Facility of GLR	each GLRs		
CP-13 : Ground Level Reservoir along Western Route (JICA)				
1	Gottigere GLR	1 Unit (2 Basins)	112,896 m^3	
2	Doddakanahalli GLR	1 Unit (2 Basins)	48,000 m^3	
3	Kadugodi GLR	1 Unit (2 Basins)	48,000 m^3	
4	Disinfection Facility of GLR	each GLRs		
CP-14 : 110 Villages Water Supply Facilities in Bytrayanapura Zone(BWSSB)				
1	Feeder Pipes between GLRs and OHTs	Length: 45.7 km	Dia. 150 – 1,350 mm	Pipe Material: DIP & MS
2	Over Head Tank (OHT)	30 Nos.		
3	Booster Pump, Pump House, Water Sump	21 Nos.		
CP-15 : 110 Villages Water Supply Facilities in Mahadevpura Zone (BWSSB)				
1	Feeder Pipes between GLRs and OHTs	Length: 26.0 km	Dia. 200 – 1,000 mm	Pipe Material: DIP & MS
2	Over Head Tank (OHT)	17 Nos.		
3	Booster Pump, Pump House, Water Sump	13 Nos.		
CP-16 : 110 Villages Water Supply Facilities in Bommanahalli Zone (BWSSB)				

No.	Facility Name	Quantity	Capacity	Type Remarks
1	Feeder Pipes between GLRs and OHTs	Length: 95.1 km	Dia. 200 – 1,750 mm	Pipe Material: DIP & MS
2	Over Head Tank (OHT)	60 Nos.		
3	Booster Pump, Pump House, Water Sump	15 Nos.		
CP-17 : 110 Villages Water Supply Facilities in R.R. Nagar Zone (BWSSB)				
1	Feeder Pipes between GLRs and OHTs	Length: 0.0 km		Utilize Existing Facility
2	Over Head Tank (OHT)	3 Nos.		
3	Booster Pump, Pump House, Water Sump	0 Nos.		
CP-18 : 110 Villages Water Supply Facilities in Dasarahalli Zone (BWSSB)				
1	Feeder Pipes between GLRs and OHTs	Length: 32.5 km	Dia. 150 - 900 mm	Pipe Material: DIP & MS
2	Over Head Tank (OHT)	25 Nos.		
3	Booster Pump, Pump House, Water Sump	12 Nos.		
CP-19 : 110 Villages Distribution Pipe Networks in Bytrayanapura Zone (BWSSB)				
1	Distribution Pipe Networks	Length: 601.5 km	Dia. 100 - 762 mm	Pipe Material: DIP & MS
CP-20 : 110 Villages Distribution Pipe Networks in Mahadevpura Zone (BWSSB)				
1	Distribution Pipe Networks	Length: 521.1 km	Dia. 100 - 600 mm	Pipe Material: DIP
CP-21 : 110 Villages Distribution Pipe Networks in Bommanahalli Zone (BWSSB)				
1	Distribution Pipe Networks	Length: 938.4 km	Dia. 100 - 600 mm	Pipe Material: DIP
CP-22 : 110 Villages Distribution Pipe Networks in R.R. Nagar Zone (BWSSB)				
1	Distribution Pipe Networks	Length: 307.7 km	Dia. 100 - 600 mm	Pipe Material: DIP
CP-23 : 110 Villages Distribution Pipe Networks in Dasarahalli Zone (BWSSB)				
1	Distribution Pipe Networks	Length: 609.9 km	Dia. 100 - 600 mm	Pipe Material: DIP
CP-24 : Centralized SCADA System for Both Water Supply and Sewerage Facilities (JICA)				
1	Centralized SCADA System	1 Unit		
CP-25 : 110 Villages STP and ISPS in Bytrayanapura Zone (JICA)				
1	STP	4 Nos.	7.0 MLD, 6.0 MLD, 7.0 MLD, 17.0 MLD	EA*
2	ISPS	1 No.	125 m^3/hr x H 35.0 m x 2 Nos.	
CP-26 : 110 Villages STP and ISPS in Mahadevpura Zone (JICA)				
1	STP	1 No.	15.0 MLD	EA
2	ISPS	1 No.	564 m^3/hr x H 25.0 m x 3Nos. + 282 m^3/h x 25.0 m x 2 Nos.	
CP-27 : 110 Villages STP and ISPS in Bommanahalli Zone (JICA)				
1	STP	2 Nos.	4.0 MLD, 5.0 MLD	EA
2	ISPS	1 No.	338 m^3/hr x H 36.0 m x 3Nos. + 169 m^3/hr x H 36.0 m x 2 Nos.	
CP-28 : 110 Villages STP and ISPS in R.R. Nagar Zone (JICA)				
1	STP	2 Nos.	8.0 MLD, 13.0 MLD	EA

No.	Facility Name	Quantity	Capacity	Type Remarks
2	ISPS	2 Nos.	138 m^3/hr x H 25.0 m x 2 Nos., 213 m^3/hr x H 23.0 m x 2 Nos.	
CP-29 : 110 Villages STP and ISPS in Dasarahalli Zone (JICA)				
1	STP	5 Nos.	9.0 MLD, 10.0 MLD , 3.0 MLD, 6.0 MLD, 4.0 MLD	EA
2	ISPS	2 Nos.	63 m^3/hr x H 15.0 m x 2 Nos., 304 m^3/hr x H 34.0 m x 3Nos. + 152 m^3/hr x H 34.0 m x 2 Nos.	
CP-30 : 110 Villages Main Sewer in Bytrayanapura Zone (JICA)				
1	Main Sewer	Length: 50.3 km	Dia. 300 ~1000 mm	Pipe Material: Concrete
2	Pressure Main	Length: 1.4 km	Dia. 250mm	Pipe Material: DIP
CP-31 : 110 Villages Main Sewer in Mahadevpura Zone (JICA)				
1	Main Sewer	Length: 44.7 km	Dia. 300 ~800 mm	Pipe Material: Concrete
2	Pressure Main	Length: 5.3 km	Dia. 800 mm	Pipe Material: DIP
CP-32 : 110 Villages Main Sewer in Bommanahalli Zone (JICA)				
1	Main Sewer	Length: 65.011 km	Dia. 300 ~1,200 mm	Pipe Material: Concrete
2	Pressure Main	Length: 3.0 km	Dia. 600 mm	Pipe Material: DIP
CP-33 : 110 Villages Main Sewer in R.R. Nagar Zone (JICA)				
1	Main Sewer	Length: 14.8 km	Dia. 300 ~500 mm	Pipe Material: Concrete
2	Pressure Main	Length: 2.2 km	Dia. 250 ~400 mm	Pipe Material: DIP
CP-34 : 110 Villages Main Sewer in Dasarahalli Zone (JICA)				
1	Main Sewer	Length: 27.5 km	Dia. 300 ~700 mm	Pipe Material: Concrete
2	Pressure Main	Length: 3.4 km	Dia. 200 ~600 mm	Pipe Material: DIP
CP-35 : 110 Villages Lateral Sewer in Bytrayanapura Zone (BWSSB)				
1	Lateral Sewer	Length: 379.2 km	Dia. 230 mm	Pipe Material: GSW
CP-36 : 110 Villages Lateral Sewer in Mahadevpura Zone (BWSSB)				
1	Lateral Sewer	Length: 367.5 km	Dia. 230 mm	Pipe Material: GSW
CP-37 : 110 Villages Lateral Sewer in Bommanahalli Zone (BWSSB)				
1	Lateral Sewer	Length: 773.5 km	Dia. 230 mm	Pipe Material: GSW
CP-38 : 110 Villages Lateral Sewer in R.R. Nagar Zone (BWSSB)				
1	Lateral Sewer	Length: 243.3 km	Dia. 230 mm	Pipe Material: GSW
CP-39 : 110 Villages Lateral Sewer in Dasarahalli Zone (BWSSB)				
1	Lateral Sewer	Length: 493.1 km	Dia. 230 mm	Pipe Material: GSW

*): EA; Extended Aeration process of sewage treatment

Table 15.9.2 Construction Cost for Each Package

Package	Cost (Million INR)
CP-2 : Water Treatment Plant - TK Halli WTP - (JICA)	2,412
CP-3 : Transmission Facilities at TK Halli (JICA)	2,557
CP-4 : Transmission Facilities at Harohalli (JICA)	1,279

Package	Cost (Million INR)
CP-5 : Transmission Facilities at Tataguni (JICA)	1,279
CP-6 : Procurement of MS Plates (JICA)	4,552
CP-7 : Transmission Facilities From TK Halli to Harohalli (JICA)	4,850
CP-8 : Transmission Facilities From Harohalli to Vajarahalli (JICA)	2,942
CP-9 : City Trunk Main along Eastern Route (JICA)	3,565
CP-10 : City Trunk Main along Western Route (JICA)	4,355
CP-12 : Ground Level Reservoir along Eastern Route (JICA)	1,639
CP-13 : Ground Level Reservoir along Western Route (JICA)	1,512
CP-24 : Centralized SCADA System for Both Water Supply and Sewerage Facilities (JICA)	137
Subtotal Stage V(CP2-10, 12-13, 24)	**31,079**
CP-25 : 110 Villages STP and ISPS in Bytrayanapura Zone (JICA)	1,382
CP-26 : 110 Villages STP and ISPS in Mahadevpura Zone (JICA)	1,548
CP-27 : 110 Villages STP and ISPS in Bommanahalli Zone (JICA)	804
CP-28 : 110 Villages STP and ISPS in R.R. Nagar Zone (JICA)	621
CP-29 : 110 Villages STP and ISPS in Dasarahalli Zone (JICA)	655
CP-30 : 110 Villages Main Sewer in Bytrayanapura Zone (JICA)	753
CP-31 : 110 Villages Main Sewer in Mahadevpura Zone (JICA)	347
CP-32 : 110 Villages Main Sewer in Bommanahalli Zone (JICA)	198
CP-33 : 110 Villages Main Sewer in R.R. Nagar Zone (JICA)	1,044
CP-34 : 110 Villages Main Sewer in Dasarahalli Zone (JICA)	990
Subtotal 110 Villages Sewerage Main Facility(CP25-34)	**8,342**
JICA Sub-total	**39,421**
CP-35 : 110 Villages Lateral Sewer in Bytrayanapura Zone (BWSSB)	1,896
CP-36 : 110 Villages Lateral Sewer in Mahadevpura Zone (BWSSB)	1,766
CP-37 : 110 Villages Lateral Sewer in Bommanahalli Zone (BWSSB)	1,539
CP-38 : 110 Villages Lateral Sewer in R.R. Nagar Zone (BWSSB)	1,032
CP-39 : 110 Villages Lateral Sewer in Dasarahalli Zone (BWSSB)	3,277
Subtotal 110 Villages Sewerage Lateral Sewer(CP35-39)	**9,510**
CP-14 : 110 Villages Water Supply Facilities in Bytrayanapura Zone(BWSSB)	1,111
CP-15 : 110 Villages Water Supply Facilities in Mahadevpura Zone (BWSSB)	467
CP-16 : 110 Villages Water Supply Facilities in Bommanahalli Zone (BWSSB)	2,749
CP-17 : 110 Villages Water Supply Facilities in R.R. Nagar Zone (BWSSB)	60
CP-18 : 110 Villages Water Supply Facilities in Dasarahalli Zone (BWSSB)	977
Subtotal 110 Villages Water Supply(CP14-18)	**5,364**
CP-19 : 110 Villages Distribution Pipe Networks in Bytrayanapura Zone (BWSSB)	1,772
CP-20 : 110 Villages Distribution Pipe Networks in Mahadevpura Zone (BWSSB)	2,474
CP-21 : 110 Villages Distribution Pipe Networks in Bommanahalli Zone (BWSSB)	3,245
CP-22 : 110 Villages Distribution Pipe Networks in R.R. Nagar Zone (BWSSB)	673

Package	Cost (Million INR)
CP-23 : 110 Villages Distribution Pipe Networks in Dasarahalli Zone (BWSSB)	1,664
110 Villages Distribution(CP19-24)	**9,828**
CP-1 : Raw Water Conveyance Pipeline - From Valve Chamber to TK Halli WTP (BWSSB)	**1,760**
CP-11 : Branch Feeding Pipes (BWSSB)	**905**
BWSSB Sub-total	**27,367**
Grand Total (Direct Cost)	**66,788**

15.9.2 Overall Project Cost

Considering indirect cost including price escalation, physical contingency and other items, estimated project cost is shown in Table 15.9.3. In this Table, 91 % of JICA funded construction costs are set in "A: Eligible Portion" and the rests are "B: Non Eligible Portion". Overall cost required is estimated at about 149 Billion Yen.

Table 15.9.3 Project Cost for Water Supply and Sewerage Project

Item	Water Supply			Sewerage			Total		
	FC	LC	Total	FC	LC	Total	FC	LC	Total
A. ELIGIBLE PORTION	Million JPY	Million INR	Million JPY	Million JPY	Million INR	Million JPY	Million JPY	Million INR	Million JPY
Ⅰ) Procurement / Construction	2,327	33,170	60,043	0	9,375	16,313	2,327	42,545	76,356
Base cost for JICA financing	2,072	27,091	49,210	0	7,591	13,209	2,072	34,682	62,419
Price escalation	144	4,500	7,974	0	1,338	2,328	144	5,838	10,302
Physical contingency	111	1,580	2,859	0	446	777	111	2,026	3,636
Ⅱ) Consulting services	1,928	1,061	3,774	844	561	1,821	2,772	1,622	5,595
Base cost	1,726	875	3,249	753	460	1,554	2,479	1,336	4,803
Price escalation	110	135	345	51	74	180	161	209	526
Physical contingency	92	51	180	40	27	87	132	77	266
Total (Ⅰ + Ⅱ)	4,255	34,231	63,817	844	9,936	18,134	5,099	44,167	81,951
B. NON ELIGIBLE PORTION							0	0	0
a Procurement / Construction	230	23,348	40,855	0	12,824	22,315	230	36,172	63,170
Base cost for JICA financing	205	20,536	35,938	0	10,261	17,854	205	30,797	53,792
Price escalation	14	1,699	2,971	0	1,953	3,398	14	3,652	6,369
Physical contingency	11	1,112	1,945	0	611	1,063	11	1,723	3,008
b Land Acquisition	0	0	0	0	0	0	0	0	0
Base cost	0	0	0	0	0	0	0	0	0
Price escalation	0	0	0	0	0	0	0	0	0
Physical contingency	0	0	0	0	0	0	0	0	0
c Administration cost	0	1,740	3,027	0	666	1,159	0	2,406	4,186
d GST	0	73	128	0	0	0	0	73	128
e Import Tax	0	220	384	0	0	0	0	220	384
Total (a+b+c+d+e)	230	25,381	44,393	0	13,490	23,473	230	38,871	67,866
TOTAL (A+B)	2,557	58,552	104,437	0	22,866	39,787	2,557	81,418	144,224
C. Interest during Construction	3,596	0	3,596	776	0	776	4,372	0	4,372
Interest during Construction(Const.)	3,594	0	3,594	775	0	775	4,369	0	4,369
Interest during Construction (Consul.)	2	0	2	1	0	1	3	0	3
D. Front End Fee	120	0	120	33	0	33	153	0	153
GRAND TOTAL (A+B+C+D)	6,273	58,552	108,151	808	22,866	40,595	7,081	81,418	148,746
E. JICA finance portion (A)	4,255	34,231	63,817	844	9,936	18,134	5,099	44,167	81,951

Source: JICA Survey Team

15.9.3 Overall Project Schedule

The overall project schedule both for JICA Survey Project and that to be undertaken by Indian side is shown in Figure 15.9.1.

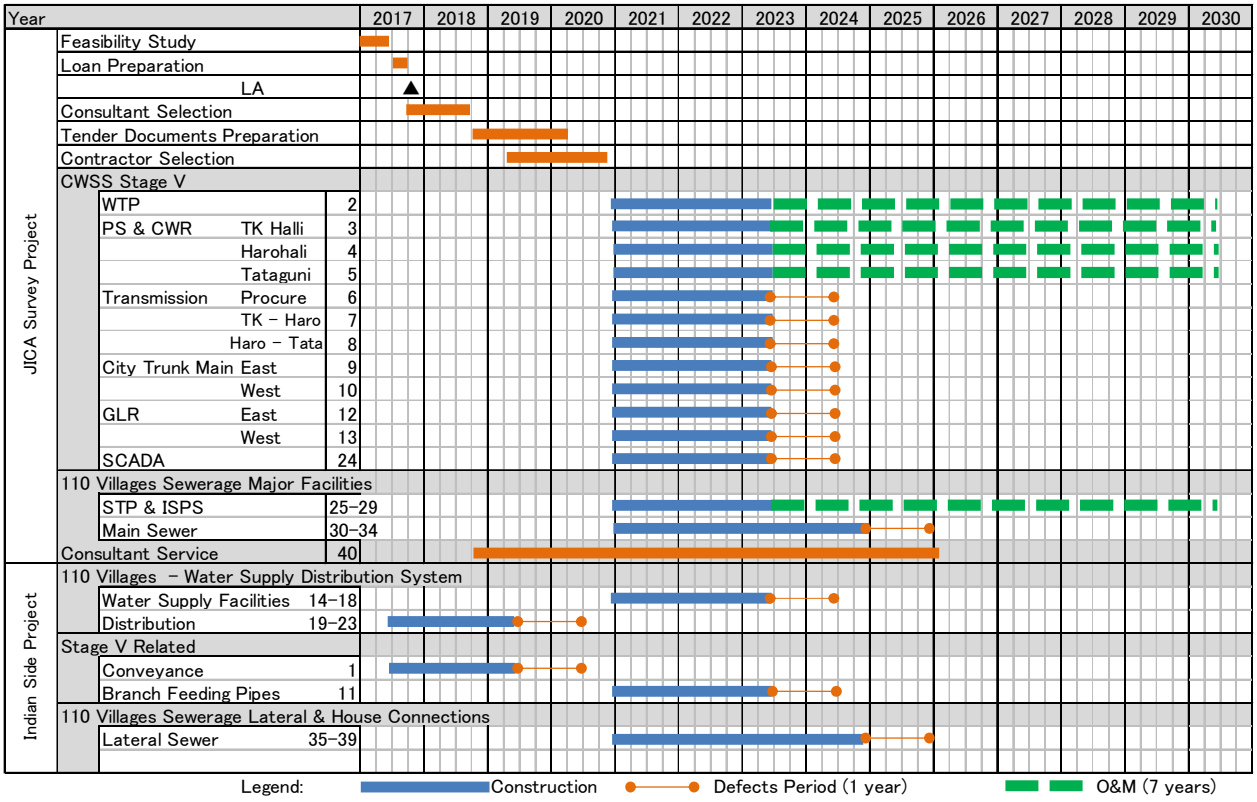


Figure 15.9.1 Overall Implementation Schedule

15.10 Study on the Reduction of Construction and/or O&M Cost

The followings are considered in the preliminary design of sewerage facilities for the reduction of cost requirements.

(1) Reduction of Construction and O&M Cost

The study was made for the adoption of simple facilities and equipment through the investigations on local products and practices for the reduction of construction cost and the saving of O&M cost. Details are enumerated below.

- No application of facilities for ventilation and deodorization providing open air space at ISPSs and sludge treatment buildings
- Reduction of the cost for construction of grid chamber being installed at shallow elevation after pumping up sewage at the inlet point of the STP
- Reduction of excavation cost installing buildings/facilities on the ground
- No thickening of sludge in application of local practices

(2) Reduction of construction cost in effective use of existing facilities

- Utilization of existing facilities at the ISPSs as much extent as possible

(3) Reduction of labor cost and improvement of services to the customers through effective O&M

- Effective O&M using SCADA System, GIS system and MIS system

15.11 Project Effectiveness

The performance indicators are studied for monitoring of inputs, outputs, outcomes, and impacts of the project. These indicators shall be monitored during project implementation to assess project progress toward project objectives, and for evaluation of project accomplishments after project implementation.

Construction work for the Project is planned to be completed in December, 2023. The projected indicators by target year are shown in Table 15.11.1. The target may be achieved by completion of both JICA Survey project and that to be undertaken by Indian side.

Table 15.11.1 Operation and Effect Indicators

Water Supply Project

Indicator	Indicator	Unit	Standard Value 2016	Target Value 2026
Operation Indicator	Served Population (110 Villages) < for reference >	Person	0	1,570,000 *1
	Served Population (BBMP) < for reference >	Person	5,840,000*2	9,060,000*1
	Daily Average Amount of Water Supply (110 Villages)	m^3/day	0	280,000 *3
	Daily Average Amount of Water Supply (BBMP)	m^3/day	1,310,000	1,710,000 *4
	Rate of Facility Utilization (TK Halli WTP of Phase 3)	%	-	52 *5

*1, 2, 3, 4, 5: It is based on the detailed water demand for indicator (water supply).

*1, 2: For reference only due to unavailability of population data. As a supposition, served population in 2026 was estimated as total population (projection based on 2011 census) minus groundwater consumers.

*2: Since the water is not supplied for 110 Villages in 2016, it is assumed as follows;

assumed served population total (BBMP Total) 6,695,298 – assumed served population total (110 Villages) 858,292

≒ 5,840,000

*3: 280 MLD is based on assumption of 150 LPCD x 1,570,000 / (1 - UFW 16%).

*4: Total population in BBMP - groundwater dependent population = served population. 150 LPCD for household tap and 20 LPCD for public tap x served population = water consumed and considering UFW, we get water demand of 1,710 MLD.

*5: It is calculated as follows;

(daily average water supply amount from BWSSB 1,712,951 m^3/d – existing WTP capacity of 1,310,000 m^3/d) / WTP capacity of Phase 3 (775,000 m^3/d)

Sewerage Project

Indicator	Indicator	Unit	Standard Value 2016	Target Value 2026
Operation Indicator	Population Treated (110 Villages) < for reference>	Person	0	1,210,000*6
	Amount of Wastewater treated (110 Villages)	m^3/day	0	160,000*7
	Rate of Facility Utilization (14 STPs of Phase 3)	%	-	37*8
	BOD_5 concentration (Effluent from 14 STPs of Phase 3)	mg/l	-	not more than 10*9
	TSS concentration (Effluent from 14 STPs of Phase 3)	mg/l	-	not more than 20*9

*6, 7, 8: It is based on the detailed water demand for indicator (sewerage).

*6: For reference only due to unavailability of population data. Total population of 110 Villages (2,134,676: projection based on 2011 census) x estimated connection ratio (average 57% shown in Table 15.11.3).

*7: Population treated x 132 LPCD (for Phase 3, only 37 % utilization in 2026 i.e 43 MLD shown in Table 15.11. 3). Balance 160 - 43= 117 MLD to be treated in existing / future plants. Full utilization of 114 MLD is expected to be in 2034.

*8: It is calculated as daily average amount of wastewater in 14 systems of Phase 3 (43 MLD) / Total STP capacity of Phase 3 (114 MLD).

*9: Effluent Discharge Standards for Sewage Treatment Plant: Section 18 (1) (b) of the Water Prevention and Control of Pollution Act, 1974, which was amended and issued from CPCB (Central Pollution Control Board) to KPCB (Karnataka Pollution Control Board) on April 21st, 2015. Treated effluent shall not be more than the target value shown in the above table any time, it means the value shall be compared as a maximum (peak) value.

The detailed water demand for indicator is shown in Tables 15.11.2 and 15.11.3. These tables show the population in BBMP, groundwater consumer and water supply served population annually. For Core and ULB areas, public tap consumer and UFW ratio decreasing were also estimated, however, no public tap user and fixed UFW ratio of 16 % were considered in 110 Villages.

Table 15.11.2 Detailed Demand for Indicators (1)

Detaield Water Demand for Indicator (High Population Growth)

