THE STATE GOVERNMENT OF UTTAR PRADESH
THE REPUBLIC OF INDIA

PREPARATORY SURVEY ON GANGA REJUVENATION PROJECT IN THE STATE OF UTTAR PRADESH, INDIA

FINAL REPORT

(2/3)

June 2017

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

NJS CONSULTANTS CO.,LTD.

NIPPON KOEI CO.,LTD.

CHAPTER 10 Operation and Maintenance of Sewerage Facilities

<Objective of the study>

The followings are confirmed/studied in this Chapter: 1) Confirmation of current practice of the sewerage sector, 2) Guidelines for the O&M, 3) Existing sewerage assets, 4) Performance Indicator, 5) O&M costs, 6) Capacity building, 7) Training Plan,

<Result of the study>

Based on the collected information and analysis on it, Survey Team is suggesting some improvement plans in performance indicators, effluent quality, modification of responsibilities, capacity building as well as training plans.

10.1 Introduction

Sewerage facilities to be operated and maintained include sewers, intermediate pump stations (IPSs) and sewage treatment plants (STPs) in the Project Area that consists of Varanasi city and nearby towns of Chunar, Mirzapur, Saidpur, Ghazipur and Ramnagar. Presently, O&M of these facilities is performed by the government agencies through their own staff and there is no outsourcing of the O&M. However, the guidelines of the current government schemes such as Mission for Clean Ganga and AMRUT require the initial five years of O&M to be included in the scope of the construction contractor, which will require a shift in the O&M policy.

This section will provide information on the current O&M practice, requirement of the current government schemes, information on the current assets and proposed assets that will be required O&M and a list of issues to be addressed during this Preparatory Survey.

10.2 Current Practice and NGRBA/NMCG Guidelines for O&M

10.2.1 Current Practice

The Jalkal operates under the Nagar Nigam and looks after O&M of all the water supply infrastructure (treatment plant to house connection) and underground sewer network (home connection to pump station or STP inlet). Though the UP Jal Nigam is primarily as executing agency that undertakes construction of water supply and sewerage works, it also looks after the O&M of sewage pump stations and sewage treatment plants on behalf of Nagar Nigam, as the Nagar Nigam does not have the technical knowhow to maintain these assets. This arrangement for O&M is practiced throughout the State of Uttar Pradesh.

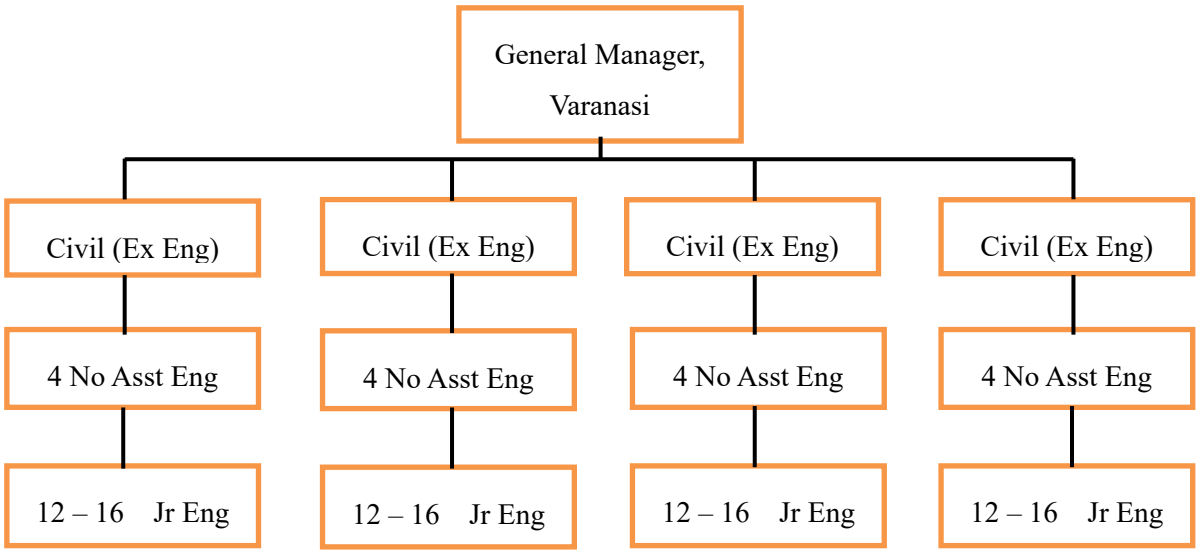
The UPJN regional office, such as the UPJN office in Varanasi prepares the estimate for annual O&M of the sewage pump stations and STPs in Varanasi City as well as in nearby towns such as Mirzapur. The O&M budget is prepared as per the NGRBA (National Ganga River Basin Authority),

Government of India, guidelines, which specify the staff and other O&M requirements for different capacity STPs and based on capital cost. The costs such calculated are used for tendering purpose.

The O&M estimate is sent to respective Nagar Nigam offices for review and counter signature. Once signed by the Nagar Nigam, the estimate is forwarded by UPJN, Varanasi office to the UPJN head office in Lucknow. UPJN head office compiles such O&M budgets received from various offices and then gets the funds from the State Government, which are then utilized for the O&M. The O&M budget is inclusive of electricity charges, and these are directly paid by the UPJN head office to the Uttar Pradesh State Electricity Board. The remaining amount is transferred to the respective offices for O&M of STPs and pump stations.

The O&M budget for Varanasi City sewage facilities for 2015-16 is Rs 252.5 million.

The UPJN, Varanasi office has the following organization chart.



Thus, the General Manager has 4 Executive Engineers, 16 Assistant Engineers and about 50 – 60 Junior Engineers under him to execute the capital works as well as to perform O&M of the sewage pump stations and treatment plants. ~~There is no dedicated O&M wing in UPJN.~~ The Bhagwanpur and Dinapur STPs are operated by the Ganga Pollution Prevention Unit (GPPU) of UPJN.

For O&M of the sewer network, following equipment is available with Varanasi Jalkal office:

- 6 nos of jetting cum sucker machines. Out of these, two machines were procured in 2013 and four were procured in 2014
- 1 no of super sucker machine
- 2 nos of bucket machines
- 4 nos of old jetting cum sucker machines, which are to be renovated

Machines for septage management are proposed under the GAP II, and Rs 30 million budgetary provision has been made for this purpose through the capacity building component. Jalkal officials have expressed desire to procure additional septage management machines due to large number of unconnected houses with septic tanks.

10.2.2 NMCG / NGRBA / AMRUT Guidelines for O&M

National Mission for Clean Ganga (NMCG) is the implementation wing of National Ganga River Basin Authority (NGRBA). It is a registered society originally formed by Ministry of Environment, Forests and Climate Change (MoEFCC) on 12th August 2011 under the Societies Registration Act, 1860. As per the 306th amendment in the Government of India (Allocation of Business) Rules, 1961, both NGRBA and NMCG are allocated to the Ministry of Water Resources, River Development and Ganga Rejuvenation (MoWR,RD &GR). As per the approval of the Cabinet Committee on Economic Affairs (CCEA), the mandate of NGRBA is being implemented by the National Mission for Clean Ganga (NMCG). At national level NMCG is the coordinating body and is being supported by States Level Program Management Groups (SPMGs) of Uttar Pradesh, Uttarakhand, Bihar and West Bengal which, are also registered as societies under Societies Registration Act, 1860 and a dedicated Nodal Cell in Jharkhand.

The area of operation of NMCG is the Ganga River Basin, including the states through which Ganga flows, as well as the National Capital Territory of Delhi, and the guidelines of NGRBA are applicable to the Ganga Rejuvenation project being proposed for Varanasi and surrounding towns.

The NGRBA Guidelines state that:

i. First 5 years O & M cost to be in-built in the project cost. This will ensure unhindered O & M of assets which is necessary for achieving the river cleaning objectives.

ii. Next 10 years O & M cost to be also worked out with revenue generation plan. The O & M responsibility beyond 5th year will rest with the State Government/ ULB.

iii. Tripartite MoA amongst MoEF, State Government and the local body is also to be signed. State governments are expected to take all necessary measures available at their control to address this problem in a sustainable manner.

iv. Funds for O&M for a period of 5 years initially, would be shared in the ratio of 70:30 between the Centre and the State Government.

v. It is necessary to accurately work out O&M cost. The records of O&M of assets created under

GAP/NRCP may be examined carefully and updated to the current levels as well as the periods when new facilities would be ready for operation. Cost of electricity is the major component of O&M accounting singly for 65-70%. These as well as other components like manpower, consumables, etc. should be calculated on a realistic basis to arrive at the total annual cost to operate an asset. Continuous availability of electricity for both STPs and PSs must be ensured on round the clock basis by the implementing agency.

vi. Preventive maintenance or repairs needed after a few year's initial operations are often lost sight of. This is an important element of overall O&M cost and must be provided for appropriately.

vii. The DPR must clearly reflect the total component-wise funds needed for O&M and how and wherefrom these would be provided.

The NGRBA has also provided detailed guidelines for providing O&M Staff and O&M Staff quarters in Annexure 7 of the 'Guidelines for Preparation of Project Reports under National River Conservation Plan and National Ganga River Basin Authority' published in December 2010. This Annexure 7 is reproduced and enclosed as Annex-I. Though these guidelines are for calculation of the O&M cost when O&M is performed by the government departments, the same will be used for calculating O&M expenditure, with suitable margin for contractor's profit.

AMRUT (Atal Mission for Rejuvenation and Urban Transformation) scheme was launched by the Central Government in 2014, and it intends to take up 500 Indian cities with more than 100,000 population with purpose to (i) ensure that every household has access to a tap with assured supply of water and a sewerage connection; (ii) increase the amenity value of cities by developing greenery and well maintained open spaces (e.g. parks); and (iii) reduce pollution by switching to public transport or constructing facilities for non-motorized transport (e.g. walking and cycling). Under the AMRUT scheme, 100 cities will be transformed into Smart Cities, and Varanasi is on this list. Therefore, it is necessary to consider the guidelines proposed by AMRUT for O&M, which are given below, and are more concerned with service levels to be provided to the consumers:

i. Experience with past programmes has shown that once projects are completed the ULBs pay little attention to the operation and maintenance of infrastructure assets created. Therefore, the tender should include O & M for five years based on user charges. For the purpose of calculation of the project cost, the O&M cost will be excluded; however, the States/ULBs will fund the O&M through an appropriate cost recovery mechanism in order to make them self-reliant and cost-effective.

ii. The Service Level Improvement Plans will first provide for provision of water and sewerage connections to all households.

Thus, it is observed that both the NGRBA guidelines for O&M are more extensive than AMRUT; however, both the guidelines require the first five years of O&M to be included in the tender. Schemes under the NGRBA will provide for 70% of the O&M cost for the first five years, whereas schemes under AMRUT require user fees to be collected for funding the O&M cost. It should be noted that, at this moment, the eligibility of O&M cost requires the internal review of JICA.

10.3 List of Assets for O&M at the End of the Project

The Project Area has some existing sewerage assets, and some are being created under the currently ongoing Ganga Action Plan II. These assets are tabulated below.

Table 10.3.1 List of Existing Sewerage Assets in Project Area

Town	Sewerage Network Assets	Sewage Treatment Plant Assets
Chunar	There is no sewerage system. Some houses have own septic tanks whereas most of the houses discharge directly to Nalas that flow into the Ganga.	None
Mirzapur	Has existing sewerage network that is determined to be mostly functional except for a sewer of 4.5km length. There are 4 sewage pump stations	2 STPs: 4mld at Vindhyachal on WSP technology and 14mld at Mirzapur on UASB technology
Saidpur	no existing sewerage	None
Ghazipur	no existing sewerage	None
Varanasi Dist I	Almost 80% sewerage coverage	3 STPs: Dinapur STP 80mld, activated sludge process with roughing filter; BHU/Bhagwanpur STP 8mld, activated sludge with surface aeration; DLW STP 12mld
Varanasi Dist II	Partial sewerage system	Sewage from Dist II is treated at Dinapur STP in Dist I
Varanasi Dist III	Partial sewerage system; BHU area fully sewered with sewage flow to BHU/Bhagwanpur STP	2 STPs: Bhagwanpur STPs of 1.8mld and 8mld capacity
Varanasi Dist IV	No sewerage system, the area is outside municipal	None

	limits	
Ramnagar	35km of sewerage existing in Ramnagar area but there is no clear network of these sewer lines as many interconnections have not been constructed. There is no sewerage network in Padao area. Only few houses have septic tanks.	None
Total	Partial sewerage network in the Project Area with sewage pumping stations	7 STPs of capacities ranging from 1.8mld to 80mld with aerobic and anaerobic processes

Source: Discussion with GAP II Team

The Ganga Action Plan II is being implemented only in the City of Varanasi, and the list of assets being created in GAP II is given below.

Table 10.3.2 List of Sewerage Assets Being Created under GAP II in Varanasi

Town	Sewerage Network	Sewage Treatment Plant
Varanasi Dist I	Rehabilitation of existing old trunk sewer; Rehabilitation of Konia MPS; Rehabilitation of Ghat pumping stations; Sarai IPS (new); Narokar pumping station (new)	Construction of new 140mld STP to treat sewage from Dist II, STP with ASP process and digestion and power generation
Varanasi Dist II	Relief trunk sewer (new); Chauka Ghat pump station (new); Varuna River interceptor sewer (new); Phulwaria pumping station (new)	None
Varanasi Dist III	Assi nala interceptor sewer (new); Nagwa pumping station (constructed but not yet commissioned)	Ramana STP of 50mld capacity (new) is under bidding process as of April 2017;
Varanasi Dist IV	None as not in municipal area	None as not in municipal area
Total	Extensive sewerage network in Varanasi with rehabilitation of existing pump stations and new pump stations	2 new STPs of 50mld and 140mld capacity

Source: Discussion with GAP II Team

The DPRs provided to the Preparatory Survey team were studied and the proposed works in the Project Area are listed below. The sewerage facilities are proposed with Base Year 2020, and as per the

CPHEEO Manual, the design year for the sewerage network is considered as 2050 (30 year design horizon) and the STPs are proposed with design year of 2030 (10 year design horizon).

Table 10.3.3 List of Sewerage Assets Proposed in the Project Area

Town	Sewerage Network Assets	Sewage Treatment Plant Assets
Chunar	60.7km of sewerage network including mains, sub-mains and lateral sewers with sewer diameters from 200mm to 700mm dia Flushing mobile van to flush the sewers as velocities will be low	6.5 mld on WSP (waste stabilization ponds) technology followed by disinfection
Mirzapur	245.4km of sewerage network including mains, sub-mains and lateral sewers with sewer diameters from 200mm to 1000mm dia Replacement of non-functional sewer length of 4.5km	Upgrade the Vindhyachal STP to 6mld capacity with disinfection; Construct a new STP of 18mld capacity with SBR technology in Mirzapur; Upgradation of the existing 14mld STP with MBBR addition
Saidpur	DPR not yet available	DPR not yet available
Ghazipur	DPR not yet available	DPR not yet available
Varanasi Dist I	Almost 80% sewerage coverage	Rahab of existing Dinapur 80mld STP
Varanasi Dist II	Secondary and branch sewers being designed to achieve 100% coverage	Sewage flow to be treated at new 140mld STP at Dinapur located in Dist I
Varanasi Dist III	Secondary sewers and branch sewers with final outlet to Ramna STP through Nagwa Pump station	Ramana STP (being designed by UPJN under another project)
Varanasi Dist IV	DPR not yet available	DPR not yet available
Ramnagar	Sewage pump station at Ramnagar of 20.7 mld peak capacity Sewage pump station at Padao of 3mld peak capacity Main pump station at Kodopur of 32mld peak capacity	1 STP at Ramnagar of 14mld capacity with Activated Sludge based MLE Process
Total	Complete sewerage network in the Project Area with sewage pumping stations	3 new STPs of 6.5mld, 18mld and 14mld capacities

Source: DPRs given to the Preparatory Survey Team

The information from the above tables is compiled below to compare the existing assets vs the assets after completion of the ongoing GAP II Project and after completion of the assets being proposed under the current study.

Table 10.3.4 Comparison of Existing and Total Future Sewerage Assets the Project Area

Project Area	Existing Sewerage Assets	Total Future Sewerage Assets
Chunar, Mirzapur, Saidpur, Ghazipur, Varanasi, Ramnagar	Partial sewerage network With sewage pumping stations 7 STPs	Complete sewerage network With sewage pumping stations 12 STPs

10.4 Performance Monitoring of the Sewerage Facilities during O&M

The sewer network is designed to convey the entire sewage generated in the coverage area to sewage treatment plants that then treat the sewage to required discharge norms. Therefore, the performance indicators for sewer network are typically associated with conveyance of 100% sewage volume, and as the network has interface with the house connections, the service levels are related to addressing complaints such as blockages and overflows. The performance indicators for treatment plants are specific to volume being treated and the effluent quality to be achieved. These are noted below.

10.4.1 Suggested Performance Indicators for the Sewerage Network

The recommended performance indicators were formulated after considering the objectives of NGRBA that required no untreated sewage to flow into the Ganga River, meaning 100% coverage. The suggested criteria are also in line with the objectives of the AMRUT scheme, in view that the Varanasi City, the largest populated city in the Project Area is one of the 100 SMART Cities in the AMRUT program. The recommended performance indicators are given below:

- Coverage of latrines : 100%
- Collection of sewage : 100%
- Complaint resolution in 24hrs : 80%

10.4.2 Suggested Performance Indicators for the Sewage Treatment Plants

The sewage treatment plants should treat the entire volume of incoming sewage flow, without any bypass, and produce treated flow meeting the water quality specified by the NGRBA for discharging to Ganga River or by CPHEEO for discharging into Surface Water bodies that are used a source of drinking water. The suggested performance criteria are given below:

- Sewage treatment capacity : 100% of inflow to be treated without bypass

- Treated sewage quality : Give below (from CPHEEO Manual 2015)

  BOD : < 10mg/L

  TSS : < 10mg/L

  TN : < 10mg/L

  TP : < 2mg/L

  F. Coli : < 230 MPN/100mL

It is recommended that following measures be taken to ensure proper O&M of the STPs. During the first two years of the O&M Contract (1 year of defect liability period + 1 year of O&M), the STP influent and effluent shall be sampled as scheduled in Table 10.4.1 and analysed in the laboratory (in-house) at the STP.