	Population in BBMP (a)				Groundwater Consumer (b)			Served Population Total (c)=((a)-(b))*100%				Served Population by Household Tap (d)=(c)			Served Population by Public Tap (e)			Served Population in Slum by Pubilc Tap (f)				Per Capita Consumption (g)		Daily Average Water Consumption (m3/d)				UFW (%) (i)			Average Amount of Water Supply (m3/d)				Load Factor (k)	Maximum Amount of Water Supply (m3/d)			
	Core	ULB	110 V	Total	Core	ULB	110V	Core	ULB	110V	Total	Core	ULB	110V	Core	ULB	110V	Core	ULB	110V	Total	Household	Pubic Tap	Core	ULB	110V	Total	Core	ULB	110V	Core	ULB	110V	Total		Core	ULB	110V	Total
2011	5,422,033	1,969,414	1,103,515	8,494,962	1,643,163	596,837	560,000	3,778,870	1,372,577	543,515	5,694,962																													
2012	5,464,325	2,055,674	1,151,849	8,671,848	1,643,163	596,837	560,000	3,821,162	1,458,837	591,849	5,871,848																													
2013	5,506,947	2,145,713	1,202,300	8,854,959	1,643,163	596,837	560,000	3,863,784	1,548,876	642,300	6,054,959																													
2014	5,549,901	2,239,695	1,254,961	9,044,557	1,643,163	596,837	560,000	3,906,738	1,642,858	694,961	6,244,557																													
2015	5,593,190	2,337,794	1,309,928	9,240,912	1,643,163	596,837	560,000	3,950,027	1,740,957	749,928	6,440,912																													
2016	5,636,817	2,440,189	1,418,292	9,495,298	1,643,163	596,837	560,000	3,993,654	1,843,352	858,292	6,695,298	3,195,654	1,495,437	858,292	54,000	25,500	0	744,000	322,415	0	1,066,415	150	20	495,308	231,274	128,744	855,326	48%	48%	16%	952,516	444,757	153,266	1,550,539	1.0	952,516	444,757	153,266	1,550,539
2017	5,680,784	2,547,069	1,502,237	9,730,090	1,643,163	596,837	560,000	4,037,621	1,950,232	942,237	6,930,090	3,239,621	1,602,317	942,237	54,000	25,500	0	744,000	322,415	0	1,066,415	150	20	501,903	247,306	141,336	890,545	46%	46%	16%	929,450	457,974	168,257	1,555,681	1.0	929,450	457,974	168,257	1,555,681
2018	5,725,094	2,658,631	1,567,019	9,950,744	1,643,163	596,837	560,000	4,081,931	2,061,794	1,007,019	7,150,744	3,283,931	1,713,879	43,647	54,000	25,500	0	744,000	322,415	0	1,066,415	150	20	508,550	264,040	151,053	923,643	44%	44%	16%	908,124	471,500	179,825	1,559,450	1.0	908,124	471,500	179,825	1,559,450
2019	5,769,750	2,775,079	1,634,608	10,179,437	1,643,163	596,837	560,000	4,126,587	2,178,242	1,074,608	7,379,437	3,328,587	1,830,327	1,074,608	54,000	25,500	0	744,000	322,415	0	1,066,415	150	20	515,248	281,507	161,191	957,947	42%	42%	16%	888,359	485,358	191,894	1,565,610	1.0	888,359	485,358	191,894	1,565,610
2020	5,814,754	2,896,628	1,705,125	10,416,506	1,643,163	596,837	560,000	4,171,591	2,299,791	1,145,125	7,616,506	3,373,591	1,951,876	1,145,125	54,000	25,500	0	744,000	322,415	0	1,066,415	150	20	521,999	299,740	171,769	993,507	40%	40%	16%	869,998	499,566	204,487	1,574,050	1.0	869,998	499,566	204,487	1,574,050
2021	5,860,109	3,023,500	1,778,698	10,662,307	1,643,163	596,837	560,000	4,216,946	2,426,663	1,218,698	7,862,307	3,418,946	2,078,748	1,218,698	54,000	25,500	0	744,000	322,415	0	1,066,415	150	20	528,802	318,770	182,805	1,030,377	38%	38%	16%	852,906	514,146	217,625	1,584,677	1.0	852,906	514,146	217,625	1,584,677
2022	5,905,818	3,136,881	1,844,787	10,887,486	1,643,163	596,837	560,000	4,262,655	2,540,044	1,284,787	8,087,486	3,464,655	2,192,129	1,284,787	54,000	25,500	0	744,000	322,415	0	1,066,415	150	20	535,658	335,778	192,718	1,064,154	36%	36%	16%	836,966	524,653	229,426	1,591,045	1.0	836,966	524,653	229,426	1,591,045
2023	5,951,883	3,254,514	1,913,336	11,119,734	1,643,163	596,837	560,000	4,308,720	2,657,677	1,353,336	8,319,734	3,510,720	2,309,762	1,353,336	54,000	25,500	0	744,000	322,415	0	1,066,415	150	20	542,568	353,423	203,000	1,098,991	34%	34%	16%	822,073	535,489	241,667	1,599,229	1.0	822,073	535,489	241,667	1,599,229
2024	5,998,308	3,376,558	1,984,437	11,359,303	1,643,163	596,837	560,000	4,355,145	2,779,721	1,424,437	8,559,303	3,557,145	2,431,806	1,424,437	54,000	25,500	0	744,000	322,415	0	1,066,415	150	20	549,532	371,729	213,665	1,134,926	33%	33%	16%	820,197	554,820	254,364	1,629,380	1.0	820,197	554,820	254,364	1,629,380
2025	6,045,095	3,503,179	2,058,184	11,606,458	1,643,163	596,837	560,000	4,401,932	2,906,342	1,498,184	8,806,458	3,641,132	2,574,548	1,498,184	54,000	25,500	0	706,800	306,294	0	1,013,094	150	20	561,386	392,818	224,728	1,178,931	32%	32%	16%	825,567	577,674	267,533	1,670,774	1.0	825,567	577,674	267,533	1,670,774
2026	6,092,246	3,634,549	2,134,676	11,861,471	1,643,163	596,837	560,000	4,449,083	3,037,712	1,574,676	9,061,471	3,725,483	2,722,038	1,574,676	54,000	25,500	0	669,600	290,174	0	959,774	150	20	573,295	414,619	236,201	1,224,115	31%	31%	16%	830,862	600,897	281,192	1,712,951	1.0	830,862	600,897	281,192	1,712,951
2027	6,139,766	3,770,844	2,214,016	12,124,626	1,643,163	596,837	560,000	4,496,603	3,174,007	1,654,016	9,324,626	3,810,203	2,874,454	1,654,016	54,000	25,500	0	632,400	274,053	0	906,453	150	20	585,258	437,159	248,102	1,270,520	30%	30%	16%	836,084	624,513	295,360	1,755,957	1.0	836,084	624,513	295,360	1,755,957
2028	6,187,656	3,912,251	2,296,309	12,396,216	1,643,163	596,837	560,000	4,544,493	3,315,414	1,736,309	9,596,216	3,895,293	3,031,982	1,736,309	54,000	25,500	0	595,200	257,932	0	853,132	150	20	597,278	460,466	260,446	1,318,190	29%	29%	16%	841,237	648,544	310,055	1,799,835	1.0	841,237	648,544	310,055	1,799,835
2029	6,235,920	4,058,960	2,381,667	12,676,547	1,643,163	596,837	560,000	4,592,757	3,462,123	1,821,667	9,876,547	3,980,757	3,194,812	1,821,667	54,000	25,500	0	520,800	225,691	0	746,491	150	20	609,354	484,568	273,250	1,367,172	28%	28%	16%	846,324	673,011	325,298	1,844,633	1.0	846,324	673,011	325,298	1,844,633
2030	6,284,560	4,211,171	2,470,202	12,965,934	1,643,163	596,837	560,000	4,641,397	3,614,334	1,910,202	10,165,934	4,066,597	3,363,144	1,910,202	54,000	25,500	0	483,600	209,570	0	693,170	150	20	621,486	509,495	286,530	1,417,511	27%	27%	16%	851,350	697,939	341,108	1,890,397	1.0	851,350	697,939	341,108	1,890,397
2031	6,333,580	4,369,090	2,562,035	13,264,704	1,643,163	596,837	560,000	4,690,417	3,772,253	2,002,035	10,464,704	4,152,817	3,537,183	2,002,035	54,000	25,500	0	446,400	193,449	0	639,849	150	20	633,674	535,279	300,305	1,469,259	26%	26%	16%	856,317	723,350	357,506	1,937,173	1.0	856,317	723,350	357,506	1,937,173
2032	6,382,982	4,511,086	2,645,046	13,539,113	1,643,163	596,837	560,000	4,739,819	3,914,249	2,085,046	10,739,113	4,239,419	3,695,300	2,085,046	54,000	25,500	0	409,200	177,328	0	586,528	150	20	645,921	558,674	312,757	1,517,352	25%	25%	16%	861,228	744,899	372,330	1,978,456	1.0	861,228	744,899	372,330	1,978,456
2033	6,432,769	4,657,696	2,730,747	13,821,211	1,643,163	596,837	560,000	4,789,606	4,060,859	2,170,747	11,021,211	4,326,406	3,858,031	2,170,747	54,000	25,500	0	372,000	161,208	0	533,208	150	20	658,225	582,761	325,612	1,566,598	24%	24%	16%	866,085	766,791	387,633	2,020,510	1.0	866,085	766,791	387,633	2,020,510
2034	6,482,944	4,809,071	2,819,225	14,111,241	1,643,163	596,837	560,000	4,839,781	4,212,234	2,259,225	11,311,241	4,413,781	4,025,526	2,259,225	54,000	25,500	0	334,800	145,087	0	479,887	150	20	670,587	607,563	338,884	1,617,034	23%	23%	16%	870,892	789,043	403,433	2,063,369	1.0	870,892	789,043	403,433	2,063,369
2035	6,533,511	4,965,366	2,910,025	14,408,903	1,643,163	596,837	560,000	4,890,348	4,368,529	2,350,025	11,608,903	4,501,548	4,197,942	2,350,025	54,000	25,500	0	297,600	128,966	0	426,566	150	20	683,008	633,103	352,504	1,668,615	22%	22%	16%	875,652	811,671	419,647	2,106,970	1.0	875,652	811,671	419,647	2,106,970
2036	6,584,473	5,126,740	3,003,755	14,714,968	1,643,163	596,837	560,000	4,941,310	4,529,903	2,443,755	11,914,968	4,589,710	4,375,437	2,443,755	54,000	25,500	0	260,400	112,845	0	373,245	150	20	695,488	659,405	366,563	1,721,457	21%	21%	16%	880,365	834,690	436,385	2,151,440	1.0	880,365	834,690	436,385	2,151,440
2037	6,635,832	5,293,359	3,100,510	15,029,701	1,643,163	596,837	560,000	4,992,669	4,696,522	2,540,510	12,229,701	4,678,269	4,558,177	2,540,510	54,000	25,500	0	223,200	96,725	0	319,925	150	20	708,028	686,493	381,076	1,775,598	20%	20%	16%	885,035	858,117	453,662	2,196,815	1.0	885,035	858,117	453,662	2,196,815
2038	6,687,591	5,465,393	3,200,386	15,353,370	1,643,163	596,837	560,000	5,044,428	4,868,556	2,640,386	12,553,370	4,767,228	4,746,332	2,640,386	54,000	25,500	0	189,000	80,604	0	266,604	150	20	720,628	714,394	396,058	1,831,080	19%	19%	16%	889,664	881,968	471,497	2,243,130	1.0	889,664	881,968	471,497	2,243,130
2039	6,739,754	5,643,019	3,303,485	15,686,258	1,643,163	596,837	560,000	5,096,591	5,046,182	2,743,485	12,886,258	4,856,591	4,940,078	2,743,485	54,000	25,500	0	186,000	80,604	0	266,604	150	20	733,289	743,134	411,523	1,887,945	18%	18%	16%	894,255	906,261	489,908	2,290,423	1.0	894,255	906,261	489,908	2,290,423
2040	6,792,324	5,826,417	3,409,912	16,028,653	1,643,163	596,837	560,000	5,149,161	5,229,580	2,849,912	13,228,653	4,946,361	5,139,597	2,849,912	54,000	25,500	0	148,800	64,483	0	213,283	150	20	746,010	772,739	427,487	1,946,236	17%	17%	16%	898,807	931,011	508,913	2,338,731	1.0	898,807	931,011	508,913	2,338,731
2041	6,845,305	6,015,775	3,519,773	16,380,852	1,643,163	596,837	560,000	5,202,142	5,418,938	2,959,773	13,580,852	5,036,542	5,345,076	2,959,773	54,000	25,500	0	111,600	48,362	0	159,962	150	20	758,793	803,239	443,966	2,005,998	16%	16%	16%	903,325	956,236	528,531	2,388,093	1.0	903,325	956,236	528,531	2,388,093
2042	6,898,698	6,196,249	3,624,752	16,719,699	1,643,163	596,837	560,000	5,255,535	5,599,412	3,064,752	13,919,699	5,127,135	5,541,670	3,064,752	54,000	25,500	0	74,400	32,242	0	106,642	150	20	771,638	832,405	459,713	2,063,756	16%	16%	16%	918,617	990,959	547,277	2,456,853	1.0	918,617	990,959	547,277	2,456,853
2043	6,952,508	6,382,136	3,732,865	17,067,509	1,643,163	596,837	560,000	5,309,345	5,785,299	3,172,865	14,267,509	5,218,145	5,743,678	3,172,865	54,000	25,500	0	37,200	16,121	0	53,321	150	20	784,546	862,384	475,930	2,122,860	16%	16%	16%	933,983	1,026,648	566,583	2,527,214	1.0	933,983	1,026,648	566,583	2,527,214
2044	7,006,737	6,573,600	3,844,205	17,424,543	1,643,163	596,837	560,000	5,363,574	5,976,763	3,284,205	14,624,543	5,309,574	5,951,263	3,284,205	54,000	25,500	0	0	0	0	0	150	20	797,516	893,199	492,631	2,183,346	16%	16%	16%	949,424	1,063,333	586,465	2,599,222	1.0	949,424	1,063,333	586,465	2,599,222
2045	7,061,390	6,770,808	3,958,869	17,791,067	1,643,163	596,837	560,000	5,418,227	6,173,971	3,398,869	14,991,067	5,364,227	6,148,471	3,398,869	54,000	25,500	0	0	0	0	0	150	20	805,714	922,781	509,830	2,238,325	16%	16%	16%	959,183	1,098,548	606,941	2,664,673	1.0	959,183	1,098,548	606,941	2,664,673
2046	7,116,469	6,973,932	4,076,955	18,167,356	1,643,163	596,837	560,000	5,473,306	6,377,095	3,516,955	15,367,356	5,419,306	6,351,595	3,516,955	54,000	25,500	0	0	0	0	0	150	20	813,976	953,249	527,543	2,294,768	16%	16%	16%	969,019	1,134,821	628,028	2,731,867	1.0	969,019	1,134,821	628,028	2,731,867
2047	7,171,977	7,183,150	4,198,567	18,553,694	1,643,163	596,837	560,000	5,528,814	6,586,313	3,638,567	15,753,694	5,474,814	6,560,813	3,638,567	54,000	25,500	0	0	0	0	0	150	20	822,302	984,632	545,785	2,352,719	16%	16%	16%	978,931	1,172,181	649,744	2,800,856	1.0	978,931	1,172,181	649,744	2,800,856
2048	7,227,919	7,398,645	4,323,809	18,950,372	1,643,163	596,837	560,000	5,584,756	6,801,808	3,763,809	16,150,372	5,530,756	6,776,308	3,763,809	54,000	25,500	0	0	0	0	0	150	20	830,693	1,016,956	564,571	2,412,221	16%	16%	16%	988,921	1,210,662	672,109	2,871,691	1.0	988,921	1,210,662	672,109	2,871,691
2049	7,284,297	7,620,606	4,452,789	19,357,687	1,643,163	596,837	560,000	5,641,134	7,023,769	3,892,789	16,557,693	5,587,134	6,998,269	3,892,789	54,000	25,500	0	0	0	0	0	150	20	839,150	1,050,250	583,918	2,473,319	16%	16%	16%	998,988	1,250,298	695,141	2,944,427	1.0	998,988	1,250,298	695,141	2,944,427
2050	7,341,115	7,849,224	4,585,620	19,775,959	1,643,163	596,837	560,000	5,697,952	7,252,387	4,025,620	16,975,959	5,643,952	7,226,887	4,025,620	54,000	25,500	0	0	0	0	0	150	20	847,673	1,084,543	603,843	2,536,059	16%	16%	16%	1,009,134	1,291,123	718,861	3,019,118	1.0	1,009,134	1,291,123	718,861	3,019,118
2051	7,398,376	8,084,702	4,722,416	20,205,494	1,643,163	596,837	560,000	5,755,213	7,487,865	4,162,416	17,405,494	5,701,213	7,462,365	4,162,416	54,000	25,500	0	0	0	0	0	150	20	856,262	1,119,865	624,362	2,600,489	16%	16%	16%	1,019,359	1,333,172	743,289	3,095,820	1.0	1,019,359	1,333,172	743,289	3,095,820

Table 15.11.3 Detailed Demand for Indicators (2)

Detailed Sewerage Demand for Indicator (High Population Growth)

	Population (a)	Target Poplation (person) (b)				Percentage of Population connected (%) (c)				Population Treated (person) (d) = (b) * (c)				Per Capita Amount (e)	Amount of wastewater treated (m3/d) (f) = (d) * (e)			
	110 V	Stage I V STP	Stage V STP	Others	Total	Stage IV STP	Stage V STP	Others	Ave.	Stage IV STP	Stage V STP	Others	Total	LPCD	Stage IV STP	Stage V STP	Others	Total
2011	1,103,515	664,343	337,260	101,912	1,103,515	0%	0%	0%	0%	0	0	0	0	132	0	0	0	0
2012	1,151,849	693,442	352,032	106,376	1,151,849	0%	0%	0%	0%	0	0	0	0	132	0	0	0	0
2013	1,202,300	723,814	367,450	111,035	1,202,300	0%	0%	0%	0%	0	0	0	0	132	0	0	0	0
2014	1,254,961	755,518	383,545	115,898	1,254,961	0%	0%	0%	0%	0	0	0	0	132	0	0	0	0
2015	1,309,928	788,609	400,344	120,975	1,309,928	0%	0%	0%	0%	0	0	0	0	132	0	0	0	0
2016	1,418,292	853,847	433,463	130,982	1,418,292	0%	0%	0%	0%	0	0	0	0	132	0	0	0	0
2017	1,502,237	904,384	459,118	138,735	1,502,237	0%	0%	0%	0%	0	0	0	0	132	0	0	0	0
2018	1,567,019	943,384	478,917	144,718	1,567,019	0%	0%	0%	0%	0	0	0	0	132	0	0	0	0
2019	1,634,608	984,074	499,574	150,960	1,634,608	0%	0%	0%	0%	0	0	0	0	132	0	0	0	0
2020	1,705,125	1,026,528	521,125	157,472	1,705,125	0%	0%	0%	0%	0	0	0	0	132	0	0	0	0
2021	1,778,698	1,070,821	543,611	164,267	1,778,698	0%	0%	0%	0%	0	0	0	0	132	0	0	0	0
2022	1,844,787	1,110,608	563,809	170,370	1,844,787	10%	0%	10%	7%	111,061	0	17,037	128,098	132	14,660	0	2,249	16,909
2023	1,913,336	1,151,876	584,759	176,701	1,913,336	30%	10%	30%	24%	345,563	58,476	53,010	457,049	132	45,614	7,719	6,997	60,330
2024	1,984,437	1,194,680	606,489	183,267	1,984,437	40%	30%	40%	37%	477,872	181,947	73,307	733,126	132	63,079	24,017	9,676	96,773
2025	2,058,184	1,239,078	629,028	190,078	2,058,184	50%	40%	50%	47%	619,539	251,611	95,039	966,189	132	81,779	33,213	12,545	127,537
2026	2,134,676	1,285,128	652,406	197,142	2,134,676	60%	50%	60%	57%	771,077	326,203	118,285	1,215,565	132	101,782	43,059	15,614	160,455
2027	2,214,016	1,332,893	676,654	204,469	2,214,016	70%	60%	70%	67%	933,025	405,992	143,128	1,482,146	132	123,159	53,591	18,893	195,643
2028	2,296,309	1,382,435	701,805	212,069	2,296,309	80%	70%	80%	77%	1,105,948	491,263	169,655	1,766,867	132	145,985	64,847	22,394	233,226
2029	2,381,667	1,433,823	727,892	219,952	2,381,667	90%	80%	90%	87%	1,290,440	582,314	197,957	2,070,711	132	170,338	76,865	26,130	273,334
2030	2,470,202	1,487,123	754,951	228,128	2,470,202	93%	90%	93%	92%	1,383,025	679,456	212,159	2,274,640	132	182,559	89,688	28,005	300,252
2031	2,562,035	1,542,409	783,017	236,609	2,562,035	96%	93%	96%	95%	1,480,712	728,205	227,145	2,436,063	132	195,454	96,123	29,983	321,560
2032	2,645,046	1,592,383	808,387	244,276	2,645,046	98%	96%	98%	97%	1,560,536	776,051	239,390	2,575,977	132	205,991	102,439	31,599	340,029
2033	2,730,747	1,643,977	834,579	252,190	2,730,747	99%	99%	99%	99%	1,627,538	826,233	249,668	2,703,439	132	214,835	109,063	32,956	356,854
2034	2,819,225	1,697,244	861,620	260,361	2,819,225	100%	100%	100%	100%	1,697,244	861,620	260,361	2,819,225	132	224,036	113,734	34,368	372,138

15.12 Risk and Mitigation Measures

BWSSB has enough experience on water supply and sewerage projects through the implementation of Phase 1 and 2 projects. They can manage in the implementation of projects. But natural phenomenon such as drought cannot be controlled, though it is possible to discharge some additional water from dam. Even providing some countermeasures, it is not avoidable to decrease supply hours in severe draught year. Assumed risk and its mitigation measures are shown in Table 15.12.1.

Table 15.12.1 Risk Management Framework

Potential project risks	Assessment
1. Water Source	Probability: Low
1.1 Quality of Water Source	Impact: Middle
(Description of risk) Water pollution in the Cauvery River may happen, if eutrophication in the dam occurs; population increase in the river basin.	Analysis of probability and impact: As of now, water quality of the river water is favorable for drinking purpose and there is no big size development plan in the upstream of Cauvery River. Therefore, possibility of water pollution by the development may be small. However, there is a possibility of offensive odour and algae outgrowth by eutrophication at the dams. In case of arising such problems, countermeasures to the clogging at filter basin and offensive odor are required. Mitigation measures: Introduction of advanced water treatment process to reduce offensive odor. Action during the implementation: Regular water quality monitoring Contingency plan (if applicable): -
1.2 Quantity of Water Source	Probability: Low-middle
(Description of risk) Reduction of Cauvery River flow may happen and it may cause reduction of production water amount.	Impact: Middle Analysis of probability and impact: Planned intake water amount is less than average droughty water- discharge of Cauvery River. However, planned amount can't be taken in droughty year from the river. Mitigation measures: Request concerned Authority to discharge water from the dams. Promotion of water saving by users. Action during the implementation: N.A. Contingency plan (if applicable): -
2. Water Demand	Probability: Middle Impact: Low
(Description of risk) Increase/decrease of actual water demand caused by the differences of water demand between projection	Analysis of probability and impact: Population in the BBMP area was projected based on past tendencies. Because of a larger range of projected population, there is a possibility of big difference between projected and actual ones. The users may adjust their

Potential project risks	Assessment
and actual results	demand to meet limited water source available, because the capacity of water supply facilities is planned to meet the water right.
	Mitigation measures:
	N.A.
	Action during the implementation:
	N.A.
	Contingency plan (if applicable):
	Saving of water and cooperation for the improvement of UFW
3. Insufficient Water tariff	Probability: Middle
	Impact: Low
(Description of risk) If the tariff raise does not meet the price escalation, project cost may not be recovered	Analysis of probability and impact:
	Presently, progressive charges for water supply and sewerage services are collected, but the tariff is not sufficient to manage O&M cost of the facilities.
	Mitigation measures:
	BWSSB shall increase tariff with concurrence from GoK.
	Action during the implementation:
	Negotiation with GoK and community meeting with users shall be regularly conducted. The notification must be obtained before the completion of the projects from GoK
	Contingency plan (if applicable):
	-
4. Construction Schedule	Probability: Low
4.1 Delay of Indian side Project	Impact: High
(Description of risk) Delay of construction schedule on the projects undertaken by Indian side	Analysis of probability and impact:
	The distribution facilities shall be constructed before completion of Stage V Project. Lateral sewers shall also installed to meet the completion time for major sewerage facilities.
	Mitigation measures:
	N.A
	Action during the implementation:
	The projects categorized into two groups; JICA assisted and Indian side participation, shall be cooperated including schedule control.
	Contingency plan (if applicable):
	-
5. Implementation	Probability: low
5.1Construction period	Impact: Middle
(Description of risk) Construction period may be longer due to delay of Consultant and Contractor Selection	Analysis of probability and impact:
	The selection procedure and decision making process shall be improved to maintain planned construction period.
	Mitigation measures:
	Bidding shall be conducted according to JICA Guideline to ensure transparency.
	Action during the implementation:

Potential project risks	Assessment
	To conduct monitoring
	Contingency plan (if applicable):
	-
5.2 Cost increase of materials/equipment	Probability: Middle
	Impact: Low
(Description of risk) Difficulty of materials/equipment procurement affected by price increase	Analysis of probability and impact:
	The implementation of a huge size of the project may trigger unbalance between demand and supply of materials/equipment, resulted in the abnormal increase of prices.
	Mitigation measures:
	To ensure contingencies
	Action during the implementation:
	Cooperate with contractor to procure materials/equipment smoothly and on time.
	Contingency plan (if applicable):
	-
5.3 Change of planned facility sites	Probability: Low
	Impact: Middle
(Description of risk) Because of the site changes for project facilities, some problems may arise including change of pipeline routes, need of extension of construction period and increase of construction cost	Analysis of probability and impact:
	BWSSB has experiences on the change of STP sites after start of construction work.
	Mitigation measures:
	Required site shall be selected in the public land available and follow up with field people concerned until construction time.
	Action during the implementation:
	Land acquisition shall be started as early as possible upon project decision.
	Contingency plan (if applicable):
	-

Chapter 16 Financial and Economic Considerations

16.1 Financial Capability of Concerned Agencies

16.1.1 Financial Capability of the BWSSB

(1) Financial Soundness of the BWSSB

It is obvious that the financial capability of the BWSSB is in a negative situation from the Income and Expenditure Statement, and the Balance Sheet. Although water revenue has been increasing, operation and maintenance cost, and depreciation have increased more rapidly than income. Consequently, only water revenue could not recover O&M cost, depreciation and interest on loans. Moreover, liabilities such as loans, grants and current liabilities from the state governments, have gradually increased. These cannot be repaid since the BWSSB borrowed funds for water supply and sewerage projects annually from the state government.

Positively, there is the presence of the BCC which is a local fund and the main source of funds for the BWSSB. Therefore, the BWSSB will manage to run with their financial assistance.

At present, the BWSSB is ready to revise water tariff revision to increase water revenue and try to improve the deficit step by step. Moreover, the BWSSB has been requesting the GoK that the unpaid loans from the state government be waived by converting interest payable to the state government. If these plans could be realized, the financial status of BWSSB would be improved.

The main points from the Income and Expenditure Statement, and the Balance Sheet are as follows:

- Water revenue which occupies 86% of total revenue has been increasing year by year. But, only water revenue could not recover O&M cost, depreciation and interest on loans.
- Power charge is the main constraint, which occupies around 44% of the cost and plays a vital role in adding up of the deficit by rising every year. On the other hand, the water tariff was revised only two times in FY2005 and FY2014. These revisions were not enough. Moreover, the power charge is absolutely necessary in running the pumping station, so it is difficult to reduce.
- Depreciation and interest on loan have increased gradually and are consequently a cause of the deficit.
- Fixed assets and Work In Progress (WIP) consist of 70% of assets. WIP in future will convert to fixed assets only. Then it will further increase the depreciation charge.
- Water charge receivable amounted to 5,430 Million INR. It will further increase in the future.
- The BWSSB made short term investments into bank as fixed deposit for the purpose of enjoying favorable interest rates while securing principal and the amount of investment has been increasing. Therefore, the amount of funds has remained idle.
- Loans, grants, and current liabilities have been increasing gradually because the BWSSB borrowed funds for water supply and sewage projects annually from the state government. In particular, loans were 28% of total liabilities and 95% of total loans were from the GoK. It can be inferred that the BWSSB depends on the GoK financially.

- Grants and contributions were 40% of the total liabilities. In the real sense, grants and contributions are not substantial liabilities of the BWSSB. In the future, there will be not repay obligation so it can be said to be only a liability on the books.
- Sundry creditors as mentioned above were only the interest payable on loan which amounts to 21.04 Billion INR only.

The BWSSB has adopted an accrual basis. The Income and Expenditure Statement and the Balance Sheet were audited by the comptroller and auditor general of India (supreme audit institution of India). According to the Income and Expenditure Statement, the BWSSB has suffered deficits in these years. Table 16.1.1 shows a summary of the Income and Expenditure Statement for last three years.

Table 16.1.1 Income and Expenditure Statement in FY2013-2015

Unit: 10 Million INR

Item		Particulars	FY2013	FY2014	FY2015	FY2015 %
Income	a	Water Revenue	512	592	979	86%
	b	Other Income	71	149	162	14%
	A	**Total Income**	**583**	**741**	**1,141**	**100%**
Expenditure	c	Establishment	130	153	164	11%
	d	Power Charges	325	356	655	44%
	e	Repairs and Maintenance	78	95	110	7%
	f	Cost of General Administration	51	87	77	5%
	g	**Operation and Maintenance Cost (c to f)**	**584**	**691**	**1006**	**68%**
	h	Depreciation	88	163	167	11%
	i	Write off	0	0	0	0%
	j	Interest Payment on Loans	108	300	316	21%
	k	Provisions	1	1	1	0%
	B	**Total Expenditure (g + h to k)**	**781**	**1155**	**1490**	**100%**
Income After O&M Cost (A-g)			***-1***	***50***	***135***	
Total Surplus/Deficit (A-B)			***-198***	***-414***	***-349***	

Source: BWSSB Annual Accounts

1) Analysis of Income and Expenditure Statement

With regards to cash flows from the Income and Expenditure Statement, it can be clearly seen that year-to-year, the BWSSB's Income has fallen short of its expenditure. As a result, the BWSSB has been in a deficit for several years. Although water revenue has been on an increase, O&M cost and depreciation have increased more rapidly than income. Consequently, only water revenue could not recover O&M cost, depreciation and interest on loans.

a) Income

Income of the BWSSB consists of water revenue (including water supply service charges and sewerage service charges) and other income. The major source of income is water revenue. Water revenue comes from 2 types of charges: monthly water tariff charge and new connection charge.

Other income consists of interest income generated by specified time deposits and rental income received. The BWSSB invests some portion of amounts received as prorated charges into bank deposits and gets interest income. Out of other income received about 96% was received interest and about 4% was rental income.

The total amount of income has been increasing year by year in a whole, which is brought by the increase of water revenue and other income. Water tariff was revised only two times in FY2005 and FY2014, however, these revisions were not enough to cover depreciation and interest costs.

b) Expenditure

The total amount of expenditure has been increasing year by year and has been doubled from FY2013 to FY2015, which is brought by the increase of power charges and interest payment on loans dramatically.

Expenditures of the BWSSB are broadly categorized into 6 heads and the respective expenditure ratios in FY2015 are shown in Table 16.1.2.

Table 16.1.2 Expenditure Component Ratio

No.	Head of Expenditure	FY 2015 %
1	Establishment Expenses	11%
2	Power Charges	44%
3	Repairs and Maintenance	7%
4	Cost of General Administration	5%
5	Depreciation	11%
6	Interest Payment on Loans	21%
	Total	100%

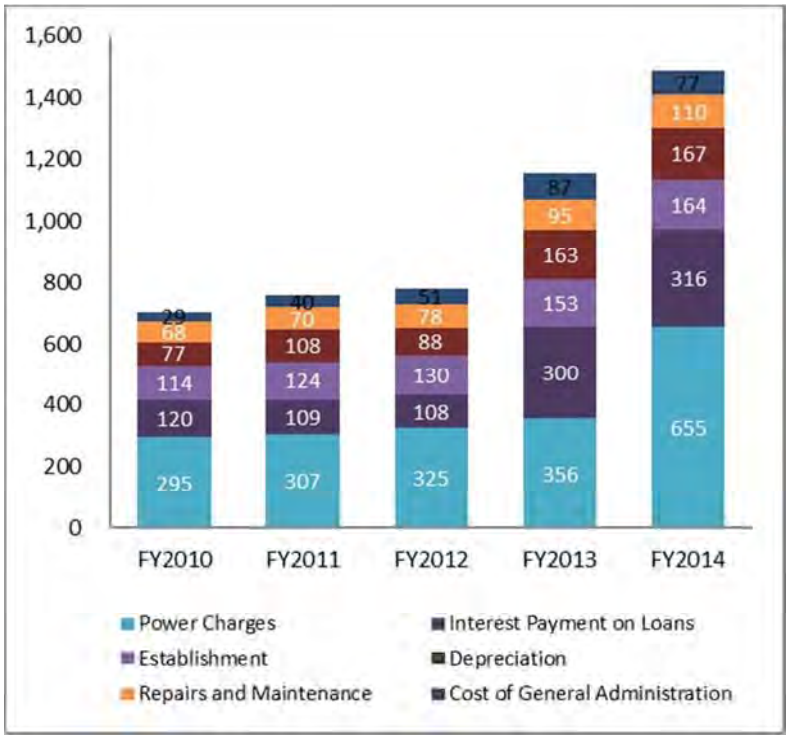
Source: BWSSB Annual Accounts

Power charges dramatically elevated in FY2015 as shown in Figure 16.1.1. There are two (2) reasons why power charges significantly rose. Firstly, the electricity tariff increased from 3.8 INR/unit to 4.0 INR/unit during FY2014. Secondly, more usage of electricity at the pumping stations was required because the BWSSB started supplying more water by launching the CWSSB Stage IV Phase 2.

Interest on loans occupies 21% of total expenditure. It increased about threefold from FY2013 (1,080 Million INR) to FY2014 (3,000 Million INR). Interest expenditure consists of payable interest for the year. A major part of interest on loans is the interest payable on loans from the GoK. From the Annual Accounts, it can be observed that these have just been accumulated for years, but the actual payment has not been done.

Depreciation increased twofold from FY2013 to FY2014, since there was depreciation generated by facilities completed by water supply and sewerage projects. Fixed assets that the BWSSB has acquired are mostly occupied by waterways and pipelines and it depreciated the amount of 710 Million INR in FY2014 followed by pumps, motors accessories (260 Million INR) and reservoir and dams (130 Million INR), according to statement of depreciation.

Establishment expenses consist of manpower expenses. These have been on the increase despite the fact that the number of workers has been unchanged. The reason is their salary increase with about 10% every year.



Source: BWSSB Annual Accounts

Figure 16.1.1 Expenditure Structure in FY2010-14 (in 10 Million INR)

2) Analysis of Balance Sheet

After analyzing the Balance Sheet (see Table 16.1.3), it can be concluded that it is necessary for the BWSSB to start re-paying to reduce loans, grants, and current liabilities and try to restore its financial stability. Moreover, reducing excessive contributions leads to an increase in the cash and bank balance.

The details point from the Balance Sheet are highlighted as follows.

- Loans from the GoK were 95% of the total loans. There is no repayment instructions and conditions mentioned in the loan agreement. The BWSSB was trying to shift these loans to grants and contributions from the GoK. Concretely, the BWSSB tried to shift 95% of the loan (35.3 Billion INR) and interest payable on it (reflected as current liabilities in the Balance Sheet (21.04 Billion INR) to grants and contributions.

- There was a huge fund blockage in the sundry debtors (5,640 Million INR), investments (11.57 Billion INR), cash and bank (3,360 Million INR) in FY 2015. The total amount in these liquid funds was 20.57 Billion INR which was more by 3,520 Million INR than the accumulated deficit of 17.05 Billion INR.
- Grants and contributions (40% of total liabilities) are not actually at all the liability, so it doesn't have to be repaid and forms part of capital receipts only.

Table 16.1.3 Balance Sheet of BWSSB in FY2013 - 15

Unit: 10 Million INR

Item			FY2013	FY2014	FY2015	FY2015 %
Assets	1	Fixed Assets	3,104	6,126	6,210	47%
	2	Work in Progress	3,387	941	1,461	11%
	3	Work in Progress Deposit Works/GBWASP	814	1,093	1,467	11%
	4	Sundry Debtors	347	349	564	4%
	5	Deposits	94	120	120	1%
	6	Current Assets	114	90	110	1%
	7	Investments	580	528	1,157	9%
	8	Internal Divisional Transfers Debits	4	20	9	0%
	9	Cash and Bank	558	916	336	3%
Accumulated Deficit	1	Net Deficit as per previous B/S	741	942	1,356	10%
	2	Add Deficit for the year	201	414	349	3%
Total			**9,944**	**11,540**	**13.139**	**100%**
Liabilities	1	Loans	3,149	3,446	3,713	28%
	2	Grants	3,782	4,621	5,257	40%
	3	Current Liabilities	1,499	1,791	2,104	16%
	4	Suspense Credit	21	21	21	0%
	5	Sundry Creditors	327	333	552	4%
	6	Provisions	336	333	329	3%
	7	Reserve Funds	814	977	1,144	9%
	8	Internal Divisional Transfer Credits	17	17	19	0%
Total			**9,944**	**11,540**	**13,139**	**100%**

Source: BWSSB Annual Accounts

a) Assets

The amounts of fixed assets and Work In Progress (WIP) have gradually increased. Both of these assets have covered around 70% of assets of the BWSSB. WIP converted into fixed assets, which were mainly WIP in the CWSS Stage IV Phase 2 (29.69 Billion INR).

With regard to Work In Progress Deposit Works, the amounts have increased year by year because the BWSSB undertook the work for other public utility agencies. Work In Progress Deposit: Works means security deposits from those public utility agencies. The work that is in the BWSSB's domain is to be undertaken for the BBMP, the BDA and the other private agencies/government organizations, the GBWSSP (Greater Bengaluru Water Supply and Sewerage Project), and the KMRP (Karnataka Municipal Reform Project). These bodies will park certain amount with the BWSSB.

Sundry debtors consist of water charges receivable and interest receivable on investments. Water charges receivable were around 96% of total debtors (5,430 Million INR).
The amounts of investment increased in FY2015 because grant and loan amounts when received and parked in time deposits until actual usage increased significantly.
With regards to cash and bank balance in hand is significantly lower in FY2015 because the BWSSB made short term investments into bank as fixed deposit during the year for the purpose of enjoying favorable interest rates while securing principal. Therefore, these are the funds lying idle in bank accounts.

b) Liabilities

The total amount of liabilities increased step by step. Especially, loans, grants and current liabilities has been increasing gradually. The reasons are that the BWSSB borrowed funds for water supply and sewerage projects annually from the state government.

Loans were around 28% of the total liabilities of the BWSSB. The total outstanding loans has increased year by year. The main channel for loans is the GoK as shown in Table 16.1.4. From this, it can be said that the BWSSB received loans and grants from the GoK and they depend on the GoK financially.

Table 16.1.4 BWSSB's Outstanding Loans as of end March, 2015

Classification	Closing Balance (in 10 Million INR)	FY2015 %
GoK	3,530	95%
KUIDFC	110	3%
BBMP	26	0.7%
Other	47	1.3%
TOTAL	3,713	100%

Source: BWSSB

Grants and contributions were around 40% of the total liabilities of the BWSSB. Table 16.1.5 shows the breakup of grants and contributions as of FY2015. The BWSSB has received grants and contributions from various authorities out of which the GoK has 19% and pro-rata charges received 27%. Pro-rata charges are the charges received as one time charges collected per connection.

Table 16.1.5 Outstanding Grants and Contributions as of end March, 2015

Classification	Closing Balance (in 10 Million INR)	FY2015 %
GoK	1,007	19%
BBMP	346	7%
KUIDFC	302	6%
BDA	286	5%
Pro-rata Charges	1427	27%
Other	1889	36%
TOTAL	5,257	100%

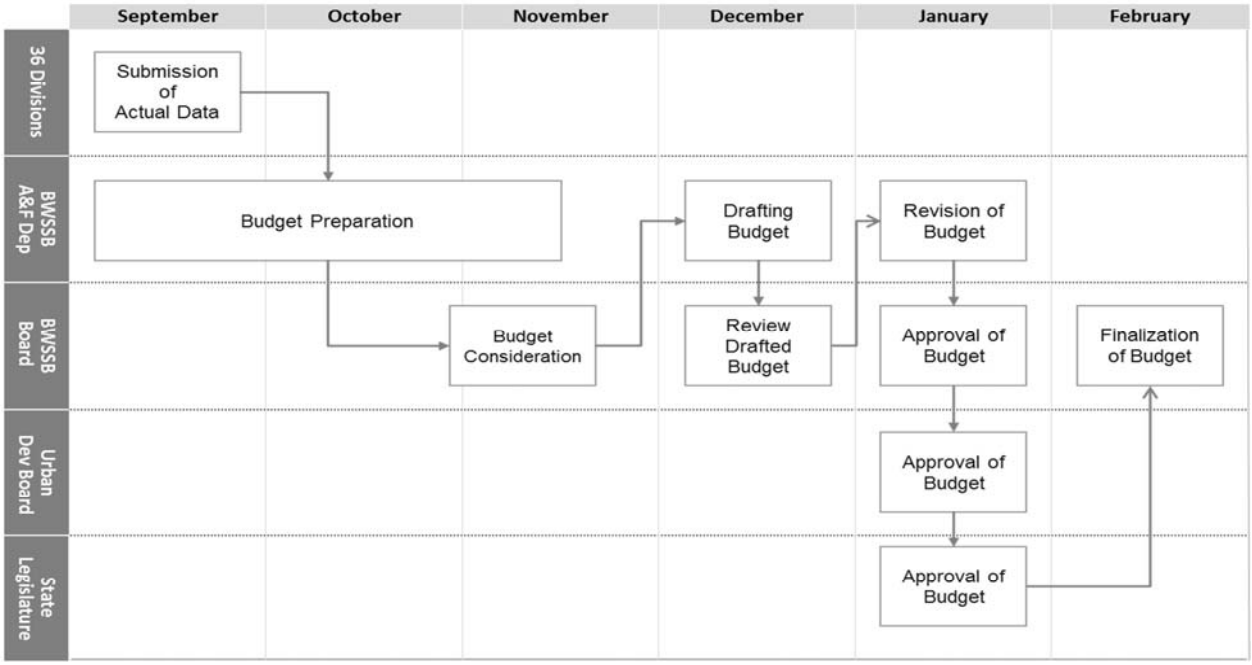
Source: BWSSB

Current liabilities consist of only Interest payable on various loans. The total interest payable on loans is 21.04 Billion INR as of the end of March 2015. The amounts of current liabilities have been increased from FY2013 to FY2015. The reason is additional amounts of accrued interest, which have occurred gradually by increasing loans from the state government for water supply and sewerage projects.

(2) Efficiency of Budgetary Procedure

1) Budgetary Process

Annual financial statement for budgetary arrangement is required to be submitted to the state government on February. Figure 16.1.2 illustrates budgetary process in Karnataka state. An internal circular is generated each year and the budgetary process is initiated on September and it takes about 6 months until the state government approve the budget.



Source: BWSSB

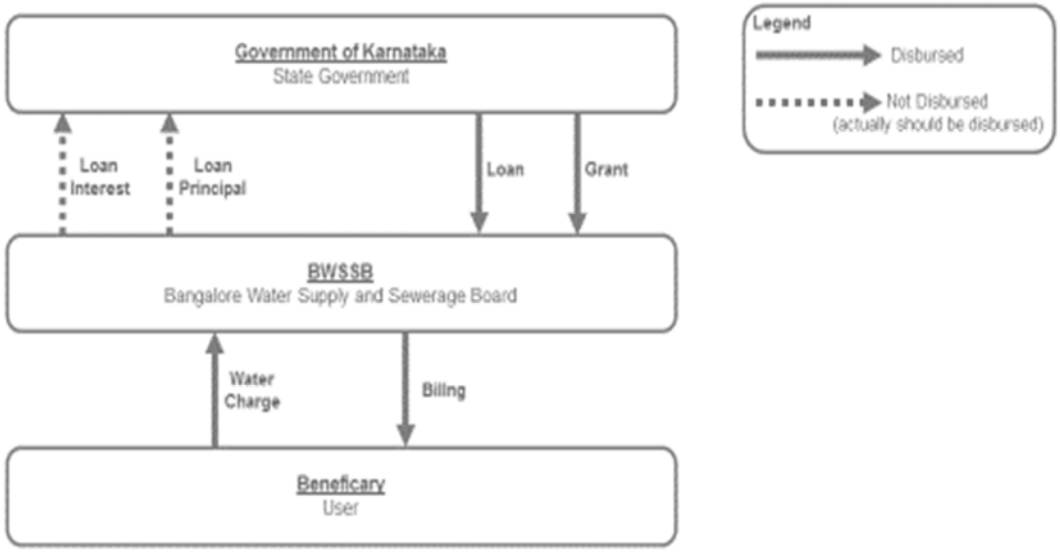
Figure 16.1.2 Budgetary Process in Karnataka State

Before submission of the budgetary request to the state government, the approval of the BWSSB board has to be ensured. The budget plan is prepared by the BWSSB's accounts and finance department and is placed before the BWSSB's board. The process has to be completed by the month of February and the approved budget is required to be sent to the urban development board that will place it before the state legislature.

One of the major issues in the BWSSB's budgeting procedure is the inadequate information sharing. The budgeting information from smaller projects is not often received at the start of the process. Therefore, reallocations of budget need to be conducted. Revision of budgets takes place in the month of January. So the budgeting information of the smaller projects is required to be shared at an earlier stage of the procedure.

2) Relational Structure of Budget

The BWSSB receives loans and grants from the state government and is not financially independent. On the other hand, the BWSSB has not repaid loans principal and interest on loan because of their current financial situation. Therefore, the BWSSB does not give income to the government although income is recorded as own revenue to cover operation and maintenance cost as shown in Figure 16.1.3.



Source: BWSSB

Figure 16.1.3 Relational Structure of Budget

16.1.2 Financial Capability of the Government of Karnataka

(1) Financial Soundness of the Government of Karnataka

The GoK is financially sound, since the surplus margin is positive as shown in Table 16.1.6. As a result, the GoK can afford to make additional loans and grants for the BWSSB. The following are key features which are related to the BWSSB from Karnataka budget in FY2014-15.

- Revenue receipts have increased, which is caused by the increase in own state taxes and share of central taxes. So it is said that the GoK has stable income.
- The GoK cannot prepare capital outlay on water supply and sanitation.
- The GoK affords to make additional loans and grants for the BWSSB.

Table 16.1.6 Budget and Performance in Government of Karnataka in FY2014-15

(in 10 Million INR)

Item			Actual FY2014	Budget FY 2015	FY2015 %
Revenue Account	Receipts	State Taxes	70,180	75,568	65%
		Share of Central Taxes	14,654	23,983	20%
		Grants from Central Government	14,619	12,768	10%
		Non Tax Revenue	4,688	5,411	5%
		Total	104,142	117,731	100%
	Expenditure	Social Services	39,366	46,837	40%
		Economic Services	29,971	33,087	28%
		General Services	28,265	30,496	26%
		Grant in Aids and Contributions	6,011	6,312	6%

Item			Actual FY2014	Budget FY 2015	FY2015 %
		Total	103,614	116,732	100%
	Revenue Accounts Surplus / Deficit		528	999	-
	Surplus Margin Rate		0.5%	0.8%	-
Capital Account	Receipts	Internal Debts	20,509	19,508	90%
		Loans and Advances from GOI	1,365	1,725	7%
		Recoveries of Loans and Advances	84	93	1%
		Miscellaneous Capital Receipts	10	331	2%
		Contingency Fund	0	5	0%
		Total	21,968	21,662	100%
	Disbursements	Capital Outlay	19,622	21,134	82%
		General services	618	761	-
		Social Services	4,181	4,750	-
		Water Supply and Sanitation	-1,220	-443	-
		Economic Services	14,823	15,623	-
		Repayment of Public Debt	4,812	3,788	14%
		Disbursement of Loans and Advance	576	849	3%
		Contingency Fund	0	5	1%
		Total	25,011	25,776	100%
	Capital Account Surplus/ Deficit		-3,043	-4,114	-
Public A/C	Receipts		326,985	291,791	-
	Disbursements		324,552	288,819	-
	Net		2,433	2,972	-
Overall Surplus / Deficit of the year			-82	-144	-

Source: Government of Karnataka Budget, Financial and Performance Audit on State Finances of Government of Karnataka

(2) Possibility of Additional Financial Arrangements with GoK

Table 16.1.4 shows that other authorities financially assist the BWSSB. The major portion of financial support was from the GoK with about 95% of total loans. In short, the GoK is indispensable to the BWSSB.

Moreover, the BWSSB has been requesting the GoK to convert loans to grants, but no arrangement was made by the GoK as of now. The GoK has a sound financial position in spite of a budget deficit. In short, the fact that the BWSSB does not pay for interest on loans to the government. This might make it difficult for the BWSSB to acquire new financial arrangements with the GoK. The tariff revision is actually decided by the GoK and the approval of tariff revision plan depends on their political decision. On the other hand, the GoK provided the BWSSB with financial assistance as necessary. Considering the actual investments for the part of capital budget, it seems that such investments will be possible in the future.

16.2 Budgetary Arrangement for the Project

16.2.1 General

There are two potential financial sources for the implementation of the projects; foreign and local funds for capital and O&M requirements. The projects selected as the JICA Survey Project are considered to apply for the JICA loan in this study. Table 16.2.1 shows concerned projects with estimated cost requirements.

Table 16.2.1 Total Capital Cost

JICA Survey Projects	Million INR
1. CWSS Stage V	44,350
2. Major Sewerage Facilities for 110 Villages	12,549
Total	56,899

Source: JICA Survey Team

16.2.2 Capital Budget

(1) Cash out (Expenditure)

The following assumptions are adopted for estimating the required cost based on the preliminary design of required facilities.

- Base cost for construction work and consulting services is on 2017 year price level
- Construction and Consultancy cost
- Price escalations
- Physical contingency

(2) Cash in (Revenue)

Cost sharing for capital investment between JICA loan and local fund is assumed to be 85% and 15%, respectively as shown in Table 16.2.2. Local fund means funded by the GoK and the BWSSB. The GoK and the BWSSB provides this capital cost from their annual budget. However, the project regarding UFW reduction should be shouldered solely by the BWSSB. Considering this financial situation, it may be said that the capital cost of the JICA Survey Project could be provided as a grant from the GoK. The financial capability of the BWSSB is as analyzed in sub-section 16.1.1.

Table 16.2.2 Funding Pattern and Amount of Capital Budget

Funding Pattern		
Organization	**Ratio**	**Million INR**
JICA	85.00%	48,364
GoK	7.50%	4,267
BWSSB	7.50%	4,267

Source: JICA Survey Team

16.2.3 Operation and Maintenance Budget

O&M budget includes the cost for existing and new facilities, which shall be recovered by revenue. All O&M cost shall be considered the price escalations of 5%.

(1) Cash out (Expenditure)

Table 16.1.1 shows the heads of O&M cash expenditure and its percentage breakup for FY2014-15. Concretely, the price escalations for each expenditure are considered as shown in Table 16.2.3.

Table 16.2.3 Price Escalations

Expenditure	Ratio
a. Establishment Cost	5.0%
b. Power Cost	5.0%
c. Chemical Cost	5.0%
d. Repairs and Maintenance Cost	5.0%
e. Cost of General Administration	5.0%

Source: JICA Survey Team

(2) Cash in (Revenue)

Revenue for O&M budget consists of tariff income from domestic and non-domestic customers served by water supply and sewerage services.

16.3 Present Practice for Water and Sewerage Tariff

The water revenue has been increasing year by year, which is brought by water tariff revisions two times in 2005 and 2014. However, these revisions were not enough to cover the O&M cost in the past years.

Table 16.3.1 Water Revenue and O&M Costs in the Past

Item		Particulars	FY2013	FY2013 %	FY2014	FY2014 %	FY2015	FY2015 %
Income	1	Water Revenue	512	-	592	-	979	-
Expenditure	A	Establishment	130	22%	153	22%	164	16%
	B	Power Charges	325	56%	356	52%	655	65%
	C	Repairs and Maintenance	78	13%	95	14%	110	11%
	D	General Administration Cost	51	9%	87	13%	77	8%
	2	Total O&M Cost (A to D)	584	100%	691	100%	1,006	100%
Revenue After O&M Cost (1-2)			*-72*		*-99*		*-27*	

Source: BWSSB (in 10 Million INR)

Table 16.3.1 shows that power charges occupied more than half of the total O&M cost. It was 65% in FY 2015 and the ratios of the remaining items have gradually reduced. It was directly related to the need of

a large amount of water to be transmitted by the Stage IV project. Regarding water revenue, the present water tariff charge system was not sufficient to recover O&M cost in any past years.

16.3.1 Study on Present Water and Sewerage Tariff

(1) Domestic Water Use

Revenue percentage of domestic use is 84% of total income, while domestic water consumption is 89% of total water consumption. Table 16.3.2 shows the present tariff for domestic water use. Tariff is established using a progressive charge system depending on the amount of water consumption. Sewerage tariff is set as sanitary charges adding to the water charge and with a uniform rate of 25% to water charge.

Table 16.3.2 Tariff for Domestic Water Charges

Slab wise consumption of water (kL)	Rate of Water Supply Charges		Rate of Sanitary Charges for Household (HH) Connections (INR/kL)
	Flat/Progressive charge (INR)	Additional charge per kL (INR/kL)	
0 - 8	56	-	14
8 - 25	Progressive charge	11	25% of water charges
25-50		26	
Above 50		45	

Source: BWSSB

Note: Slum group; free charge, Poor group; flat charge 56 INR, Low, middle, higher than middle and highest groups; progressive charge depending on water consumption.

The detailed progressive charge system is as follows:

In domestic tariff, there is a tendency that a lower income household is associated with less water consumption. On the other hand, there is a tendency that a higher income household is associated with large water consumption.

The BWSSB assumed six categories for their convenience on the domestic consumers with reference to income groups by monthly household water consumption volume in line with the above mentioned tendencies, which are the slum group, the poor group, the low income group, the middle income group, higher than the middle income group, the highest income group.

Among them, slum and poor groups don’t have individual water meter. Under this condition, people in the slum group, who belong to the lowest income group, use free water from public taps. On the other hand, the poor group which is the second lowest income group and live on less than 65 INR/day according to the world bank, regardless of water consumption, they are uniformly billed the fixed monthly charge of 70 INR (flat charge without water meter) broken down into 56 INR/ household (HH) for water and 14 INR/HH for sewerage charge.

In the low income group which is the third lowest income group, a progressive system by water consumption with meter is imposed on them and they are billed the amount of water consumption (0-8 kL) × 7 INR/kL + sewerage charge (25% of water charge). The charge for them may be less than the flat charge. However, water consumption in this group seems to be more than 8 kL/month/HH, resulted in a higher charge than flat charge. In the middle income group, which is the standard income group, the progressive system by water consumption with meter is imposed on them and they are billed the amount of water consumption {56 INR + (8-25 kL) × 11 INR/kL + sewerage charge (25% of water charge)}. In higher than the middle income group, which is the second highest income group, progressive system by water consumption with meter is imposed on higher than middle income group and they are billed the amount of water consumption {56 INR + 187 INR + (25-50kL) × 26 INR/kL + sewerage charge (25% of water charge). In high income group, which is the highest income group, progressive system by water consumption with meter is imposed on high income group and they are billed the amount of water consumption {56 INR+ 187 INR + 650 INR + (Above 50 kL) × 45 INR/kL + sewerage charge (25% of water charge).

The current average water consumption of domestic consumer is assumed to be 100 lpcd and it means monthly HH water consumption is 12 kL {100 (lpcd) × 4 (persons) × 30 (days)}. Then, the current average water & sewerage tariff is 125 INR {(56 INR + 4 kL × 11 INR/kL)} x 1.25. As a result, average monthly HH charge against the average monthly HH income (16,610 INR) is around 0.75%. As mentioned in the chapter 16.4.6 later, it is said that the amount is affordable considering common percentage affordable (3% to 5%) to the average monthly HH income. On the other hand, the present average water and sewerage monthly HH charge (432 INR) against the average income/month is around 2.60%. The reason of this difference is that income from non-domestic consumers is larger than that of domestic consumers. In the future, the basic water consumption of domestic consumer is assumed to be 135 lpcd and it means 16 kL/HH/month and 144 INR water charge per month, and total charge for water and sewerage is 180 INR, which is 1.08 % against the average income/month. Thus, there is still enough room to increase tariff level of domestic consumer.

(2) Non-Domestic Water Use

Revenue percentage of non-domestic use is 16% of total income, while non-domestic water consumption is 11% to the total water consumption. Table 16.3.3 shows the present tariff for non-domestic water use, as reference value per household (This manner is practiced by BWSSB.). Tariff is established using a progressive charge system depending on the amount of water consumption. Sewerage tariff is set as sanitary charges adding to the water charge and with a uniform rate of 25% to water charge. Comparing with domestic charge, the unit price per water consumption for non-domestic (hospital, commercial facility, etc.) is set significantly higher than that for domestic, so that it is possible to get more income with less consumption.

Table 16.3.3 Tariff for Non-Domestic Water Charges

Slab wise consumption of water (kL)	Rate of Water Supply Charges		Reference Rate of Sanitary Charges per HH Connections (INR/kL)
	Base/Progressive charge (INR)	Additional charge per kL (INR/kL)	
0-10	500		25% of water charge
10-25	Progressive charge	57	
25-50		65	
50-75		76	
Above 75		87	

Source: BWSSB

Regarding average water & sewerage charge in the future (150 lpcd × 4persons × 30days = 18 kL/month), tariff is 1,195 INR {(500 INR + 8 kL × 57 INR/kL)} x 1.25. Therefore, it is said that income from non-domestic consumers increase average water charge per HH in a total. Therefore, if non-domestic consumer use more than 150 lpcd, the tariff will be set so that heavy rate will be charged to them as studied in sub-section 16.4.4.

(3) Other Special Arrangements

1) Bulk water use

Bulk water supply is provided both for domestic and non-domestic uses. Large facilities (school, swimming pool etc.) are consumers with larger water consumption. A fixed charge per consumption (kL) is adopted for this supply, without an adoption of a progress charge system. Sewerage tariff is set as sanitary charges on water tariff and with a uniform rate of 25% to water charge. Table 16.3.4 shows tariff for bulk water use. These are collected from bulk domestic consumers such as high-rise/multistoried buildings/central and state government housing complexes, villas/individual group housing. Water tariff is specified for the different connections.

Table 16.3.4 Tariff for Bulk Water Charges

Connection Type	Water Tariff (INR/kL)	Sanitary Charges
Industries, Swimming Pool	90	25% of water charges per month per HH
BIAL	90	
Bidadi Industrial Area (KIADB)	90	
Kanakapura Bulk Supply	10	
Vedavijnana Maha Vidya Peeta, Kanakapura Road, Jain International Residential School, Kanakapura Taluk	60	
Agara Grama Panchayat	19	
BBMP jurisdiction other than erstwhile 7 CMC and 1 TMC	19	
Flats, Group housing, multi-storied domestic building	60	

Source: BWSSB

2) Other Charges

There are other several charges such as special sanitary charge, new connection charge. However, these charges are only less than 5 % of domestic and non-domestic charges.

a) Special Sanitary Charges

In case of having supplementary water supply by deep well or water tanks in addition to water connections, the BWSSB levies additional charges as special sanitary charges. The details are shown from Table 16.3.1 to Table 16.3.2 in Supporting Report.

b) New Connection Charge

New connection charges are imposed on the consumers one time in newly connecting water supply or sewerage pipes and comprise 8 sub charges to be paid by the applicant. The details are shown in Table 16.3.3 to Table 16.3.11 in Supporting Report.

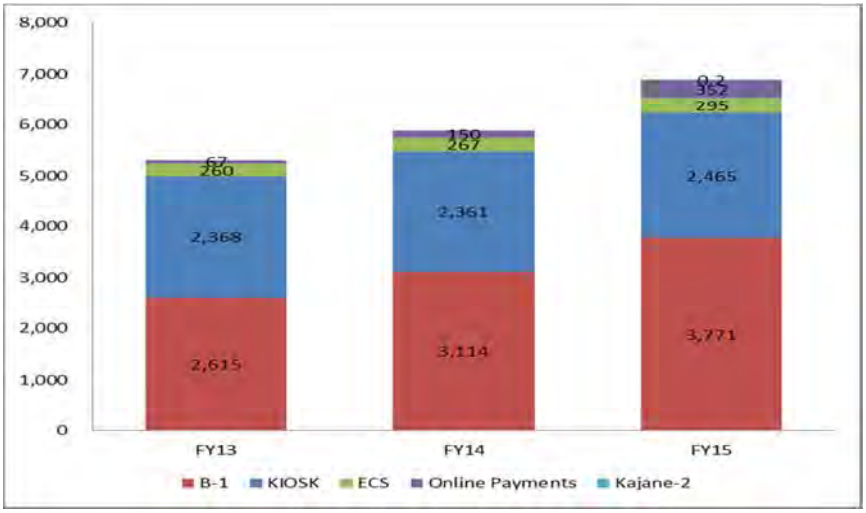
16.3.2 Bill Collection Method and its Efficiency

(1) Bill Collection Method

There are some collection methods including Bengaluru One, Kiosk, ECS, Online Payment and Kajane-2.

The collected amount by channel is shown in Figure 16.3.1.

- Bengaluru One (B-1): Approximately 70-80 centers are setup by The Government of Karnataka. These centers provide multiple facilities; one among them is collection of water charges for the BWSSB. A charge of 5 INR per bill collected on behalf of the BWSSB is charged. These charges are borne by the BWSSB.
- Kiosk: There are 74 kiosks placed in the BWSSB's premises and are manned by board's officials.
- ECS: Electronic clearing system: This is a standing instruction issued by consumers to their bank/s to clear the utility bills (in this case BWSSB bill), once the same is requested by the utility banks (BWSSB nominated banks) for clearance of the bill payment every month.
- Online Payment: 5 payment gateways are made available.
- Kajane-2: Kajane-2 is an integrated electronic platform to government agencies, which started the operation in FY2015.



Source: BWSSB (Unit: 10 Million INR)

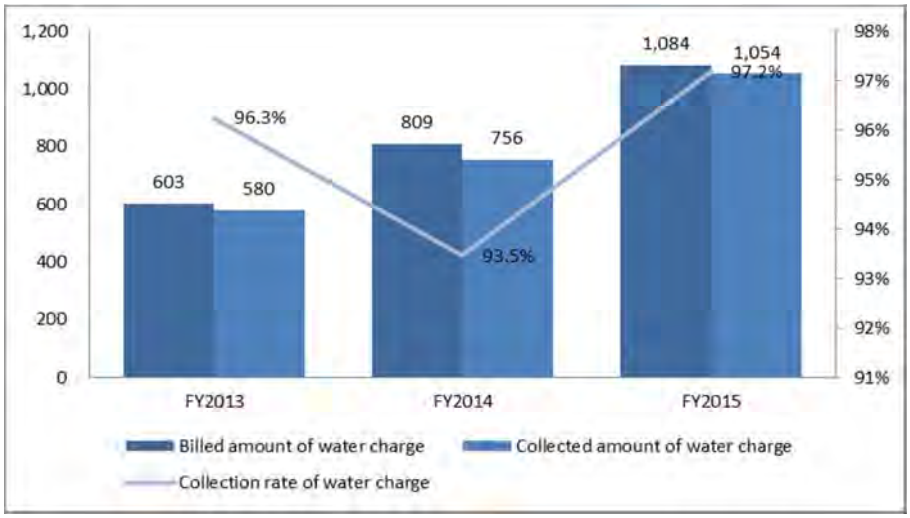
Figure 16.3.1 Collected Amount by Channel in FY2013-15

Water bills have been successfully collected from FY2013 to FY2015, considering that the collection rate in the last year is more than 90%. The number of transaction in a total has been steadily increasing by 1.6 Million (29.7%) in the past 3 years. Especially, Transaction by Bengaluru One (B-1 as shown in Figure 16.3.2) has been significantly rising by 1.2 Million (44.2%). While Kiosk is stable collection in the recent years, Online Payments has been dramatically increased by 0.3 Million (42.3%).

(2) Bill Collection Efficiency

There are only 865,000 meters installed by the BWSSB. Total household as reported by the census data in FY2011 were 2,101,831, which results in a ratio of 41% per connected household. The reason for the low rate of meter installation is caused by the existence of bulk water meters installed for the apartments/ buildings. Billed and collected amounts of water charge and collection rate is shown in Figure 16.3.3.

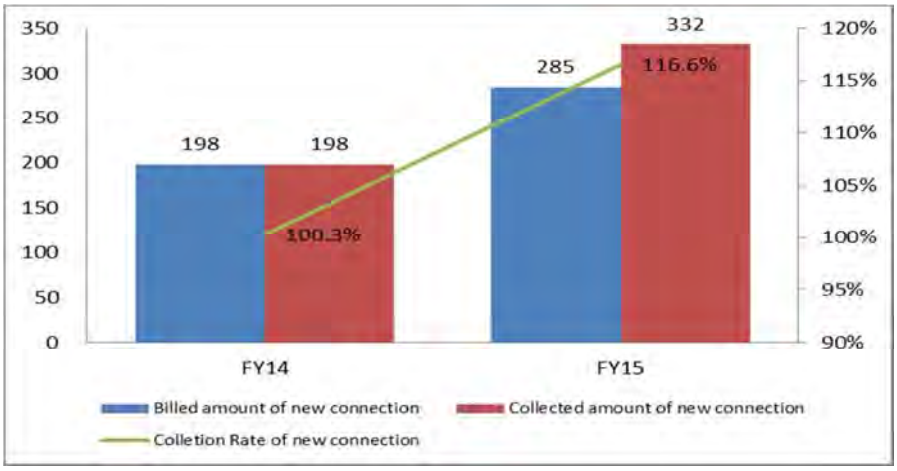
Bill collection rate is calculated by dividing the collected amount by the billed amount. The collection rate of water charge (including sewerage charge) in the last 3 years is more than 90%. This higher percentage seems to have brought by a variety of payment method set by the BWSSB. Especially, use of internet banking and ECS gave a positive impact. The efficiency of charge collection by the BWSSB was a satisfactory level.



Source: BWSSB (Unit: 10 Million INR)

Figure 16.3.2 Billed and Collected Amount of Water Charge and Collection Rate

Moreover, the collection rate for new connection charges is inherently high, because these charges are collected upfront effectively. The reason of being collected more money than planned is payment in advance of new connection. Regarding this point, it is said that the BWSSB's collection method is so effective. Figure 16.3.3 shows that the collection rate increased from FY2014 to FY2015. The BWSSB collected the charges beyond billed amount.



Source: BWSSB (Unit: 10 Million INR)

Figure 16.3.3 Billed and Collected Amount of New Connection and Collection Rate

16.3.3 Issues and Problems and Required Countermeasures

(1) Water Tariff Revisions in the Past (year 2005 and 2014)

Even though a tariff revision was made twice as shown is Table 16.3.5 in 2005 and 2014, the revisions were not sufficient to recover O&M cost for water supply and sewerage facilities in any past years. Therefore, it is necessary to revise tariff more often along with increasing the related cost of water sup-

ply, such as staff salary cost, electricity cost, repair and maintenance cost. Moreover, water revenue (9,790 Million INR) is short to O&M cost (10,060 Million INR) in the present practice as mentioned in Table 16.3.1. According to social survey, 21.6% of respondents are ready to pay 500 to 1,000 INR for water supply and 13.6% of them are ready to pay 300 to 600 INR for sewerage services. Therefore, it can be said that there is room for raising the tariff, considering payment intention of users who are 21.6% in water supply and 13.6% in sewerage with regard to willingness to pay.

The latest tariff revision was made in November, 2014. Although the BWSSB has tried to revise water tariff and submitted its revised plan to the GoK many times, water tariff was actually revised only two times in the last 9 years. Tariff revision plan was almost determined by the GoK on the basis of their political decision. Therefore, the BWSSB cannot change the conditions for progressive charges and sewerage tariff.

Though the cost for required items for O&M has increased every year including staff salary, electricity cost, repair and maintenance cost, water tariff was not revised as required to meet the yearly increase of the expenditures. The revised points of the tariff in 2014 are the change of the conditions of INR/kL for each water consumption layers. Especially, the conditions of INR/kL for the water consumption layer (25-50 kL), which has the largest consumer, is the most significant change (increased by 73%) because regarding income level, consumer of this layer is higher than middle income group and they can afford to pay a certain amount of tariff. Nevertheless, it is logical that water revenue based on the present practice is not still enough to recover O&M cost for water supply and sewerage facilities.
In short, not only the tariff revision is not enough, but also it is necessary to set basic tariff itself such as the conditions of INR/kL for each water consumption layer to recover O&M cost. The BWSSB submitted the tariff revision idea which shows logical conditions for water consumption layer and INR/kL for its layer to the GoK.

Table 16.3.5 Comparison between Previous Water Tariff (2005) and Revised Water Tariff (2014)

Slab-wise water consumption (kL)	Previous water tariff (INR/kL) (Effective from February, 2005) (INR)	Revised water tariff (INR/kL) (Effective from November, 2014)	Change in %
0 - 8	6.00 (48.00 for minimum)	7.00 (56.00 for minimum)	17%
8-25	9.00	11.00	22%
25-50	15.00	26.00	73%
50-75	30.00	45.00	50%
75-100	36.00	45.00	25%
Above 100	36.00	45.00	25%

Source: BWSSB

(2) Validity for Water Tariff Level

Current Water and sewerage tariff per household (4 persons/house) per month is calculated at 432 INR in Table 16.3.6. Whereas, average monthly income of household in Bengaluru is 16,610 INR according to Economic Survey of Karnataka in 2015 (See Table 16.3.7). So, the ratio of water tariff is 2.60% and this level is lower than that of other countries. For example, average tariff level in Europe is around 4% according to Public Water Supply and Sanitation Services in France 2015. In conclusion, it is said that there is room for rising up to valid water tariff level, considering that of other countries.

Table 16.3.6 Current Water and Sewerage Tariff per Household per Month

No.	Contents	Amounts (INR)
a	Average Water and Sewerage Charge / kL	36
b	Average Water Consumption per person per day - litter	100
c	Average Water Consumption per person per month - litter(b × 30)	3,000
d	Average Water and Sewerage Tariff per person per month (a / 1,000 × c)	108
e	Average Water and Sewerage Tariff per household/month (d × 4 persons/ house)	432

Source: JICA Survey Team

Table 16.3.7 Current Percentage of Water and Sewerage Tariff per Household

Area / Income of Household	Per Year (INR)	Per Month (INR)	Percentage of Water and Sewerage Tariff
Average Income in Bengaluru	199,326	16,610	2.60%

Source: Economic Survey of Karnataka (GOK) in 2015

(3) Other Issues and Problems

1) Non-Revenue Water Supply through Public Faucet

There are a lot of public faucets without water charge. The BWSSB cannot charge for Social Development Unit because they cannot grasp the water consumption of public faucets. Moreover, Social Development Unit cannot collect from consumers such as slums people. It is assumed that a lot of time will be required for Social Development Unit to collect charges from consumers such as slums people. Therefore, for the time being, the BWSSB shall manage water consumption of public faucets in use of the water meters and start to charge for Social Development Unit.