Table 10.4.1 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
Turbidity	1. Daily	Flow-weighted 24-hour composite	Effluent from secondary clarifiers or from SBR basin
	2. Continuous	On-line	Effluent from secondary clarifiers or from SBR basin
COD	1. Daily	Flow-weighted 24-hour composite	a) Raw Sewage b) Plant Effluent
	Weekly	Influent	Influent sewage after grit chamber
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 (Tue, Thu)	Grab	Waste activated sludge (WAS)
Residual chlorine (if applicable)	1. Daily	Grab	Plant Effluent
	2. Continuous	On-line	Plant Effluent
BOD	1. Three times per week	Flow-weighted 24-hour composite	a) Raw Sewage Influent b) Plant Effluent
TKN	1. 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 phosphorous	1. Three times per week	Flow-weighted 24-hour composite	Raw Sewage and Plant Effluent

Soluble phosphorous	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
Faecal coliform	1. Three times per week	Flow-weighted 24-hour composite	a) Raw Sewage b) Plant Effluent
VFAs	1. Three times per week	Grab	a) Raw Sewage b) Anaerobic zone c) Anaerobic Digester – if provided
MLSS	1.Twice a week	Grab	Aerobic zone
MLVSS	1.Twice a week	Grab	Aerobic zone
Flow rate	1.Continuous	On-line flowmeter	a) Raw Sewage (Plant Effluent) b) Plant Effluent c) RAS d) WAS e) Sludge
Temperature	1. Daily	Flow-weighted 24-hour composite	a) Raw Sewage b) Plant Effluent
Specific gravity and concentration	1. Three times per week	Grab	Chemicals Sludge for consistency
Volume	1. Three times per week	Grab	Chemicals/Screenings/Grit/ Gas generation if applicable
Electricity Generation	Daily	On-line	Gas Quality, Volume, Engine running and Electricity Generation.

10.5 Suggested Responsibilities of the O&M Contractor and the Supervising Agency (Nagar Nigam)

It is presumed that necessary modifications will be made to the current O&M practice as per the guidelines of NGRBA and AMRUT so that the O&M will be performed by the Contractor for the first five years, and then on it will be outsourced a natural continuation of the process. Thereby, the Nagar Nigam will need to perform only a supervisory role, and will need to build its capacity appropriately, or can outsource the supervision task to UP Jal Nigam.

The analysis requirements for the first two years are noted in the previous section, and for the subsequent three years of the O&M period included in the contract, the sampling and analysis shall be conducted (on 24 hours-composite sample) once every week and shall cover all the days of the week during a seven week period. In addition, the Contractor shall be required to validate its analysis of effluent samples up to four times in a month from an approved laboratory (by Bureau of India Standards), which is not connected with the Project. The validation sampling shall be randomly selected based on Supervising Agency's decision and the cost of validation/analysis shall be borne by the Contractor. The Contractor shall then provide the influent and effluent water quality information tabular and graphical form to illustrate trends in water quality parameters.

The Supervising Agency shall check the treated effluent quality trends and ask the Contractor to undertake appropriate remedial actions, if the performance of the plant is observed as not satisfactory i.e., non-meeting the functional guarantees or drifting away from the desired performance levels.

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

During the entire operation and maintenance period, Supervising Agency shall nominate their official/counterparts for the inspection of specific STPs on weekly basis. Supervising Agency 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 to ensure proper O&M of the STPs.

During the Defect Liability Period (DLP) the Supervising Agency shall carryout monthly, quarterly, half yearly and annual inspection of the treatment plant through its designated personnel as well as with the assistance of project management consultants and based on their suggestions, the Supervising Agency shall suggest necessary improvements to the Contractor for efficient O&M of the STP

10.6 Operation & Maintenance Costs

The O&M cost is based on the NGRBA guidelines. The O&M cost for sewage facilities includes the following items:

1) Repair cost
2) Staff cost
3) Energy charges cost
4) Residual disposal cost (for STP)
5) Chemicals cost (for STP)

Under the NGRBA Guidelines, the Annual O&M cost of sewers is calculated as 0.25% of construction cost using NGRBA guidelines, same as the DPR. For STPs and Pump Stations, the methodology given in Annexure 7 of the NGRBA Guidelines that are summarized below.

Annual O&M cost of the Pump Station is calculated by the following conditions

- Civil works: 1.5% of cost
- Mechanical and Electrical works: 3.0% of cost
- Staff and Power works: As detailed in the DPR.

It is noted that this methodology has been followed in the DPRs given to the Preparatory Survey team, and the O&M costs compiled from those DPRs are given below in Table 10.6.1.

Total annual O&M cost for sewerage for five years is estimated at approximately 23,690.4 Lakhs INR excluding Saidpur.

Table 10.6.1 Estimated O&M Cost of Proposed Sewerage Works (INR Lacs)

Town	Sewerage Network Construction Cost	Sewage Treatment Plant Construction Cost	Sewage Pump Stations Construction Cost	Sewerage O&M Cost for 5 years
Chunar	8163.01	638.70	1132.54	905.16
Mirzapur	21455.25	3683.41	2078.80	2958.28
Saidpur	No recent DPR	No recent DPR	No recent DPR	No recent DPR
Ghazipur	9941.70	3664.49	1479.85	2803.27
Varanasi Dist I	28027.29	No STP in DPR	No PS in DPR	948.84
Varanasi Dist II	42050.79	6703.39	No PS in DPR	6765.58
Varanasi Dist III	15045.98	10301.90	No PS in DPR	3754.60
Ramnagar	8860.92	2233.62	1477.32	5554.67

CHAPTER 11 Environmental and Social Considerations

<Objective of the Study>

According to the JICA's TOR (Terms of References) for the preparatory survey, the proposed projects have been classified as Category B as per the JICA's Guideline for Environmental and Social Considerations by the reasons that the projects may affect less significant impacts compared to than those of Category A projects which are likely to have significantly adverse impacts on the environment or society since they have a wide range of impacts, impacts that are irreversible, complicated, or unprecedented, and impacts that are difficult to assess, or, project for a sector that requires special attention (e.g., a sector that involves large-scale infrastructure development), involves activity that requires careful consideration (e.g., large-scale involuntary resettlement), or takes place inside or adjacent to a sensitive area (e.g., protected natural habitat).

Therefore, the study for the ESCs (Environmental and Social Considerations) was carried out for the following issues based on the "JICA's Guideline for Preparation of the Reports for Environmental and Social Considerations for Category B Projects".

<Result of the Study>

The following results were obtained in the ESCs;

- *The proposed project will not require EIA as per Indian regulation of EIA Notification 2006.*
- *Estimated impact on pollution aspect: air, water pollution waste, noise, offensive odor*
- *Natural environment: there will be no adverse impact on protected area or important species since such national parks or protected area or such species has not been identified at the project sites, while some impact for hydrology was estimated at construction phase*
- *Social environment: some impacts on land issue (land acquisition for STP and pumping station sites), social infrastructure (traffic, underground utilities), infectious diseases, working environment and safety and accidents were identified*
- *Environmental monitoring was established as mitigation measures for the potential adverse impacts*

The project scope and component for actual implementation have not been approved by the project proponent (NMCG) at the JICA survey. However, additional action will be necessary for the issues as listed below;

- *Clarification of implementation structure for the mitigation measures and environmental*

monitoring

- *Resettlement and acquisition plan for the STP sites and pumping stations*
- *Holding SHMs (Stakeholder Meetings)*

11.1 Project Component for Environmental and Social Considerations

The project component of each project site is summarized in **Table 11.1.1**.

The objectives of the project particularly for the improvement of the environmental are the following:

- Improvement in sewage collection and treatment;
- Prevention of ground water and soil pollution due to infiltration of untreated sewage;
- Prevention of discharge of untreated sewage into River Ganga;
- Improvement in water quality of River Ganga;
- Improvement in environmental sanitation health and reduction in associated health hazards, within the city; and
- Improvement in quality of life, human dignity and increase productivity.

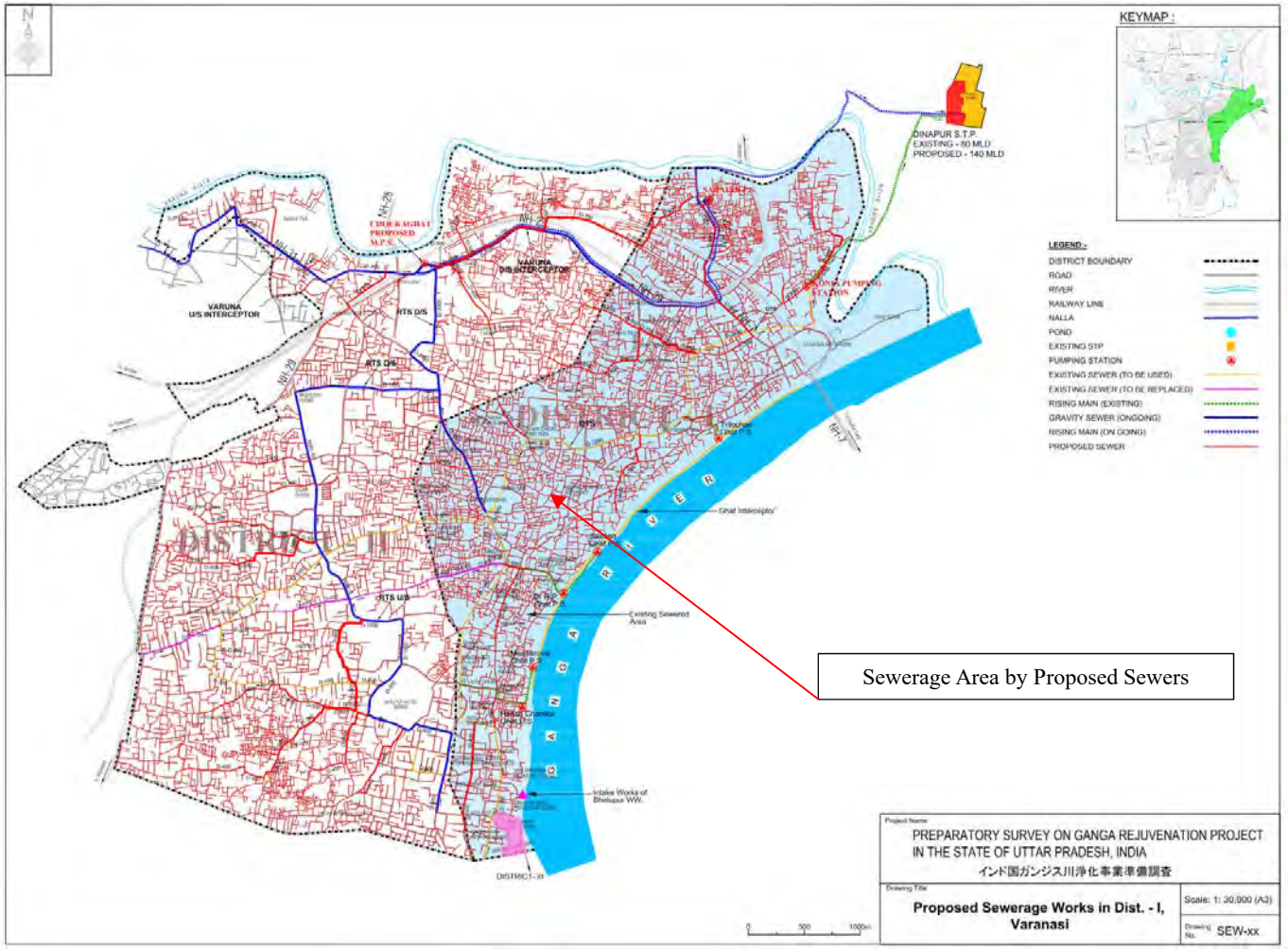
The project component in **Table 11.1.1** has not been approved by the project proponent (NMCG) including selection of the sewage collection method of ID & T (Interception, Diversion and Treatment) or Comprehensive (sewer networks) methods. The location map of the project site is shown in . The detail of the project sites for the project component at each city is shown in **Figure 11.1.2** to **Figure 11.1.8**.

Figure 11.1.1 Location Map of Project Sites

Table 11.1.1 Summary of Project Component

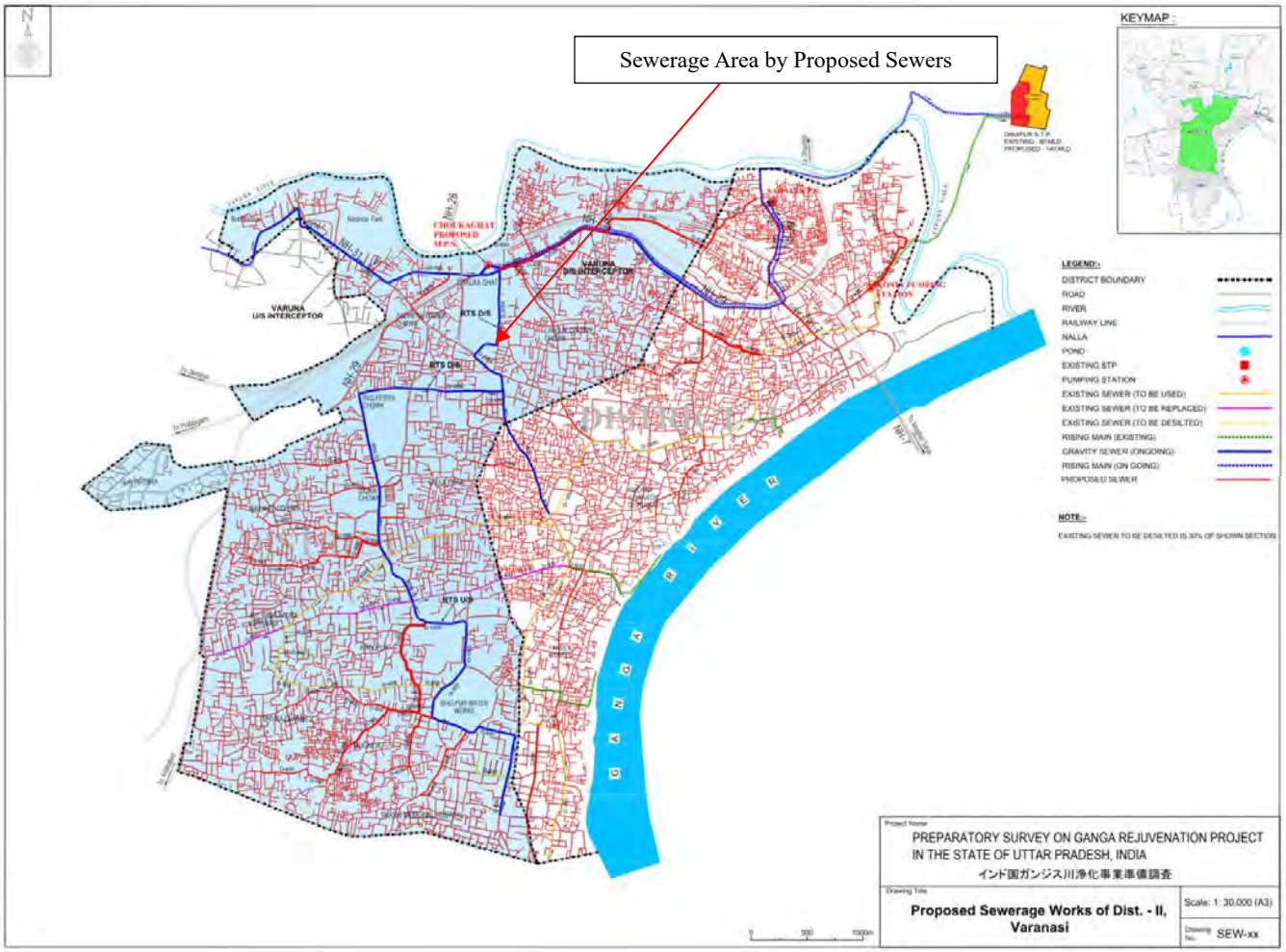
City	Varanasi	Mirzapur	Ghazipur	Ramnagar	Chunar
District	Varanasi	Mirzapur	Ghazipur	Varanasi	Mirzapur
Component	(1) District - I 1) Sewer • Dia.: 200 to 900 mm • Length: 217,772 m (Open) , 1,876 m (Micro Tunnelling) • Manhole: 10,925 nos. • House connection: 9,804 nos 2) Pumping Station: None 3) STP: None (2) District - II 1) Sewer • Dia.: 200 to 900 mm • Length: 272,096 m (Open) , 3,911 m (Micro Tunnelling) • Manhole: 13,128 nos. • House connection: 34,216 nos. 2) Pumping Station: None 3) STP: None (3) District - III 1) Sewer • Dia.: 400 to 600 mm • Length: 807 m 2) Pumping Station: • Location: Sarai Nandan • Unit: 6 (Duty: 4, d: 2) • Capacity: 400 m3/hr 3) STP: <u>Ramna STP</u> Capacity: 50 MLD • Sewage treatment: Single stage CND • Sludge treatment: Thickener Digestion SDB	1) Sewer: • Dia.: 200 to 900 mm • Length: 8,835 m (Open) , 5,340 m (Rising Main), 7,000 m (Reuse Line) • Manhole: 344 nos. • Interception structure: 17 nos. (new), 9 nos. (Revamping) • House connection: 9,804 nos. 2) Pumping Station • Proposed: 3 (IPS), 1 (MPS) • Rehabilitation: 2 (IPS), 2 (MPS) 3) STP <u>Mirzapur STP</u> • Capacity: 32 MLD • Sewage treatment: USAB + SBR (14 MLD), SBR (18 MLD) • Sludge treatment: Thickening by gravity, Mechanical dewatering <u>Vindhyachal STP</u> • Capacity: 6 MLD • Sewage treatment: SBR • Sludge treatment: Thickening by gravity, Sludge drying bed	1) Sewer: • Dia.: 350 to 1,200 mm • Length: 8,335 m (Open) , 25 m (Rising Main) • Manhole: 284 nos. • Interception structure: 17 nos. (new) • House connection: 9,804 nos. 2) Pumping Station: N/A 3) STP <u>Ghazipur STP</u> • Capacity: 18 MLD • Sewage treatment: SBR • Sludge treatment: Thickening by gravity, Mechanical dewatering	1) Sewer: • Dia.: 350 to 900 mm • Length: 3,080 m (Open) • Manhole: 10 nos. • Interception structure: 4 nos. (new) • House connection: None. 2) Pumping Station • Proposed: 1 (IPS) 3) STP <u>Ramnagar STP</u> • Capacity: 14 MLD • Sewage treatment: Single stage CND (Circulated Nitrification / Denitrification) method • Sludge treatment: Thickening by gravity, Mechanical dewatering	1) Sewer: • Dia.: 350 to 700 mm • Length: 4,308 m (Open) 2,160 m (Rising Main), 3,695 m (Reuse Line) • Manhole: 149 nos. • Interception structure: 22 nos. (new) • House connection: None. 2) Pumping Station • Proposed: 1(IPS), 1 (MPS) 3) STP <u>Chunar STP</u> • Capacity: 6.5 MLD • Sewage treatment: SBR method • Sludge treatment: Thickening by gravity, Mechanical dewatering

Notes;
HAM (Hybrid Annuity Model)-PPP scheme will be applied for Ramna STP in Varanasi, Mirzapur, Ghazipur and Chunar cities.
Source: JICA Survey Team



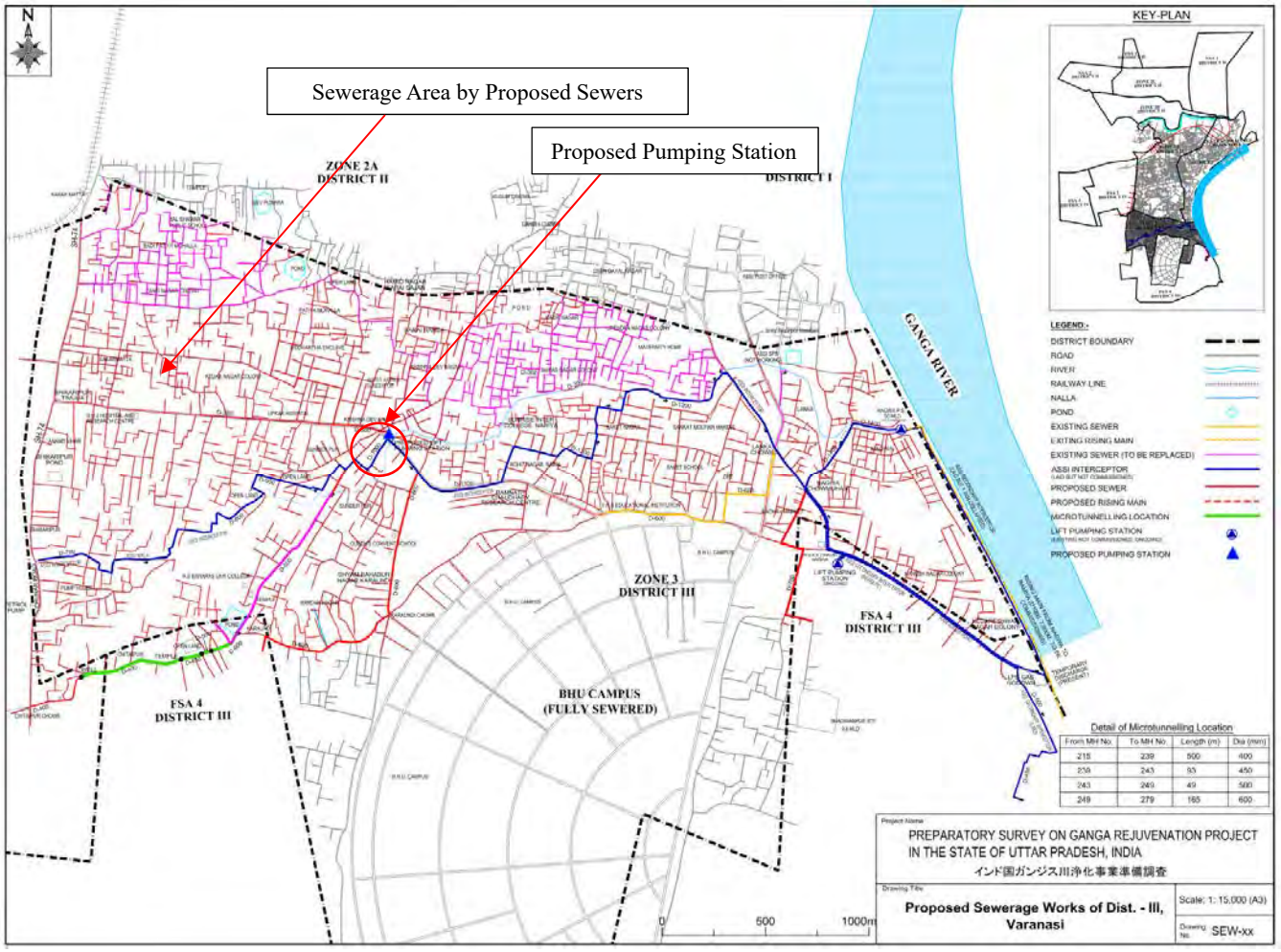
Source: JICA Survey Team

Figure 11.1.2 Location Map of Proposed Project in District I, Varanasi City



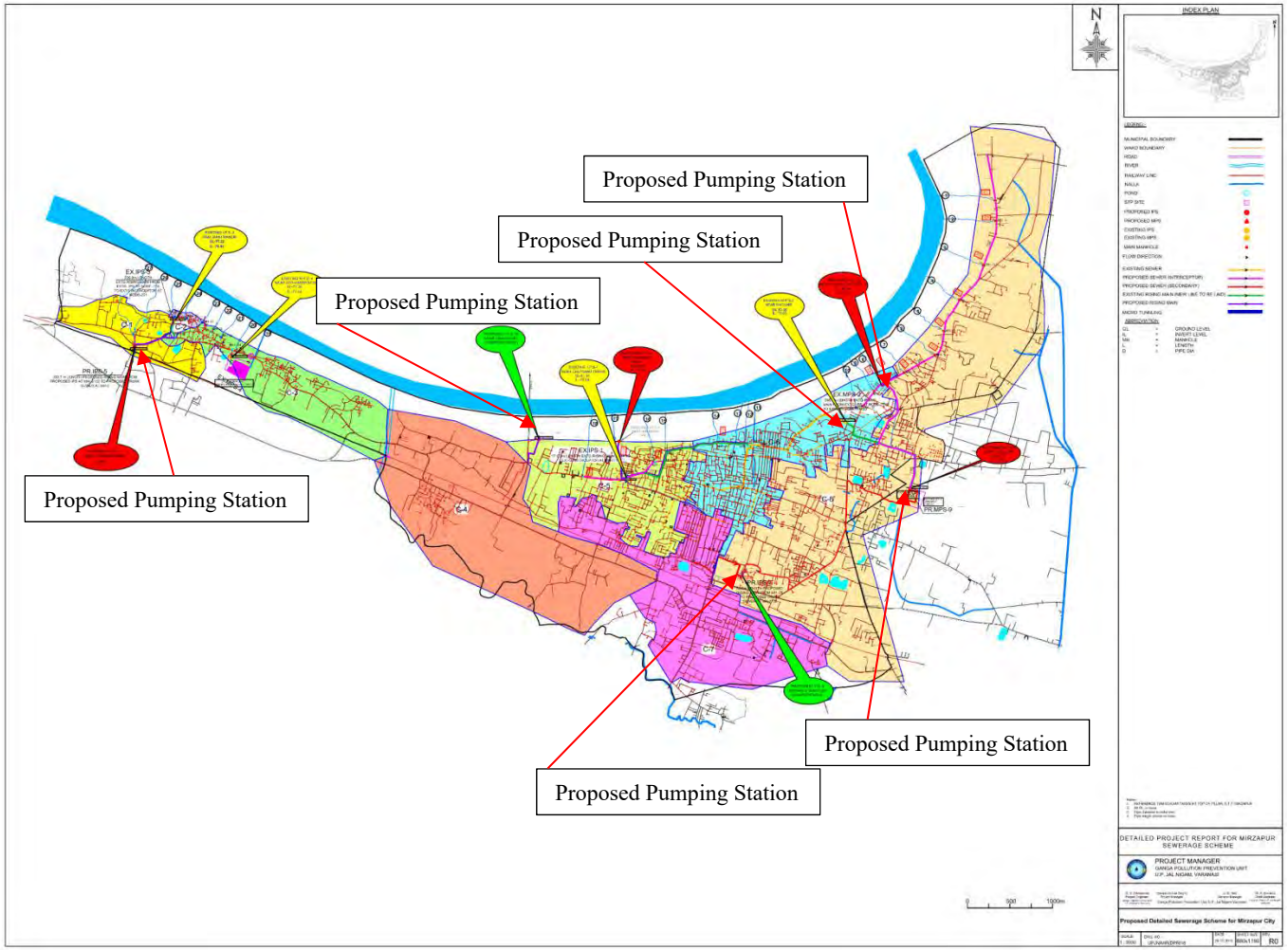
Source: JICA Survey Team

Figure 11.1.3 Location Map of Proposed Project in District II, Varanasi City



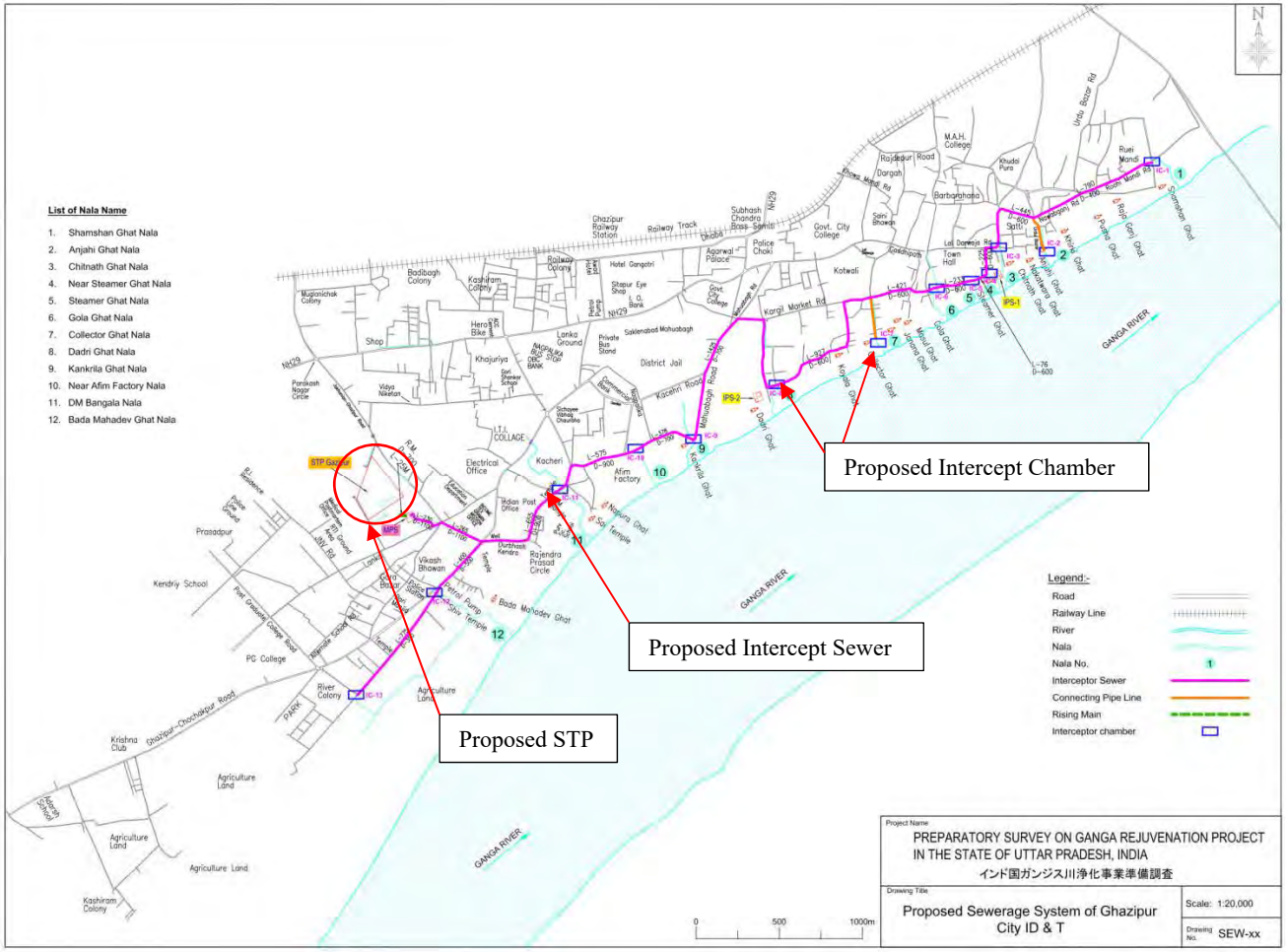
Source: JICA Survey Team

Figure 11.1.4 Location Map of Proposed Project in District III, Varanasi City



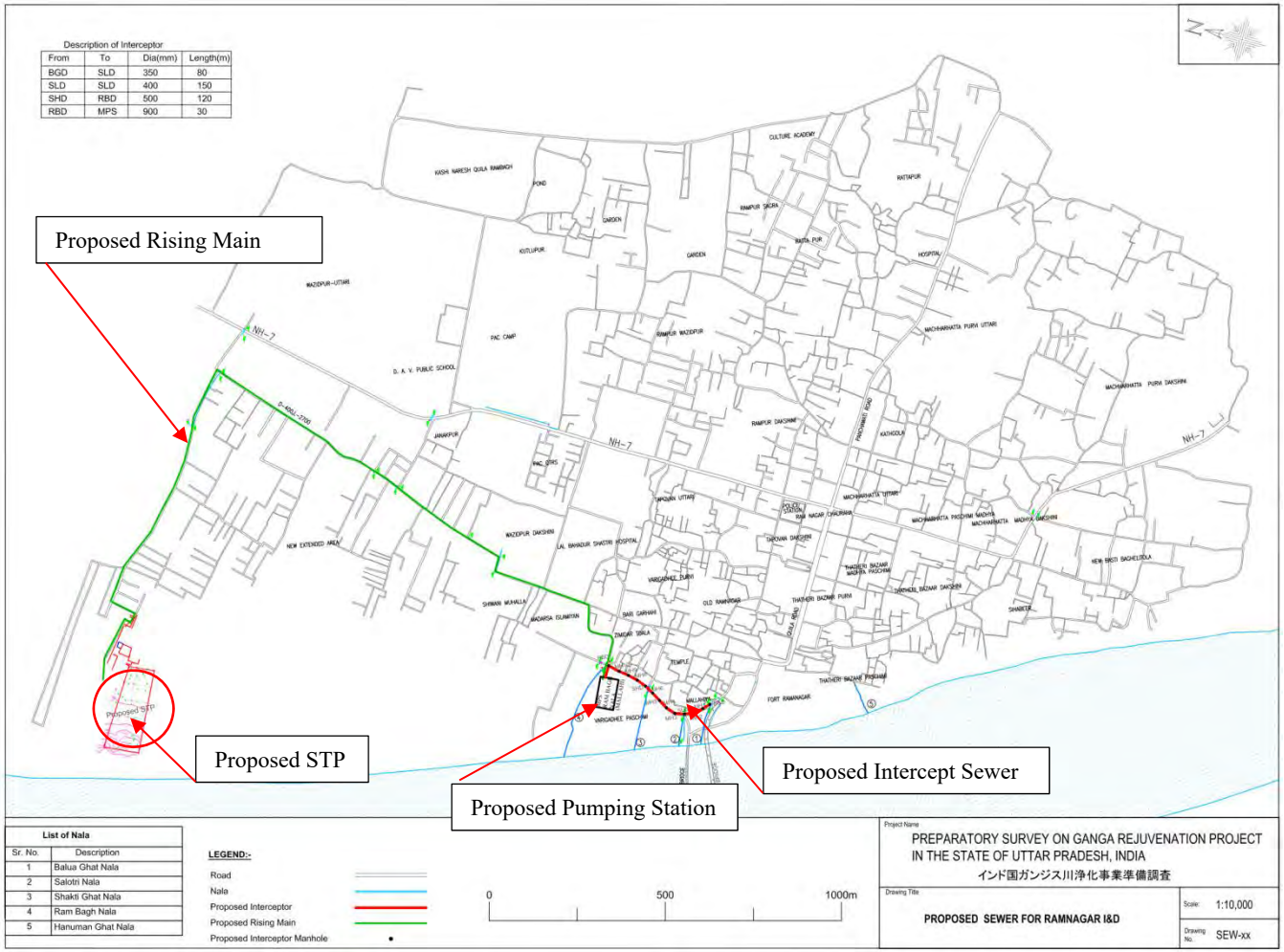
Source: JICA Survey Team

Figure 11.1.5 Location Map of Proposed Project in Mirzapur City



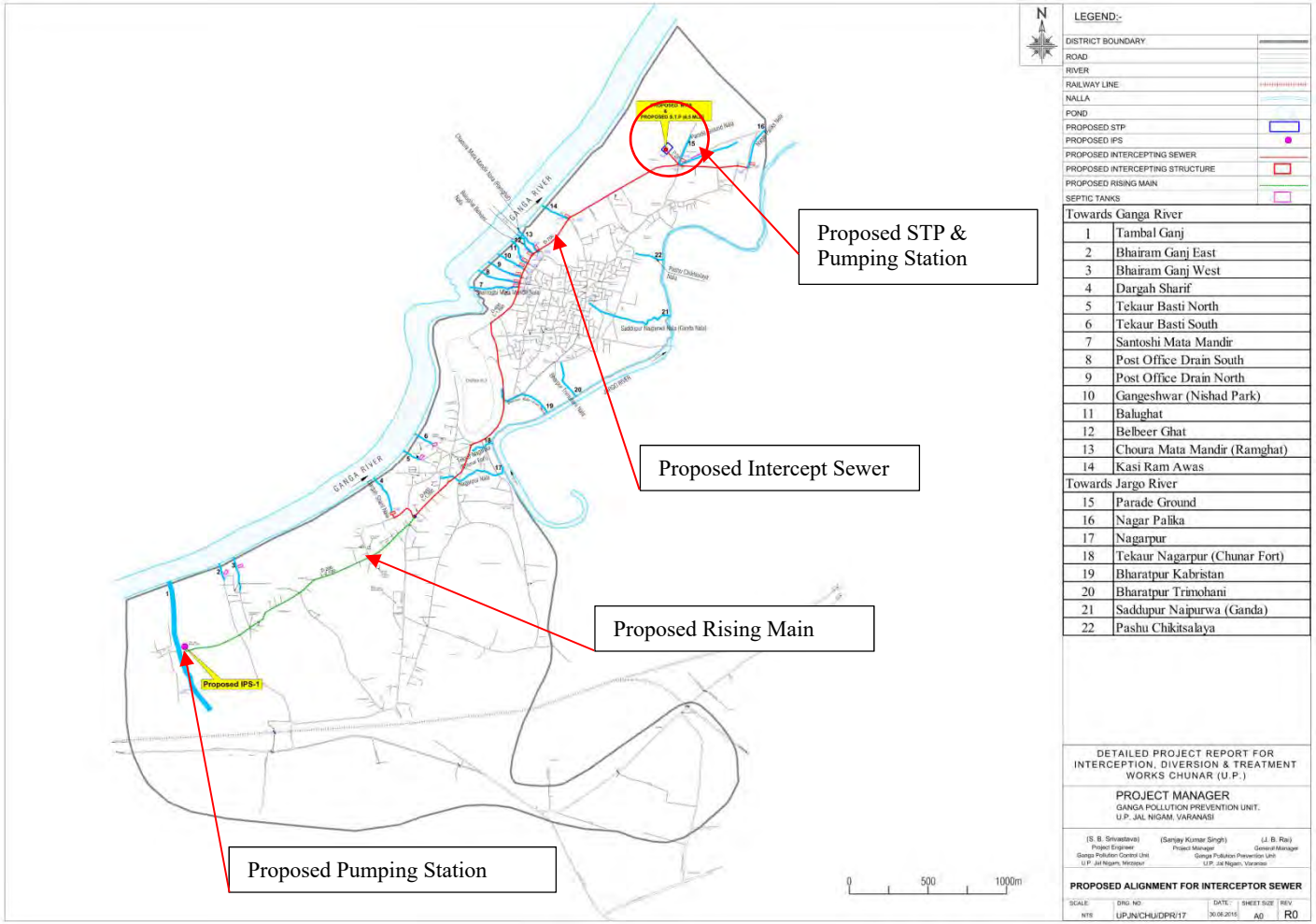
Source: JICA Survey Team

Figure 11.1.6 Location Map of Proposed Project in Ghazipur City



Source: JICA Survey Team

Figure 11.1.7 Location Map of Proposed Project in Ramnagar City



Source: JICA Survey Team

Figure 11.1.8 Location Map of Proposed Project in Chunar City

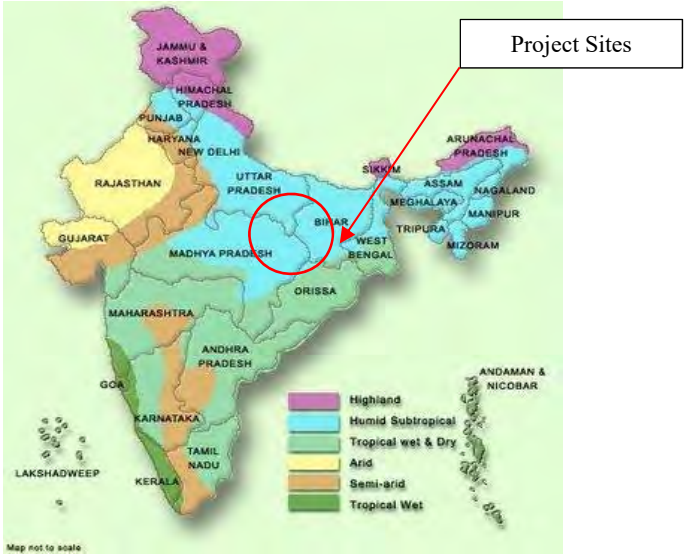
11.2 Environmental and Social Baseline of Project Sites

This section comprises the descriptions of the environmental and social baseline of the project sites and surrounding area. The physical, biological and socio-economic environments are considered in the discussions. Most of information is addressed to Varanasi since the place is famous and more documents are available.

11.2.1 Natural Environment

(1) Meteorology / Climatology

The climate status of the UP state is subtropical and congenial for agriculture. In winter the average minimum temperature ranges from 25 °C in northern part of the plains to 15 °C in eastern part of the state. The maximum temperature during hot season varies from 32 °C in Northern part to 46°C in South Western part of the state. The annual relative humidity ranges from 60 to 70% in North Eastern Tarai region to 30 to 40% in South Western areas. The normal annual rainfall of the state is 947.4 mm and it ranges from 710 mm to 1,750 mm during for the past 40 years. As regards the precipitation trend in the South West and South Eastern part of the state, it ranges from 672 to 1,381 mm. The target five (5) cities belong to above sub-tropical climate as shown in Figure 11.2.1. Their temperature ranges 22°C in winter to 44°C in summer. Their annual average rainfall of the target cities is about 1,100 mm.



Source: "Impact of Climate Change of Indian Agriculture & Its Mitigation Priorities", Manas Ranjan Senapati et al., 2013

Figure 11.2.1 Climate Map of the Project Sites

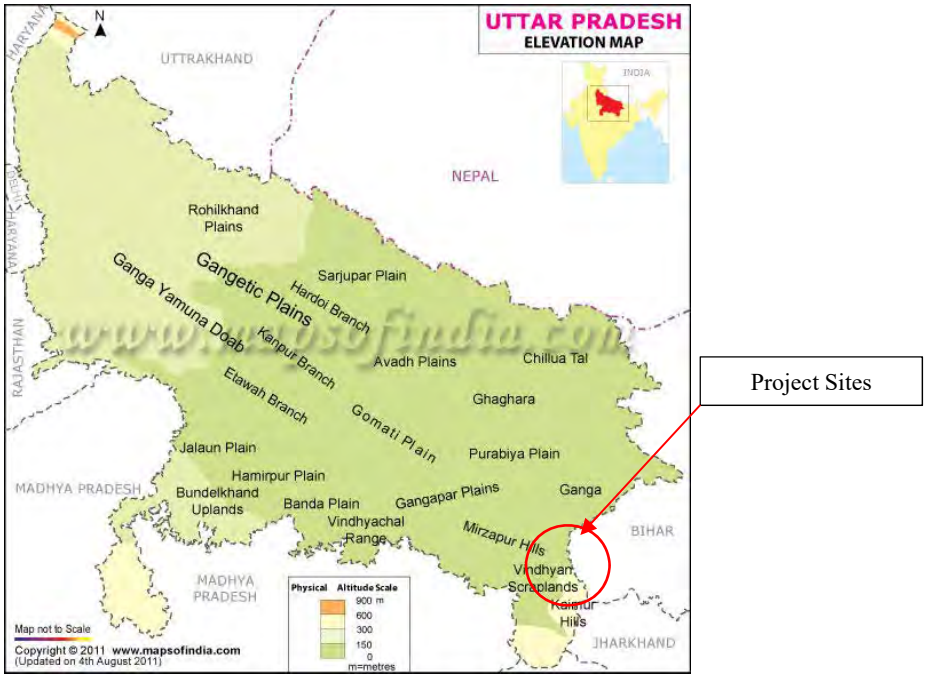
(2) Geographical / Topographical Situation

The geographical situation of the cities is shown in **Table 11.2.1**. The topographical map is shown in **Figure 11.2.2**. All the cities are situated in the South-East edge of the state of UP with their geographical locations of 82°30'E to 83° and 23°N to 25°N. All the cities belong to the Indo-Gangetic Plains of North India and face the river Ganga. The target cities are stretched along the river Ganga with their altitude of 85 m above sea level in Mirzapur to 65 m in Ghazipur city.

Table 11.2.1 Geographical Situation of Target Cities

	Varanasi	**Mirzapur**	**Ghazipur**	**Ramnagar**	**Chunar**
Area (km^2)	Over 1,535 km^2	20.88 km^2	N/A	N/A	8.31 km^2
Stretch	• 82° 56'E to 83° 03'E • 25° 14'N to 25° 23.5'N	• 82º 72' to 83ºE • 23º 52' to 23º 32'N	• 83° 4' and 83° 58' E • 25° 19' and 25° 54'N	• 83° 1'50'' E • 25°16'22''N	82° 45' E and 35° N