In addition, at many public faucets, many slums people may have connected to the system illegally. It is necessary for the BWSSB to grasp the amount of NRW and analyze how water-theft affects.

2) Financial Impact by Rising Power Charge

Power charge is rising every year as mentioned in sub-section 16.1. On the other hand, water tariff was revised only two times in FY2005 and FY2014. The revenue was not enough to cover the expenditures. Therefore, water tariff that can correspond to escalation of power charge and other expenses should be considered.

16.4 Study on Water and Sewerage Tariff

16.4.1 General

The main income source of the BWSSB is water and sewerage charges. However, the revenue according to the present tariff system is not sufficient to recover O&M cost. Therefore, it is necessary for the BWSSB to increase the revenue by revising water and sewerage tariff. The flow chart for the study to come up with the alternative water and sewerage tariff in the target year is shown in Figure 16.4.1.

As a base information for the study of future tariff, the present water and sewerage charge system is analyzed with identification of issues and problems. The conditions and assumptions for the study are established to calculate required charges by sub-sector; water supply and sewerage services for the year 2034 to cater for projected O&M cost.

O&M cost for water supply and sewerage facilities in the target year 2034 is estimated for two cases. One is O&M cost for the facilities to be provided by the JICA Survey Project. In water supply component, O&M cost for the facilities to be provided by the Stage V Project shall be shared between 110 Villages (408/775 MLD) and Core/ULB (367/775 MLD) in proportion to respective percentages of planned distribution amount. On the other hand, in sewerage component, major sewerage facilities are planned to serve for only 110 Villages.

Another case is O&M cost for the facilities in the entire BBMP area after completion of the JICA Survey Project. In water supply component, total O&M cost includes that for existing facilities in Core/ULB, for the facilities provided by the Stage V Project and distribution facilities in 110 Villages to be undertaken by the BWSSB using local fund. On the other hand, in sewerage component, major sewerage facilities are planned to provide only for 110 Villages. While, there is no expansion plan for Core/ULB areas. Therefore, O&M cost for the sewerage facilities is limited to that for 110 Villages. An average sewerage charge for O&M of sewerage facilities calculated for 110 Villages may also be applied for Core/ULB areas.

The number of beneficiaries (residents/households) is also studied for two cases as mentioned above for O&M cost estimate. One is the beneficiaries to be served by the JICA Survey Project. In water supply component, beneficiaries to be served by the shared water through the Stage V Project are all residents in Core/ULB in 2034. While for 110 Villages, beneficiaries to be served by the shared water through the Stage V Project are planned population for water supply by the BWSSB. Population to be served by the distribution systems for 110 Villages are all planned population, the same as those to be served by the Stage V Project. Likewise, in sewerage component, the beneficiaries in 110 Villages are same as those planned for the water supply.

Another case is beneficiaries in the entire BBMP area after completion of the JICA Survey Project. In water supply component, beneficiaries to be served by existing and the Stage V Project in Core/ULB are all residents in 2034. In addition, beneficiaries by the Stage V Project and served by planned water sup-

ply project for 110 Villages are also planned population in the Villages. On the other hand, in sewerage component, beneficiaries to be served by planned sewerage facilities are limited to the planned population for 110 Villages, same idea as mentioned for O&M cost estimate.

Using O&M cost and the number of households to be served, monthly average charges per household required are calculated by water supply and sewerage services. The required charges are calculated for the above mentioned two cases. Referring to the calculation results, a progressive charge system is studied for the entire BBMP area. Finally, tariff required to meet O&M cost in 2034 is studied in combination of water supply and sewerage need.

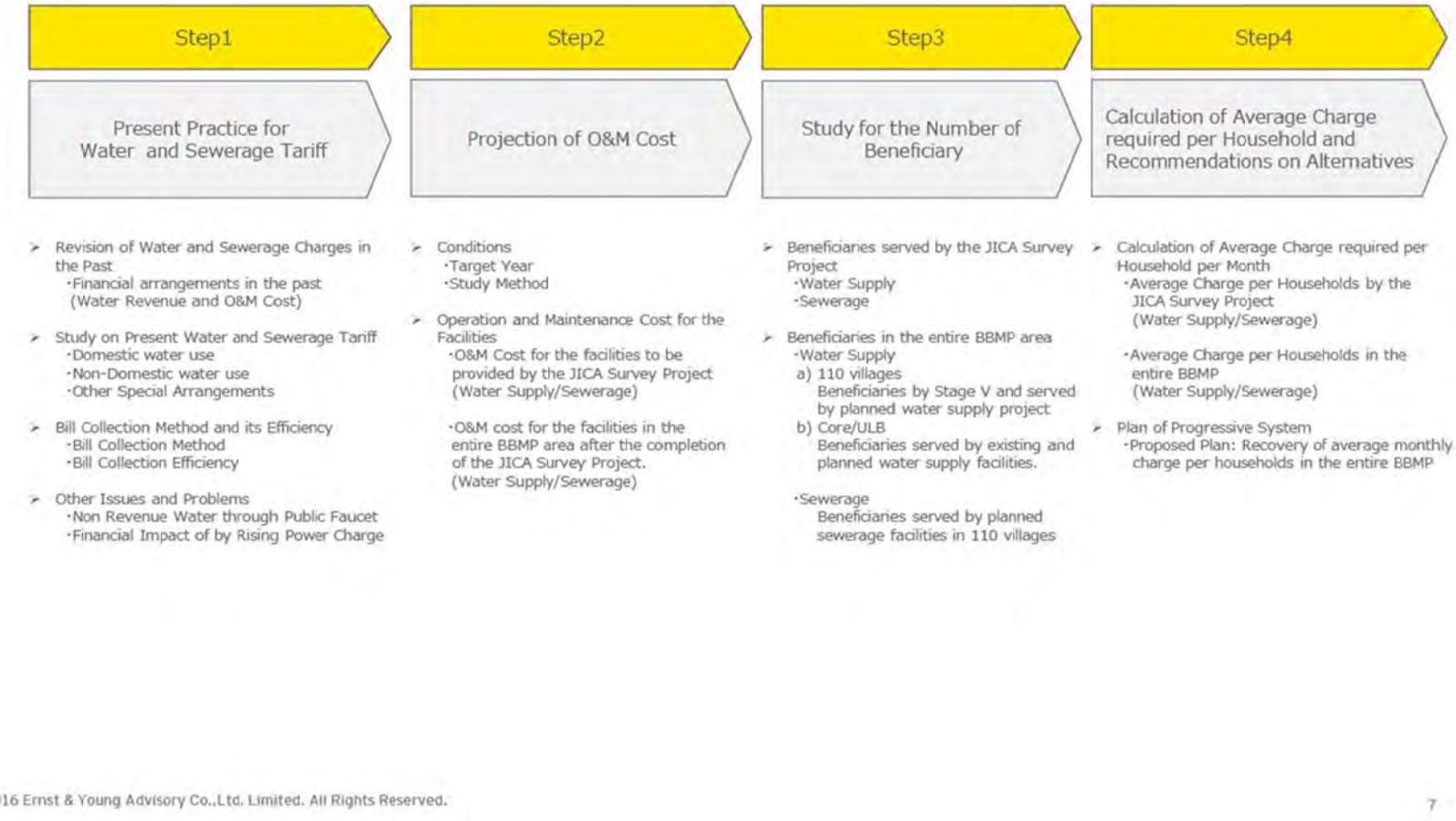


Figure 16.4.1 Flow Chart for the Study of Water Supply and Sewerage Tariff

16.4.2 Projection of Operation and Maintenance Cost

(1) Conditions

1) Target Year

Design target years for this JICA Survey Project is set as 30 years and 15 years from base year for final and medium term target years, respectively. For the tariff study, the year 2034 was set as target year.

2) Study Method

O&M cost for the facilities to be provided by the JICA Survey Project is projected both for water supply and sewerage facilities. O&M cost for the water supply facilities to be served in the entire BBMP area after completion of the JICA Survey Project is also projected. While, projection of O&M cost for sewerage facilities is limited to those for 110 Villages. Overall sewerage O&M cost required in the entire BBMP area will be projected based on the study results of 110 Villages sewerage project.

(2) O&M Cost for the Facilities

1) O&M cost for the facilities to be provided by the JICA Survey Project

Required O&M cost in 2034 for the facilities provided by the JICA Survey Project is projected for water supply and sewerage components. The cost required in base year 2017 is escalated using fixed escalation ratio of 5%. Table 16.4.1 shows O&M cost for the facilities to be provided by the Stage V Project.

O&M cost for the water supply facilities provided by the Stage V Project is estimated at 5,219 Million INR/year, which shall be shared by the two areas; 2,472 Million INR/year in Core/ULB and 2,747 Million INR/year in 110 Villages. Sewerage cost arrived at 1,082 Million INR/year for 110 Villages. The cost is considered 5% annual escalation ratio from base year 2017.

Table 16.4.1 O&M Cost for the Facilities to be Provided by the JICA Survey Project

		2034				
		Water		Sewerage	Total	
	O&M Cost	Core/ULB	110 Villages	110 Village	Water	Sewerage
a	Establishment Cost	118	131	296	249	296
b	Power Cost	2,119	2,355	363	4,474	363
c	Repairs & Maintenance Cost	235	261	360	495	360
d	Cost of General Administration	0	0	63	0	63
e	**Total O&M Cost**	2,472	2,747	1,082	5,219	1,082

Source: JICA Survey Team （Unit: Million INR）

2) O&M Cost for the Facilities in the Entire BBMP Area after the Completion of the JICA Survey Project

a) Water Supply

In water supply, required O&M cost in the entire BBMP area are the total O&M cost for existing facili-

ties in Core/ULB (21,079 Million INR/year), facilities provided by the Stage V Project (5,219 Million INR/year) and distribution facilities in 110 Villages (646 Million INR/year), which will be constructed as the Indian local fund project. Thus, overall O&M cost required in the entire BBMP is 26,944 Million INR/year as shown in Table 16.4.2.

Table 16.4.2 O&M Cost in the Entire BBMP after the JICA Project

O&M Cost		2034						
		BWSSB		New - JICA Survey PJ			Total	
		Water		Water		Sewerage	Water	Sewerage
		Existing	110 Village	Core/ULB	110 Village	110 Village	ALL	110 Village
a	Establishment Cost	3,432	299	118	131	296	3,981	296
b	Power Cost	13,731	165	2,119	2,355	363	18,370	363
c	Repairs & Maintenance Cost	2,298	182	235	261	360	2,975	360
d	Cost of General Administration	1,618	-	-	-	63	1,618	63
e	**Total O&M Cost**	21,079	646	2,472	2,747	1,082	26,944	1,082

Source: JICA Survey Team （Unit: Million INR）

b) Sewerage

The construction of sewerage facilities is planned only for 110 village and O&M cost for 2024 and 2034 is projected at 671 Million INR /year and 1,082 Million INR/year, respectively. While, expansion of the sewerage systems in the Core/ULB is not planned. Therefore, O&M cost for 110 Villages is only calculated.

Overall sewerage O&M cost in the BBMP area for the year 2024 and 2034 was calculated projecting the required cost for Core and ULB areas based on study results for 110 Villages sewerage project. According to the calculation results in 7.1.5, Chapter 7, sewerage generation volume in 2024 and 2034 by area is projected as shown below. However, because of sewerage plan and on-going arrangements between ULB and 110 Villages, sewerage volume to be treated by the STPs in 110 Villages is planned at 114 MLD. Therefore sewerage volume to be treated in Core/ULB areas is 1,390 MLD (1,504 MLD - 114 MLD) and 1,751 MLD (1,865 MLD - 114 MLD) for the year 2024 and 2034, respectively.

Table 16.4.3 Sewerage to be Treated / Assumed Volume to be Treated

Area	Generated sewerage: MLD		Sewerage to be treated : MLD Assumed volume to be treated (70% of generated volume)		Remarks
Year	2024	2034	2024	2034	
Core	792	856	1,390	1,751	
ULB	447	634	(973)	(1,226)	
110 Villages	263	372	114	114	Some sewage is treated at STPs in ULBs
Total	1,502	1,862	1,504 (1,087)	1,865 (1,340)	

Source: JICA Survey Team

Annual O&M cost required for the sewerage systems in Core/ULB is projected referring to the cost required for 110 Villages in proportion to sewerage treatment volume. Actual sewerage treatment percentage is assumed to be 70% of generated sewerage volume based on the experience at present in the existing service area in BBMP. The cost for year 2024 and 2034 arrived at 5,727 (973/114×671) and 11,636 (1,226/114×1,082) Million INR/year, respectively. Accordingly, total O&M cost in BBMP area in 2024 and 2034 is 6,398 Million INR/year and 12,718 Million INR/year, respectively.

16.4.3 Study for the Number of Beneficiaries

(1) Beneficiaries to be served by the JICA Survey Project

Beneficiaries to be served by the JICA Survey Project are studied separately for water supply and sewerage components. The details are included in Table 16.4.1 in supporting report.

1) Water Supply

Of the total amount (775 MLD) to be produced by the Stage V Project, sharing of water to 110 Villages and Core/ULB is planned at 408 MLD and 367 MLD respectively. It is assumed that water supply service coverage for the entire BBMP in 2034 shall be 100%. In 110 Villages, the beneficiaries by the JICA Survey Project are those planned in 110 Villages in water supply project. Table 16.4.4 shows households to be served from 2024 to 2049. Number of households is calculated using projected population and the number of average persons per household (4 persons/HH).

Table 16.4.4 Beneficiary in 110 Villages Served by the JICA Survey Project (Number of People)

Year	Total Beneficiaries	Number of Households
2024	2,003,593	500,898
2034	2,843,080	710,770
2049	4,490,582	1,122,646

Source: JICA Survey Team

In Core/ULB area, the beneficiaries by the JICA Survey Project are the same as those served by existing facilities where additional water is planned to be supplied by the Stage V Project. Table 16.4.5 shows households to be served from 2024 to 2049 in the same manner as employed for the calculation of HH number in 110 Villages.

Table 16.4.5 Beneficiary in Core/ULB served by the JICA Survey Project (Number of People)

Year	Total Beneficiaries	Number of HHs	Reference: Number of HHs to be served by sewerage systems (70%)
2024	9,374,866	2,343,717	1,640,602
2034	11,292,013	2,823,003	1,976,102
2049	14,904,901	3,726,225	2,608,358

Source: JICA Survey Team

2) Sewerage

Sewerage facilities are planned to construct only for 110 Villages. Table 16.4.5 shows assumed beneficiaries in Core/ULB area, the same as those to be served by planned water supply project. Sewerage service coverage in Core/ULB area is assumed to be 70% of overall HH number (reference in the table).

(2) Beneficiaries in the entire BBMP Area

Beneficiaries in the entire BBMP area after the completion of the JICA Survey Project are studied for water supply and sewerage separately.

1) Water Supply

Beneficiaries served by existing facilities are those in Core/ULB. While, beneficiaries served by the facilities provided by the Stage V Project are those allocated to Core/ULB and 110 Villages. Beneficiaries served by distribution facilities in 110 Villages are those served by the Stage V Project.

a) 110 Villages

Beneficiaries served by the Stage V Project and planned water supply project are shown in Table 16.4.6. The number of HHs is calculated using projected population and the average number of HHs.

b) Core / ULB

Beneficiaries served by existing facilities and the Stage V Project are shown in Table 16.4.6.

2) Sewerage

Beneficiaries to be served by planned sewerage facilities is limited to those in 110 Villages. There is no expansion plan as of today for the existing sewerage facilities in Core/ULB area. For tariff study, beneficiaries to be served by planned sewerage project in 110 Villages are considered. The number of HHs to be served is same as that for the HHs to be served by water supply project for 110 Villages (see . The sewerage service coverage in the 110 Villages in 2034 is assumed to be 100%.

Table 16.4.6 Total Beneficiary in the entire BBMP after the JICA Project (Number of People)

Year	Total Beneficiary	Number of HH to be served by Water Supply systems			Number of HH to be served by sewerage systems in 2034
		Core/ULB	110 Villages	Total	
2024	11,378,459	2,343,717	500,898	2,844,615	
2034	14,135,093	2,823,003	710,770	3,533,773	2,686,872 (1,976,102 + 710,770)
2049	19,395,483	3,726,225	1,122,646	4,848,871	

Source: JICA Survey Team

16.4.4 Calculation of Average Monthly Charge Required per Household in 2034 and Recommendations on Progressive Charge Systems

(1) Average Monthly Charge per Household in 2034

Average monthly charge per household required for O&M of the facilities to be provided by the JICA Survey Project and average monthly charge per household required in the entire BBMP considering all facilities to be served is studied both for water supply and sewerage components separately.

1) Average Monthly Household Charge Required for the JICA Survey Project

a) Water Supply

Average household charge for water supply by the JICA Survey Project is calculated by Core/ULB and 110 Villages considering calculated respective beneficiaries.

i. 110 Villages

Average charge per household (4 persons) arrived at 322 INR in 110 Villages as shown in Table 16.4.7.

Table 16.4.7 Average Monthly HH Charge for Water Supply in 110 Villages

a. O&M cost for Facilities provided by the Stage V Project - Million/month: Million INR	229
b. Beneficiary - Number of Household: HH	710,770
c. Average Charge per Household per Month (a / b): INR	322

Source: JICA Survey Team

ii. Core/ULB

An additional average monthly HH charge arrived at 73 INR in Core/ULB as shown in Table 16.4.8.

Table 16.4.8 Average Monthly HH Charge for Water Supply in Core/ULB

a. O&M cost for Facilities provided by the Stage V Project - Million/month: Million INR	206
b. Beneficiary - Number of Household: HH	2,823,003
c. Average Charge per Household per Month (a / b): INR	73

Source: JICA Survey Team

b) Sewerage

Average monthly HH charge for sewerage service is arrived at 127 INR in 110 Villages as shown in Table 16.4.9.

Table 16.4.9 Average Monthly HH Charge for Sewerage in 110 Villages

a. O&M cost - Million/month: Million INR	90
b. Beneficiary - Number of Household: HH	710,770
c. Average Charge per Household per Month (a / b): INR	127

Source: JICA Survey Team

2) Average Monthly Household Charge in the entire BBMP

a) Water Supply

Average monthly HH charge for water supply in the entire BBMP is arrived at 635 INR as shown in Table 16.4.10.

Table 16.4.10 Average Monthly HH Charge for Water Supply in the Entire BBMP

a. O&M cost - Million/month: Million INR	2,245
b. Beneficiary - Number of Household: HH	3,533,773
c. Average Charge per Households per Month (a / b) : INR	635

Source: JICA Survey Team

b) Sewerage

Average monthly HH charge for sewerage service in the entire BBMP area is arrived at 394 INR (12,718 Million INR/year/2,686,872-HH) as shown in Table 16.4.11. In case of the same beneficiary HHs as water supply (3,533,773), the charge arrived at 300 INR/HH. The percentage of sewerage charge to water charge is 47% to 66%. An average monthly HH charge for water supply and sewerage services is 1,029 INR.

Table 16.4.11 Average Monthly HH Charge for Sewerage in the Entire BBMP

a. O&M cost - Million/month: Million INR	1,060
b. Beneficiary - Number of Household: HH	2,686,872
c. Average Charge per Household per Month (a / b): INR	394

Source: JICA Survey Team

(2) Plan of a Progressive Charge System

The proposed tariff plan for a progressive charge system is studied to recover monthly O&M cost for the facilities operated in the entire BBMP.

The percentage of sewerage charge to water charge for O&M cost in 2034 is calculated at 47% as shown in Table 16.4.12. In other words, the percentage of sewage charge to water charge is about 50%. Currently, sewerage charge is adopted at 25% of water charge. In this regard, the percentage of sewerage charge to water charge shall be increased.

Table 16.4.12 Percentage of Sewerage to Water for O&M Cost in the Entire BBMP

(Million INR)

Item	O&M Cost for the entire BBMP	Amount
a	Water	26,943
b	Sewerage	12,718
Item	**Calculation for Percentage of O&M Cost**	**Proportion**
c	Percentage of sewerage to water (b / a)	47%

Source: JICA Survey Team

1) Proposed Tariff: Recovery of Monthly O&M Cost in the Entire BBMP

For the entire BBMP, a progressive charge system was studied. It is assumed that consumers who use water more than 135 lpcd for domestic and 150 lpcd for non-domestic shall be charged with heavy charge rate. The following assumptions are also made referring to present practices on the tariff.

- Water charge per kL is assumed referring to the present practice.
- Water charge per kL is estimated: total water consumption of domestic and non-domestic by slab × each Rate/kL set up base on the present practice.
- Water consumption percentage on each tariff slab for domestic and non-domestic is assumed based on the present practice in December 2016.
- Monthly water consumption by layer is calculated using the formula: water consumption rate (lpcd) × 4 persons-HH × 30days.
- Total water consumption excluding groundwater is calculated at 51,000 ML/month = {2,120 ML/day - (500 ML/day × 0.84)} × 30 day.
- The percentage of sewerage charge to water charge is assumed to be 50%.

The Rate/kL for domestic and non-domestic in 2034 is assumed considering 2% annual increase from 2016 to 2034. The details on the tariff plan are follows:

a) Domestic

- The water consumption layer is established for 4 groups, which are below 65 lpcd, from 65 lpcd to 135 lpcd, from 135 lpcd to 300 lpcd and above 300 lpcd.
- Rate/kL for the lowest domestic water consumption layer (below 65 lpcd) is assumed based on the same Rate/kL as the present lowest one, considering the poor group.
- Rate/kL for the middle domestic water consumption layer (from 65 lpcd to 135 lpcd) is about 2 times of Rate/kL in the lowest water consumption layer (below 65 lpcd).
- Rate/kL for the higher group than the middle water consumption layer (from 135 lpcd to 300 lpcd) is about 5 times of Rate/kL in the lowest water consumption layer (below 65 lpcd).
- Rate/kL for the highest domestic water consumption layer (above 300 lpcd) is about 9 times of Rate/kL in the lowest water consumption layer (below 65 lpcd).

b) Non-Domestic

- The water consumption layer is established for four (4) groups, which are below 150 lpcd, from 150 lpcd to 400 lpcd, from 400 lpcd to 600 lpcd, above 600 lpcd.
- Rate/kL for the lowest water consumption layer (below 150 lpcd) of non-domestic is about 1.1 times of Rate/kL in the highest water consumption layer of domestic (above 300 lpcd).
- Rate/kL for the second water consumption layer (from 150 lpcd to 400 lpcd) is about 1.16 times of Rate/kL in the lowest water consumption layer (below 150 lpcd).
- Rate/kL for the third than the middle water consumption layer (from 400 lpcd to 600 lpcd) is about 1.4 times of Rate/kL in the lowest water consumption layer (below 150 lpcd).

- Rate/kL for the highest water consumption layer (above 600 lpcd) is about 1.7 times of Rate/kL in the lowest water consumption layer (below 150 lpcd).

Table 16.4.13 shows the proposed water tariff for the entire BBMP. The water consumption layer for domestic and non-domestic consists of 4 groups in terms of water consumption per person/day. The composition percentages by layer is referred to present records. An average consumption rate is set for each water consumption layer for domestic and non-domestic uses. Consumption (liter/month) is also allocated to each water consumption layer for domestic and non-domestic uses. The total charge in Million INR/month is calculated in the right most column (Rate/kL × Consumption/liter/month). Projected total charge for water supply is almost same as required O&M cost in assumption of the above mentioned conditions.

Table 16.4.13 Proposed Water Tariff for the Entire BBMP

Domestic					
Consumption / person	Tariff Slab (KL)	Set INR/KL	Assumed	Consumption	Million INR
LPCD	Water Consumption		Consumption %	ML/Month	Per/Month
Upto 65 lpcd	0 - 8	7	5%	2,550	18
65 to 135	8 - 16	15	15%	7,650	115
135 to 300	16 - 36	36	25%	12,750	459
Above 300	Above 36	64	26%	13,260	849
Sub - Total			**71%**	**36,210**	
Non Domestic					
Upto 150 lpcd	0 - 18	70	1%	510	36
150 to 400	18 - 48	81	1%	510	41
400 to 600	48 - 72	98	2%	1,020	100
Above 600	Above 72	120	3%	1,530	184
Sub - Total			**7%**	**3,570**	
High Rise		28	8%	4,080	114
Partial ND		32	11%	5,610	180
Industry		98	3%	1,530	150
Total Water Supplied/month			**100%**	**51,000**	**2,245**

Source: JICA Survey Team

Note1: The percentage of each Tariff slab (kL) is referred to current records as request of the BWSSB.

In application of the tariff in Table 16.4.13, required monthly O&M cost for water supply in the entire BBMP can be recovered. Water charges in combination of water and sewerage shall be determined as 1.5 times of water charge, since the required O&M cost for the sewerage service is about 50% of water charge as discussed before.

16.4.5 Willingness to Pay for Water Supply and Sewerage

According to the results of "Social Condition Survey on households and business establishments" in Bengaluru rural and urban district, 95.3% of respondents were ready to pay for water supply services. Furthermore, 93.9% of respondents were ready to pay for sewerage services.

(1) Willingness to Pay for Water Supply

77.5% of respondents showed the difficulty to pay more than 500 INR. While, 21.6% are ready to pay

500 to 1,000 INR for water supply. Table 16.4.14 shows the results of the survey.

Table 16.4.14 Willingness to Pay for Water Supply

Expected Amount for Water Tariff per Household per month	Percentage of Respondents
Under 500 INR	77.50%
500 to 1,000 INR	21.60%
1,000 to 2,000 INR	0.90%
Total	100.00%

Source: JICA Survey Team

(2) Willingness to Pay for Sewerage Services

Majority of respondents with 85.7% showed the difficulty to pay more than 300 INR. While, 13.6% were ready to pay 300 to 600 INR for sewerage service (refer to Table 16.4.15).

Table 16.4.15 Willingness to Pay for Sewerage

Expected Amount for Sewerage Tariff per Household per month	Percentage of Respondents
Under 300 INR	85.70%
300 to 600 INR	13.60%
Above 600 INR	0.70%
Total	100.00%

Source: JICA Survey Team

16.4.6 Affordability to Pay for Water Supply and Sewerage

According to Economic Survey of Karnataka (GoK) - 2015, average income of household in Bengaluru is 16,610 INR/month as shown in Table 16.4.16. The Pan American Health Organization (PAHO) recommends that the affordability of people to pay for the services of water supply and sewerage is 5% of the total monthly income per household as a maximum, which consists of 3.5% for water supply and 1.5% for sewerage.

Economic growth rate of State of Karnataka is 7% in FY 2015-16, whereas it was 5% in FY 2014-15. Even if we consider the average growth rate of 6%, the per capita income will go up as shown in Table 16.4.16.

Table 16.4.16 Affordability to Pay for Water and Sewerage Monthly per Household

Unit: INR

Economic Survey of Karnataka (GOK) – 2015: Economic annual Growth Rate at 6%			
Average HH Income	**2015**	**2024**	**2034**
Average monthly HH Income in Bengaluru	16,610	28,063	50,257

ATP for Water and Sewerage per Household per month			
Water Charge at 3.5% of Average monthly HH income	581	982	1,759
Sewerage Charge at 1.5% of Average monthly HH income	249	421	754
Total	831	1,403	2,513

Source: JICA Survey Team

It can be concluded that the amount of affordability to pay for water charges per household per month comes to 581 INR and sewerage charges comes per household per month to 249 INR in 2015. Therefore, it is concluded that average charge per households per month is lower than affordability to pay. In the future, if India joins the ranks of advanced nations and become an economic power or the number of the poor group decrease, it is assumed that the total amounts of solvency margin will increase and affordability to pay will be higher.

16.5 Financial Analysis and Consideration on the Proposed Project

16.5.1 General

For the financial analysis, we have opted the analysis of IRR by cash flow method. Total financial cost of this project consists of initial investment costs, O&M costs, and replacement costs of mechanical and electrical equipment. The financial benefit is the only tariff income from customers served by water supply and sewerage facilities.

16.5.2 Assumption for Financial Analysis

With regard to financial analysis, assumptions and conditions are as follows.

Table 16.5.1 Assumptions and Conditions for Financial Analysis

1	Project Term	2017-2046 (For 30 Years)
2	Evaluation Term	2017-2046 (For 30 Years)
3	Price Standard Year	2017
4	Exchange Rate ※	1 INR = 1.74 JPY
5	Weighted Average Cost of Capital	4%

Source: JICA Survey Team

※Source of Exchange rate: Guidelines for Financial Management and Financial Analysis of Projects in 2006

In calculating FIRR, the conditions are set as follows:

- Financial cost consists of initial investment cost, O&M cost and replacement cost of mechanical and electrical equipment for both JICA Survey Project and Indian Project.
- Initial investment cost consists of procurement and construction cost, consulting cost, physical contingency, administration cost, interest during construction. However, price contingency and interest during construction is not included in financial analysis because of the fact that inflation is not generally reflected in financial revenue.
- Tariff income is based on average monthly HH charge for water and sewerage on the water con-

sumption per person per day at 2034, which is based on 135 lpcd for domestic and 150 lpcd for the average water consumption of domestic and non-domestic. Average monthly HH charge for water and sewerage on the present practice is 432 INR (water/346 INR, sewerage/86 INR). While, on basis of the present tariff table, the present tariff on the water consumption per person per day (100 lpcd) is 100 INR and the future tariff on the water consumption per person per day (135 lpcd) is 144 INR, so the difference between 100 lpcd and 135 lpcd result in 44 INR. Therefore, average monthly HH charge for water and sewerage at 2034 is 476 INR (432 + 44), which leads to tariff income.

- O&M cost for the JICA Survey Project of sewerage is increased with coverage ratio between 2023 to 2034, however, water supply cost is the same due to the supply amount is 775 MLD.
- Financial benefit of this project is caused by water and sewerage tariff income from domestic and non-domestic customers by using water and sewerage. Basic water consumption of domestic is based on 135 lpcd and average water consumption of domestic and non-domestic is based on 150 lpcd.
- Tariff income is based on the present tariff level per household income.
- Served household consists of the beneficiaries of Core/ULB and 110 Villages for the JICA Survey Project.

16.5.3 Cash Flow Analysis and FIRR

Table 16.5.2 shows cash flow analysis of this project. FIRR: Financial internal return of rate is -0.13 %. This figure (-0.13 %) is lower than Weighted Average Cost of Capital, but this project is based on the assumption that initial investment cost is originally contributed by the state government. Therefore, it is concluded that this project would be financially acceptable.

Table 16.5.2 Cash Flow Analysis (FIRR)

(Unit: INR. Million)

Year in Order	Fiscal Year	Financial Cost				Financial Benefit		Cash Balance
		Construction Cost	O&M cost	Replacement Cost	Total	Water & Sewerage Charge Collection		
						Served Household	Tariff Income	
1	2017	7,485	0		7,485			-7,485
2	2018	4,428	0		4,428			-4,428
3	2019	2,001	0		2,001			-2,001
4	2020	23,524	0		23,524			-23,524
5	2021	15,665	0		15,665			-15,665
6	2022	15,912	0		15,912			-15,912
7	2023	5,106	2,667		7,774	1,082,402	6,183	-1,591
8	2024	1,792	2,726		4,518	1,082,402	6,183	1,664
9	2025	11	2,771		2,782	1,082,402	6,183	3,401
10	2026		2,816		2,816	1,082,402	6,183	3,366
11	2027		2,862		2,862	1,082,402	6,183	3,321
12	2028		2,907		2,907	1,082,402	6,183	3,276
13	2029		2,952		2,952	1,082,402	6,183	3,231
14	2030		2,974		2,974	1,082,402	6,183	3,208
15	2031		2,988		2,988	1,082,402	6,183	3,195
16	2032		2,997		2,997	1,082,402	6,183	3,186
17	2033		3,006		3,006	1,082,402	6,183	3,177
18	2034		3,011		3,011	1,082,402	6,183	3,172
19	2035		3,011		3,011	1,082,402	6,183	3,172
20	2036		3,011		3,011	1,082,402	6,183	3,172
21	2037		3,011		3,011	1,082,402	6,183	3,172
22	2038		3,011	1,502	4,513	1,082,402	6,183	1,670
23	2039		3,011	1,502	4,513	1,082,402	6,183	1,670
24	2040		3,011	1,502	3,011	1,082,402	6,183	3,172
25	2041		3,011	1,502	3,011	1,082,402	6,183	3,172
26	2042		3,011		3,011	1,082,402	6,183	3,172
27	2043		3,011		3,011	1,082,402	6,183	3,172
28	2044		3,011		3,011	1,082,402	6,183	3,172
29	2045		3,011		3,011	1,082,402	6,183	3,172
30	2046		3,011		3,011	1,082,402	6,183	3,172
Total		75,924	70,804	6,008	149,732		148,383	-1,350
FIRR:								-0.13%

Source: JICA Survey Team

16.5.4 Financial Sensitivity Analysis

Simulate four cases of -10% cost reduction, -5% cost reduction, +5% cost increasing and +10% cost increasing. Range of inflection is limited in -3.22 % to -0.13 % as shown in Table 16.5.3. We may conclude an inflation of O&M cost is not significant. According to Asian Development Bank's Asian Economy Outlook 2014, change of consumer price index is 6%. Therefore, this scenario of inflation sensitivity analysis is reasonable. The detailed analysis is shown in from Table 16.5.1 to Table 16.5.3 on supporting report.