Location	It is situated on the bank of river Ganga of State of UP. It is located between the confluences of river Ganga and Varuna and river Ganga and Assi rivulet.	It is surrounded by Varanasi and Sant Ravidas Nagar on the north, Allahabad on the west, and towards south east its boundaries are contiguous with district, Sonebhadra and the state of Madhya Pradesh.	Ghazipur district forms the eastern part of the Varanasi Division. It lies to the east and north of the Jaunpur and Varanasi district respectively. The River Ganges from one side and Karmnasa from other side divided it from Bihar State.	Ram Nagar is situated near the Ganga River on its eastern bank, opposite to the Tulsi Ghat.	It is situated at south of the river Ganga.

Source: JICA Survey Team

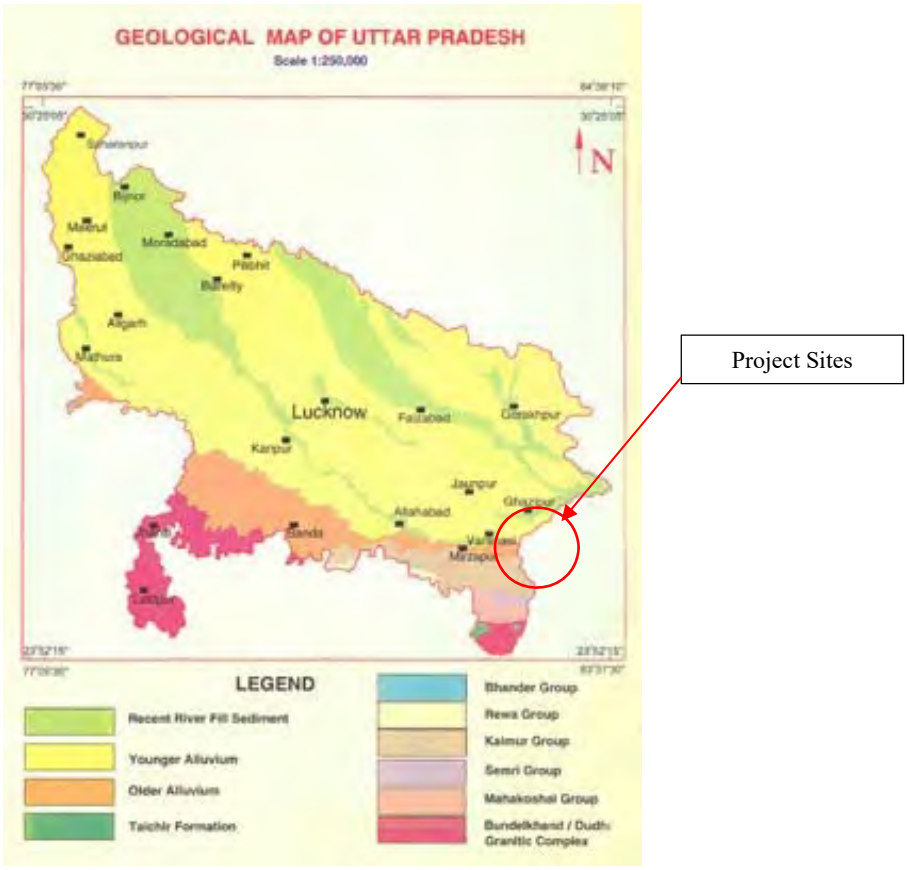


Source: www.mapof india.com

Figure 11.2.2 Topographic Map of the Project Sites

(3) Geology

The geological map of the project sites is shown in **Figure 11.2.3**.The Ganga plain which dominates the landscape and nearly covers three fourth of the geographical area of the State of UP, lies between the rocky Himalayan belt in the north and the southern hilly tract comprised of mainly Pre-Cambrian rocks. The Ganga plain is filled with recent alluvial sediments which are at places more than 1,000 m. thick and an amalgam of sand, silt, clay in varying proportions. As shown in **Figure 11.2.3**, Varanasi and Ramnagar Districts falls under the Younger Alluvium classification and same with Ghazipur District which also covers Saidpur. For Mirzapur District which includes Chunar, two (2) classifications covered, namely: Mahakoshal Group and Kaimur Group. Younger Alluvium - Younger alluvium (Qal) is underlying geologic unit. This is an unconsolidated, poor to well graded mass consisting of sand, gravel, and cobbles. Surface soils are well drained, with moderately rapid permeability, slow runoff, and slight erosion hazard.



Source: Department of Mines and Geology, State of UP

Figure 11.2.3 Geological Map of Project Sites

(4) Land Use

Table 11.2.2 shows the land use classification of each district covered by the project areas. Varanasi and Ghazipur district is the most developed area among all districts because of their highest percentage of net sown land.

Table 11.2.2 Land Use Classification of the Project Area

Type	Varanasi District (incl. Varanasi & Ramnagar)		Mirzapur District (incl. Mirzapur & Chunar)		Ghazipur District (incl. Ghazipur)	
	Area in Hectare	Percentage	Area in Hectare	Percentage	Area in Hectare	Percentage
Forest	0	0.0	109,236	25.9	121	0.0
Cultivable Wasteland	2,153	1.4	13,693	3.2	3,557	1.1
Fallow Land	22,182	14.8	10,197	2.4	15,558	4.7
Non-Cultivable Land	2,247	1.5	9,166	2.2	3,007	0.9
Other Land Excluding Agriculture	26,097	17.4	49,589	11.8	48,797	14.8

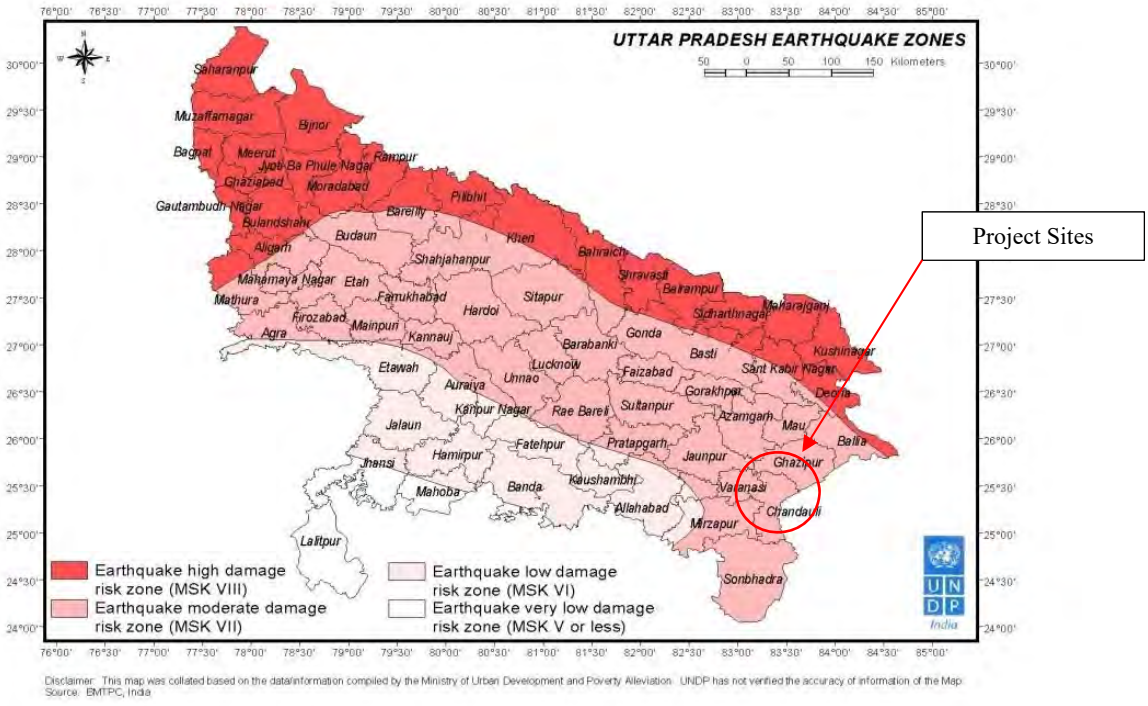
Type	Varanasi District (incl. Varanasi & Ramnagar)		Mirzapur District (incl. Mirzapur & Chunar)		Ghazipur District (incl. Ghazipur)	
Pasture Land	23	0.0	514	0.1	806	0.2
Groves and Gardens	2,961	2.0	29,093	6.9	3,405	1.0
Net Sown Land	94,605	63.0	200,190	47.5	254,512	77.2
Total	150,268	100	421,678	100	329,763	100

Source: Land Use Pattern in Eastern Uttar Pradesh, 2010

(5) Natural Disaster

Natural disasters that are of significance in Uttar Pradesh are: floods, droughts, fires and earthquakes as characterized as below. UP is also vulnerable from the aspect of manmade hazards such as stampede, chemical, radiological and other hazards.

- Eastern part of the state is historically flood prone but since last few years western UP region has also experienced massive flood disaster.
- Drought is another major natural hazard affecting UP state. The recurrence of highly deficient rainfall in East U.P. occurs approximately every 6 to 8 years whereas in West U.P. it is 10 years.
- Moderate damage risk of earthquake: The type of earthquake that covers all project sites belong to Moderate Damage Risk Zone of MSK VII (MSK: Medevedev – Sponheuer – Karnik. MSK VI (or less), VII and VIII (or above) corresponds to Zones 2, 3, 4 and 5 of MCE (Maximum Considered Earthquake)) as shown in **Figure 11.2.4** for the Disaster Earthquake Zone Map.



Source: Status of Environment and Related Issues (ENVIS Centre: Govt. of Uttar Pradesh)

Figure 11.2.4 Earthquake Zone Map

(6) Hydrology

Rainfall, subsurface flows and snow melt from glaciers are the main sources of water in river Ganga. Surface water resources of Ganga have been assessed at 525 billion cubic meters (BCM). Out of its 17 main tributaries Yamuna, Sone, Ghagra and Kosi contribute over half of the annual water yield of the Ganga. These tributaries meet the Ganga at Allahabad and further downstream.

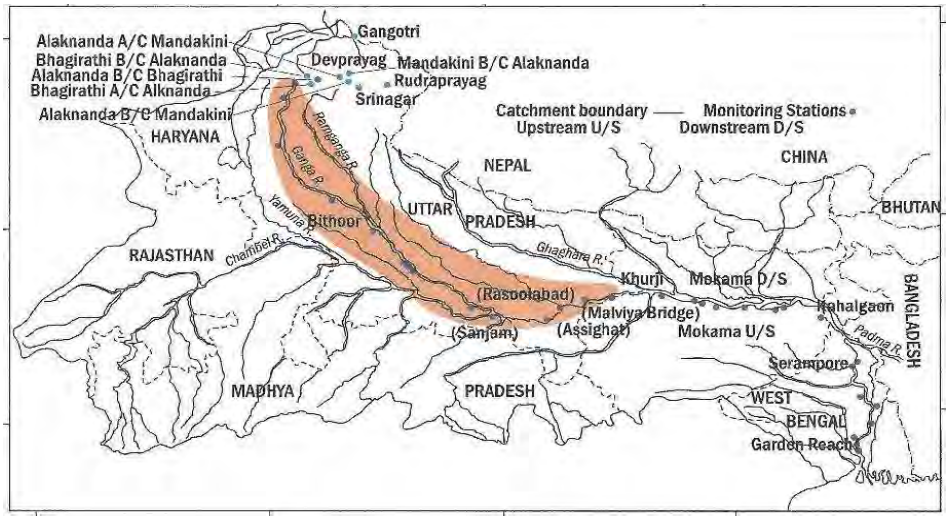
The river has a problem of low flows between the Haridwar - Allahabad stretch. December to May is the months of low flow in the Ganga. On an average, each square km of the Ganga basin receives a million cubic meters (MCM) of water as rainfall. 30% of this is lost as evaporation, 20% seeps to the subsurface and the remaining 50% is available as surface runoff. The deep channel of the river bounded by high banks facilitates the passage of ground water as base flow. Annual flooding is the characteristic of all rivers in the Ganga basin. The Ganga rises during the monsoon but the high banks restrict the flood water from spreading. The flood plain is usually 0.5 to 2 km wide. This active flood plain is flooded every year.

The project sites of the target five (5) cities are located at the middle reach of the Gange river.

11.2.2 Pollution

(1) Surface Water Quality

The Uttar Pradesh Pollution Control Board (UPPCB) is an organization authorized by the Government of India to conduct monitoring of the river water quality within the State. There are total of fifty-three (53) monitoring stations in the State of UP and eight (8) monitoring points are within and near the project sites. **Figure 11.2.5** shows the location of the monitoring stations in the State.



Source: UPPCB

Figure 11.2.5 Location Map of Monitoring Stations in River Ganga in Uttar Pradesh

Table 11.2.3 shows the tabulated results of the river water analysis from October to December 2015 for the eight (8) monitoring stations at the vicinity area of the project sites. The descriptions of the sampling points are the following. Among the monitoring stations, the worst water quality was measured at Station 7. All parameters did not meet the national standards. The results show that River Ganga is really polluted that needs immediate action to rejuvenate.

Table 11.2.3 River Water Quality Analysis Results (October to December 2015)

Date/Parameter	Sampling Stations								Standard
	Sta. 1	Sta. 2	Sta. 3	Sta. 4	Sta. 5	Sta. 6	Sta. 7	Sta. 8	
October 2015									
DO, mg/L	7.60	8.10	8.70	7.80	8.00	8.20	3.50	8.20	5
BOD, mg/L	2.30	2.50	2.80	5.00	3.80	2.60	26.40	3.30	3
Total Coliform, MPN/100ml	2,100	2,500	2,700	43,000	34,000	11,000	240,000	14,000	500
November 2015									
DO, mg/L	7.90	8.20	8.80	7.60	8.00	8.50	3.20	8.40	5
BOD, mg/L	2.20	2.40	3.00	5.20	4.00	2.80	27.60	3.20	3
Total Coliform, MPN/100ml	32,000	2,000	3,100	49,000	34,000	8,000	240,000	17,000	500
December 2015									
DO, mg/L	8.00	8.30	8.60	7.50	7.80	8.60	3.00	8.50	5
BOD, mg/L	2.30	2.50	2.50	5.30	4.30	3.00	25.60	3.30	3
Total Coliform, MPN/100ml	2,500	2,100	2,100	49,000	34,000	8,000	220,000	17,000	500
Average									
DO, mg/L	7.83	8.20	8.70	7.63	7.93	8.43	3.23	8.37	5
BOD, mg/L	2.27	2.47	2.77	5.17	4.03	2.8	26.53	3.27	3
Total Coliform, MPN/100ml	12,200	2,200	2,633	47,000	34,000	9,000	233,333	16,000	500

Notes ;

1) Monitoring stations

- Sta. 1: Upstream point of River Ganga in Vindhayachal, Mirzapur;
- Sta. 2: Downstream point of River Ganga in Mirzapur;
- Sta. 3: Upstream point of River Ganga in Varanasi;
- Sta. 4: Downstream point of River Ganga in Varanasi;
- Sta. 5: Downstream point of River Ganga in Tarighat, Varanasi;
- Sta. 6: At River Varuna in Rameshwar, Varanasi;
- Sta. 7: At River Varuna contact before River Ganga; and
- Sta. 8: At Gomati River contact before River Gomati in Rajwari, Varanasi

2) Indian Standard for Class B Surface Water: DO – 5 mg/L or more; BOD – 3 mg/L or less, Total Coliform – 500 MPN/100 ml or less

Source: http://www.uppcb.com/river_quality.htm

(2) Groundwater Quality

A study was done in 2010 by RWTH Aachen University. They surveyed tube wells from Ghazipur, Varanasi and Mirzapur districts of Uttar Pradesh. The survey results show that 60% of the samples were beyond ≥ 10 µg/L and 20% had ≥ 50 µg/L regarding Arsenic contamination. Arsenic was detected from the tube wells with the depths ranging from 25 to 45 m. The contaminated wells are mainly located in Holocene Newer Alluvium which is characterized by grey to black coloured organic-rich argillaceous sediments. They concluded that the arsenic in groundwater of this area was released from the associated sediments which were mainly deposited from the Himalayan hill ranges and very little inputs from peninsular India. (Source: www.waterandmegacities.org)

Other information regarding the groundwater quality in the project areas are:

- Varanasi District has fallen into water shortage. The district takes a total of 270 million liters water from the river Ganga and tube wells. Yet the citizens lack drinking water. The groundwater is polluted due to nitrate and faecal coliform. There is no proper management of groundwater recharging in the area.
- In Mirzapur district, tube wells in Mirzapur and Chunar towns have low concentrations of Arsenic (As) in groundwater (As <10 µg/l) because of their locations on the Pleistocene Older Alluvium upland surfaces. Most of the contaminated villages in Mirzapur district are located close to abandoned or present meander channels and floodplains of the Ganga River.
- The groundwater in Ghazipur district is not suitable for its potability because most of the parameters were beyond the acceptable limits as prescribed by WHO (2004) and ICMR. The parameters exceeding the limits are total dissolve solid, total hardness, chloride, calcium, electrical conductivity, total alkalinity and phosphate. However, the parameters were not too high to pose any serious health hazard.

(3) Water Quality at STPs, Canal, Ghat and Varuna River

On December 8-10, 2015, the JICA Study Team conducted water samples from the existing Dinapur and Bhagwanpur Sewage Treatment Plants (STPs) in Varanasi district. This is to determine the current water quality from the source passing through the canal to the riverside down to the main river. The location of the sampling points is shown in **Figure 11.2.6** (For details, refer to **Chapter 6**).

There were 25 sampling points taken the water samples in Varanasi city. The parameters considered in the analyses are temperature, pH, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD_5), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Free Ammonia (NH_3), Ammonia Nitrogen (NH_4-N), Total Kjeldahl Nitrogen (TKN), Nitrate (NO_3^-), Total Phosphorus (T-P) and Faecal Coliform. Samples were analyzed by SAI International.

Source: JICA Survey Team

Figure 11.2.6 Location of Water Sampling Stations

Among the parameters, faecal coliform had extreme value in all sampling points except for the upstream and downstream location of Bhagwanpur STP. Half numbers of the total samples have high NH_4-N, and few samples exceeded BOD and TSS values. Only sample taken from the shorefront of Dinapur STP is beyond the pH limit. The rest of the samples are within the national standard limit. For the purpose of the design and monitoring during construction and

operation, a new guideline on effluent standards for STPs (New Effluent Water Quality Standard by CPHCCO, 2017) is being implemented. The tabulated results for Varanasi city are shown in **Table 11.2.4**. For the results for Ram nagar, Mirzapur, Saidpur and Ghazipur cities, refer to Chapter 6.

Table 11.2.4 Water Quality Results of Samples of STPs, Canal, Ghat and River

Location	Parameters												
	Temp., °C	pH	DO, mg/L	BOD_5, mg/L	COD, mg/L	TSS, mg/L	TDS, mg/L	NH_3, mg/L	NH_4-N, mg/L	TKN, mg/L	NO_3, mg/L	T-P, mg/L	Faecal Coliform
V-1	23.1	8.4	5.2	11.0	29.2	8.0	512	1.84	*13.0*	15.6	20.7	1.96	*22,000*
V-2	21.8	*9.5*	4.3	17.0	44.0	16.0	436	<1.0	*7.81*	11.3	5.56	1.48	*25,000*
V-3	24.2	8.2	0.8	*72.0*	174	*102*	428	2.38	*23.4*	46.0	0.81	2.28	*26,000*
V-4	24.9	8.1	4.8	13.0	34.0	<5.0	522	2.14	*18.2*	22.6	8.49	1.86	*22,000*
V-5	21.9	8.3	7.0	<2.0	<4.0	6.0	202	<1.0	<1.0	3.47	4.85	<0.1	*8,000*
V-6	22.1	8.2	6.3	<2.0	<4.0	10.0	216	<1.0	<1.0	3.47	6.65	0.11	*6,000*
V-7	24.7	7.6	1.0	*62.0*	143	*66.0*	410	2.46	*21.7*	31.2	1.90	3.00	*46,000*
V-8	23.9	7.9	5.4	8.2	23.5	<5.0	318	<1.0	*9.54*	13.0	10.7	1.82	*39,000*
V-9	22.3	7.5	1.5	*42.0*	102	60.0	548	6.28	*27.8*	38.2	1.85	3.92	*27,000*
V-10	23.0	8.0	0.8	*83.0*	196	*126*	534	5.26	*26.9*	36.5	1.38	3.26	*41,000*
V-11	20.8	7.8	4.2	8.4	32.8	28.0	550	2.18	*17.4*	21.7	1.44	1.80	*33,000*
V-12	23.4	8.1	4.7	6.8	24.0	26.0	556	2.47	*19.9*	24.3	1.38	1.83	*27,000*
V-13	23.3	7.6	3.4	*28.0*	76.8	*56.0*	368	3.24	*15.6*	19.9	<0.5	2.03	*36,000*
V-14	21.6	8.3	6.3	<2.0	<4.0	10.0	216	<1.0	<1.0	2.60	3.12	<0.1	*11,000*
V-15	21.7	8.2	6.5	<2.0	<4.0	6.0	236	<1.0	<1.0	3.47	6.88	0.13	*8,000*
V-16	22.1	7.9	5.6	2.4	12.8	10.0	264	<1.0	3.47	6.07	<0.5	0.50	*14,000*
V-17	21.7	8.2	6.1	<2.0	<4.0	12.0	206	<1.0	<1.0	2.60	2.71	<0.1	*9,000*
V-18	21.9	8.1	6.2	<2.0	<4.0	10.0	244	<1.0	<1.0	3.47	5.43	0.21	*13,000*
V-19	21.7	8.3	7.1	<2.0	<4.0	6.0	228	<1.0	<1.0	3.98	4.50	<0.1	*12,000*
V-20	21.8	8.3	6.9	<2.0	<4.0	8.0	218	<1.0	<1.0	3.47	4.39	<0.1	*10,000*
V-21	23.1	7.9	5.3	7.4	36.8	*32.0*	548	2.64	*20.8*	21.7	0.69	1.76	*14,000*
V-22	21.7	8.4	6.8	<2.0	7.2	<5.0	216	<1.0	1.73	4.37	2.65	<0.1	*11,000*
V-23	21.6	8.3	6.5	<2.0	8.0	<5.0	206	<1.0	<1.0	2.60	3.52	<0.1	*13,000*
V-24	22.3	7.9	5.9	4.3	20.0	6.0	346	<1.0	*8.68*	11.3	0.75	1.32	*17,000*
V-25	21.5	8.34	7.0	<2.0	5.6	8.0	196	<1.0	1.73	4.34	3.12	0.68	*12,000*
Effluent Discharge Standards													
NGRBA Guidelines (2010)	-	5.5 – 9.0	-	20	-	30	-	-	-	-	-	-	D – 1,000 P -10,000
Sewage Manual (2013)	-	-	-	<10	-	<10	-	<10	-	-	-	<2	<230
New Guideline (plan	-	6.5 – 9.0	-	≤10	≤50	≤20	-	≤10	≤5	-	-	-	<100

Note:

1) Values in italic were exceeded the allowable limits.

2) Location of sampling:

V-1: Upstream of Dinapur STP
V-2: Shorefront of Dinapur STP
V-3: Raw Sewage from Dinapur STP
V-4: Treated Sewage from Dinapur STP
V-5: Upstream of Bhagwanpur STP
V-6: Downstream of Bhagwanpur STP
V-7: Raw Sewage from Bhagwanpur STP

V-8: Treated Sewage from Bhagwanpur STP
V-9: : Upstream of Assi Nala
V-10: Mount of Assi Nala
V-11: Upstream of Varuna River
V-12: Mouth of Varuna River
V-13: Mouth of Assi Nala (Shorefront)
V-14: Upstream of the Mouth of Assi Nala (Centre)
V-15: Upstream of the Mouth of Assi Nala (Shorefront)
V-16: Downstream of the Mouth of Assi Nala (Shorefront)
V-17: Downstream of the Mouth of Assi Nala (Centre)
V-18: Intake Tower (Shorefront)
V-19: Assi Ghat (Shorefront)
V-20: Assi Ghat (Centre)
V-21: Mouth Varuna River (Shorefront)
V-22: Upstream of the Mouth of Varuna River (Shorefront)
V-23: Upstream of the Mouth of Varuna River (Centre)
V-24: Downstream of the Mouth of Varuna River (Shorefront)
V-25: Downstream of the Mouth of Varuna River (Centre)

Source: JICA Survey Team

(4) Air and Noise Quality

Air Quality

The ambient air quality used was acquired from the monitoring data results conducted by UPPCB. Monthly monitoring is being conducted and the nearest sampling points were taken in Varanasi city. **Table 11.2.5** shows the laboratory results of the air quality. Based on the table, SO_2 and NO_2 were within the limits set by the Indian government while PM-10 was beyond the standard. This is potentially caused by too much matters which are dusts circulating within the area.

Table 11.2.5 Air Quality Analysis Results (October to December 2015)

Date/Parameter	Sampling Stations in Varanasi		Standard
	Residential (Jawahar Nagar)	Commercial (Sigra)	
October 2015			
PM-10, µg/m^3	146.9	147.3	100
SO_2, µg/m^3	19.5	19.3	80
NO_2, µg/m^3	33.5	34.1	80
November 2015			
PM-10, µg/m^3	143.7	148.6	100
SO_2, µg/m^3	19.0	19.7	80
NO_2, µg/m^3	33.0	33.7	80
December 2015			
PM-10, µg/m^3	147.7	153.3	100
SO_2, µg/m^3	19.9	20.5	80
NO_2, µg/m^3	34.9	34.1	80
Average			
PM-10, µg/m^3	**146.1**	**149.7**	100
SO_2, µg/m^3	19.5	19.8	80
NO_2, µg/m^3	33.8	34.0	80

Indian Standard for Residential and Commercial: PM-10 – 100 µg/m^3; NO_2 – 80 µg/m^3; SO_2 – 80 µg/m^3
Source: http://www.uppcb.com/air_quality.htm

Ambient Noise

A study was carried out in 2005 by CPCB to acquire the noise levels in different parts of Varanasi city. Noise pollution affects the millions of people in all parts of the world, especially those who live in large cities, due to heavy vehicular traffic. The study had been performed in Varanasi city to assess the noise levels at selected locations with heavy traffic. The data were compared with standards and recommendations made to overcome the noise pollution in urban areas. Noise levels have been estimated at six sites in Varanasi city, representing various zones like residential, commercial, silence and traffic crossings. Noise level at all the sites of these zones during day hours has been observed to be far exceeded than the prescribed limit. Main source of noise was vehicular traffic. The survey also revealed that the afternoon hours are the noisiest. The noise level ranged from 46.3 (dBA) to 88.5 (dBA). Lahartara crossing (at G.T. Road) was highly noisy (Leq about 76 dBA).The noise pollution parameter (LnP) values ranged in between 76.37(dBA) to 99.44 (dBA). The TNI values were recorded in between 70.80 to I 13.20. The noise levels recorded at all the six sites far exceed the prescribed limits. (Source: www.envirobiotechjournals.com)

11.2.3 Biological Environment

(1) Flora

The flora of a region includes all the varieties of plants which grow there. The plains of Uttar Pradesh have been very rich in natural vegetation which has, however, diminished due to wide-ranging needs of the people. The project sites are public roads, vacant lands or facility areas of sewerage systems where some shrubs or scrubs are growing. The project sites are public roads, vacant lands or facility areas of sewerage systems where some shrubs or scrubs are growing where common species inhabits, and will not affect above important species.