Table 16.5.3 Sensitivity Analysis

FIRR		Benefit		
		Base	-5 %	-10 %
Cost +	Base	-0.13%	-0.88%	-1.70%
	5%	-0.85%	-1.62%	-2.46%
	10%	-1.54%	-2.34%	-3.22%

Source: JICA Survey Team

16.6 Economic Analysis and Considerations on the Proposed Project

16.6.1 General

Economic analysis takes into account the opportunity costs of resource employed and attempts to measure in monetary terms the private and social costs and benefits of a project to the community or economy. Economic cost of this project was converted to international price level for all financial expenses. However, inflation and interest during construction is not included in because of the fact that the inflation is not reflected in economic benefits. Economic benefit of this project consists of quantifiable effectiveness, which is saving water tanker cost, bottled water cost, and medical cost as well as tariff income from customers by using water and sewerage.

To evaluate any economic benefits, the following assumptions, conditions and factors are considered.

16.6.2 Assumption for Economic Analysis

With regard to economic analysis, assumptions and conditions is as follows.

Table 16.6.1 Assumptions and Conditions for Economic Analysis

1	Project Term	2017-2046 (For 30 Years)
2	Evaluation Term	2017-2046 (For 30 Years)
3	Price Standard Year	2017
4	Exchange Rate	1 INR = 1.74JPY
5	Opportunity Cost of Resource ※	12% per annual
6	Standard Conversion Factor	0.96

Source: JICA Survey Team

※Source of Opportunity Cost of Resource: JICA Report in 2014

In calculating EIRR, the conditions are set as follows.

- Economic cost of this project is converted to international price level for all financial expenses. However, inflation and interest during construction is not included in because of the fact that the inflation is not reflected in economic benefits.
- Economic cost consists of initial investment costs (including construction cost), O&M cost and replacement cost of mechanical and electrical equipment for the JICA Survey Project.
- O&M cost for the JICA Survey Project of sewerage is increased with coverage ratio between 2023 to 2034, however, water supply cost is the same due to the supply amount is 775 MLD.
- Economic benefit of this project consists of the benefits that quantifiable effectiveness such as saving of alternative water acquisition costs other than public water supply.
- Saving of water tanker cost (1,300 INR/month) and bottled water cost (600 INR/month) will become economic benefit. It is assumed that 100% of the cost will be saved per each household, which will result in economic benefit.
- Saving of medical cost (250 INR/year) will become economic benefit. It is assumed that this cost will be saved per each household in 110 Villages, which will result in economic benefit.
- Served household consists of the beneficiaries of Core/ULB and 110 Villages for the JICA Survey Project.

16.6.3 Factors for Economic Analysis

(1) Economic benefit for this project

Economic benefit for this project is shown in Table 16.6.2.

Table 16.6.2 Economic Benefit for this project

No	Effectiveness	Economic Factor	Quantifiable/ Non-Quantifiable
1	Improvement of Comfort	Improvement of the quality of life of public water users in the house	Non-Quantifiable
2	Saving Cost	Saving of alternative water acquisition costs other than public water supply	Quantifiable
3	Improvement of Public Health	Saving of medical costs by reduction of waterborne diseases	Quantifiable
		Increase in the number of attracting tourists due to improved water quality	Non-Quantifiable
4	Rising of Land Prices	Rising of land price due to improved environment	Non-Quantifiable
5	Environmental Conservation	Conservation of groundwater resources by restraining the construction of wells	Non-Quantifiable

Source: JICA Survey Team

(2) Cost of Water Tanker & Bottled Water

There will be saving of cost of water tanker and bottled water in 110 Villages. The cost of water tanker

per house per month is 1,300 INR and those of bottled water per house per month is 600 INR. These prices are average of five zones in the Table 14.2.17 in Chapter 14 (based on Social Condition Survey in the Preparatory Survey). On a very conservative basis, it is assumed that 100% of the cost will be saved per household, which will result in an economic benefit.

(3) Medical Cost

By this project, sanitary conditions of the river in the project area is improved and the ratio of water-borne disease which people are infected with will decrease. Therefore, the medical cost for water-borne disease may be saved and saving the medical cost will be economic benefit. It is assumed that the medical cost as average 250 INR per household per year may be saved which are shown in Table 16.6.3. This project affects the people who live in 110 Villages positively.

Table 16.6.3 Annual Medical Cost per HH Caused By Waterborne Disease

Percentage under 5 years old in India		Number of annual medical examination in Japan			Neonatal and infant mortality in India and Japan				Ratio of water-borne disease		Average medical cost caused by waterborne disease (US Dollar)			Exchange	Number of Household	Annual medical cost per HH caused by waterborne disease (INR)
					India		Japan									
Male	Female	Hospitalization	Outpatient Service	Population Parameter	Neonatal	Infant	Neonatal	Infant	Diarrhea	Pneumonia	Low	High	Average	INR/USD		
4.40 %	4.90 %	1,000	7,000	100,000	32	48	1	2	11 %	18 %	10	23	2	65	4	**247**
a	b	c	d	e	f	g	h	i	o	p	j	k	l	m	n	Formula
Source: The World Population		Source: Ministry of Health			Source: WHO				Source: UNICEF		Source: WHO					(a+b)×(c+d)/e×(f+g)/(h+i)× (o+p)×(j+k)/l×m×n

Source: JICA Survey Team

(4) Septic Tank Cost

The beneficiaries served by sewerage systems can save the cost for the construction of septic tanks and the cost for desludging. Based on the information collected from BWSSB and local consultants, and experiences in India, the averaged construction cost of septic tank is assumed to be 8,500 INR/unit and the averaged desludging cost 2,000 INR/household/time. In this study, the desludging frequency is assumed as once every three (3) years.

(5) Economic impact factors not count on this report

Following factors are not considered in this report:

- Use of effluent for construction
- Use of effluent for fish farming, irrigation and railway

a) Use of effluent for construction

Interview with several construction companies revealed a poor willingness to buy the treated sewerage

water for the use of construction works. They use the river water and grand water for construction and are satisfied with the quality of water. These days regulation requests the recycling of treated sewerage. The New Town Developing Company, for example, use recycled water for gardening or mid-water flushing toilet. Sometimes they use treated sewage for their managed new town in construction work. This kind of arrangements in new town development are practiced in case of water shortage or to secure purchasing water. Namely, they are not willing to purchase treated sewage. Thus, this factor should not be counted as an economic benefit in this Project.

b) Use of treated sewage for fish farming, irrigation and railway

Using effluent for fish farming is quite limited in the BBMP jurisdiction and should be ignored as an economic benefit of the project. The effluent discharged to the irrigation channels for contributing to farming, as well as using water for railways (washing car), should not be counted as an economic impact of this project because such water would be free of charges.

16.6.4 Economic Analysis and EIRR

Table 16.6.4 shows that this project's economic internal rate of return (EIRR) is 21.26 %. In short, it is concluded that this project would be economically acceptable more than opportunity cost of resource.

Table 16.6.4 Economic Analysis (EIRR)

(Unit: INR. Million)

Year in Order	Fiscal Year	Economic Cost				Economic Benefit							Cash Balance
		Construction Cost	O&M cost	Replacement Cost	Total	Served Household	Saving of Water Tanker Cost	Saving of Bottled Water	Saving of Medical Cost	Septic Tank	Sludge removal	Total	
							Basic unit: Rs.	Basic unit: Rs.	Basic unit: Rs.	Basic unit: Rs.	Basic unit: Rs.		
							15,600	7,200	250	8,500	2,000		
							Rs. Million /Y per HH	Rs. Million /Y per HH	Rs. Million /Y per HH	Rs. Million/Nos	Rs. Million /3Y per HH		
1	2017	7,230	0		7,230								-7,230
2	2018	4,277	0		4,277								-4,277
3	2019	1,933	0		1,933								-1,933
4	2020	22,724	0		22,724								-22,724
5	2021	15,133	0		15,133							0	-15,133
6	2022	15,371	0		15,371							0	-15,371
7	2023	4,933	2,426		7,359	1,082,402	16,885	7,793	135	304	24	25,142	17,783
8	2024	1,731	2,658		4,390	1,082,402	16,885	7,793	140	176	38	25,032	20,643
9	2025	10	2,518		2,529	1,082,402	16,885	7,793	145	153	50	25,026	22,497
10	2026		2,744		2,744	1,082,402	16,885	7,793	151	163	62	25,055	22,311
11	2027		2,787		2,787	1,082,402	16,885	7,793	156	175	76	25,086	22,299
12	2028		2,830		2,830	1,082,402	16,885	7,793	162	187	91	25,118	22,289
13	2029		2,872		2,872	1,082,402	16,885	7,793	168	199	106	25,153	22,280
14	2030		2,894		2,894	1,082,402	16,885	7,793	174	132	117	25,102	22,208
15	2031		2,907		2,907	1,082,402	16,885	7,793	178	106	125	25,088	22,181
16	2032		2,915		2,915	1,082,402	16,885	7,793	183		133	24,995	22,079
17	2033		2,924		2,924	1,082,402	16,885	7,793	189		140	25,009	22,085
18	2034		2,928		2,928	1,082,402	16,885	7,793	196		144	25,019	22,091
19	2035		2,928		2,928	1,082,402	16,885	7,793	202		144	25,025	22,097
20	2036		2,928		2,928	1,082,402	16,885	7,793	209		144	25,032	22,104
21	2037		2,928		2,928	1,082,402	16,885	7,793	215		144	25,038	22,110
22	2038		2,928	1,451	4,379	1,082,402	16,885	7,793	222		144	25,045	20,666
23	2039		2,928	1,451	4,379	1,082,402	16,885	7,793	230		144	25,053	20,674
24	2040		2,928	1,451	2,928	1,082,402	16,885	7,793	237		144	25,060	22,132
25	2041		2,928	1,451	2,928	1,082,402	16,885	7,793	245		144	25,068	22,140
26	2042		2,928		2,928	1,082,402	16,885	7,793	253		144	25,076	22,148
27	2043		2,928		2,928	1,082,402	16,885	7,793	261		144	25,084	22,156
28	2044		2,928		2,928	1,082,402	16,885	7,793	269		144	25,093	22,164
29	2045		2,928		2,928	1,082,402	16,885	7,793	278		144	25,101	22,173
30	2046		2,928		2,928	1,082,402	16,885	7,793	281		144	25,104	22,176
Total		73,343	68,542	5,804	144,787		405,251	187,039	4,878	1,595	2,839	601,603	456,816
EIRR:													21.26%

Source: JICA Survey Team

16.6.5 Economic Sensitivity Analysis

Simulate four cases of -10% cost reduction, -5% cost reduction, +5% cost increasing and +10% cost increasing. Range of inflection is limited in 17.77 % to 21.26.26 % as shown in Table 16.6.5. It may conclude that an inflection of O&M cost is not significant. The detailed analysis is shown in from Table 16.6.2 to Table 16.6.5 in Supporting Report.

Table 16.6.5 Economic Sensitivity Analysis

EIRR		Benefit		
		Base	**-5 %**	**-10 %**
Cost +	Base	21.26%	20.35%	19.40%
	5%	20.39%	19.49%	18.56%
	10%	19.57%	18.69%	17.77%

Source: JICA Survey Team

16.7 Recommendations

16.7.1 Operation Deficit on the BWSSB

Taking into consideration earnings before interest and depreciation charge, it can be observed that the BWSSB has an operation surplus. It may be concluded that new capital funds coming in would be utilized for its intended purpose and not for deficit financing.

16.7.2 Debt Servicing

According to the BWSSB's official web site, the BWSSB could not discharge the loan liability of the government, due to financial constraints and accumulated deficit coupled with subsidized water being supplied to the economically vulnerable sections of the society, which is a major strain on the finances. The existing tariff is able to recover only the O&M cost. Unless tariff recovers the cost of debt from the general public, the BWSSB will not be in a position to repay the loan, as the BWSSB is not receiving any budgetary support from the government of Karnataka.

The Budget for FY2014 shows that out of the total debt servicing component of 127,000 Million INR, the interest component is 80,500 Million INR (interest on loans from the government - 73,000 Million INR) and the principal component is 46,500 Million INR (repayment of principal amount of loans from the government (30,000 Million INR). It appears that there is a tacit agreement between the two parties wherein interest payable on loans from government would eventually be converted to grant-in aid.

16.7.3 Inefficient Budgeting Procedure

Concerning the budgetary process, the main issue faced during the budgetary process is that of information sharing. The practice of making random allocations for smaller projects and then revising the allocations as and when actual requirements are known could be attributed to a lack of coordination among the various departments. Therefore, it could be necessary to share the budgeting information of the smaller projects at an early stage of the budgeting process.

16.7.4 Water Tariff Revision

It may be concluded that water tariff was not revised as required because there is unwillingness to change on part of political counterparts in spite of requesting the tariff revisions. As a result revenue incomes are falling short of revenue expenditures. Water tariff should be in synchronized with the costs of

production. At a minimum, the inflation effect must be considered and water tariffs revised as mentioned in sub-section 16.4.4.

16.7.5 Investigation of Water Meters

At present, the BWSSB investigate the meters twice a year due to lack of sufficient staff. Therefore, it is recommenced to investigate the water meters on a more appropriate interval. The BWSSB should establish respective staff arrangements and install the effective investigation system on water meters.

16.7.6 Installation of Water Meters to Poor

Currently there is connection of water supply line to the urban poor and slums. Sewerage treatment is also being provided to them. However, it is not billed and even quantum of water supplied is not recorded.

It is recommended that water meters should be installed at each and every house.

16.7.7 Billing of Public Taps and Fountains

The BWSSB is supplying water through public taps. However, many slums people have been taking free water illegally from public taps. Therefore, the BWSSB cannot bill and the revenue is also not being generated. As a result, NRW is occurring. The situation like this is happening to even public faucet. Water meters were also not installed on the public taps as well as public faucet. Therefore, it is recommended to install water meters and water-theft prevention functions on public taps and faucet. By doing so, it is necessary for the BWSSB to grasp the amount of NRW and how water-theft affects the NRW ratio.

16.7.8 Financial Arrangement with the GoK

It can be said that the government of Karnataka financially affords to fund loans for the BWSSB as the government has a plentiful cash balance (239,010 Million INR) in addition to good operation soundness which can be seen from the historically positive operation surplus. Having disbursed the amount of 12,200 Million INR for the expenditure in FY2014, and then it might be possible for the state government to budget to that extent, although the BWSSB seems to not be preparing for the amount of capital outlay for water supply and sanitation only up to 4,900 Million INR in FY2016 as of today.

As for other authorities, it is necessary to acquire the cooperation with the government of Karnataka in advance in order to be given loans and grants from their funds. It should be mentioned that persuading the generals of the government of Karnataka is critical. However, it is still questionable that the government accepts the additional loans because the BWSSB does not pay for the interest on loans to the government, though the BWSSB is claimed for the payable interests. Consequently, it can be mentioned that additional funding from the government of Karnataka and other authorities is difficult to realize.

16.7.9 Financial Arrangement by PPP

There are no on-going PPP projects now. It is assumed that the PPP method is effective when constructing and operating a recycled water plant.

・Operation and maintenance of a recycled water plant

A recycled water plant is the facility to carry out advanced treatment of sewage as required and sell the water. Operation and maintenance of STPs has been practiced by private contractors in Bengaluru. Therefore, the involvement of private sector applying PPP method in Bengaluru seems possible.

・Operation method from financial viewpoint

Comparing with public operation method, more aggressive operation is expected for private contractors selling treated sewage with profit (incentive), which needs to save O&M cost for the sewerage facilities.

・Construction term and construction cost

It is expected to shorten the construction term and to save the construction cost by consigning the construction of a recycled water plant to private contractors.

・Organizational system

Regarding the organizational system, it is assumed that a little additional O&M cost will occur in addition to current O&M cost for STP, so it seems that it is possible to minimize the number of administrative personnel.

・An important notice in the future

In case that treated sewage is used for recycled water utilization with emphasis on profit, it is necessary to pay attention to how to use because it may be difficult to keep the minimum discharge amount for conservation of lake and there is a possibility to have a negative influence on the water environment. Furthermore, it is necessary to monitor the water environment and negotiate retailer in order to keep the water environment, because it is expected that the private contractors construct and operate.

Chapter 17 Institutional Development

With the enactment of the BWSSB Act, 1964 a statutory body named BWSSB was established on 30th Sept 1964. As per the Act, BWSSB was entrusted the overall responsibility of water supply and sewerage services in the Bengaluru Metropolitan Area (BMA). BWSSB is an autonomous body formed by the State legislature, but financial matters are regulated by GoK requiring its approval in case of large capital works either financed by external aide or local aid by Indian Government. The tariff setting is also need GoK approval, as it is a socio-political issue. Never the less, since its inception in 1964 as a small organization, it has expanded enormously and had undergone several structural and functional changes, mainly due to changes in area under BMA and service requirements of its population. The status of BWSSB including its vision, mission and mandate is described below:

17.1 Present Organizational Situation of BWSSB

17.1.1 Mandate of BWSSB

The existing vision, mission and mandate of BWSSB indicating its strategic direction are as follows:

(1) Vision Statement

The Bangalore Water Supply and Sewerage Board (BWSSB) is committed to providing drinking water of unquestionable quality in sufficient quantity and also to treat the generated sewage to the required quality parameters. As the leader in providing water and sanitation services, BWSSB is recognized as an effective instrument of change through adopting state-of-the-art technologies for improving the quality of its services to the general public.

(2) Mission Statement

BWSSB's vision rests on its unwavering commitment to providing value added quality services using innovative and cost effective solutions to achieve customer satisfaction, by remaining ever sensitive to their needs by anticipating their requirements, keeping public interface always open and staying in the forefront in all endeavors.

(3) Mandate

BWSSB has been entrusted to provide water supply and sewerage services to the citizens of BBMP area and is to operate as an autonomous body. The envisaged functions of BWSSB are:

- To provide water supply and undertaking arrangements for the sewerage and disposal of sewage from the existing and developing (new) regions of BBMP Area.
- To investigate adequacy of water supply for domestic purpose in BBMP area.
- To prepare and implement plans/schemes for supply of water for domestic purposes within the BBMP area to the required standards.
- To prepare and implement plans/schemes for proper sewerage management and disposal of sewage of the BBMP area.
- To levy and collect water and associated charges (like sanitary charges for sewerage services) on "no

loss no profit basis."

(4) Service Level Benchmarks

Realizing the emerging need for a paradigm shift in focus of WSS utilities from infrastructure development to service delivery, Ministry of Urban Development (MoUD) and GOI released a number of Service Level Benchmarks (SLBs). The proposition of SLBs have been pursued to facilitate a shift in focus of ULBs and UUAs (Urban Utilities Agencies) from infrastructure creation to delivery of service outcomes. To monitor service delivery focus, 18 service level performance indicators/benchmarks were identified. For water supply, this includes 100% coverage, 135 lpcd water supply, 24 hour supply, maximum of 20% non-revenue water, 100% metering, 100% cost recovery etc., whereas for sewerage services it has 100% coverage, 100% sewerage treatment, 20% recycle/reuse of sewerage, 100% cost recovery etc. as the monitoring parameters. However, whether to adhere or use these benchmarks as "targets" for improvement needs shall be decided by BWSSB based on a fair assessment of its organizational capacity, capability and resources required, and availability for the envisaged improvements.

17.1.2 Governance

All the employees of BWSSB are governed by the Service Rules (SR) and Financial Rules (FR) of the Government of Karnataka (GoK). Besides these, BWSSB needs to follow a number of GoK Acts, Codes, Manuals and Rules for discharge of their duties and responsibilities. These mainly include:

- Karnataka Financial Code
- PWD (Public Works Department) Accounts Code
- Karnataka Treasury Code
- PWD Code
- BWSSB Act and its amendments
- The Karnataka Government Servant Service Rules
- Karnataka Civil Services (KCS - CCA & Conduct Rules)
- Karnataka Transparency in Public Procurements Act 1999 and Rules 2000 and Procurement Reforms

In addition, BWSSB has also been issuing a number of notifications (water tariff rates etc.), internal circulars and officer orders (transfer, promotions etc.) to streamline its internal operations. The overall purpose is to direct, guide and support the functioning of BWSSB in a uniform, effective, transparent and equitable (non-discriminatory) manner, while following GoK systems and procedures.

17.1.3 Organizational Structure

BWSSB is headed by a Chairman, who is generally an Indian Administrative Service (IAS) officer and is responsible for overall functioning of BWSSB. The Chairman is appointed. BWSSB is governed by a Board of Directors, which at present constitutes of 7 members including representatives from BBMP and Chairman of BWSSB as an ex-officio member. The Board of Directors and senior functionaries constitute the top management of BWSSB, who provide strategic direction and are responsible for formulation of policies, approval of major plans, resource mobilization arrangements etc.,

The senior functionaries of BWSSB, at present include one Engineer-in- Chief, 4 Chief Engineers, One

Chief Administrative Officer cum Secretary, One Financial Advisor cum Chief Accounts Officer and 13 Additional Chief Engineers.

(1) Functional Responsibilities

For undertaking its functional responsibilities, BWSSB has been recently (from Sept 19, 2016) restructured into 7 Zones as shown in Figure 17.1.1. The Zones and their responsibilities are as follows:

1) Maintenance Zone

Operating under the control of EIC and CE (Maintenance), the Zone is responsible for undertaking O&M of water supply works, revenue billing and collection in the coverage areas, bulk metering of water supplied to Gram Panchayats, water auditing and for undertaking measures to reduce UFW/NRW. For this it has 4 ACEs (Assistant Chief Engineer, Maintenance) and one ACE (UFW). Overall, the Zone has 11 field Divisions and 3 divisions at head office. Further, CE (Maintenance) is supported in its official works by two DCEs (Deputy Chief Engineers), in the rank of EE (Executive Engineer).

2) Waste Water Management Zone

Operating under the control of CE (WWM), the Zone is responsible for collection and treatment of wastewater up to specific stages before disposing it to water sources/natural valleys and maintenance of sewers and processing units (STPs). The Zone is authorized to deal with other Government Departments (GoK or GOI) on behalf of Board to seek necessary permissions/clearances, utility shifting, land acquisition for establishing wastewater related facilities etc. Also responsible for providing needful documentation, data/information for seeking finances from foreign/Indian funding agencies. Overall, the Zone has 5 field Divisions, operating under 2 ACEs.

3) Kaveri Zone

Operating under the control of CE (Kaveri), the Zone is responsible for execution including procurement of works under Stage IV Phase 2 of Kaveri Water Supply Scheme, associated land acquisition, maintaining main pipelines and treatment of water, rejuvenation of Arkavathi works, processing of Kaveri-Arkavathi water and transportation of required processed water to the city, and implementation of major works to receive water. Besides the CE, it has 2 ACEs to manage 5 field divisions. CE (Kaveri) is also supported in its official works by a DCE (in the rank of EE). The ACE (2) is also responsible for implementation of SCADA for automated operation of WSS (WTP, STP etc.).

4) Projects Zone

Operating under the control of CE (Projects), it has three major functional areas headed by respective ACEs. ACE (CMC) is responsible for providing water supply and creation of sewerage system in the CMC areas. ACE (DCW) is responsible for undertaking WSS infrastructure works as “Deposit Works” in new layouts developed by BBMP, BDA and other government organizations. They also undertake implementation of new technologies in works and services of BWSSB besides undertaking and promoting recycling and reuse of wastewater including promotion of initiatives like “new water”. ACE (QA + B and V) is responsible for quality assurance of all supplied materials (exclusive of turnkey projects) required

for various maintenance

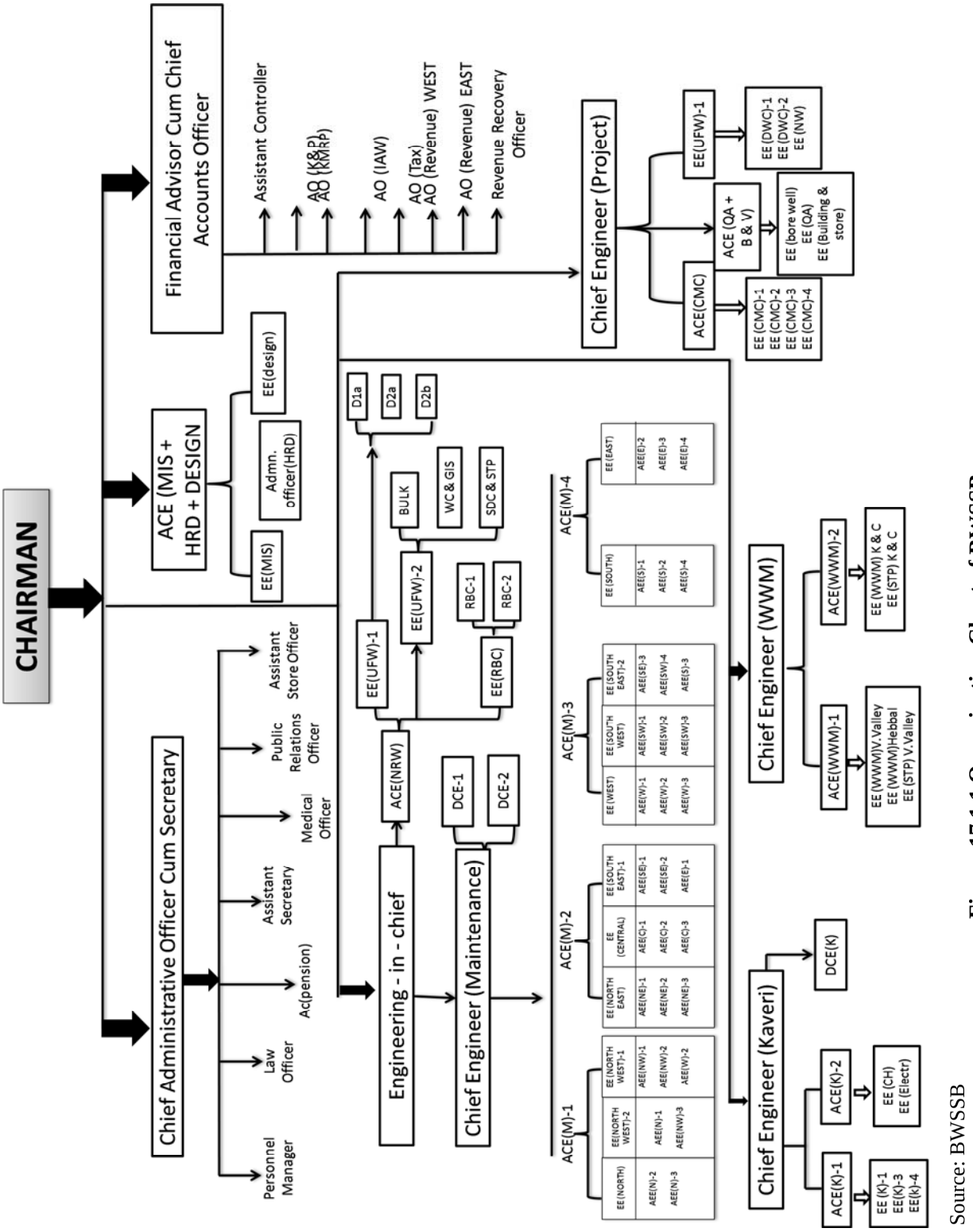


Figure 17.1.1 Organization Chart of BWSSB

Source: BWSSB

and project works by undertaking central procurement. In addition, the ACE is also responsible for regulation of water quality, meter quality etc. and upkeep and management of various Buildings, Vehicles and Stores of BWSSB. Overall, the Zone has 7 Divisional offices in field and another 3 working Divisions at head office.

5) MIS+HRD+Design Zone

The Zone is headed by an ACE and has three Divisions: One each for Management Information System (MIS) of BWSSB, Human Resource Development and Training (HRD) and Design of WSS infrastructure. With this, it has 3 working Divisions at head office.

6) Office of CAO cum Secretary

Responsible for all administrative and personnel matters, organizing board meetings and for implementing the decisions of the BWSSB Board. The zone (office) is headed by a Chief Administrative Officer (CAO) cum Secretary and is supported by officers like Personnel Manager, Law Officer, Assistant Secretary, Medical Officer, Public Relations Officer, Administrative Officer (Pension) and an Assistant Stores Officer .

7) Office of Financial Adviser cum Chief Accounts Officer

The zone (office) is headed by a Financial Advisor cum Chief Accounts Officer and supervises the work of Assistant Controller (Accounts), Accounts Officer (AO, Kaveri and Projects), AO (KMRP), AO (Law), AO (Internal Audit and Tax), AO (Revenue - East), AO (Revenue-West) and a Revenue Recovery officer. The Zone is responsible for the accounts and finances (receipt, loans, payment) of the Board and also advises the Board on various strategic financial matters.

As can be seen, Zone 1 to 5 are engaged in engineering functions, whereas zone 6 is responsible for administration and Zone 7 (FA cum CAO) is responsible for accounting and financial management. To streamline its operations, zonal heads and senior functionaries operate from head office (Cauvery Bhavan), whereas, a substantial number of staff discharge their duties from its network of field offices (located close to WSS service points encompassing the coverage areas). A description of functional distribution at these offices is as follows:

(2) Functioning at Head Office

Besides the office of Chairman, BWSSB, most of the senior officials of all Zones (one EIC, 4 CEs and 13 ACEs) function from the Head Office of BWSSB located at Cauvery Bhavan, Kempe Gowda Road, Bengaluru. The senior management focuses on plans, policies, directives, project approvals, procurement, monitoring, administration, financial management etc. whereas field offices are mainly engaged in project execution, contract management, operation and maintenance etc.

Besides senior functionaries, following 8 divisions also function from head office: Two of UFW, one of Revenue Billing and Collection, one of bore-well, one of quality assurance, one for building and vehicles,

one of MIS and one of Design. Each of the above division is headed by an EE. In addition, the two Deputy Chief Engineers (DCEs) in the rank of EE, operate from head office and support Chief Engineer (Maintenance) in official responsibilities. Similarly, one DCE supports CE (Kaveri) at Head Office.

Realizing the strategic need of water auditing and reduction of UFW/NRW, one ACE (NRW) - reporting directly to Engineer in Chief (Maintenance), has been exclusively assigned this responsibility. The ACE (NRW) supervises two UFW divisions and one Division of revenue billing and collection (RBC). UFW-1 Division has three sub-divisions, each one looking after various UFW/NRW initiatives in the BBMP areas. Presently, they are managing three sub-projects on "Reduction of UFW" under Phase 2 of JICA supported BWSSP. Similarly, UFW-2 Division has three sub-divisions: One of them is responsible for bulk metering (mostly to adjoining Gram Panchayats), one for GIS and the third one looks after Slum Development (SDC and STP) activities. The division of revenue billing and collection (RBC) has two sub-divisions for attainment of higher efficiency in revenue billing and its collection.

Overall, BWSSB has a well-defined set-up for undertaking construction, operation and maintenance, revenue billing and collection etc.