(2) Fauna

For fauna, animal depends on forest not only of food but also for habitat. The diversity of fauna living in water and terrestrial environment in the air are found in the UP State. The Project may affect to local fauna during construction. Since their list is long, mention shall be made here only of important species mainly found in the State:

- Fish - Mahaser, Hilsa, Saul, Tengan, Parthan, Rasela, Vittal, Rohu, Mirgal,Kata, Labi,

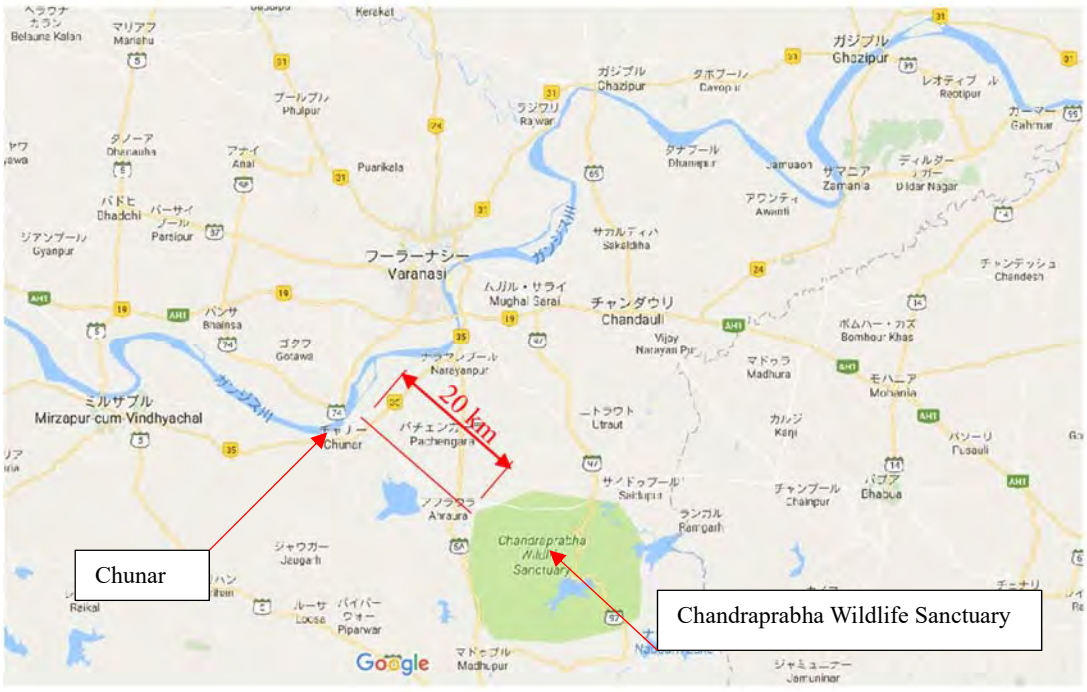
Mangur, Cuchia, Eel, Einghi, Mirror Carp, Trout;

- Amphibia - Frog and Toad;
- Reptiles - Bamania, Pit-viper, Lizard, Goh, Cobra, Tortoise, Krait, Dhaman and Crocodile;
- Aves - Cheel, Vulture, Peacock, Nightingale, Pigeon, Parrot, Owl, Nilkanth and Sparrow;
- Mammals - Shrew, Porcupine, Sqirrel, Hare, Mongoose, Cow, Buffalo and Mouse; and
- Other common species found here are Tiger, Panther, Snow Leopard, Sambhar, Cheetal, Kastura, Chinkara, Black Deer, Nilgai, Back-brown Bear, Mountain Goat, Hyena, Hill Dog, Elephant etc. Among the birds Fowl, Pheasant, Partridge, Florican, Duck, Goose and Wader are common.

The project sites are public roads, vacant lands or facility areas of sewerage systems where some shrubs or scrubs are growing where common species inhabits, and will not affect above important species.

(3) Protected Area

Chandraprabha Wildlife Sanctuary that is endowed with beautiful picnic spots, dense forests, and scenic waterfalls to its vicinity is located at about 20 km from the project site of Chunar as a closest distance as shown in **Figure 11.2.7**. It is assumed that the project may not influence anything to the Sanctuary since it is enough too far.



Source: JICA Survey Team

Figure 11.2.7 Location Map of Chandraprabha Wildlife Sanctuary

11.2.4 Socio-Economic Environment

(1) Socio-Economic Profile

Uttar Pradesh is the most populous state in the country accounting for 16.4 per cent of the country's population. It is also the fourth largest state in geographical area covering 9.0 per cent of the country's geographical area, encompassing 294,411 km^2 and comprising of 83 districts, 901 development blocks and 112,804 inhabited villages. The density of population in the state is 473 persons per square km^2 as against 274 for the country. The population, population growth from 2001 to 2011, employment rate and industries of the target cities is shown in **Table 11.2.6**.

Table 11.2.6 Socio-Economic Profile of Target Cities

	Varanasi	Mirzapur	Ghazipur	Ramnagar	Chunar
Population	3,676,841 (Male: 1,921,857, Female: 1,754,984)	2,496,970 (Male: 1,312,302, Female: 1,184,668)	3,620,268 (Male: 1,855,075, Female: 1,765,193)	49,132 (Male: 26,071, Female: 23,061)	37,185 (Male: 19,647, Female: 17,538)
Population growth (%)	17.15	18.00	19.18	N/A	N/A
Employment rate	29%	N/A	N/A	N/A	N/A
Industry	• Spinning • Weaving • Metal • printing and publishing • electrical machinery,	• Carpet manufacturing .	N/A	No major industries. Some micro & small enterprises	• Agriculture • Agri-based business.

Source: Census India 2011.

(2) Indigenous Groups

Regarding "Indigenous Groups" as per the world bank's OP 4.10, SCs (Scheduled Casts) and STs (Scheduled Tribes) are regarded as indigenous group by the Indian Government. In UP state, the tribes of Baiga, Agaria, Aheria, Baiga、Belder and Buksh have been recognized as STs by the Indian Government. Among them, only Agariya has been inhabited in Mirzapur of the target cities. However, the location of the inhabitant cannot be identified. The proposed sites are public roads and vacant lands, which will not include the tribe and may not affect these groups even if they are identified. In addition, the project sites are not mountainous area will not include "Forest Dweller".

11.2.5 Baseline Data which was not available

Some data was available only for UP state and Varanasi city. The data in other cities which was not available in the survey will be a pending issue.

11.3 Indian Legislative and Institutional Framework on Environmental and Social Considerations

11.3.1 Legal Framework of the Government of India

The Government of India has laid various policy guidelines, acts and regulations pertaining to the environment. The Environment (Protection) Act, 1986 is the umbrella legislation for the protection of environment. As per this Act, the responsibility to administer the legislation has been jointly entrusted to the Ministry of Environment and Forests (MoEF) and the Central Pollution Control Board (CPCB)/State Pollution Control Boards (SPCBs).

11.3.2 Key Environmental Laws and Regulations

The key environmental laws and regulations relevant to the projects are shown in **Table 11.3.1**. The complete lists are shown as well as the applicability in the projects.

Table 11.3.1 Environmental Regulations and Legislations

No.	Act/Rules	Purpose	Applicable (Yes/No)	Reason for Applicability	Authority
1	The Environment Protection Act, 1986	To protect and improve overall environment	Yes	As all environmental notifications, rules and schedules are issued under this act.	MoEF, CPCB, SPCB
2	Environmental Impact Assessment Notification, 14th Sep-2006	To provide environmental clearance to new development activities following environmental impact assessment	No	This notification is applicable only to the identified 29 projects that need an EC posted at UPPCB website	MoEF
3	Municipal Wastes (Management and Handling) Rules, 2000	To manage the collection, transportation, segregation, treatment and disposal of municipal solid wastes	No	This notification is applicable to municipal solid waste treatment facility projects	MoEF, CPCB, SPCB
4	Notification for Use of Fly Ash	Reuse large quantity of fly ash discharged from thermal power plant to minimize land use for disposal	No	If thermal plant is within 100 km from any sewerage treatment facility projects	
5	National Environment Appellate Authority Act (NEAA) 1997	Address grievances regarding the process of environmental clearance	No	If EC is issued but for NOC, not applicable	NEAA (National Environment Appellate Authority)
6	The RFCT in LARR (Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act), 2013	Set out for acquisition of land by government	Yes	This act will be applicable to as there will be acquisition of land for the projects.	Revenue Department State Government
7	The Forest (Conservation) Act 1980	To check deforestation by restricting	No	This act is applicable if there is diversion of	Forest Department, State

No.	Act/Rules	Purpose	Applicable (Yes/No)	Reason for Applicability	Authority
		conversion of forested areas into non-forested areas		forest land for non-forest activities for any of the projects	Government and MoEF
8	MoEF circular (1998) on linear plantation on roadside, canals and railway lines modifying	Protection/planting roadside strip as avenue/strip plantation	Yes	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	Forest Department, State Government and MoEF
9	Wild Life Protection Act 1972	To protect wildlife through certain of National Parks and Sanctuaries	No	This act is will be applicable, if there are any points of wildlife crossings in proximity to project locations	Chief Conservator Wildlife, Wildlife Wings, State Forest Department and MoEF
10	Air (Prevention and Control of Pollution) Act, 1981	To control air pollution from transport and controlling emission of air pollutants as per prescribed standards	Yes	This act will be applicable during construction for obtaining NOC for establishment of workers' camp, construction camp, etc.	SPCB
11	Water Prevention and Control of Pollution Act, 1974	To control water pollution by controlling discharge of pollutants as per prescribed standards	Yes	This act will be applicable during construction for obtaining NOC for establishment of workers' camp, construction camp, etc.	SPCB
12	The Noise Pollution (Regulation Control) Rules, 2000	The standards for noise for day and night have been promulgated by MoEF for various land uses	Yes	This act will be applicable for all construction equipment deployed at the worksite	SPCB
13	Ancient Monuments and Archaeological Sites and Remains Act, 1958	Conservation of cultural and historical remains found in India	No	This act will be applicable only if any of the projects is in proximity to any ancient monuments, declared protected under the act	Archaeological Dept. GoI, Indian Heritage and Indian National Trust for Art and Culture Heritage (INTACH)
14	Public Liability Act, 1984	Protection from hazardous materials and accidents	Yes	Contractor need to stock hazardous material like diesel, bitumen, emulsions, etc.	SPCB
15	Explosive Act, 1984	Safe transportation, storage and use of explosive material	Yes	For transporting and storing diesel, oil and lubricants, etc.	Chief Controller of Explosives
16	Central Motor Vehicle Act 1988 and Central Motor Vehicle Rules 1989	To check vehicular air and noise pollution	Yes	This rule will be applicable to vehicles deployed for construction activities and construction machinery.	Motor Vehicles Department

Source: JICA Survey Team

11.3.3 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 the 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

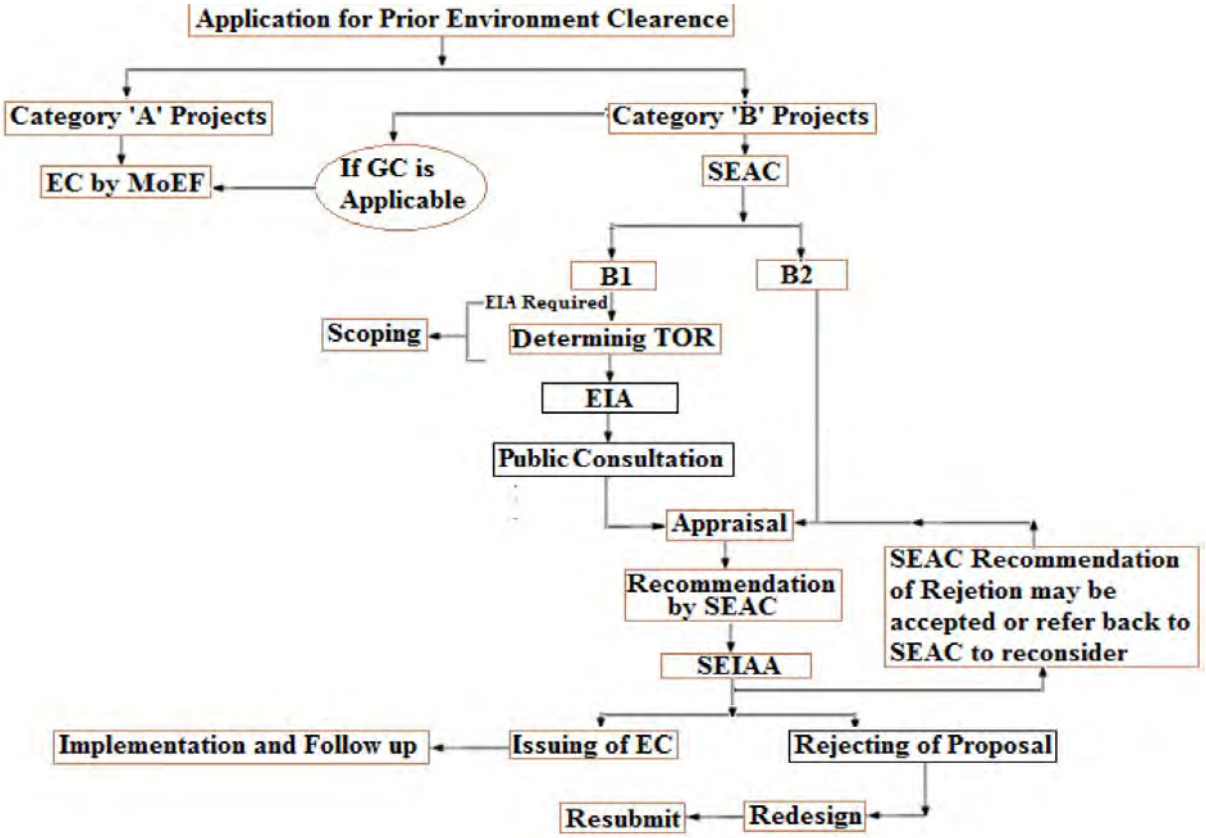
(2) Stage 1: Screening

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 the project requires further environmental studies for preparation of an Environmental Impact Assessment (EIA).

The 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 general process flow of the prior EC in India is shown in **Figure 11.3.1.**



Source: "Public Involvement in Environmental Impact Assessment: A Study of Sorang Hydroelectric Power Project in District Kinnaur, Himachal Pradesh, India", Lata R et.al, 2015

Figure 11.3.1 Prior Environmental Clearance Process Flow in India

(3) 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 based on Form 1and a conceptual plan.

(4) 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 considering 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.

(5) 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 based on the prescribed application Form 1 and Form1A as applicable. After the final EIA report is received by the EAC or SEAC, it takes 60 days to approve the report.

(6) EIA Requirement for Proposed Projects

According to EIA Notification 2006, water supply and sewerage projects is categorized as Category B2 and will not require conducting EIA (Environmental Impact Assessment) nor information disclosure.

(7) Comparison of India EIA System and JICA Guideline

The comparison on the requirements in between Indian EIA system which is mainly regulated in EIA Notification 2006 and JICA guideline (JICA Guideline for Environmental and Social Considerations 2010) is summarized in **Table 11.3.2**.

Table 11.3.2 Comparison between Indian EIA System and JICA Guideline

JICA Guideline	Indian EIA System as per EIA Notification 2006 or other Relevant Legislation / Regulation	Gap between JICA Guideline and India EIA System	Action to fill Gap by the Project
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. • 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	• 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. • For obtaining responses in writing from other concerned persons having a plausible stake in the	Yes.	Project proponent is recommended to disclose the results on ESCs various stakeholder as much as possible.

JICA Guideline	Indian EIA System as per EIA Notification 2006 or other Relevant Legislation / Regulation	Gap between JICA Guideline and India EIA System	Action to fill Gap by the Project
implementing cooperation projects as needed.	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	• 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 • For Category A projects, EC shall be obtained from the EAC (Expert Appraisal Committee) of the central MoEF (Ministry of	Yes. There is no Category for F1 in Indian EIA system.	Not applicable.

JICA Guideline	Indian EIA System as per EIA Notification 2006 or other Relevant Legislation / Regulation	Gap between JICA Guideline and India EIA System	Action to fill Gap by the Project
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	Environment and Forestry) • For Category B projects, EC shall be obtained from state level EAC, where B1 projects require EIA and B2 projects do not require EIA		
1. 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	At the screening based on Form 1, the current status and potential impacts on the following environmental and social aspects shall be examined in combination with EMMP (Environmental management and Monitoring Plan). • Land environment • Water environment • Vegetation • Fauna • Air environment • Aesthetics • Socio-economic aspects	Yes. There are no environmental and social elements for the following to be assessed in Indian EIA system. • 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 • local conflicts of interest • infectious	The project needs to encourage the project proponent to take the JICA requirement as much as possible.

JICA Guideline	Indian EIA System as per EIA Notification 2006 or other Relevant Legislation / Regulation	Gap between JICA Guideline and India EIA System	Action to fill Gap by the Project
groups such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety.		diseases such as HIV/AIDS,	
2. 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 undertake 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 lands • All building / construction projects/ area development projects and townships • All Category 'B2' projects and activities. • All projects or activities concerning national defence and security or involving other strategic considerations as determined by the Central Government.	Yes.	The project proponent needs to hold stakeholder meetings as much as possible.

JICA Guideline	Indian EIA System as per EIA Notification 2006 or other Relevant Legislation / Regulation	Gap between JICA Guideline and India EIA System	Action to fill Gap by the Project
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 lands 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..	No	

Source: JICA Survey Team

11.3.4 Relevant Clearance / Permissions other than Environmental Clearance

The major relevant clearances / permissions other than EC (Environmental Clearance) for implementation of the proposed projects and relevant information regarding the process details are shown in **Table 11.3.3**.

Table 11.3.3 Relevant Clearance / Permissions other than Environmental Clearance

No.	Action by Project	Authority for Granting Permission	Process to be Required
1	Crossing of Railways	Indian Railways	• Basis for legal or regulations: Guideline on Pipeline Crossing under Railway Track, 2009 • Responsible agency who shall grant a permission: Ministry of Railways • Approximate period from application to final permission for construction: 4 months • Required condition for permission: UPJN has to pay a charge depending the size of R/W to Indian Railways
2	Excavation of underground road area (highway, district roads, village roads, municipality roads)	PWD (Public Works Department)	• Basis for legal or regulations: The U.P. Roadside Land Control Rules, 1964 • Responsible Agency who shall grant the permissions: PWD • Approximate Period from Application to final approval: 1 to 2 month • UPJN has to prepare an application document and submit it to PWD
3	Discharge of treated wastewater	UPPCB	• Basis for legal or regulations: Guideline of MOEF / CPCB (Central Pollution Control Board) • Responsible Agency who shall grant the permissions: UPPCB (Uttar Pradesh State Pollution Control Board) • Approximate Period from Application to Final approval.: 1month • Concerned Executive Engineer of UPJN has to prepare an application document.
4	Permission for tree cutting	Forest Department (State Government of U.P.)	• Basis for legal or regulations: U.P. Transit Timber and Other Forest Produce Rules, 1978 • Responsible Agency who shall grant the permissions: Forest Department • Approximate Period from Application to Final approval: 2 months at maximum • Concerned department to prepare and apply document to each municipality
5	Power Receiving	PuVVNL (Purvanchal Vidynt Vitran Nigam Limited)	• Basis for legal or regulations: N/A • Responsible Agency who shall grant the permissions: PuVVNL • Approximate Period from Application to Final approval: 15 days • Concerned Executive Engineer to prepare and submit to PuVVNL

Source: JICA Survey Team

11.4 Project Alternatives Analysis

11.4.1 Zero Option

Zero option is the current sewerage system which does not implement projects. Generally, periodical maintenance has not been carried out for the drainages and the drainage channel has been filled with lots of garbage and causing worsened drainage to flow due to its clogging at the channels. Water quality observed in the drainages was almost raw sewage since sewerage system has not been developed. **Table 11.4.1** summarizes the comparison of potential negative and positive impacts against the zero option (without implementing projects) and the project scenario (with projects implementation).

Table 11.4.1 Summary of Major Potential Impacts by Zero Option and Project Scenario

	Zero Option	Project Scenario
Negative Impact	• Worsened water pollution of the Ganga river due to untreated sewage flow-in • Increased infectious risks due to worsened hygine status due to untreated sewage discharge • Decreased opportunities for local economy due to no construction works • Decresed value of estates	• Temoprary impact on social infrasturucture such as roads, railways and utilities at construction phase • Temporary impact of dust and noise at construction sites at construction phase • Increased social unrest against future potential tariff increase
Positive Impact	• Less risks of accicendents and third parties because of no construction works • No disturbance or destruction of ecosystem in case of sites with higer rich of flora and fauna species	• Increased opportunities for local economy due to employment of construction workers at local level • Improved water water quality of the Ganga river due to reduced pollutant loads by treatment of sewage at pollutant source • Decreased infectious risks due to improved hygine status through treatment of sewage • Increased values of estate

Source: JICA Survey Team

11.4.2 Selection of Location of Target Catchment Area

The target catchment area of the sewage and drainage for implementation of the projects is basically based on the DPRs. Through verification of the DPRs, the project sites in each catchment were selected in terms of current status of development of sewerage system, land availability for STP sites, pumping stations and project implementation / procurement method including fund allocation.

11.4.3 Selection of Treatment Method

(1) Sewage Treatment

Originally, the process of the sewage treatment of the STPs in each municipality was proposed in DPRs. Then, verification was made for the proposed process in the DPRs in the JICA study. Table 11.4.2 shows the treatment process of each STP which was finally selected by the JICA survey for the originally proposed treatment methods by DPRs through a comprehensive

evaluation in terms of pollution control performance of nitrogen removal and effluent quality, cost (capital, operation and maintenance cost) and past record in India. Originally, advanced type SBR was adopted for the STPs for Chunar, Vindhyachal, Mirzapur, and Ghazipur, CND process for Ramnagar and Ramna. These treatment methods were adopted to meet more strict standards toward improved water environment.

Table 11.4.2 Comparison of Sewage Treatment Processes

Item			Varanasi	Mirzapur		Ghazipur	Ramnagar	Chunar	New Standard (Planned)
			Ramna STP	Mirzapur STP (new)	Vindhyachal STP (new)	Ghazipur STP	Ramnagar STP	Chunar STP	
Base Year		-	2020	2020	2020	2015	2020	2020	
Target Year		-	2050	2050	2050	2045	2050	2050	
Project Area		ha	-	1,795.44	292.82	2000	494.66	831.2	
Population Projection		no.	-	347,938	75,686	205,000	118,503	80,000	
Density of Population		no./ha	-	193.8	258.5	102.5	239.6	96.2	
Unit Rate of Water Consumption		lpcd	150	135	135	135	135	135	
Sewage Volume at Target Year (Daily Ave.)		MLD	-	41	9	24.36	14.06	9.48	
Design Sewage Volume	Existing	MLD	-	-	-	-	-	-	
	Future	MLD	50	18 (2030)	2 (2030)	18 (2025)	13 (2050)	6.5 (2030)	
Raw Sewage Quality	pH	-	7-8	7-8	-	6-8	7-7.5	7-8	
	BOD	mg/l	200	250	-	250	250	250	
	SS	mg/l	600	400	-	250	450	400	
	TK-N	mg/l	40	-	-	35	30	-	
	Fecal Coliform	MPN/100 ml	10^7	10^8	-	-	-	10^8	
Treated Effluent Quality	pH	-	10	6.5-8	-	6.5	7.5	6.5-8	6.5-9
	BOD	mg/l	10	10	10	10	10	≦10	≦10
	SS	mg/l	10	10	10	10	10	≦10	≦10
	T-N	mg/l	10	10	10	10	10	10	≦10
	Faecal Coliform	MPN/100 ml	230	230	230	230	230	230	<230
Sewage Treatment Process	Proposed by DPRs		CND (Single-stage)	SBR	SBR	Advanced SBR	CND (Single-stage)	SBR	
	Proposed by JICA Survey		Same as DPR	Advanced SBR	Same as DPR	Same as DPR	Same as DPR	Advanced SBR	
Disinfection Process		-	Chlorine Contact						
Sludge Treatment Process		-	Thickener Digestion SDB			Thickener Digestion Centrifuge	Thickener Digestion Centrifuge	Thickener Digestion Centrifuge	

Source: JICA Survey Team

(2) Sludge Treatment Process

Refer to Chapter 9 for details on the study on sludge treatment process.

(3) Sludge Disposal

As the sludge disposal process in the urban area in Japan, dewatered sludge is often treated furthermore for volume reduction to landfill or re-use by incineration. However, in case of the proposed project, the STPs are located near farmland, thus a final disposal of the dewatered sludge in farm lands was selected.

11.5 Scoping and Terms of References for Environmental and Social Considerations

11.5.1 Initial Scoping

An initial scoping for the proposed projects was made as shown in **Table 11.5.1**. The following adverse environmental and social impacts are estimated.

- At construction phase: hydrology, resettlement / land issues, social infrastructure, infectious diseases, working environment and safety, air pollution (dust) , waste, noise and accidents
- At operation phase: poverty, landscape, working environment and safety, water pollution, waste, soil contamination, noise, offensive odour, accident, climate change

Table 11.5.1 Results of Initial Scoping

Category	No.	Impact	Assessment		Reason for Assessment
			Const.	Oper.	
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	B-	D	At construction stage: Potential disturbance of natural drainage is estimated by the temporary storage of excavated soil and construction materials. At operation stage: The current sewage discharging in nallah and finally into rivers will be taken into the proposed sewerage system as a balance.
	4	Topography / Geology	D	D	At construction stage: The construction works will not cause a large-scaled topographical and geological alteration.
Social Environment	5	Resettlement / Land Issue	B-	D	The project will require land acquisition for the construction of STPs and pumping stations.
	6	Poverty	D	B-	At Operation stage: The increase of sewage tariff may affect the low-income households.
	7	Ethic Minority	D	D	There is no ethnic minorities nor indigenous people at the project sites.

Category	No.	Impact	Assessment		Reason for Assessment
			Const.	Oper.	
	8	Employment, sustenance and regional economy	B+	D	At Construction stage: An opportunity for employment of 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 existing facility areas of sewerage treatment facilities and the vacant areas in the built-up area and the public roads.
	10	Water Use	D	D	The project does not relate to water use.
	11	Social Infrastructure / Service	B-	D	At Construction stage: The excavation / construction works at the construction sites may affect the traffic flow and existing public utilities such as water pipes, telephone cables.
	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 provide improved sanitation system to the citizens equally.
	14	Local Conflicts of Interests	D	D	The project does not provide its improved sanitation system only to partial people or social structure, and it will not bring local conflicts.
	15	Heritage or Cultural Assets	D	D	The project sites are public roads or built-up areas which 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	Working Environment and Safety	B-	B-	At Construction stage: Care should be taken for the working environment of the construction workers At Operation stage: Care should be taken for the maintenance works of sewers for potential generation of toxic gases 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∓	At Construction stage: Turbid water will be generated temporarily at construction sites. However, its impact is minor. At Operation stage: Basically, the project will improve water quality. However, inappropriate operation or system dysfunction may cause water quality pollution.
	23	Waste	B-	B-	At Construction stage: Construction / demolition debris, excavation soil and the garbage at construction camps will be generated. At Operation stage: Sludge will be generated at the sewage and sludge treatment process.
	24	Soil Contamination	D	B-	The leakage of sewage at the sewers may pollute the surrounding ground.
	25	Noise / Vibration	B-	B-	At Construction stage: Noise will be generated by the operation of construction vehicles and equipment.

Category	No.	Impact	Assessment		Reason for Assessment
			Const.	Oper.	
					At Operation stage: Noise will be generated by the operation of blowers and pumping equipment at STPs and pumping stations
	26	Ground Subsidence	D	D	The project does not extract groundwater.
	27	Offensive 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 for construction workers and third parties 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

11.5.2 Terms of References for IEE

The IEE (Initial Environment Examination) for the potential adverse impact was conducted through literature survey, interview with the C/P (Counter Parts), construction plan,future plan of the projects and legal and isnstitutional requirements.

11.5.3 Estimation of Potential Impacts and Assessment

The potential adverse impact by the proposed projects is shown in **Table 11.5.2**.

Table 11.5.2 Potential Adverse Impacts at Project Phase

Phase: Construction

No.	Impact	Potential Adverse Impact
1	Hydrology	At monsoon season, the stockpile of the excavated soil and construction materials may block the natural drainage flow by the placement at lower area or on the direct water course of the drainage flow.
2	Resettlement / Land Issue	The land of Ramnagar STP site has not been secured. The land acquisition process is currently under way. The impact of discontent will be generated for the PAPs (Project Affected Persons) in terms of compensation process and some risk will remain for the project implementation.
3	Social Infrastructure / Service	The excavation works and pipe laying works of the proposed sewer lines may cause traffic congestion and public utilities such as water pipes and telephone cables and power lines specially on the following areas which has currently large volume or densely areas ; • Varanasi city: All project sites of sewer lines • Mirzapur city: Jln Lohiya Talab Road, Rambagh Road, Railway

		• Chunar city: Dragh Sharif Station Road, Chunar Fort Road
4	Infectious Diseases (e.g. HIV / AIDS)	During the construction phase, risk of HIV/AIDS infection may increase among construction workers around construction sites due to the inflow of construction workers from various districts in India.
5	Working Environment and Safety	During construction stage, adverse impact of working environment and safety on construction workers is estimated by the inappropriate construction manners and unexpected emergent events and poor work environment.
6	Air (Dust)	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	Waste	The excavation works or demolition works at the proposed sewer lines, rising mains, MPS, IPS and STPs will generate excavated soil and demolition waste by their construction works. And, domestic garbage will be generated at the construction camps. The impact due to treatment and the final disposal of such waste is estimated.
8	Noise	Some impact of noise on the surrounding residential area by the travelling of construction vehicles and operation of construction machineries. Special care should be taken in case that vulnerable sound receptors such as schools and hospitals exist at the vicinity areas of the project sites.
9	Accident	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.

Source: JICA Survey Team

Phase: Operation

No.	Impact	Potential Adverse Impact
1	Poverty	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. Therefore, future increase of sewage tariff may affect the household economy of the urban poor.
2	Landscape	The appearance of new facilities of STPs, MPSs and IPSs may affect the city scape of the project sites. However, the height of the proposed STPs which will be below 10 m may not damage the existing landscape
3	Working Environment and Safety	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. These O&M works may cause adverse impact.
4	Water Pollution	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 for the following STPs. • Varanasi city: Dinapur STP whose effluent will be discharged into Varuna river • Mirzapur city: Mirzapur STP and Vindhyachal STP • Ghazipur city: Ghazipur STP • Ramnagar city: Ramnagar STP • Chunar city: Chunar STP
5	Waste	Screen residues and sludge will be generated by the STP process. Some impact is estimated relating to the disposal of the sludge due to is inappropriate manners of disposal.
6	Soil contamination	Potential leakage of the sewage at the sewer lines and manholes may cause a risk of soil contamination of the surrounding ground at the operation and the maintenance stage.
7	Noise	Pumping unit, blower, emergency generator and dewatering centrifuge will be source of generating noise at the STPs, MPSs and IPSs especially on the following sites where some residential houses exist currently. • Varanasi city: Dinapur STP • Mirzapur city: Mirzapur and Vindhyachal STP • Ghazipur city: Ghazipur STP

8	Offensive Odour	Odour may be generated at the sludge treatment at the proposed STPs due to dysfunction of the operation of STPs. Some impact of odour on surrounding areas especially on the following STPs where more residential houses exist rather than other STPs; • Varanasi city: Dinapur STP • Mirzapur city: Mirzapur and Vindhyachal STP • Ghazipur city: Ghazipur STP
9	Accident	Some accidents are estimated due to the travelling of the trucks of conveying treated sludge and incoming of honey wagons. However, the impact level is less compared to the construction phase.
10	Climate change	The following GHGs are estimated at the proposed STPs and MPSs; (1) GHGs due to power consumption • Dinapur STP: 9,696 – 7,763 = 1,933 MWh/y (which is power consumption – power generation by biogas recovery) • Mirzapur STP: 2,151 MWh/y • Vindhyachal STP: 722 MWh/y • Mirzapur MPS: 629 MWh/y • Chunar STP: 769 MWh/y • Chunar MPS: 112 MWh/y • Ghazipur STP: 2,090 MWh/y • Ramnagar STP: 1,223 MWh/y • Ramnagar MPS: 335 MWh/y Total power consumption: 9,964 MWh/y Therefore, 9,964 MWh/y x 0.82 t-CO_2/MWh* = 8,170.5 t-CO_2/year is estimated for GHGs generation by the power consumption. *: Source: "CO_2 Baseline Database for the Indian Power Sector", April 2016, Ministry of Power Central Electricity Authority, India (2) GHGs Emission due to disposal of sludge Sludge generation in dry base* • Mirzapur STP: 56.26 m^3/day • Vindhyachal STP: 9.31 m^3/day • Chunar STP: 10.1 m^3/day • Ghazipur STP: 16.0 m^3/day • Ramnagar STP: 17.57 m^3/day Total generation of treated sludge to be disposed: 109.24 m^3/day 0.0667 t- CH_4/ds-t is assumed as the emission factor for landfilling of sludge in semi-aerobic state.** 0.0667 x 109.24 m^3/day x 0.8 t/m^3 = 5.83 t-CH_4/day (= 2,128.0 t-CH_4/year) CH_4 converted to CO_2: 25 x 2,128.0 tCO_2e/year = 53,200 tCO_2e/year Therefore, 53,200 tCO_2e/year of GHGs is estimated by the sludge disposal. Notes *: Biogas (GHGs) is recovered for power generation. **Source: Ministry of Land, Infrastructure, Transport and Tourism, Government of Japan (3) Potential Generation of GHGs The total generation of GHGs is 61,370.5 tCO_2e/year is estimated by the operation of STPs and MPSs.

Source: JICA Survey Team

11.6 Assessment Results of Environmental and Social Impacts at Initial Scoping and IEE

The assessment result toward potential adverse impacts for the initial scoping and IEE is shown in **Table 11.6.1**.

Table 11.6.1 Assessment Results at Initial Scoping and IEE

Category	No.	Impact	Initial Scoping		IEE		Reasons for Assessment
			Const.	Oper.	Const.	Oper.	
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	B-	D	B-	N/A	At monsoon season, the stockpile of the excavated soil and construction materials may block the natural drainage flow.
	4	Topography / Geology	D	D	N/A	N/A	The project does not include large-scaled excavation works.
Social Environment	5	Resettlement / Land Issue	B-	D	B-	N/A	The land of Ramnagar STP site has not been secured. The land acquisition process is currently under way. The impact of discontent will be generated for the PAPs (Project Affected Persons) in terms of compensation process and some risk will remain for the project implementation.
	6	Poverty	D	B-	N/A	B-	Future increase of sewage tariff may affect the household economy of the urban poor.
	7	Ethic Minority	D	D	N/A	N/A	There is no ethnic minority nor indigenous people at the project sites.
	8	Employment, sustenance and regional economy	B+	D	N/A	N/A	An opportunity for employment of 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 existing facility areas of the sewerage systems, vacant areas in the built-up area and the public roads which may not cause significant change the land use.
	10	Water Use	D	D	N/A	N/A	The project does not relate 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 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 bring local conflicts.
	15	Heritage or Cultural Assets	D	D	N/A	N/A	Historical/cultural assets are conserved by UP states. The project will not affect these issues since the project sites do not encompass such historical or cultural assets.
	16	Landscape	D	B-	N/A	D	The heights of buildings of the proposed STPs are below 10 meters; therefore it may not have impacts to local 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.