(3) Functioning of Field Offices

The major functions of BWSSB includes construction of water supply and sewerage infrastructure and their operation and maintenance to provide satisfactory services to citizens of BBMP. This requires extensive field (close to construction sites, service areas, plants and consumers) presence of BWSSB. For which, it has 11 Divisional offices under Maintenance Zone, 7 offices under Projects Zone, 5 offices under Waste Water Management Zone and 5 offices under Kaveri Zone i.e. a total of 28 Divisional offices, which are headed by respective Executive Engineers.

1) Operation and Maintenance Works

The "Maintenance Zone" is responsible for operation and maintenance of entire water supply and maintenance of sewerage network (up to 300 mm sizes, mostly stoneware pipes) in Core and ULB areas. The entire area is served by 11 O&M cum revenue divisions (North, South, Central, West, East, North-East, South East-1, South East -2, North West-1, North West-2 and South-West), each one headed by an Executive Engineer. For administrative efficiency, each Division has 2 to 4 sub-divisions. Overall, the eleven O&M cum Revenue divisions have 31 sub-divisions, each headed by an AEE. At present, one O&M sub- division is catering to 28 thousand service connections on an average, though there are sub-divisions (NW3 and SE1) having little more than 42 thousand connections each.

To provide better customer services including grievance redressal, a sub-division has 2 to 6 service stations, each one managed by an AE or JE. Each service station covers a specific water "distribution area", depending upon existing water network. Due to this, there are large variations in extent of coverage of distribution area as well as number of service connections under a sub-division. The details of existing service stations, number of connections served and the billed revenue for Nov 2016 is presented in Table

17.1 in supporting report. As per data, the number of connections under one service station had varied from 1,033 to 25,269. Overall, there are 112 service stations (105 providing commercial services and generating revenues, whereas 7 are still developing). In addition, each EE (O&M cum revenue) has one AEE and one AE/JE for supporting them in discharge of their other responsibilities to manage a field division. Thus, these O&M Cum Revenue field divisions have 11 EEs, 42 AEEs and 123 AEs/JEs. All of them have a reporting relationship with CE and EIC (maintenance) through respective ACEs.

To manage operation and maintenance of water supply services, there are water inspectors (one inspector on an average of 5,000 connections). Under each inspector, there are about 3-4 valve operators to manage the intermittent water supply (4-6 hour on alternate days) needs. For revenue billing, the bills are raised each month and one meter reader has been provided to read on average 2,000 connections. These meter readers undertake readings for about 20 days in a month and then assist in making entries at sub-division office for the remaining days. Overall, BWSSB has about 169 water inspectors and 239 meter readers on regular role (as of 25 January, 2017), whereas another 200 meter readers are working on outsourcing basis.

Similarly for sewerage maintenance, it has a fleet of 130 jetting machines, 36 bucket machines and 30 rodding machines. Though, use of bucket machines and rodding machines is getting limited, but BWSSB has no plans to replace them. For operation of these machines, it employs about 43 sanitary supervisors and 133 sanitary workers on regular basis, besides outsourcing the services of little more than 300 sanitary workers. The sanitary staff is provided both training as well as required safety equipment like helmet, goggles, jacket, hand-gloves and gum boots. As a result of above measures, there has been no accident/casualty during recent times in maintenance of sewerage network, undertaken by BWSSB employed professionals.

2) Field Office of WWM Zone

The Wastewater Management (WWM) Zone is headed by a CE and is responsible for O&M of existing STPs besides laying and maintenance of sewers of 400 mm to 2,100 mm (RCC Hume pipes) as main sewers in Core and ULB areas. The CE is supported by two ACEs. To undertake these activities, there are 5 field level divisions, each headed by one EE. The functional coverage of these divisions is as follows:

- Divisions under ACE (WMM) -1
  ⇒ Sewerage Network of Vrishabhavat Valley (V. Valley);
  ⇒ Sewerage Network of Hebbal Valley;
  ⇒ All STPs of V. Valley and Hebbal Valley;
- Divisions under ACE (WMM) -2
  ⇒ Sewerage Network of Koramangala and Chalagatta (K&C) valley and
  ⇒ All STPs of K&C Valley.

Each division has 4 sub-divisional offices, headed by an AEE i.e. a total of 20 sub-divisional offices and

equal number of AEEs. Overall, the five divisions have 5 EEs, 20 AEEs and 35 AEs/JEs. Besides, the office of CE (WMM) has 2 AEEs and 5 AE/JEs to support official responsibilities at HQ. Thus, the total strength of middle and senior staff in WMM Zone is 1 CE, 2 ACE, 5 EE, 22 AEE and 40 AE/JE.

3) Field Offices - Construction Works

The construction works related to transmission and treatment of water from Cauvery and the works required for laying water supply lines in the Core area is under the administrative control of Chief Engineer (Kaveri). For which it has 2 ACEs and 5 field offices.

Similarly, Chief Engineer (Projects) is responsible for managing construction works related to distribution of water in other ULB areas, implementing WSS related construction works in 110 Villages as well as for deposit works under KMRP and GBWSSP. The ACE (CMC) has four field offices, whereas ACE (DCW-Deposit Capital Works) has two field offices.

Chief Engineer (WWM) undertakes/manages sewerage related construction works in the Core as well as in ULB areas. However, these works are undertaken by the same field offices, which are responsible for undertaking O&M of sewerage works.

17.1.4 Management System

The management system means “systems and procedures” adopted by BWSSB for discharging various functions/responsibilities. These mainly include:

(1) Decision Making Process

Decisions in BWSSB are taken based on the merits of the issues, relative priorities and availability of funds, in accordance with the documented procedures, defined criteria and rules. The procedures followed in the decision making process, including channels of supervision and accountability, are as per existing “delegation of powers” of BWSSB (updated from time to time). Over the period, BWSSB has progressively decentralized the authority and responsibility and the results have been positive. A close review of delegation of powers indicates that “authority” of senior officers is either equivalent or less than their counterparts in PWD, GoK. Being an autonomous service delivery organization requiring provision of essential services, such limited delegation could impact service delivery and requires a review.

(2) Revenue Generation System for WSS Services

The revenue generation system comprises of water and sewerage tariff policy, existing rates of WSS services, metering, billing and revenue collection system. As per BWSSB Act, the Board is empowered to levy and collect charges for the WSS services rendered to the citizens as per GoK approved tariff structure. The consumers are billed for the water charges (as per volumetric meter reading and class i.e. domestic, non-domestic etc.), sanitary charges, meter charges, bore-well charges etc. For which, on-the-spot bills are raised by authorized meter readers by using hand-held machines. Being web-connected, the bill also includes details of last payment, previous dues etc.

For bill payment, consumers can opt for cash payment at BWSSB Kiosks (sub-divisional offices), Electronic Clearance System, on-line payment using net banking, Debit or Credit cards or by using "Bangalore One" kiosks (authorized collection center for most of public services of GoK). The present collection efficiency of the water bills is high (about 98%). However, the major concerns are lack of autonomy in revision of water tariffs, billing of public fountains etc.

(3) Asset Management

The assets in BWSSB are managed on normative basis rather than on a scientific system of asset management. The major reason is that an Asset Management System (AMS) requires proper asset records as a pre-requisite. It generally requires location wise details (Preferably GIS linked) of water supply/sewerage infrastructure (pipes, valves, bends etc.), their specifications (material, size, length, thickness etc.), age/condition, maintenance records etc. BWSSB lacks most of such records and therefore, efforts are underway to develop a GIS based asset inventory so that scientific asset management can be introduced.

(4) UFW Reduction

Bengaluru has a UFW of about 48%, against a defined target of 20% under SLB of MoUD. During last few years, focus has been laid on reducing UFW under BWSSB project (Phase 2). Accordingly, a division for UFW, headed by an EE was created in BWSSB. Under this, works were undertaken on water accounting and leakage detection. Three major studies were undertaken by covering about 50% of the Core area (133 km^2), wherein it was envisaged to reduce the water losses to 16%. There were more than 3.0 hundred thousand connections in the study area and the total distribution network for water supply was 3,325 km. The expected benefits of these works were: improvement in supply hours, pressure and assets condition, improvement in water quality, reduction in customer complaints, total water accountability and increase in revenue. These ongoing leak detection works using MRI Technology and L-sign leakage detection and monitoring system are financially supported by JICA. It uses the equipment provided under JICA grant.

In another on-going pilot study (not covered under above mentioned Core area UFW project) "Helium Gas Based Detection Technology" is being used in four sub-divisions, to detect underground hidden leaks. The results of the study are encouraging with high precision in leak detection. Realizing the benefits and environmental and social need of water conservation, the Division of UFW has been quite recently (September, 2016) upgraded to a sub-zone with two divisions of UFW. Both these divisions now work under the control of a ACE (UFW).

(5) Communication

As part of its communication strategy, BWSSB, utilizes a variety of means to reach out to its stakeholders. These mainly includes the followings:

- BWSSB Website:
- Customer Care: It maintains a central 24/7 complaints cell to facilitate the logging of complaints so as to address their grievances. Customers can use online system, hotline, directly calling or meeting

Divisional Executive Engineer/AEE of respective areas

- Demonstration: It manages Theme park on rain water harvesting (RWH) to demonstrate various means and modes of RWH to public.
- Publication: BWSSB publishes following materials for communication with the stakeholders. This includes Annual Report, Annual Accounts and Audit Report, Pamphlets on Conservation of Water, Rain Water Harvesting, Good Sanitation Practices etc.
- Media Usage: It also uses Newspaper, Radio Talks etc. to disseminate to public/stakeholders.

A review indicates that most of the above communication channels are indirect. However, it also needs to have direct communication with slum dwellers, communities etc. for projects requiring public participation, facilitation of connections, creating awareness on WSS and related issues, water conservation, water recycling and reuse etc. This needs to be addressed.

(6) Procurement

The procurement process of BWSSB follows Procurement Act, Rules and guidelines of GoK. Accordingly, e-procurement is followed for procurement of works, goods and services of value of more than 0.1 Million INR. The authorized person to undertake respective procurement is as per "delegation of powers of BWSSB". To avoid/minimize litigation and to have uniformity, BWSSB uses respective Standard Bidding Documents for works, goods and services. The processing of bids, their evaluation and finalization of contractor is undertaken by BWSSB. However, before placement of procurement order, respective approval is needed from 'competent authority". In simple terms, for procurement of 0.1 Million to 10 Million INR, competent authority is CE. For procurement of 10 Million to 100 Million INR, approval of Chairman is needed, whereas for procurement above 100 Million, approval of Board is needed.

(7) Outsourcing

With long ban on recruitment, BWWSB relies heavily on outsourcing of works, goods and services. It contracts out most of its capital works, uses service providers to outsource its required human resources for routine works and engages consultants to provide specialized services (survey, design included) and even O&M contractors to keep operate and maintain its facilities. Therefore, outsourcing is a norm in BWSSB. The important inference from this is that as an organization, BWSSB is transforming its role into that of manager and facilitator from its previous role of operator and manager.

17.1.5 Human Resource Planning and Training

The efficacy of an organization besides number of HR lies in the quality of the workforce, which is generally governed by academic qualifications and work experience of its top-level engineers, managers and technical staff. Considering this, the education/experience criteria for entry at these positions appears adequate, with a high likelihood of satisfactory staff performance. However, once recruited, they need to be trained at specific intervals in their functional areas to equip them with emerging advances/modern methods of operation/management of WSS utilities. However, no specific HRM systems are available in BWSSB involving scientific HR Planning, Succession Planning, HRD (Training Policy, Training needs

assessment, training plan development, Training, Monitoring etc.). Overall, there is no well laid system of developing and improving performance of its human resources.

Human Resources: BWSSB has 2,203 regular staff, against a sanctioned strength of 3,500, as of January 25, 2017 (Source: Office of Secretary cum CAO, BWSSB). The sanctioned staff strength includes 1 EIC, 4 CE, 13 ACE, 39 Executive Engineers/DCEs, 133 AEEs, 233 AEs and 94 JEs. The category wise details of sanctioned and filled-up (on regular basis) positions are presented in Table 17.1.1, whereas position-wise details are provided in Table 17.1.2 in supporting report.

Table 17.1.1 Status of Human Resources of BWSSB (as of 25 Jan 2017)

S/N	Category of Human Resources	Sanctioned Strength	In-Position Staff (regular)
1	**Group "A' Staff** (Chairman, All engineers of AEE and above grade, CAO, CFO etc.)	**207**	**155**
2	**Group "B' Staff** (AEs, Assistant Officers, Accounts Staff)	**309**	**191**
3	**Group "C' Staff** (JE, Chemist, Superintendent, Senior Assistant, Junior Assistant, Data entry Operators, Meter Readers, Operators, Water Inspectors, Work Inspectors, Sanitary Mistry, Fitters etc.)	**1,935**	**1,253**
4	**Group "D' Staff** (Helpers, Attendants, Sanitary workers, Sweepers, Watchmen etc.)	**1,049**	**604**
	Total Staff	**3,500**	**2,203**

Source: BWSSB

However, to bridge the work-load gap arising due to restrictions on regular appointment, a substantial number of services have been outsourced from private service providers. This has resulted in engagement of about 2,000 staff. Most of these outsourced HR have been engaged under Group "D" category (valve operators, sanitary workers, helpers etc.).

17.1.6 Financial Position of the Board

The major source of revenue for the Board is from water user Charges (domestic and non-domestic including for water supply to high rise buildings) and from bulk water supply to Kanakapura Town and Tataguni Gram Panchayat. It also collects sanitary charges and bore well charges as a part of water bill. In addition, Board has "Capital Receipts" from other sources like one time pro-rata charges, levied at the time of new connection.

On expenditure side, it is executing some major capital intensive works like Cauvery Water Supply Scheme Stage IV Phase 2, Greater Bangalore Water Supply and Karnataka Municipal Reforms Works with the assistance of JICA and The World Bank, respectively. Besides, it also depends on some development works as well as asset replacements, initiated by itself. For regular WSS services, the major heads of revenue expenditures of the Board is for power charges payable to BESCOM and CHESCOM, Estab-

lishment and General Administration charges (rents, consumables etc.) and general repair and maintenance charges of the Water supply facilities including bore wells in the city, sewerage infrastructure and office assets. Under "capital" expenditure, the other major expenses are on debt servicing of loans taken by BWSSB. Besides, it has been receiving "capital deposits" from BDA etc. for undertaking various deposit works.

During FY 2015-16, the Board had a current expenditures of about 16 Billion INR including 3.5 Billion INR for debt servicing, whereas the current revenue was about 12.2 Billion INR. Overall, if debt servicing was not included, revenue and expenses on current account were nearly at par. So the Board during FY 2015-16 was able to meet all its O&M expenses from the water bills (which includes water charges, meter charges, bore-well and sanitary charges). With the growing need for undertaking major capital works, the balance sheet of Board on "capital account" has been operating in red for many years.

17.2 Approach and Framework for Institutional Development

17.2.1 Justification

JICA has been providing technical and financial support to BWSSB for more than 10 years. Based on the support under Phase 1 and Phase 2 of BWSSP, it was expected that BWSSB would have transformed itself into an efficient, effective and self-sustaining autonomous organization in various spheres (Technical, Financial, Organizational etc.). However, a quick review of available data/information highlights a number of critical gaps in institutional and organizational development of BWSSB. Thus, it is necessary to not only continue but to intensify the institutional inputs under Phase 3 of BWSSP, leading to desired transformation of the organization.

17.2.2 Objectives of Institutional Development

In view of past experience and justification, the objectives of the institutional study (under preparatory study for BWSS Phase 3) have been:

- To analyze existing status of BWSSB (AS IS Study)
- To project and establish institutional requirements of BWSSB (TO BE Study) to make it a self-sustaining organization in line with VISION, MISSION and Mandate of BWSSB
- To suggest the approach for strategic organizational and institutional improvements for its transformation (TO BE state from AS IS state)

It is expected that the improved organization shall be an efficient, effective and self-sustainable autonomous organization, with its planning and operations based on sound business principles.

17.2.3 Approach to Organizational and Institutional Development of BWSSB

Organizational development (OD) is the process through which an organization develops its internal capacity to be the most effective. It can be towards attainment of its vision and mission and/or to sustain itself over the long term. This definition highlights the explicit connection between organizational development work and the achievement of organizational mission. This connection is the basic rationale for

undertaking organizational development activities.

In effective organizations, the vision, values and mission are derived from the convictions of people in the organization and impacts all other components of the organization. When the Core components listed below are in alignment with the vision, values and mission, they are more likely to be in alignment with one another and could lead to an effective work outputs and a sustainable organization. The broad components to be aligned could include: Vision and Mission, Governance, Strategic Thinking and Planning, Program Development and Implementation, Human Resource Management, Organizational Culture, Management Systems and Structures, Legal Compliance, Fiscal Management and Public Accountability, Resource Development, Stakeholder Relationships and Collaboration. The OD work under the study is planned to be focused on few important/impactful components from these. Considering this, improvements in plans, policies, organizational structure, management systems, human and other resources (technology, financial, physical) were considered comparatively important for BWSSB. With the component identification, following OD approach for BWSSB has been used:

1) Situational analysis: Review, Feedback, Analysis and validation of "AS IS" situation of BWSSB encompassing its Plans, Policies, Management Systems, Organizational Structure, Human Resources, other resources etc.
2) Review of Vision, mission, mandate and plans/targets of BWSSB (Possible realignment of needs), external environment, public demand etc. and accordingly project a TO BE Scenario
3) Assessment of gaps in present scenario (AS IS) and desired (TO BE) scenario
4) Development of strategies to bridge the gap between AS IS and TO BE scenario
5) Finalization of Strategies (including change management strategies)
6) Development of action plans with resource requirements
7) Implementation
8) Monitoring, Evaluation and feedback for improvements
9) Integration of Feedback and moving forward (steps 7), 8) and 9) can be repeated more than once)

Considering these, analysis has been undertaken to assess AS IS situation and efforts have been made to visualize and develop a TO BE state of BWSSB.

17.2.4 Situation Analysis (AS IS) of BWSSB

To commence with any improvement and creation of a more appropriate mechanism, it is essential to understand and analyze the prevailing situation in BWSSB. The AS IS study is a technique, commonly used by organizations, to evaluate key factors, that affects and are important in achieving the organizational mission and mandate. Such an assessment was conducted for BWSSB, with particular focus on the mandate of BWSSB and project objectives. The ultimate aim was to eventually identify the areas needing institutional improvements, given the impacts of both the internal and external environmental factors.

For situational analysis, review of available documents and reports, interactions with key BWSSB staff at

various levels, discussions with consultants/contractors having working relationship with BWSSB, specific observations on the working culture of BWSSB etc. were undertaken. The analysis of these resulted in assessing and understanding "AS IS" situation of BWSSB. A commentary on the results of situational analysis and the identified "challenges/areas for improvement" are presented herewith.

(1) Participants to the AS IS Assessment

One of the major selection criteria of the participants for the SWOT (Strengths, Weaknesses, Opportunities and Threats) assessment has been that they should be in the top echelons of general management and administration of BWSSB, as well as the senior technical officers and/or head of the functional areas of the BWSSB. In other words, these officials were selected for their positions of authority, responsibility and accountability in terms of meeting objectives, resource management and allocation, the over-all performance of their unit in the achievement of goals and objectives. They not only had a macro-perspective of the workings of their Zones (like Department in BWSSB), but also experience and expertise with regard to operating environment of the BWSSB and thus were selected as participants for discussions.

(2) Process of Assessment

Initially a review of available documents and reports was undertaken along with a preliminary assessment of BWSSB. Based on the assessment, a number of issues were identified for discussions with key informants (participants) and a "semi-open" check list was developed. Using the check list, a number of issues were discussed with key informants (both at individual level as well as under focus group discussions) and their responses were compiled. The key informants responded to most of our "discussion points" and offered their views. Based on their feedback and comments coupled with analysis of available reports and literature, identification of potential strengths and weaknesses with reference to the organizational objectives was undertaken. The findings were then validated by a presentation to senior officials of BWSSB.

(3) Results of the Situational Analysis in Component Areas

The reviewed information and responses were analyzed and integrated for major management challenges like Planning, Policies and Laws; Management Systems; Organizational Structure; Human Resources; Other Resources; Work Environment etc. It identified various strengths and areas needing improvements for BWSSB. The findings are presented in Table 17.2.1.

Table 17.2.1 Summary Matrix of Situational Analysis of BWSSB

Area	Strength	Weakness (Areas needing improvements)
Vision	➢ Provision of WSS infrastructure and services	➢ More focus is needed on service delivery and technological up-gradation
Planning	➢ On-Going Master Planning ➢ Annual Budget (includes Plan of infrastructure development)	➢ No Strategic Planning (small part of NI) ➢ Absence of a long term Corporate Plan and Strategic Plan

Area	Strength	Weakness (Areas needing improvements)
Policies, laws	➢ BWSS Act ➢ Highest priority provided to Drinking water under Water Policy 2002 ➢ GoK Acts and Rules, Presence of GW Act	➢ Absence of long-term water tariff policy ➢ Absence of policy on Reduction of Public Fountains, UFW and NRW ➢ Lack of Specific Policy on duration of water supply (24* 7)
Systems and Processes	➢ Presence of a number of tried and tested Systems and Procedures of GoK ➢ CPHEEO Guidelines, KSPCB/CPCB quality standards, BIS Standards	➢ Delegation of Powers ➢ Asset management system ➢ Reduction of UFW, NRW and Pubic Fountains ➢ Monitoring of GW extraction ➢ Accountability on enforcement provisions
Organization-al Structure	➢ Departmental Structure: simple, line responsibilities, better control	➢ Reduction of overlaps in roles, responsibili-ties ➢ Need for functional units of Planning, IT, HRD, Monitoring, Asset Management, Re-search Collaboration, Public Awareness and Public participation (PAPP) etc. ➢ Integrated and aligned customer services unit ➢ Strengthen unit of water accounting and Reduction of UFW/NRW ➢ Additional Field Offices (Divi-sions/Sub-Divisions) to cater 110 Villages
Human Re-sources	➢ Well experienced in management of WSS services using conventional wisdom ➢ Availability of adequate number of administrative and support staff ➢ Adequate requirements of qualifica-tions and experience of its top man-agement and technical staff	➢ Scientific HR Planning and Recruitment ➢ HRD system, managing staff training at regular intervals to improve staff competen-cies ➢ Performance Management of Staff
Financial As-pects	➢ High Revenue Collection efficiency ➢ High Capital Asset Base ➢ Counter - Guarantee by GoK for loans ➢ Current account balancing (last year) except for debt servicing	➢ High NRW including non-billing of public fountains (should be done to BBMP) ➢ Water Tariff not based on sound business principles ➢ No analytics undertaken at lower (division/ sub-division) levels ➢ High loans and debt servicing charges ➢ For most of the years, both capital and cur-rent revenue account has been negative (in red) ➢ Lack of efforts to recover high outstanding dues
Resources	➢ Inherited large asset base ➢ New asset development is well planned and as per needs and available	➢ Ageing assets having maintenance and leakage issues ➢ Operational MIS, HRMS and FMS

Area	Strength	Weakness (Areas needing improvements)
	finances ➢ Partial completion of Asset Registry ➢ Increasing use of automated process control (SCADA) etc.	

Source: JICA Survey Team

17.2.5 TO BE State of BWSSB

Based on review of vision, mission, SLBs and AS IS situation within BWSSB and project requirements, a TO BE situation has been visualized for BWSSB. This TO BE situation has been validated with senior officers of BWSSB. These include;

- Role as Facilitator: Limiting its role to Planning and Policy, Project and Contract Management, Financial Management, Supervision and Monitoring (including quality, performance), Regulating, Studies and Innovation (Research, Technology adoption etc.), Enforcement etc.; while outsourcing major works of survey and investigations; design, construction; operation, maintenance and improvements of WSS and associated facilities besides hiring routine services from private sector (administrative support, housekeeping, vehicles, maintenance services etc.)
- Efficient: low UFW and NRW, low operational breakdowns (well managed assets), low employee ratio/'000 connections
- Effective: Faster Decision making, Effective Execution
- Technology Status: Adopted appropriate technological applications and tools: HRMIS, FMIS, AMS, GIS, SCADA, etc.
- Quality Service Organization: Achievement of various SLBs of MoUD
- Financially Independent: "Self-sustainable" organization in long run (may be by 2034), Encouraging and adopting various PPP models
- Customer Oriented: low customer complaints, less time to resolve
- Responsive to Public Needs: Adopting 24/7 water supply (from present day intermittent supply),
- Socially and Environmentally Sensitive: Engaged in Recycle and Reuse of Water, Supporting RWH, Water Conservation, Mainstreaming slums; Informed public, no over exploitation of GW, adopting climatically resilient strategies;
- Learning: A continuously learning organization - Learning from both internal and external experiences through knowledge management, documentation and dissemination; Trainings, National and International Exposure, Case studies, Participation in seminars/conferences, e-library etc.

17.2.6 Technical Cooperation Needs

(1) Required field for technical cooperation

Ten items are listed in sub-section 17.2.5, as the required field for the BWSSB to be improved. Among them the improvement need for the reduction of UFW and NEW is very high. Although currently BWSSB has put into practice to reduce UFW through project implementation, it is important to provide such countermeasures covering other areas beyond present project area and furthermore, such works shall

be incorporated in the O&M of the facilities. In this regard it is highly recommended to adopt the know-how and experience by local government units in Japan as they maintain a high level performance on the reduction of UFW/NRW.

(2) Required Technical Cooperation for Reduction of UFW/NRW

According present statistics by BWSSB, NRW percentage in the BWSSB service area is very high with about 50 %, which include not only leakage, but also those losses caused by illegal connections, inoperative water meter, mistakes in collection of data and management, etc. BWSSB has been undertaking the replacement of deteriorated and/or capacity shortage pipes and installation of DMAs. Through the on-going project, reduction of NRW and improvement of monitoring activities are expected. However, the following countermeasures are also required.

- Periodic leakage survey and repairs
- Minimize the errors on water meter reading and data management in provision of examination and replacement of inoperative water meter and improvement of meter readers' skill
- Minimize illegal connections and tariff collection mistake
- Measurement on water consumption by slum people and at public offices/facilities

There are some constrains for BWSSB for the implementation of water supply including the following:

- Water production cost is very high due to the location (long distance and lower elevation) of available water source (Cauvery River)
- There is no alternative water sources available near the BBMP and it is essential to save water for the development of the metropolitan area through the future.

Under the above conditions, technical cooperation to the BWSSB is required to prepare comprehensive water supply plans, and to utilize the technical expertise of professional staff and strengthening the capacity of BWSSB to provide effective and high level services.

(3) Manner of Technology Transfer

Technology transfer may be provided by the consulting services as a part of loan project, through technical cooperation project and dispatch of expert/s to the project site. The consulting services for the loan project usually include technology transfer. However, the combination of other methods including application of technical cooperation project and utilization of experts form local government units may be effective.

(4) Required Conditions to Implement Technical Cooperation

The following conditions shall be considered for the implementation of technical cooperation to improve UFW/NRW.

1) Advance Organizational Arrangements by BWSSB for UFW/NRW Improvement Unit

The countermeasures for the reduction of UFW/NRW will be undertaken through out-sourcing to cover huge service area in BBMP. However, BWSSB has a plan to maintain at least one professional team for the implementation of a series of NRW reduction work, which will allow for the BWSSB to conduct re-

quired work timely and adequately including proper selection of the contractors and management. Before commencement of the technology transfer, WSSB shall organize a unit as recommended later in this chapter.

2) Establishment of a Practical UFW Percentage

The final target of UFW percentage is set at 16% by BWSSB to help supplement supplying water for ever increasing water demand. However, a practical target shall be set based on present experience and business plan to be prepared in consideration of required time and cost to achieve the target value.

3) Selection of Pilot Area for the Training of BWSSB Staff

Presently water supply service in the BBMP is insufficient without provision of 24/7 services and water pressure in the distribution system is lower than the standard requirement. It is difficult to conduct training for the monitoring of NRW/UFW in the existing distribution systems under the above conditions. Therefore, some pilot areas shall be selected from the areas where the improvement of distribution pipelines was realized and DMAs were installed through UFW reduction projects.

17.2.7 Gap Identification and Strategy Development

Based on AS IS and TO BE state of BWSSB, a number of required improvements/gaps have been identified, each one having a different degree of impact on performance of BWSSB. Considering the impact of these gaps and their alignment with proposed project priorities (BWSS Project Phase 3), a list of prioritized strengthening needs have been identified. These include:

- Improved Vision, Mission (to reflect service delivery orientation)
- Corporate and prepare Business Plan
- Financial sustainability of BWSSB using improved revenue generation (especially long term water tariff policy, metering, reduced NRW), etc.
- Improved Decision making (Delegation of Powers)
- Scientific Asset Management
- Strengthening of UFW Management (up to Sub-Zone)
- Establishment of Environmental and Social (community engagement) Unit (like Sub-division)
- Human Resource Development (Training)
- Expansion in coverage areas and Piloting and implementing 24/7 water supply
- Increased IT Use and Automation

Based on the requirements, few strategies (though preliminary) have been developed and a projection has been made for the potential outputs. The same are presented in Table 17.3.1. It needs to be clarified that application of each strengthening measure shall require further assessment, data collection, analysis, option development, resourcing, implementation, monitoring etc. which shall not be part of this preparatory study. In fact, that shall be part of “Project Implementation”, after signing of the loan agreement/contract.

17.3 Institutional Development

The institutional development needed strategy development and action planning to bridge the gap between TO BE state and AS IS state. The action planning involves identifying activities and sub-activities along with responsible entities and a tentative time frame to undertake the same. It shall then assist in assessing overall resource requirements, which could involve manpower, financial and other resources. The strategic areas and plans are described below:

17.3.1 Improved Vision and Mission

Before one undertakes any OD improvements, it is essential to revisit and realign the VISION and MISSION of the organization to the changing needs. The existing VISION and MISSION of the BWSSB need serious improvements. Before, any attempt is made to improve them, it is essential to understand them one by one:

(1) What is VISION Statement

A vision statement for an organization focuses on the potential inherent in the organization's future, or what they intend to be. While a vision statement might contain references to how the organization intends to make that future into a reality, the "how" is really part of a "mission" statement, while the vision statement is simply a description of the "what," meaning, what the company intends to become. The "vision" is the dream of the organization. It's what the organization believes as the ideal conditions for the organization i.e. How things would look, if the issues important to organization were completely and perfectly addressed.

By developing a vision statement or statements, one articulates and clarifies the beliefs and governing principles of the organization. There are certain characteristics that most vision statements have in common. In general, vision statements should be:

- Understood and shared by employees of the organization
- Broad enough to include a diverse variety of organizational perspectives
- Inspiring and uplifting to everyone involved in its development
- Easy to communicate and understand:

In a nutshell, Vision statements are short phrases or sentences, preferably limited to 15-20 words but conveying your hopes for the future. They should be brief but visionary.

(2) Vision Statement of BWSSB

Realizing the attributes of a good VISION, the shortcomings of the present VISION, needing improvements are:

- Vision statement of BWSSB is quite long
- It includes certain statements, which are process related and thus not vision related
- Much of the "statement" is in "present" form, whereas VISION should highlight future state.

Therefore, VISION statement of BWSSB was developed and is proposed for approval: "Provider of quality, reliable and cost effective water, wastewater, and reclaimed water services to the communities of

BBMP through responsible stewardship of resources and environment"

(3) What is Mission Statement

Mission statements are similar to vision statements, in that they, too, look at the big picture. However, they're more concrete, and are definitely more "action-oriented" than vision statements. In fact, the vision statement inspires people to dream but mission statement inspires them to act.

The mission statement can refer to act to resolve a problem, such as an inadequate housing, or a goal, such as providing access to health care for everyone. And, while they don't go into a lot of detail, they start to hint - very broadly - at how your organization might fix these problems or reach these goals. Some general guiding principles about mission statements are that they are:

- Concise. While not as short as vision statements, mission statements generally still get their point across in one sentence.
- Outcome-oriented Mission statements explain the fundamental outcomes your organization is working to achieve.
- Inclusive. While mission statements do make statements about the organization's key goals, it's very important that they do so very broadly. Good mission statements are not limiting in the strategies or sectors that may become involved in the project.

The existing MISSION of BWSSB: "BWSSB's vision rests on its unwavering commitment to providing value added quality services using innovative and cost effective solutions to achieve customer satisfaction, by remaining ever sensitive to their needs by anticipating their requirements, keeping public interface always open and staying in the forefront in all endeavors". The aforesaid mission statement has certain limitations and therefore a redefined mission statement has been proposed.

(4) Proposed Mission of BWSSB

A typical mission statement of BWSSB should include the following:

1) To provide value added quality WSS services to the citizens in an economic manner
2) To develop innovative and cost effective solutions to support optimal use of resources and technology in provision of WSS services
3) To provide stakeholder responsive service delivery with an aim to improve customer satisfaction,
4) To adopt financially and environmentally sustainable approaches in WSS service delivery
5) To maintain and motivate an effective, efficient and committed workforce to serve the target communities with their professional conduct and work ethics

The advantage of development of the VISION and MISSION statements is to provide clarity and focus on outcomes by improved integration of objectives, future targets and value system of BWSSB.

Table 17.3.1 Strategies for Organizational Development From "AS IS" State to "TO BE" State

Area	Areas Needing Prioritized Improvements	Why (Indicator)	Strategy	Output
Organizational Focus	• More Focus on Service Delivery than Creation of Infrastructure for WSS	• Physical and Financial Progress as performance indicator rather than SLB	• Update the Vision and Mission • Monitoring of SLBs	• Service Delivery Oriented Organization
Management Systems	• Delays in Decision Making	• Qualitative feedback	• Increased Delegation of Power	• Efficiency enhancement
	• Deteriorating quality of Assets	• Number of breakdowns, customer complains	• Asset Management System	• Reduction in system breakdowns and complains
	• Reduction of UFW	• High % of UFW (about 50%)	• Strengthen UFW division (manpower, equipment, technology training)	• Reduced water supply need
	• Lack of Public Awareness on RWH, Recycling and reuse of water, addressing slum issues in projects	• No dedicated unit to involve public (partially looked after by PR)	• Establish a Division for Social and Community Development (PA, PP etc.)	• Improved acceptance and participation of public supporting attainment of objectives
Coverage	• Improved delivery of WSS services in 110 Villages (on project implementation –infra development)	• Existing poor state of SLBs • No specific improvements in WSS services in villages after merger with BBMP	• Establish additional divisions/ sub-divisions for construction, O&M etc. for the area	• Better served communities • Improved Management
	• Need for 24/7 water supply	• Part of SLB - public need	• Inclusion of "right" systems during design/execution for 110 Villages	• Improved Public Satisfaction
Human Resources	• Competency enhancement	• Qualitative - Limited exposure to advances, limited focus in aptitude	• Training	• Competent HR with service delivery aptitude
Sustainability	• Financial Health of BWSSB	• High debt servicing charges • In general, balance sheet with deficit on both current and capital accounts except for last year (2014-15), had no deficit on current account except debt servicing	• Water Tariff Policy on Sound Business Principles • Reduction in NRW (besides UFW, revenue billing of public fountains)	• Financially sustainable organization • Improved autonomy

Source: JICA Survey Team

17.3.2 Self-Sustainable Management by BWSSB

The self-sustainable management of BWSSB shall require accomplishment of various activities. These include setting up a management structure, water and sewerage tariff policy, efficient revenue billing and collection etc. These activities would need undertaking of a number of sub activities. The same has been elaborated under Table 17.3.2.

Table 17.3.2 Required Activities to Achieve the Strategy of Sustainable Business Planning

S/N	Activity	Detail Action	Target
1	Establishment of "Management Structure" and Systems for Self-sustainable Organization	- Situational analysis of organizational operation and problem detection - Arrangement of relationship between BWSSB and other stakeholders - Review of ideal situation for formation of self-sustainable organization - Introduction of detailed financial accounting system - Establishment of self-sustainable cost recovery systems to slowly become independent from government support/ subsidies - Discussion with other agencies toward self-supporting organizational operation - Establishment of "Structure" of a self-sustainable organization	- Establish required financial accounting system by 2018 (including financial statements) - Setting tariffs and recovery mechanism to have full O&M cost recovery by 2022 (5 years) on a sustained basis - Full O&M cost and depreciation cost recovery by 2027
2	Long Term Policy on Revision of Water Tariff	- Problem identification with current tariff system - Refinement of basic principles for tariff revision - Study on tariff revision methodologies - Study on management efficiency improvement efforts - Short-term, mid-term, and long-term cash flow analysis - Setting new tariff rates based on volumetric way - Revision of water tariff rate based on the updated inventory and pilot project experience - Implementation and Review of new tariff system - Annual revision of water tariff by Board based on an approved policy	- Setting new tariff policy by 2018 - Review and revision of new tariff system by 2023 - 2nd revision of new tariff system by 2028
3	Increase in Collection Efficiency of Water Tariff	- Situation analysis of current tariff collection system - Study on diversification on tariff collection methodologies and finalization of strategy - Implementation of the pilot project - Develop detailed implementation plan - Monitoring of the implementation plan - Monitor performance indicator on the water tariff collection rate	- 100% by 2021
4	Reduction in Non-revenue Water	- Study the current situation and causes of the NRW - Set the quantities target for the reduction in NRW - Develop and approve specific strategies for reduction in NRW - Make detailed implementation plan for the reduction in NRW - Monitor detailed activities of the implementation plan - Monitor the performance indicator on the reduction in NRW	- 2% reduction per annum till it is less than 15%

S/N	Activity	Detail Action	Target
5	Improved Financial Management including Cost Control	- Identification of major areas/operations needing development of cost control strategies - Study of alternate strategies for revenue billing and collection, automation in work, from the considerations of reliability, convenience, system efficiency and then cost effectiveness - Finalize the strategies for piloting - Piloting, adoption and implementation of developed strategies - Monitor the performance indicators	- Operational cost reduction by 1% per year
6	Improvement of Operation and Maintenance Efficiency	- Study the current situation and causes of inefficient operation and maintenance of facilities (WTP, STP etc.) - Set the target for improvement in operation and maintenance efficiency of facilities - Develop strategies for the improvement of the operation and maintenance efficiency of facilities - Make detailed implementation plan for adoption - Monitor the activities of the detailed implementation plan - Monitor the performance indicator on the improvement of the operation and maintenance efficiency of facilities	- 2% reduction per annum
7	Improvement of Administrative Efficiency	- Study the current situation and causes of inefficiency of administration and staff deployment - Study the positives and limitations of strategies like outsourcing of non-core, non-critical activities, outsourcing of services like housekeeping, security, revenue billing and collection etc., multi-skilling of core staff, work automation using IT etc. - Set the target of the improvement of efficiency of administration and staff deployment - Make the strategies for the improvement of efficiency of administration and staff engagement - Make detailed implementation plan - Monitor the detailed implementation plan - Monitor the performance indicators of administrative efficiency and staff engagement	- Reduction in administrative cost (real cost basis) per annum - Reduction in number of water supply staff per 1,000 connections (for same or better service levels)
8	New Initiatives	Involvement of PPP in UFW Reduction for Improved Financial Management - Study the current situation and causes of high UFW - Study the positives and limitations of financing various UFW reduction models like in-house administration, contracting out, PPP etc. and associated pre-conditions for implementation (empowerment and support needed/provided, concession period, model contracting conditions etc.) - Establishment of Division/Sub-division wise "Water Measurement Stations" and basic assessment of UFW and NRW status - Fix DMA (District Metered Area) and/or service station/sub-DMA wise bulk flow meters - Assess DMA (district Measurement Area) or Service Station (sub-DMA) wise supply and distribution of water to residences, industry, institutions etc. - Set the target of the improvements in distribution efficiency (UFW Reduction from xx % to xx %) of an	

S/N	Activity	Detail Action	Target
8	New Initiatives	sub-DMA/service station area - Make the strategies for UFW Reduction or improvement in water distribution efficiency - Assess the revenue and cost streams from adoption of UFW strategies at DMA and Sub-DMA levels - Undertake DMA/sub-DMA wise decision on adoption of UFW Reduction model (to be done by BWSSB, contracting out, PPP). This may consider availability of resources, budget, expertise and time requirements - Develop detailed implementation plan - As needed, develop procurement mechanism, which may involve Tender for "contracting out" one/some identified DMA/Sub-DMA/Service station on PPP model as a PILOT (may know many other factors/costs/issues/efficiency improvement targets considered by contractors) and then undertake procurement and execution - Use the experience of tendering in developing other Bid Documents based on PPP, Contracting out, Material procurement, etc. - Develop a Financing Plan to undertake UFW reduction across whole of BBMP areas (amount, timelines, specific area wise contracting Model for UFW Reduction etc.) - Implement (tendering, contracting out, supervision, monitoring, feedback and improvements etc.) - Monitor the overall activities of the detailed implementation plan - Monitor the performance indicator on the improvement of distribution efficiency (UFW Reduction, NRW Reduction) - Document the experiences (especially finalize leakage detection technology, measurement techniques etc.) - Assess the cost benefit analysis over time - Develop a case study with lessons learned and use the experience for further works	

Source: JICA Survey Team

17.3.3 Preparation of Long-term and Annual Business Plan

A business plan is a guideline or a roadmap for the future management (of WSS services), outlines goals and details how to achieve those goals. In order to indicate the aims and direction of BWSSB services, it is recommended to develop a long-term and annual business plan of BWSSB. This may include the following:

(1) Scope of the Business Plan

The scope of the business plan should focus on its WSS services in the coverage area. Thus, the business plan developed before the implementation of the Phase 3 Project should focus on long-term plan and annual action plans of BWSSB.

(2) Contents of the Business Plan

The typical contents of the business plan include:

1) Executive Summary
2) Introduction (background, national water policy, legal background, organization)
3) Vision, Mission, Goals
4) Strategy and Long-term Action Plan (target, strategy, activities)
5) Annual Action Plan (target, scope of work)
6) Financial Plan (revenue generation plan and strategies, investment plan)
7) Organizational Plan (self-sustainable organizational management)

(3) Establishment of Basic Tenets for Business Plan of BWSSB

The official reports/documents of BWSSB as well as its website provide VISION, MISSION and operational objectives/mandate. These have been updated and redefined now and should be considered for development of business plan.

(4) Setting of Long-term Targets and Strategy of the Business Plan

One of the ideal long-term targets of the WSS services could be to break through the current vicious cycle of deficit financing into a self-sustainable operation. The operational targets and strategy evolved based on discussions with BWSSB officials are as follows:

1) Improvement of water supply services in BBMP areas leading to +99% coverage, piloting of 24×7 water supply and reduction of NRW to 20% in next 10 years, high customer satisfaction (+98%), improved O&M and improvement of administrative efficiency etc.
2) Establishment of the financial accounting system of BWSSB so as to support undertaking analytics up to division level (in 10 years) and to sub-divisional level (15 years).
3) Establishment of financially self-sustainable system (finally - without subsidy from GoK etc.)
   a) Recovery of O&M cost → within 5 years (reaching close, achieved during last FY also)
   b) Recovery of O&M cost + Depreciation charges on capital assets → within 10 years
   c) Recovery of O&M cost + Depreciation + Debt servicing Charges → within 20 years. This shall translate and establish BWSSB as a financially self-sustainable organization.

(5) Activities to Achieve Long-term Target of the Business Plan

The improvement of WSS services need various efforts including expansion of coverage and quality of services, piloting and materialization of 24/7 water supply, reduction in NRW, improvement of O&M efficiency, reduced customer complaints, higher productivity of staff etc. The following table shows the ideal activities to achieve the stated target of the long-term business plan.

(6) Preparation of Annual Business Plans

The annual business plan should aim to coordinate the efforts of various divisions/departments within the

organization (BWSSB) to achieve the target/purpose at least possible human, material, and financial cost and to ensure that policies, program, and project support and reinforce each other. For developing the annual business plan, a "taskforce' needs to be organized to schedule various activities taking into consideration, the strategies, milestone and deliverables over the plan period.

Annual business plan is invariably a breakdown of the long-term business plan. As indicated, the short-term (the first five years) target of the business plan is restricted to cost recovery of operation and maintenance cost only and thus the activities in the annual business plan for the five years should correspond to this target only. The activities of the annual business plan and its resource and technology needs should be well coordinated with process of development of annual budget. This is necessary to ensure improved synchronization and allocation of "right" budget for required activities, which may ensure extent of achievement of targets.

(7) Financial Plan

The financial plan provides a long term (or annual) framework for policy makers and implementing bodies to collaborate to produce a WSS delivery program, which is clear, consistent, technically feasible, economically viable, environmentally safe and socially acceptable. The financial plan provides the revenue and expenditure of planned services over a period of time, their funding mechanism and mode of recoveries and repayment plan. The major objectives of such financial planning should be:

- To provide a structure to enable a policy dialogue amongst all relevant stakeholders, with the aim of produce a consensus on a feasible future WSS service delivery
- Illustrating the impact of objectives and targets in a long term perspective
- Facilitating external financing (or plan internal funding) by providing clear, justified and transparent data on planned expenditures, Recoveries, allocation and finance requirements

To visualize the balance/gap between revenue and expenditure, impacting sustainability of BWSSB's (WSS management), cash flow statements for short-term, mid-term, and long-term operations should be developed. The cash flow statement shows the movement of BWSSB's revenue and expenditure during a certain period. Cash inflow is derived from routine operations and includes water tariff revenue and other incomes including connection fees, penalties etc., whereas cash outflows include operating expenditure (including replacement costs). Cash flow analysis will help BWSSB to set water and sewerage tariff rates to cover operational costs from WSS services, and assist BWSSB in foreseeing potential problems in the future. The result of the cash flow analysis should be presented for Short-term, Medium term and Long-term.

Also, financial plan enables policy makers to have a more objective discussion of tariff policy. For BWSSB, water and sewerage tariff is the main source of income for managing WSS services and a key ingredient for successful and sustainable operation of the WSS services. To achieve the long-term target of the water supply business plan, adequate revision of water tariff shall be required and same has been described as pre-requisite activity under water tariff revision and improvement of revenue billing and

collection system under Table 17.3.2.

(8) Action Plan for "Developing Business Plan":

An action plan for developing long-term and annual business plans is presented in the Table 17.3.3.

Table 17.3.3 Action Plan for Preparation of Long-term and Annual Business Plan

S/N	Action	Issued to Be Discussed/Studied	Target Date	Budget (INR)	Responsible Official
1. Short-term Action Plan (Before Loan Agreement)					
1-1	Data Arrangement and Analysis on Past O&M and Financial Data	Subject: - Data collection (population projection, demand projection, production projection, financial data) - Problem analysis – STUDIED AND FINALIZED.	31/12/2016	Nil	CFO/CE/ACE
1-2	Review and Analysis of Performance of existing Policies for WSS Services	Subject: - Review of Basic Policy vis a vis Vision, Mission, Goals of BWSSB - Analysis of Performance and identification of areas needing improvements	31/03/2017	Nil	CE/ACE/CFO
1-3	Setting of Long-term Targets and Strategy	Subject: - Long-term target setting of Revenues, expenses including reductions by cost control - Long-term strategy to achieve the target - Cash flow analysis	30/04/2017	Nil	CE/ACE/CFO
1-4	Setting of Annual Target and Scope of Work	Subject: - Short-term target setting of Revenues, expenses including reductions by cost control - Strategic actions to achieve the target	31/05/2017	Nil	CE/ACE/CFO
1-5	Preparation of Long-term Business Plans (Corporate Plan)	Contents: - Executive summary - Vision, Mission, Goals - Strategy and Long-term Action Plan - Financial Plan - Organizational Plan	30/06/2017	Nil	CE/ACE/CFO
1-6	Preparation of Annual Business Plans	Contents: - Key issues, Strategic actions and Responsible person/entities - Budget requirements - Projected Cash Flow statement	31/12/2017	Nil	CE/ACE/CFO
1-7	Approval of Board (as necessary)	Subject: - Internal approval - Board approval - GoK's approval (as necessary)	31/02/2018	Nil	Chairman EIC
2. Long-term Action Plan (Post Project Implementation)					
2-1	Preparation of Annual Business Plans	Subject: - Periodic monitoring - Annual evaluation - Achievement of operational indicators	End of fiscal year	Non	CE/ACE
2-2	Evaluation of the Long-term Business Plan	Assessment of Performance Indicators: - Mid-term evaluation (1): after 4 years	2022, 2027, 2032	Nil	Chairman/CE/CFO

S/N	Action	Issued to Be Discussed/Studied	Target Date	Budget (INR)	Responsible Official
		- Mid-term evaluation (2): after 9 years - Final evaluation: after 14 years			

Source: JICA Survey Team

17.3.4 Asset Management Records/Ledgers

An action plan for development of an Asset Management database (ledgers) is presented in the Table 17.3.4.

Table 17.3.4 Action Plan for Development of Asset Records and Management System (AMS)

S/N	Action	Contents/Outputs Expected Hints to Be Included	Target Date	Responsible Official
1	Conceptual design of asset records for WSS facilities using GIS	Subjects: •Scope of system •Graphic data •Attribute data •Image data •etc.	30/09/2017	Zonal EEs
2	Selection of base map & software for preparation of asset ledgers	Subjects: •Type of information and use •Type of analysis •Type of output	30/11/2017	Respective EE
3	Review of input data for GIS database		31/01/2018	Senior BWSSB officials
4	Data collection of existing WSS facilities and its updating on GIS database		31/03/2018	External agency (engaged by BWSSB)
5	Provision of IT software, hardware and interfaces for GIS database preparation	Database, Computers	31/03/2018	External agency
6	Training of GIS database operators/users		30/06/2018	External agency
7	Development/Construction of GIS DB		31/12/2018	External agency
8	Operationalization of WSS asset records		01/01/2019	External agency
9	Dynamic Updating of Asset Records		Continuous	Trained staff
10	Development/adaptation of required software and Asset Management System (AMS)		31/03/2019	External Agency
11	Application, Feedback and Finalization of AMS		30/06/2019	External Agency (Under guidance of BWSSB

Source: JICA Survey Team

17.3.5 Improvement of Information Management System (IMS)

The development of IMS shall be as follows:

(1) General Description on IMS

Considering the upcoming developments (growth, expansion etc.) of BBMP areas, there is an urgent need to put in place a comprehensive, integrated IMS systems with required linkages to GIS, wherever necessary. The purpose of the system shall be to ensure that the reform agenda/action plan for implementation under proposed JICA project will be maintained and sustained. The reform agenda shall:

- Promote people/citizen centric administration: Citizens to benefit from the system of accurate billing and collection and the provision of services using different service delivery channels
- Paradigm shift of BWSSB from process accountability to productivity (service delivery) accountability and from transactional to transformative governance. What is meant is focus on achievements of service levels rather than process (BWSSB is doing "x" to improve 'y" service level). Secondly, focus shall be on – what has been transformed/changed?
- Reduce delays and shall ensure improved promptness in delivery of services (using computerization).
- E-Administration: Improve administrative processes by optimizing costs, managing performance, making strategic connections within the local bodies and creating enabling empowerment. It should be noted that e-procurement is practiced within BWSSB.

To leverage strengths of IT, one needs to create authentic baseline data and strengthen existing IT utilities and use IT to enable most of business processes at BWSSB. The strengthening of IT infrastructure (software and hardware) should enable BWSSB to integrate other business processes such as GIS, MIS, Water auditing and UFW Reduction, SCADA systems, among others.

Under recent organizational restructuring (Sept. 2016), a MIS (Management Information System) Division has already been created and placed under ACE (MIS + HRD + Design). It is aimed to undertake the responsibilities of providing all the technical and managerial information needed for strategic planning as well as for decision making during daily operations. The proposed MIS Division may comprise of some sub-divisions, catering to Personnel/HR (Human Resource Management Information System -HRMIS), Finance (Financial Management Information System - FMIS) and Technical data (SCADA etc.), from where needful data/information can be transferred to MIS.

(2) Proposed MIS Modules

The MIS should be established as the core of planning function. The database should be developed to collect all the management data/information regarding operations (water flows, pump operations, water quality, chemicals, electricity, water consumption etc.), HR work records, bill issuance and recovery, and financial management on a real-time basis. This shall provide adequate information to meet planning needs. Various functional modules under MIS could be:

- Finance and Accounting Module (FMIS)
- Human Resource Management Information system (HRMIS) Module
- Asset Management Module (AMS)

- Consumer Metering, Billing and Recovery Module
- Customer Grievance Module/Call Center Module
- Water Auditing and NRW Analysis Module
- Resource use data: Electricity, Chemicals etc.
- Water quality Test Data
- Operational Data: Plant/pump wise operation, closure data (from SCADA System) and other data from WTPs, GLRs, OHTs, and Clear Water Mains of which the data is sent to Central SCADA system. This could include raw data of automatic measurement results such as influent and effluent flows, water/sewerage qualities etc., which can then be processed to daily, monthly, and annual data records.
- Any other module – as deemed fit by BWSSB management

(3) Action Plan for introducing Information Management System

With adequate number of computer hardware and software availability, coupled with their operational knowledge, BWSSB normally stores a lot of data/information in soft formats. What is needed is a as is situational analysis, assessment of system requirements, system development and integration, data input, training of staff to manage the developed system (networking, hardware, software, IT applications, trouble shooting etc.), for which staff need to be trained or outsourced. The proposed Action Plan for IMS and MIS is listed as follows:

1) Before Loan Agreement

- Fully equipped IT hardware (server and computers) and software across head office, SCADA office, various divisions and sub-divisions along with intranet and internet connectivity across the offices
- Training on computer skills
- Availability of few trained AutoCAD staff at head quartets
- Inputting of updated lists of 1) consumer list with billed and paid amounts, 2) meter reading data, 3) staff list with salaries, 4) monthly power cost, 5) summary of water quality examination results, 6) water production and supply records, 7) repair/maintenance record of facilities/equipment and 8) ledgers as base data of MIS as soon as possible before the loan agreement.
- Updating: Maps for technical ledgers should be updated with the latest official topographic data and the supplemental land survey, if possible.

2) After Loan Agreement

- Detailed selection and tendering of MIS modules is required as mentioned in (3) Implementation Approach with the help of project consultant. In the course of the selection, the coordination with present (and upgraded) water billing system is necessary.
- Trainings on new MIS module should be conducted after the procurement with the help of vendor and soft component consultant in the project.
- With the progress of the project such as meter installation and GIS/SCADA data, the input data for

IMS should be added/updated in a timely manner. A part of information should be disclosed in BWSSB website in the future as part of periodic management reporting.

- Procurement of required hardware and trainings for staffs should be continuously and regularly undertaken.
- Based on the contents above, Table 17.3.5 presents the proposed Action Plan for IMS.

17.3.6 Preparation and Analysis of Financial Statements

The financial statements, such as balance sheet, income statement, cash flow statement etc., are necessary to manage/control the business operations. However, the problem is that financial records in BWSSB are partially organized systematically and are stored/filed in very ordinary manner. Some of the financial statements themselves have not been properly developed to the level required. In addition, computers are partially used for the financial accounting purposes. Therefore, a guideline to establish the ring-fencing accounting system is useful for developing the financial statements for the BWSSB. In this section, ideal procedure on how financial statements are developed following the concept of ring-fencing is introduced.

(1) Scope of the Financial Statement

BWSSB focuses mainly on water supply and sanitation services, therefore financial statements developed for the successful implementation of the project shall also focus on the WSS services only.

Table 17.3.5 Action Plan for Development of Information Management System (IMS)

Sr. No.	Action	Issued to Be Discussed/Studied	Target Date (DD/MM/YY)	Budget (INR)	Responsible Official
(1) Before Loan Agreement					
1-1	Identification and Initiation of data entry of various hand-written records and reports	Example: 1) Staff List, 2) Monthly Power charges, 3) Water quality examination results,	30/6/2015	Internal (HR, BWSSB)	Respective EEs
1-2	Initiation of preparing ledgers by CAD in each division on latest maps and arrangement of existing drawings	Example: - Arrange the detailed consumer connection ledgers on the latest maps - Arrange and update the design/as-built drawings	30/6/2015	0 (HR, BWSSB	EE
(2) After Loan Agreement					
2-1	AS IS Situational Analysis	- Available hardware, software, utility, staff competencies etc. - Type of data/information generated in BWSSB - Data processing needs and expected outputs - Reporting requirements		External Agency	
2-2	Detailed Selection of MIS modules with the help of project management consultants	Subjects: - Adjustment with current customer service through website Examples: 1) Finance & Accounting Module, 2) Human Resources Module 3) Asset Management Module etc.	30/4/2017	To be determined (Project cost)	CE PM of PIU
2-3	Assessment and Finalization of System Development and Integration Needs	This shall be done by the Hired agency. It may include some existing software or modules used as well as OTC (over the counter) or Open software use and their adaptation		To be determined (Project cost)	CE PM of PIU
2-4	Procurement of System, development and Integration Agency	As above		To be determined (Project cost)	CE PM of PIU
2-5	Assessment and Finalization of hardware and software development needs	Development could include procurement of open or over the counter software and its adaptation.			
2-6	System Development, Integration and Testing	Cost economic process should be the key		Externally Hired Agency	
2-7	Simultaneous Procurement of required hardware and their positioning at various divisions (separate from ones for PIU)	Subjects: - Number of required hardware and cost - Budget provision	1/8/2018	10 Million (preliminary estimate)	CE/EE
2-8	Nomination of staff, in charge of IMS in	Example:	Sept 2018	Internal: 0	CE/EE

Sr. No.	Action	Issued to Be Discussed/Studied	Target Date (DD/MM/YY)	Budget (INR)	Responsible Official
	each division	1) MIS Engineer, 2) SCADA maintenance specialist 3) GIS specialist, 4) Database / Systems Administrator, data entry Operator etc.		External: 100,000/month	
2-9	Initiate organizational improvements in structure, systems and processes to suit IMS activities	This may include establishment of specific units including an IT Unit, SCADA section, HRM(Human Resource Management) cell etc. within BWSSB and adoption of required changes in flow of data/information.	2019	Internal to BWSSB	EIC/CE
2-10	Initiate operations of MIS System	-	31/12/2017	-Internal	EIC/CE-
2-11	Trainings on IMS/MIS for concerned staffs (soft component)	In respective modules for concerned staff	31/12/2018	To be allocated (Project cost)	PM of PIU
2-12	Update/improve of the IMS/MIS using GIS based data, SCADA data etc. – on completion of project		31/12/2021	Nil	EE of …Div.
2-13	Continue hardware and software operational trainings (may be every year)	Example: 1) Networking 2) Network security 3) HRMIS (Human Resource Management Information System) 4) FMIS(Financial Management Information System)….	-	External: 750,000/yr	CE/EE

Source: JICA Survey Team

(2) Objective of the Financial Statements

Financial statements shall be formal record of financial activities of the WSS services. The purpose of developing financial statements is to provide information on financial position and activities of BWSSB that is useful to beneficiaries to understand the efficiency of activities of BWSSB, as well as to external funding agencies to make financial decisions. Also, disclosure of financial statements demonstrate their commitment to transparency. The financial statements typically include following financial documents.

- Balance Sheet: A report on an organization's assets, liabilities, and ownership (shareholding pattern and equity) at a given point in time (Generally on 31st March of FY).
- Income-Expenditure Statement: A report on an organization’s income, expenses and profits over a certain period of time (quarterly, half yearly, Financial Year wise).
- Cash Flow Statement: A report on a company's cash flow activities, particularly its operating, investing and financing activities.

(3) Procedures to Establish the Financial Account

Establishment/reconstruction of the financial accounts for BWSSB could involve following major steps:

- Setting up the books of accounts for the WSS services
- Establish the beginning balance for the Balance Sheet accounts
- Determine the Revenues and Expenses for the Financial Year
- Determine the Bad Debts Expenses for the Financial Year
- Prepare a Trial Balance
- Prepare the Income Statement
- Determine the balance of Retained Earnings/Surplus account for the Year
- Prepare the Balance Sheet
- Close the temporary account balances and transfer the payment account balances to the succeeding year

(4) Action Plan for Preparation of Financial Statement

Action Plan for Preparation of Financial Statement is presented in Table 17.3.6.

Table 17.3.6 Action Plan for Preparation of Financial Statements

S/N	Action	Issued to be Studied	Target Date	Budget (INR)	Responsible Official
1-1	Situational Analysis and Identification of Issues and Challenges in processing of Financial and Accounting Data	- Collection of basic financial data/information types, existing system etc. - Compilation of types of mandatory and required reports, which needs to be produced; - Conduct an process/activity analysis of the functions (water and sewerage operation from planning to monitoring) - Mapping of the sub-activities of key financial and commercial activities (billing, collection, estimation, expenditure sanctions, procurement, maintenance, budgeting etc.) - Identification of problems and challenges in processing of financial and accounting data/information at sub-process level - Finalization/Validation of issues and challenges in developing required statements/reports	31/10/2017	None	CFO/CE/ ACE
1-2	Study on Arrangement and Classification Method of Financial and Accounting Data	Data Collection: - Budget data - Revenue Billing, Revenue collection reports - Customer accounts receivables - Staffing list and salary schedules - Financial data on Operation and Maintenance along with status of O&M - Subsidiary records including asset ledgers (properties, plants, equipment and other assets like pipes, valves, pumps etc.) - Depreciation methods used and depreciation data records	31/03/2018	None	CFO/CE/ /ACE
1-3	Training of responsible staff in Accounting and Financial Analysis	Identification of system and process needs Assessment of competency needs for smooth data processing of finance and accounts (including system/method of accounting: single entry, double entry etc.), level of automation (computerization) etc.		Cost to be assessed	

S/N	Action	Issued to be Studied	Target Date	Budget (INR)	Responsible Official
		Assessment of available competencies for processing of data Identification of gaps in data processing Training to bridge the gap and for functional (data processing) sustainability			
1-4	Preparation of Financial Statements	Procedure: - Set up the books of accounts (for WSS) and the reporting formats - Establish the opening balance for the "Balance Sheet" - Determine the Revenues and Expenses for the FY - Determine the Bad Debts/Expenses for the FY - Prepare a Trial Balance - Prepare the Income –Expenditure Statement - Determine the balance of Retained Earnings, Surplus account for the FY - Prepare the Balance Sheet - Close the temporary account balances and transfer the payment account balances to the succeeding FY - Finalize the balance sheet	31/05/2018	None	CFO/CE/ACE

Source: JICA Survey Team

17.3.7 Human Resources Management

One of the most critical drivers for the success of an organization is their Human Resources (both quantity and quality). The "quantity" (staff number) refers to availability of "right" number of HR at required work-locations, whereas "quality" refers to the "competencies" of its staff, which comprises of knowledge (from education, experience and training), skills (from experience, training and development) and attitude (character, ethics, willingness, dedication) of its HR.

BWSSB has an approved staff strength of 3,500. However, it has only 2,200 regular staff, whereas another +2000 have been hired on "outsourcing" basis. The regular staff includes professionals (engineers), technical staff, administrative staff, skilled workers etc. Due to imposition of ban by GoK on recruitment of regular staff, there has been a continuous decline in their respective numbers. Therefore, the importance of introducing measures to optimize their productivity becomes much higher. This calls for an effective Human Resources Management (HRM) system, In its comprehensive sense, HRM is concerned with management of people within the organization by undertaking realignment of policies, systems and work culture to have optimum staff performance/productivity on a sustainable basis. Therefore, there is an urgent need to address HRM within BWSSB.

(1) Current Human Resources Profile and Practices at BWSSB

The current human resources profile and HRM practices of BWSSB have been examined with reference to recruitment and selection, promotion, performance management, compensation and benefits; training and development etc. .

To assess the baseline staff profile, broad details of its HR in terms of age, educational qualifications, position, number of years of working with BWSSB etc. were collected and analyzed.

1) Age Profile

Age profile of an organization can be a boon or a bane. In case of BWSSB, it seems to become a bane, mainly due to ban on recruitment during last few years. Due to which, a substantial number of senior engineers are due to retire in next 7-8 years and BWSSB shall be deprived of their vast experience. A good majority (about 47%) of the regular staff are in the age group of 50-60 years, whereas, another + 28% are in the age group of 40-49 years. It implies that about +75% staff are above 40 years. The average age of employees is about 47 years. High average age imposes limitations in adoption of technology, undertaking risks and challenges etc. What is needed is scientific HR planning coupled with regular recruitment of fresh engineers at lower levels and then providing them adequate learning opportunities.

2) Educational Qualifications' Profile

As stipulated, all EEs and above are degree holders in various disciplines of engineering (mostly Civil but some are mechanical and electrical also), whereas most of JEs/AEs are diploma holders in civil, mechanical or electrical disciplines. A large majority of Group B and C staff are graduates in various disciplines. However their being graduate in any discipline does not indicate specific proficiencies, as graduation

alone is not considered a "quality" criteria. It was indicated that when it comes to engagement under "accounts', simple graduation does not help much.

3) Employment Status Profile

As indicated from data, about 52 % of those employed are regular employees and holding sanctioned posts, whereas another 47% are either on contract or casual. The cases of deputation are very low.

4) Number of Years in BWSSB

Consistent with the age profile, about 60% of regular employees are with BWSSB for more than 20 years, whereas, about 36% are with BWSSB for more than 10 years.

5) Status of Training Activities

Staff training and development activities are virtually non-existent in BWSSB. Discussions indicate that there is no formal training policy, there is no provision for a specific number of training days per year and there is no budget "head" for training. All expenses under trainings are to be charged under the common budget head of "Establishment". During last 5 years, barring some sporadic cases, no other staff were provided any training. Only few staff had attended trainings/exposure visits, mostly under an international project. During discussions with middle to top level officials, the concept of regular training was agreed and appreciated. However, on the modalities, it lacked required system and enthusiasm (IF it happens, IT shall be good for the organization). It was also indicated that a dedicated unit should be developed to manage it.

(2) Current Human Resources Practices at BWSSB

1) Existing Performance Management System

As brought out under SWOT analysis, there is no performance management system within BWSSB. Instead, Annual Confidential Report (ACR) is used to measure and record employee performance. The ACRs are filled once a year and that too at the end of Financial Year. Under this, employees are rated on general criterions like work performance, obedience, punctuality, dedication, integrity etc. most of which are subjective. The ratings are poor, average, good, very good and excellent against stated criterions. These ACRs are essentially required for departmental promotions, where a consistently (at least 3 or 4 out of 5) "good" or higher rating in ACR is required by employee for his/her consideration for promotion.

No award/reward system based on ACR/Performance Management exists. Similarly, no case of removal (termination, Compulsory retirement) of an employee based on consistently poor ACR was reported. Overall, the submission, reporting and approval of ACR has been considered a routine activity, lacking commitments. The major reasons for its lack of institutionalization of performance management in BWSSB could be attributed to lack of accountability and the seeming disconnection between objectives of ACR, job description, expected results and monitoring parameters.

2) Job Descriptions

Although, BWSSB has a defined job description for its common positions, yet the feedback from employees indicate a different scenario, wherein most of them are performing totally different functions than described. Even, CPHEEO Manual on Operation and Maintenance of Water Supply Systems, the O&M jobs are undertaken by operating staff and supervisory staff. The manual does not provide specific name/category of the required posts. Accordingly, it follows that there are no details or particular description(s) of the job that needs to be performed. Though the manual emphasizes for a plan/programme containing procedures to be adopted or actions to be taken for each piece of equipment, and that the person who carries out this action is to be identified. Thus, the person's job description should contain reference to the maintenance plan/program.

17.3.8 HR Action Plan Focused on Training and Capacity Development

The HRD activities are planned to be undertaken by the Consultants during the project implementation stage. It should focus on following aspects of HRM cycle: Training and Development, Performance Management, Human Resource Planning etc.

(1) Training and Development

Lack of HRD activities for many years, emergence of various applicable technological developments (GIS, SCADA, IT, AMS, HRMIS, FMIS etc.) in the external environment as well as forward looking competency requirements shall require specific competencies to manage, operate and maintain the newly constructed and/or rehabilitated systems. This is where capacity building of its HR becomes a critical activity due to following reasons:

- There has been little to no training in the recent past
- Considerable number of experienced senior staff face retirement in next 5-7 years
- Newly recruited staff shall have to fast track their learnings in WSS services.
- Thus, there is an urgent need for the basic training
- Development and adoption of a BWSSB Training (HRD) Policy
- Formulation of a Capacity Building Plan based on a comprehensive Training Needs Assessment
- Setting up of a dedicated unit in BWSSB to manage the HRD/Capacity Building activities and
- Allocation of a dedicated budget for the training and learning activities

Therefore, during implementation of the Project, capacity development programs should be developed and undertaken in anticipation of specific project requirements. The objectives of the capacity development program could be:

- To enhance the capability of BWSSB, as an institution, to realize organizational goals and objectives;
- To enhance the competencies of its key staff, as well as identified group(s) of personnel with the competencies required to manage, operate and maintain the new and existing facilities/system thereby transforming organizational and individual potentials into actuality with each one contributing their share towards the achievement of mandate of BWSSB. The training should bring about the cor-

rect attitudinal change as well as professionalize and improve the efficiency of personnel in the performance of their tasks.

An action plan to achieve HRD is presented in Table 17.3.7

(2) Performance Management System

BWSSB employs a performance evaluation system for its employees, which is undertaken through the Submission, Review and Approval of Annual Confidential Report (ACR) of the employees. The major objectives of system are: "To improve the performance of subordinates in their present jobs, to assess their potentials and to prepare them for the jobs suitable to their personality." In other words, ACR is an important document, being the basis in making decisions on promotions, placement, training and development, and even in premature retirement. This is also the basis on which annual increases in pay called "increment" is processed.

The ACR is basically is a two-step assessment – first is a self-rated assessment (self-appraisal) by the officer or employee him/herself, and the second is the rating by the immediate supervisor of the officer or employee. There is a prescribed action time schedule followed in the submission of the ACR by the "Reporting Officer" to the "Reviewing Officer" who, in turn, sends the completed report to the "Accepting Authority."

Table 17.3.7 Action Plan for HRD

S/N	Human Resource Development (HRD)	External Consultant	BWSSB	Timeframe
1	Review of existing system of HRD (Situation, Issues, Challenges, etc.)	Lead	Associate	Week 1-2
2	Development of HRD Policy/Guidelines	Lead	Associate	Week 3-4
3	Development of HR profile of the organization (Department wise Designations, HR available, Age, Educational Qualifications, Experience, Training undertaken in recent past i.e. in last 3 years, Joining and Retirement details etc.)	Lead	Associate	Week 3-6
4	Overlaying of Roles and Responsibilities on HR profile	Lead		Week 5-8
5	Establishment of a HRD Officer/Unit/cell within BWSSB		Lead	Week 5-10
6	Assessment of Training Needs both present and emerging (Line managers, Focus Group Discussions, Questionnaire, Data Analysis etc.),	Lead	Facilitator	Week 9-18
7	Prioritization of Training Needs (Immediate, short term, medium term)	Lead	Associate	Week 19-20
8	Identification of potential resources for Training	Lead	Associate	Week 21-22
9	Development of Training Profiles (Learning Objectives, target participants, batch size, total numbers, potential resourcing, anticipated costs)	Lead		Wk 21-28
10	Development of Training Plan (scheduling, trainings offered by resource institutions, cost, availability of officials/staff) and its approval	Lead	Associate	Wk 25-32
11	Implementation of Training Plan (subject to allocation of budget)		Lead	Start Wk 32
12	Monitoring (Including evaluation of trainings)	Lead	Associate	do
13	Feedback and Improvements	Associate	Lead	Cont.
14	Developing institutional capacity to take advantage of HRD activities (procurement of software, hardware, special equipment etc.)	Associate	Lead	Wk 25 onwards

Source: JICA Survey Team

In spite of being autonomous, BWSSB still uses ACR as the performance management tool for its staff/employees. However, the Government of India and many other states have moved to using the "Annual Performance Appraisal Reports" (APAR). In actuality, both are basically the same, except that the latter connotes openness and transparency, which are needed in improving employee performance.

Based on discussions, it was revealed that BWSSB exhibits low commitment and consistency in implementing the system, thus defeating the objectives of the ACR. As an important organizational function, performance management is designed to maximize employee performance, and is primarily concerned with how people are managed within organizations, focusing on policies and systems. It should be done in systematically and periodically to objectively assess employee's job performance and productivity in relation to certain criteria and organizational objectives. There is also the documentation (appraisal report) as basis for employee decisions such as rewards, promotions, training and transfers and tracks the employee's potential for future improvement.

It is proposed that BWSSB produce and publish the "BWSSB Brochure on Performance Appraisal", the preparation and publication of which shall be at the start of the implementation of the project (2017-18). Its publication should also be given the widest dissemination among staff and employees. Table 17.3.8 provides broad contents:

Table 17.3.8 Proposed Brochure for Performance Appraisal in BWSSB

Chapter No.	Title	Description of Content
I.	Performance Appraisal: Philosophy and Approach to the System	Explains the organizational and performance objectives of appraisal as a continuous and participative process and a tool for human resource development.
II.	General Principles	States the historical and legal bases of performance appraisal.
III.	Contents of and Guidelines in the Performance Appraisal Report	• Describes each part in the report format • Provides the responsibilities of all those involved in the process – the staff being reviewed, the reporting officer and the accepting officer
IV.	Timely Completion of the Performance Appraisal Report	Gives not only the time schedule for the appraisal's completion, but also the reasons why timely completion is important in personnel administration
V.	Special Provisions	• On Adverse Remarks • On government servants covered or not covered by the performance appraisal under deputation • On those on training, or working in technical/ academic institutions
VI.	Miscellaneous	Any other provisions not covered in any of the chapter above, but may need clarification.

Chapter No.	Title	Description of Content
VII.	Appendices	
	Guidelines in filling up of APAR Annual Performance Assessment Report with numerical grading	
	Assessment of work output	
	Time schedule for preparation / completion of APAR in terms of reporting/financial year	

Source: JICA Survey Team

(3) Action Plan for Human Resource Planning

The same is presented in Table 17.4.1.

17.4 Project Management and Organizational Restructuring

The implementation of loan project shall require a PIU (Project Implementation Unit) to execute the project. However, to develop that, one need to understand various stakeholders.

17.4.1 Key Project Stakeholders

The key stakeholder institutions with interest in the project's implementation are: the Government of India, represented by the Ministry of Urban Development (MoUD), which is also supporting improvement of urban services in Bengaluru under its Jawarharlal Nehru National Urban Renewal Mission (JnNURM). There are also state-level stakeholders, such as the BWSSB, which shall implement the project, Urban Development Department (UDD, GoK), Water Resources Department (WRD, GoK) etc. The local level stakeholders include BBMP, general public of the coverage area etc. In addition, Japan International Cooperation Agency (JICA), as a financing institution has stakes in it. Besides, there are a number of central, state and local external stakeholders, with which or with whose cooperation, BWSSB shall be able to implement the project. Their details are as follows:

(1) Central Level

a) Ministry of Urban Development (MoUD), Government of India

The MoUD is responsible for formulating policies, supporting and monitoring programmes, and coordinating the activities of various Central Ministries, State Governments and other nodal authorities in so far as these relate to urban development, town and country planning and related development issues in the country. One of the urban development issues, and also a key mandate of the Ministry, is in taking up schemes to create facilities to manage water supply as well as liquid and solid wastes (or water supply, sewage, drainage and sanitation facilities), subject to the overall national perspective of water planning and coordination assigned to the Ministry of Water Resources.

In 2008, the MoUD launched and operationalized the Service Level Benchmarks identifying basic minimum service level performance parameters for four basic urban services, namely: water supply, sewerage, solid waste management, and storm water drainage. MoUD is also very active in undertaking and implementing first and second level urban reforms for urban infrastructure in water supply, sanitation and drainage and implements the Jawaharlal Nehru National Urban Renewal Mission (JnNURM), UIDSSMT, Satellite Townships program, National Water Awards and the National Urban Awards.

One of the relevant reform being pursued by the MoUD, which is cascading down to the State Governments and ULBs/BWSSB is the "regulatory frameworks" aimed at protecting consumers, applying environmental standards and supporting the delivery to the poor in financing and in the delivery of infrastructure at local level, especially in the water and sanitation sector, together with the appropriate training programme and capacity support to regulators developed in partnership with the private sector and urban research institutions.

b) Jawarharlal Nehru National Urban Renewal Mission (JnNURM)

Launched in December 2005, the JnNURM aims to create productive, efficient, equitable and responsive cities by supporting improvements in the existing service levels in a financially sustainable manner. Projects and development reforms are being implemented in 63 identified cities including Bengaluru. The focus has been on integrated and planned development and renewal of infrastructure services, efficiency in urban infrastructure service delivery mechanisms, community participation and accountability and had consisted two sub-missions: Urban Infrastructure and Governance (UIG); and Basic Services to the Urban Poor (BSUP). One of the mandates of JnNURM (at start in 2005) has been to levy reasonable fable user charges by ULBs and parastatal agencies (like BWSSB) with the objective that the full cost of O&M (recurring costs) is collected (recovered) within the next seven years (i.e. by 2013). Whereas, the relevant objective under "Provision of Basic Services to the Urban Poor" includes improved water supply and sanitation services to urban poor and slum dwellers.

Table 17.4.1 Action Plan for Human Resource Planning

S/N	Activity/Sub-Activity	External Consultant	BWSSB	Time frame
1	Review and Analysis of Organizational structure, role and responsibility definition and existing manpower (section/unit wide)	Lead	Associate	Week 1-4
2	Preliminary Assessment of "general" and 'specific" work load of employees (unit wide, category-wise)	Lead	Associate	Week 5-10
3	Review of Benchmarks/norms on workload (category wise) and assessment of unit wide and organization wide shortfall/surplus	Lead	Associate	Week 6-11
4	Assessment of anticipated (possible) adoption of a. Policies (retirement age, volumetric metering, bi-monthly billing, service out-sourcing etc.) b. System/process improvements (computerization, automatic meter reading, MIS, FMIS, e-bill payment etc.) in short and medium term and its impact on HR needs	Lead	Associate	Week 12-20
5	Reassessment of Unit wide and organization wise HR needs (category/ position wise) by considering the anticipated retirements and on-going trends of promotions, resignations, voluntary/compulsory retirements, deaths etc.	Lead	Associate	Week 21-30
6	Finalization of strategies (deputation, transfer, retrenchment, training, multiskilling, multi-tasking etc.) to "adjust" surplus/shortfalls in HR	Associate	Lead	Week 31-32
7	Finalization/Approval of HR plan for medium and long term	Associate	Lead	By week 36
8	Assessment and prioritization of "unit wide" and Organization wide HR recruitment in medium and long term	Associate	Lead	By week 40
9	Feedback, Improvements and adoption of HR Plan	Associate	Lead	By week 60

Source: JICA Survey Team

(2) State Level Stakeholders

a) Urban Development Department (UDD), GoK

This is the primary stakeholder department, to which BWSSB reports. The UDD is responsible for securing water allocation from water bodies to meet drinking water needs of urban areas. For this purpose, UDD liaises with Water Resources Department of GoK. The UDD also overlooks the BMP and other Urban Local Bodies, with which BWSSB is working and therefore, a better inter-agency relationship is always desirable. The UDD is also supporting KMRP (Karnataka Municipal Reforms Project), under which some developments works are being undertaken in erstwhile CMC and TMC areas,

b) Water Resources Department (WRD)

The WRD, GoK has the responsibility of ensuring irrigation to the agricultural sector of the State, by developing and constructing major and medium irrigation and multipurpose projects, including lift irrigation projects, leading to not only increase the irrigation potential, As per Water Policy, Gok, it is also responsible to provide raw water for water supply and hydro-power projects. It also manages all matters that relate to flood problems, such as the construction of flood control (restoration and improvement works) as well as construction of major dams and drainages. It is mandated to undertake management and preservation of the water resources of the State including investigation of ground water resources.

WRD is an indirect but major stakeholder in this project, considering that raw water for the identified water supply projects will be coming from the Cauvery River, which is managed by WRD. Therefore, close coordination is needed between BWSSB, UDD and WRD.

(3) Supporting Stakeholders

a) Department of Revenue, GoK

The department is responsible for possessing government land and to maintain all the land records of the state. It is also responsible for acquiring identified land for various development projects of the state. Therefore, role of department shall be important, if land acquisition becomes a necessity for the project.

b) Department of Ecology and Environment

The role of the department is to preserve and enhance the quality of the natural environment, including water, air and soil quality; conserve and protect flora, fauna and other natural resources; enforce environmental Acts and Rules made by the Central Government and Government of Karnataka and to coordinate various environmental policies and programs. To support the above, it undertakes various actions including granting project clearances after assessment of their environmental impacts.

c) Finance Department

The department is responsible for scrutinizing financial status of BWSSB and to approve “Guarantee” of Government of Karnataka for any loans taken by BWSSB etc. Considering the objectives, the Finance Department also recommends grant-in aids/loans/write-off of any previous loans to BWSSB, for approval of the State Legislature.

d) Law Department, GoK

The department is responsible for concurring major policy improvements and approval of amendments in BWSS Act (prior to legislative approval) etc. The scrutiny mainly includes aberrations, duplications and conflicts with any existing Acts, Rules, Policies and Guiding Principles of GoK and GoI including those laid under regulatory regime of GoK and GoI.

(4) Local Level Stakeholders

a) Bruhat Bengaluru Mahanagara Palike (BBMP)

BBMP is the administrative body responsible for the civic and infrastructural assets of the part of Greater Bangalore Metropolitan Area, which was formulated by a notification of GoK of January 2007, by combining the erstwhile Bengaluru Mahanagara Palike (BMP), seven City Municipal Councils (CMC), One Town Municipal Council (TMC) and 110 Villages. The process was completed by April 2007 and the body was renamed 'Bruhat Bengaluru Mahanagara Palike'. BBMP represents the local government or third level of government (Central and State Government being the first two levels) and is governed by a City Council, comprising of 198 elected cooperators, one from each ward (administratively demarcated localities) of the city. For effective administration, it is divided into 10 zones (Yelahanka, Dasarahalli, Govindarajanagar, Padmanabhanagar, Bommanahalli, Mahadevapura, Krishnarajapura, Jayanagar, Malleshwara and Rajajinagar), each administered by respective Joint Commissioners, who are delegated substantial powers and authorities of the Commissioner, BBMP.

As per the 12th Schedule of the Constitution of India (Article 243 W), inserted under 74th Constitutional Amendment Act of 1992, the obligatory and optional functions of ULBs (like BBMP), include 18 functions as belonging to their legitimate domain. These are:

- Urban Planning including town planning
- Regulation of land use and construction of buildings
- Planning for economic and social development
- Roads and bridges
- Water Supply for domestic, industrial and commercial purposes
- Public health, sanitation, conservancy and Solid Waste Management
- Fire services
- Urban forestry, protection of the environment and promotion of ecological aspects
- Safeguarding the interests of weaker sections of society, including the handicapped and the mentally retarded
- Slum improvement and up-gradation
- Urban Poverty Alleviation
- Provision of urban amenities and facilities such as parks, gardens and play grounds
- Promotion of cultural, educational and aesthetic aspects
- Burials and burial grounds, cremations, cremation Ghats/grounds, and electric crematoria
- Cattle pounds, prevention of cruelty to animals
- Vital statistics including registration of birth and deaths

- Public amenities including street lighting, parking lots, bus stops and public conveniences
- Regulation of slaughter houses and tanneries. It is also the responsibility of the ULB to coordinate between the different service delivery institutions.

BWSSB has been entrusted water supply and sanitation services by an Act of GoK and thus is entitled to provide services in relation to Sl. No. 5 and 6 of urban services o BBMP. Therefore, strong inter-agency relation is required between BBMP and BWSSB. The co-ordination needs are much higher, especially while implementing and maintaining WSS projects, which mostly requires road cutting, traffic management including traffic diversions, road safety measures, road restoration, utility shifting etc.

b) General Public

General public residing within BBMP area, who are being served or planned to be provided water supply and sewerage services under upcoming projects has stakes in the project and thus a local level stakeholder. Although, they seem to be a beneficiary stakeholder but as they evaluate quality of services as well as pay for the services and thus are equal partners.

c) Elected Representatives

One of the objectives of the local elected representatives (wars members, MLAs, MPs etc. representing the area) is to have quality basic services to the public, to whom they represent. BWSSB is the provider of one of the most important basic urban services like WSS, quality of which impacts the public on day to day basis and thus the elected representatives interact with BWSSB for improving service deficiencies. Secondly, any revision in water tariffs requires approval of GoK, which indirectly requires political consent of the elected representatives.

(5) Regulatory Stakeholders

Regulatory stakeholders have no direct role in the project, but sets boundary lines/conditions for adherence during the project life cycle. Besides general regulators like Tax authorities, pollution regulating bodies like Karnataka State Pollution Control Board (KSPCB) becomes a specific stakeholder.

Karnataka State Pollution Control Board (KSPCB): The KSPCB was constituted by GoK in Sept 1974 in pursuance to the Water (Prevention & Control of Pollution) Act, 1974. The Act provided for the prevention and control of water pollution and maintaining or restoring of wholesomeness of water. After the enactment of the Air (Prevention & Control of Pollution) Act, 1981 to provide for prevention, control and abatement of air pollution, the enforcing responsibility was also entrusted to the Board. As such, the Board was renamed as Karnataka State Pollution Control Board in 1985. KSPCB sets the water quality standards for both drinking water as well as for effluent discharge in water bodies (mainly applicable for design and operation of STPs). Managing due to regulatory and enforcement powers of KSPCB, it guides, sets operational limits and can monitor the operations of WSS infrastructure of BWSSB and thus has stakes in the functioning of BWSSB.

17.4.2 Project Management Experience of BWSSB

BWSSB has been managing internationally funded projects for a considerable number of years and therefore has good knowledge of financing arrangement and management, international procurement procedures, competitive bidding, liaison with financing agencies etc. and therefore, it should not be difficult for them to implement the project.

17.4.3 Project Implementation Framework

The overall project implementation and management structure shall be spelt out in the Loan Agreement/Contract between GOI/GoK and JICA/GOJ, However, it is expected that participating organizations shall be governed by following principles:

- Strict adherence to the Loan Contract/Agreement specifying the mutual rights, responsibilities and obligations of each entity:
- Abiding by and respecting all relevant and applicable rules and laws of GoK, GOI, BWSSB Act and urban development controls of BBMP/GoK;
- Providing for an institutional mechanism, which shall include setting up a multi-tier project management framework for project implementation for the entire duration of the project; Setting up the PIU to work as primary nodal point for all initiatives directed at development and execution of all processes related to project implementation.
- Setting up the Project Implementation Unit (PIU) to work as primary nodal point for all initiatives directed at development and execution of all processes related to project implementation.

As a part of project implementation framework, each project entity shall have its own roles and responsibilities, as proposed and summarized in Table 17.4.2. The framework for project implementation shall be as follows:

Table 17.4.2 Roles of Various Project Entities in Project Implementation

Project Entity	Responsibility	Level	Institution / Department	Major Role in Project Implementation
Board of Directors of BWSSB (supported by Technical Committee, Tender Scrutiny Committee and Contract Variation Committee)	Direction and Facilitative Coordination	High Level	Like Steering Committee May invite representative from Finance, WRD, Law of GoK; PMC	• **Over-all responsibility for project policy and directives besides facilitating stakeholder coordination** for time bound Project implementation • Quarterly Project Monitoring • Addressing major implementation bottlenecks due to external stakeholders Major decisions may be informed to JICA, PIU and PMC.

Project Entity	Responsibility	Level	Institution / Department	Major Role in Project Implementation
	Project Implementation	High Level	Board of Directors, BWSSB	• Accelerated decisions on specific matters using their authority as per delegation of powers (as an agenda of monthly meetings) • Approval for engagement of PMC for detailed design, and /or construction management for project implementation
Chairman, BWSSB	BWSSB as Project Implementation Agency (PIA)	BWSSB Level	Project Implementation Agency	• To ensure compliance to conditions of loan agreement • Nomination of Project Director as Head of PIU and Counterpart Officials as members of PIU • Fortnightly Project Monitoring • Liaison with Funding Agency (Nodal officer for JICA)
Project Director (CE level)	Project Implementation Unit (PIU)	Operational Level	Project Implementation Unit	Project Implementation partner to Project Management Consultants: • Signing of Contract with PM Consultants and Contract Management • Responsible for providing required approvals of design/deliverables besides supervision, interactions, monitoring and management of various aspects of Project implementation • Extending required administrative support to PMC in project preparation and implementation

Source: JICA Survey Team

17.4.4 Post Project Organizational Restructuring of BWSSB

However, post-implementation, there shall be requirement of certain structural changes within BWSSB to undertake the additional responsibilities. In view of this, the restructuring of BWSB has been undertaken. Restructuring of WSS organizations like BWSSB becomes a complex task, as it is affected by many factors, including the history of the state/country, its administrative culture, role of the state and the influential persons mapping out the sector vision and way forward. Besides these, policy changes also guides in defining, delineating and quantifying the extent of functions to be performed by BWSSB.

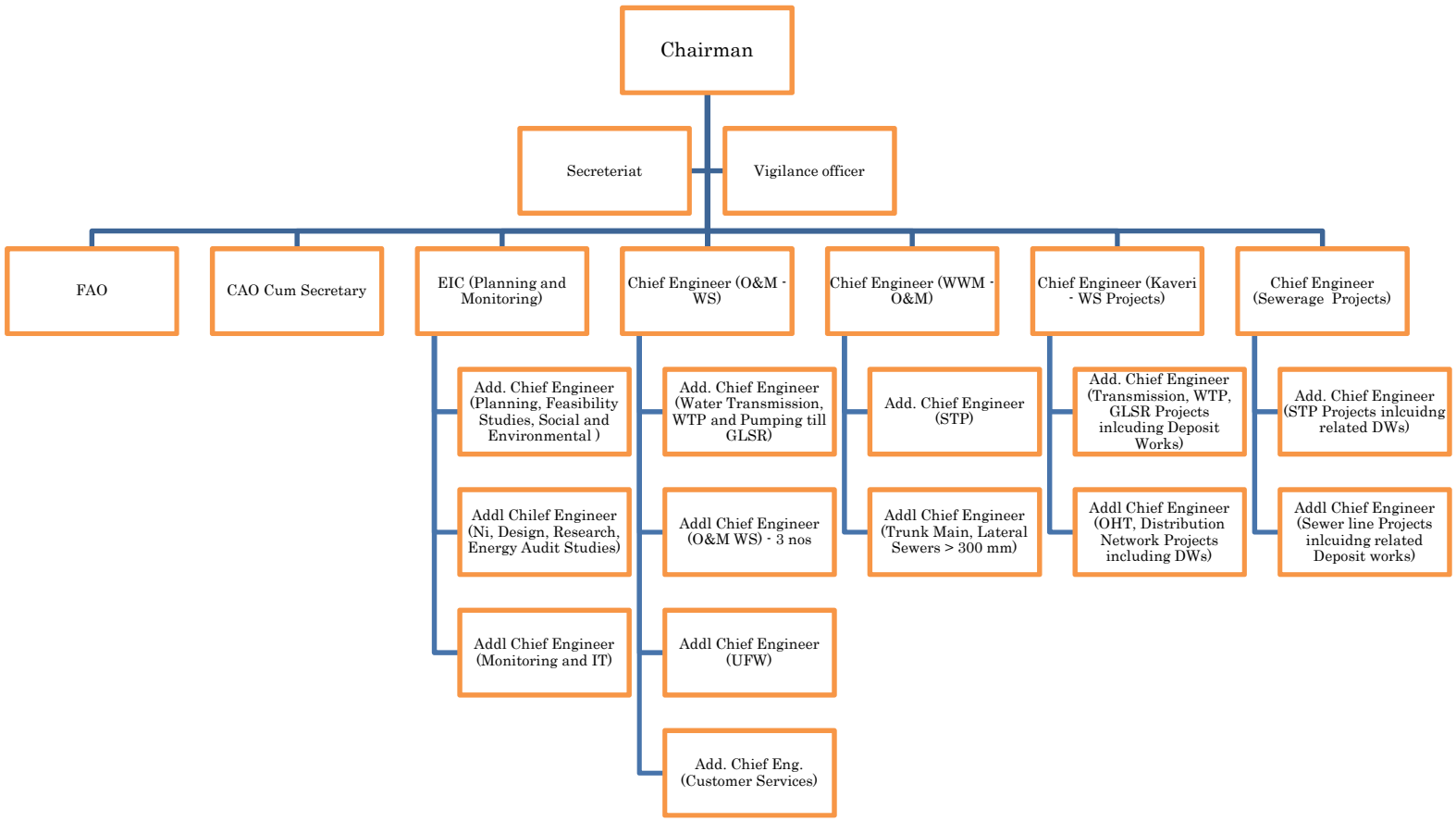
(1) Principles of Restructuring

The restructuring of BWSSB has been proposed based on following guiding principles/outputs:

- Improved decision making supporting increasing decentralization
- Increased horizontalisation
- Supporting functional specialization to the extent possible (Planning and Policy, UFW Reduction, IT, Data Collection, management and monitoring etc.),
- Efficient processing
- Minimum staff redundancies
- Multi-tasking by using HRD
- Using Perspectives of Cost Control
- Supporting wider applications of IT (IMS, SCADA, GIS etc.)
- Encouraging PPP and Outsourcing - Non-key functions can be outsourced (should in general lead to economy of operations).

(2) Restructured BWSSB

After detailed analysis and by incorporating structural needs, following organizational structure has been proposed, which is presented in Figure 17.1.1.



Source: JICA Survey Team

Figure 17.4.1 Organizational Structure

a) EIC (Planning, Policy, NI and Monitoring)

- ACE (Strategic planning, Business Planning, Annual Budget, Feasibility Studies of new projects, Liaison with International funding agencies)
- ACE (NI, Research collaboration, Design, Technology Selection, Energy Audit, Promotion of use of treated water and identification of new clients)
- ACE (Monitoring): Data management and monitoring, Vehicles and buildings, HRD, Quality assurance in BWSSB works, ISO, Monitoring RWH and bore wells, SCADA, GIS, Stores etc.

b) CE (M- WS): Operation and maintenance of water supply and sewerage pipes up to 300 mm with

- ACE (Kaveri Water transmission, WTP and PS, GLRs and OHTs)
- 3 ACEs (WS and Small sewers) to cover 11 Divisions (each ACE managing 3-4 divisions)
- ACE (UFW Reduction) with 2 Divisions
  ⇒ UFW - 1 Division: For Reduction of UFW in transmission and GLSR
  ⇒ UFW - 2 Division: For Reduction of UFW in distribution network of service stations (after GLSR)
- ACE (Customer services) – new connections, revenue billing and collection, grievance redressal

c) CE (WWM – O&M)

- 2 ACE (STP) – Valley wise or North, South
- 2 ACE (sewers >300 mm) – Valley wise or North, South

d) CE (Kaveri) for all WS Construction: Looking after all new WS works including Deposit works of BDA/BBMP as well as major asset replacement of water supply works - with Two ACE – One for WS related works up to GLSR, Second ACE for works after GLSR

e) CE (WWM – Construction): New Sewerage Works including Deposit works of BDA/BBMP and major asset Replacement - with Two ACE (One for STPs and IPS) and second for trunk main and lateral sewers. New works shall also include transmission of reused water to clients. Asset replacement may include TOTAL reconstruction of existing infrastructure like “old STPs/ISPS” etc. or complete change of outdated sewer lines.

Therefore by 2024, BWSSB shall require 1 EIC, 4 CEs and 17 ACEs as compared to 1 EIC, 4 CEs and 13 ACEs today. Similarly, there shall be a requirement of 48 Executive Engineers as compared to 39 at present.