Category	No.	Impact	Initial Scoping		IEE		Reasons for Assessment
			Const.	Oper.	Const.	Oper.	
	19	Infectious Diseases (e.g. HIV / AIDS)	B-	D	B-	N/A	A risk of HIV/AIDS infection may increase among construction workers around construction sites.
	20	Working Environment 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	D	B-	D	B-	At construction phase: Most of case, water quality problems caused by excavation works when the works are carried out in river crossing. In terms of water pollution, impact the project is low and temporary since he river water is already turbid in the project site. 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: 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 treated sludge will be generated by the STP process. Appropriate treatment and disposal is necessary.
	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 the 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	Offensive 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	There is no works affect the riverbed.
Others	29	Accident	B-	B-	B-	B-	At construction phase: The increase of vehicles for the construction

Category	No.	Impact	Initial Scoping		IEE		Reasons for Assessment
			Const.	Oper.	Const.	Oper.	
							works may increase the risk of traffic accidents around the construction sites. At operation phase: The sewers may generate hazardous gas H_2S (Hydrogen Sulphide) 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: 61,370.5 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.
N/A: Not applicable for estimation for establishment for mitigation measures and environmental monitoring
Source: JICA Survey Team

11.7 Recommended Mitigation Measures toward Potential Adverse Impacts

The recommended mitigation measures toward the potential adverse impact are shown in **Table 11.7.1.**

Table 11.7.1 Mitigation Measures toward Potential Adverse Impacts

At Construction Phase

No.	Impacts	Recommended Mitigation Measures	Actor for Mitigation Measures	Regulatory Authority	Budget / Cost
1	Hydrology	• Preparation of temporary construction plan to avoid blockage of natural drainage flow • Preparation of construction plan to avoid soil erosion at construction sites • Incorporation of above measures including indemnification into bidding and construction contract documents • Environmental monitoring of the contractor's drainage control	• Varanasi: EPC / SPC • Mirzapur, Chunar, Ghazipur: SPC • Ramnagar : EPC / SPC	UPPCB (Uttar Pradesh Pollution Control Board), UPJN, Consultant	To be covered in the project cost
2	Resettlement / Land Issue	• Preparation of appropriate compensation measures for PAPs (Project Affected Persons) • Compliance with legal requirement of LARR (Land Acquisition, Rehabilitation and Resettlement) Act, 2013 • Discussion among stakeholders	- Ditto -	UPPCB, Consultant	To be covered in UPJN budget

No.	Impacts	Recommended Mitigation Measures	Actor for Mitigation Measures	Regulatory Authority	Budget / Cost
		up to final agreement			
3	Social Infrastructure / Service	• Prior notice to traffic police before the construction works • Prior acquisition of permissions / NOC (No Objection Certificate) from relevant authorities such as road, railway, drainage and rivers • Placement of traffic guides at each end of construction sections for smooth inducement of traffic • 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 • 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 special construction method such as micro tunneling at crossing points of roads with heavy traffic and railways • Environmental monitoring • Incorporation of above measures including indemnification into bidding and contract documents	- Ditto -	UPPCB, UPJN, Consultant	Project Cost
4	Infectious Diseases (e.g. HIV / AIDS)	• Preparation of appropriate working health plan • Training / Education of working health for construction workers • Incorporation of above measures into bidding and contract documents	- Ditto -	UPPCB, UPJN, Consultant	Project Cost
5	Working Environment and Safety	• Preparation of construction plan • Training / Education 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	- Ditto -	UPPCB, UPJN, Consultant	Project Cost

No.	Impacts	Recommended Mitigation Measures	Actor for Mitigation Measures	Regulatory Authority	Budget / Cost
		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 including indemnification clauses for unexpected damage for construction workers and third parties • Environmental monitoring			
6	Air Pollution (Dust)	• Preparation of construction plan for control dust such as water spraying, covering sheets • 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	- Ditto -	UPPCB, UPJN, Consultant	Project Cost
7	Waste	• Preparation of construction plan for excavated soil and demolition waste • Preparation of hazardous waste management such as chemicals, waste oil and asbestos as per the legal requirement • Monitoring of Contractor's management of excavated soil, construction debris • Incorporation of above measures into bidding and contract documents	- Ditto -	UPPCB, UPJN, Consultant	Project Cost
8	Noise / Vibration	• Preparation of appropriate traffic management plan • 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	- Ditto -	UPPCB, UPJN, Consultant	Project Cost

No.	Impacts	Recommended Mitigation Measures	Actor for Mitigation Measures	Regulatory Authority	Budget / Cost
		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			
9	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	- Ditto -	UPPCB, UPJN, Consultant	Project Cost

Notes;
EPC: Engineering and Procurement Contractor, SPC: Special Purpose Company
Source: JICA Survey Team

At Operation Phase

No.	Impacts	Recommended 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 • Implementation of consultation meetings especially for urban poor	UPJN, State Government of UP	UPPCB, Consultant	O &M Cost
2	Working Environment and	• Facility design for prevention of leakage of chlorine gas at detail design	• Sewers: Jal Kal	UPPCB, Consultant	O &M Cost

No.	Impacts	Recommended Mitigation Measures	Actor for Mitigation Measures	Regulatory Authority	Budget / Cost
	Safety	• Preparation of appropriate O&M manual for handling of chlorine gas • Preparation of emergency safety plan • Environmental monitoring • Incorporation of above measures into bidding and contract documents	• STP, MPS, IPS: SPC		
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	SPC	UPPCB, Consultant	O &M Cost
4	Waste	• Agreement among relevant authorities such as municipalities, farmers in case of landfilling in solid waste landfill sites • Incorporation of above measures into bidding and contract documents	SPC	UPPCB, 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 residents' information relating to occurrence of odor and detection of leakage of sewage. • Environmental monitoring • Incorporation of above measures into bidding and contract documents	Sewers: Jal Kal	UPPCB, Consultant	O &M 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	SPC	UPPCB, Consultant	O &M Cost
7	Offensive Odour	• Facility design for reduction of odour generation	SPC	UPPCB, Consultant	O &M Cost

No.	Impacts	Recommended Mitigation Measures	Actor for Mitigation Measures	Regulatory Authority	Budget / Cost
		• 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			
8	Accident	• Facility design for prevention of leakage of chlorine gas at detail design • Preparation of appropriate & M manual for handling of hazardous gas such as methane and chlorine • Regular inspection of sewers • Preparation of emergency safety plan • Environmental monitoring • Incorporation of above measures into bidding and contract documents	SPC	UPPCB, 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 • Incorporation of energy saving measures into bidding and contract documents • Recovery of GHGs in treatment process in STPs in future stage through installing a biogas power generation or an incineration to reduce the generation of GHGs for the STPs which has no biogas generation unit	SPC	UPPCB, Consultant	O &M Cost

Source: JICA Survey Team

11.8 Environmental Monitoring Plan

11.8.1 Environmental Monitoring Plan

The environmental monitoring plan at each project phase is shown in **Table 11.8.1**. With regard to the monitoring of the land acquisition, necessary items for its monitoring will be prepared at preparation of the RAP (Resettlement Action Plan) after the project scope is finalized and the approval is obtained for the project component by the project proponent.

Table 11.8.1 Environmental Monitoring Plan

Construction Phase

No.	Item	Location	Parameters	Method	Frequency	Implementing Agency	Approximate Cost
1	Hydrology (Drainage, Soil Erosion)	• Construction sites for excavation works and construction works	• Contractor's practice for drainage control • Status of soil erosion	• Visual inspection • Examination of daily or monthly report	Monthly	• Varanasi: EPC / SPC • Mirzapur, Chunar, Ghazipur: SPC • Ramnagar : EPC / SPC	To be covered in project cost
2	Social Infrastructure / Service	• Construction sites • Vicinity roads of the construction sites	• Contractor's practice for traffic control • Complaints of surrounding residents	• Visual inspection • Examination of daily or monthly report	Monthly	- Ditto -	To be covered in project cost
3	Working Environment and Safety	• Construction sites	• Contractor's practice for working environment and safety	• Visual inspection • Examination of daily or monthly report	Monthly	- Ditto -	To be covered in project cost
4	Air Pollution	• Construction sites for excavation works and construction works	• Contractor's practice for dust control	• Visual inspection • Examination of daily or monthly report	Monthly	- Ditto -	To be covered in project cost
5	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 • Contractor's management for hazardous wastes	• Visual inspection • Examination of daily or monthly report	Monthly	- Ditto -	To be covered in project cost
6	Noise / Vibration	Facility boundaries at the following facilities; • Dinapur STP • Mirzapur STP • Vindhyachal STP • Ghazipur STP • Ramnagar STP • Chunar STP	• Noise level • Complaints of surrounding residents	Measurement of noise level by sound level meter for 2 samples (day time, night time) per 1 STP	Monthly	- Ditto -	60,000 Rp. per time
7	Accident	• Construction sites • Vicinity roads of	• Construction practice for	• Visual inspection	Monthly	- Ditto -	To be covered

No.	Item	Location	Parameters	Method	Frequency	Implementing Agency	Approximate Cost
		the construction sites	safety measure	• Examination of daily or monthly report			in project cost

Source: JICA Survey Team

Operation Phase

No.	Item	Location	Parameters	Method	Frequency	Implementing Agency	Approximate Cost
1	Working Environment and Safety	• STPs • Pumping stations • Sewers	• Practice for working environment and safety	• Visual inspection • Examination of daily or monthly report	• Monthly	SPC	To be covered in operation and maintenance cost
2	Water Quality	The following STPs (Raw sewage, Effluent); • Dinapur STP • Mirzapur STP • Vindhyachal STP • Ghazipur STP • Ramnagar STP • Chunar STP	• pH • BOD_5 • COD • TSS • NH_4-N • T-P • T-N • Faecal Coliform	As per CPCB's new standards dated 27th April 2016	Daily	SPC	50,000 Rp. x 6 STPs per month = 300,000 Rp./month By Chemist and an assistant
3	Soil Contamination	• Sewers	Complaints of surrounding residents for smell	• Visual inspection • Interview with residents • Examination of daily or monthly report	• Monthly	SPC	To be covered in operation and maintenance cost
4	Noise / Vibration	Facility boundaries at the following STPs; • Dinapur STP • Mirzapur STP • Vindhyachal STP • Ghazipur STP • Ramnagar STP • Chunar STP	Noise level	Measurement of noise level by sound level meter	• Monthly	SPC	60,000 Rp. per time
5	Offensive Odour	Facility boundaries at the following STPs; • Dinapur STP • Mirzapur STP • Vindhyachal STP • Ghazipur STP	1) Odour level The following chemical substances as odour source; • Ammonia • Methyl	Measurement method which is regulated in Japanese Offensive Odor Control Law	• Monthly	SPC	60,000 Rp. per time

No.	Item	Location	Parameters	Method	Frequency	Implementing Agency	Approximate Cost
		• Ramnagar STP • Chunar STP	mercaptan • Hydrogen sulfide • Methyl sulfide • Styrene 2) Complaints of surrounding residents for smell	(Law No. 91 of 1971, Latest Amendment by Law No. 71 of 1995) • Interview with residents			
7	Accident	• STPs • Pumping stations • Sewers	• EPC's practice for safety measure	• Visual inspection • Examination of daily or monthly report	Monthly	- Ditto -	To be covered in operation and maintenance cost

Source: JICA Survey Team

11.8.2 Implementation Structure for Environmental Monitoring

Since the components of the proposed projects have not been approved by NMCG, the implementation structure and its concrete framework for the environmental monitoring cannot be established at this stage.

11.9 Land Acquisition and Resettlement

11.9.1 Necessity of Land Acquisition and Resettlement

The necessity of land acquisition for the project sites is shown in **Table 11.9.1** as interim results. For the project sites of pumping stations and Ramnagar STP, land acquisition will be necessary. There will be no resettlement for these sites because of no inhabitation at these sites. However, since the components of the proposed projects and the selection of sewage collection method for either ID & T or the Comprehensive method (sewer networks) have not been approved by NMCG, the process of the land acquisition and their relevant surveys cannot be initiated. In addition, the facility plan of the pumping stations have not been approved by NMCG since the sewage collection system for Mirzapur, Ghazipur, Ramnagar and Chunar cities have not been decided, and thus, NMCG cannot initiate the process for the land acquisition of the pumping stations.

Table 11.9.1 Necessity of Land Acquisition and Resettlement (Interim)

No.	City	District	Project Site	Facility Area of Length in Approximate Scale	Necessity of Land Acquisition	Remarks
1.	Varanasi					
1.1	- Ditto -	District I	Sewer networks	• Open: 217,772 m, • Micro Tunnelling: 1,876 m	Not Necessary	
1.2	- Ditto -	District II	Sewer networks	• Open: 272,096 m, • Micro Tunnelling: 3,911 m	Not Necessary	
1.3	- Ditto -	District III	Sewer networks	• Length: 807 m,	Not Necessary	
1.4	- Ditto -	- Ditto -	Pumping Station	Area: 100 m^2	Necessary	
1.5	- Ditto -	- Ditto -	Ramna STP	Area: 141,000 m^2	Not Necessary	
2.	Mirzapur					
2.1	- Ditto -	Mirzapur	Sewer networks	• Open: 8,835 m, • Rising Main: 5,340 m • Reuse Line: 7,000 m	Not Necessary	The collection system has not been decided by NMGC
2.2	- Ditto -	- Ditto -	Pumping Station • IPS 1 • IPS 2 • IPS 3 • MPS 1	• IPS 1: 100 m^2 • IPS 2: 100 m^2 • IPS 3: 100 m^2 • MPS 1: 900 m^2	Necessary	Pumping stations incase of sewer networks
2.3	- Ditto -	- Ditto -	Mirzapur STP	Area: 37,000 m^2	Not Necessary	
2.4	- Ditto -	- Ditto -	Vindhyachal STP	Area: 57,000 m^2	Not Necessary	
3.	Ghazipur					
3.1	- Ditto -	Ghazipur	Sewer networks (Intercept Sewer)	• Open: 8,335 m, • Rising Main: 25 m	Not Necessary	The collection system has not been decided by NMGC
4.	Ramnagar					
4.1	- Ditto -	Varanasi	ID & T	Length: 3,080 m	Not Necessary	The collection system has not been decided by NMGC
4.2	- Ditto -	- Ditto -	Pumping Station	Area: 900 m^2	Necessary	Pumping stations incase of ID & T
4.3	- Ditto -	- Ditto -	Ramnagar STP	Area: 23,000 m^2	Necessary Under Negotiation	
5.	Chunar					
5.1	Chunar	Mirzapur	ID & T	• Open: 4,308 m, • Rising Main: 2,160 m • Reuse Line: 3,695 m	Not Necessary	The collection system has not been decided by NMGC
5.2	- Ditto -	Ditto -	Pumping Station • IPS: 1 • MPS: 1	• IPS 1: 10 m^2 • MPS 1: 100 m^2	Necessary	Pumping stations incase of ID & T
5.3	- Ditto -	Ditto -	Chunar STP	Area: 98,000 m^2	Not Necessary	

Source: JICA Survey Team

11.9.2 Legislative Framework for Land Acquisition and Resettlement

(1) Land Acquisition, Rehabilitation and Resettlement Act, 2013

Land acquisition and resettlement shall be conducted based on the Land Acquisition, Rehabilitation and Resettlement (LARR) Act 2013. The rehabilitation measures against the loss

of income of agricultural lands, plantation and other lands shall follow the requirement of the act as shown in **Table 11.9.2**.

Table 11.9.2 Entitlement Matrix as per LARR 2013

Target Loss/ Elements	Entitlement
1. Acquisition or Compensation Packages (No Resettlement Required)	
1.1 Loss of Land	• Market value of land; plus • Market value multiplied by a factor, at least 1 or 2 times in rural areas and 1 times in urban areas; plus • Amount calculated at the rate of 12% per annum on such market value for the period from 4(2) SIA study publication to the date of award or the date of taking possession of the land, whichever is earlier; plus • Solarium of 100% over the total compensation amount
1.2 Loss of House, Building and Other Immovable Property or Assets	• Market value based on the computation of a competent engineer or any specialist in the relevant field
1.3 Loss of Trees and Plants Attached to the Land Acquired	• Current value determined by persons in the field of agriculture, forestry, horticulture, sericulture or any related field
1.4 Loss of the Standing Crops Damaged During the Process of Land Acquisition	• Current value assessed by the experienced persons in the field of agricultures
2. In Case of Displacement (Need for Rehabilitation and Resettlement)	
2.1 Provision of Housing Units	• If house is in rural areas, house should be constructed according to Indira Awas Yojana specification; • In case in urban areas, house to be constructed should not be less than 50 sq.m in plinth area; • Families must be continuously residing in the area of not less than 3 years preceding the date of notification of the affected area which has been involuntarily displaced; • Equivalent cost of the house may be offered in lieu of the constructed house; and • No affected family must be given more than 1 house
2.2 Land to Land	• For multi-crop irrigated land, equivalent area of culturable wasteland shall be developed for agricultural purpose or an amount equivalent to the value of land acquired shall be deposited with the appropriate government for investment in agriculture for enhancing food security; • For non-irrigated multi-crop land, acquisition of the agricultural land shall in no case exceed such limits of the total sown area and be notified by appropriate government
2.3 Choice of Annuity and Employment	• Priority for employment after suitable training and skill development at a rate not lower than the minimum wage to at least 1 member per affected family in the project or arrange for a job in such other project as may be required; or • One-time payment of INR 500000.00 per affected family; or • Annuity policies that shall pay not less than INR 2000 per month per family for 20 years, with appropriate indexation to the Consumer Price Index for Agricultural Labourers.
2.4 Subsistence Grant for Displaced Families for a Period of One Year	• Each displaced family shall be given a monthly subsistence allowance equivalent to INR 3000 for a period of 1 year from the date of award; • In case displaced from the Scheduled Areas (Scheduled Castes and Scheduled Tribes), INR 50000 to preserve the economic opportunities, language, culture and community life of the tribal communications.
2.5 Transportation Cost for Displaced Families	• Each displaced family shall get a 1-time financial assistance of INR 50000 for shifting of the family, building materials, belongings and cattle.
2.6 Cattle Shed/Petty Shops Cost	• Each affected family having cattle shed or petty shop shall get 1-time financial assistance from appropriate government but should be minimum of

Target Loss/ Elements	Entitlement
	INR 25000 for construction of cattle shed and petty shop as the case may be.
2.7 One-time Grant to Artisan, Small Traders and Certain Others	• Each affected family belonged to this and has been involuntarily displaced from the affected land due to land acquisition shall get 1-time financial assistance from appropriate government and should be minimum of INR 25000.
2.8 Fishing Rights	• In case applicable, affected families may be allowed fishing rights in the reservoirs, in such manner as may be prescribed by the appropriate government.
2.9 One-Time Resettlement Allowance	• Each affected family shall be given a 1-time "Resettlement Allowance" of INR 50000 only.
2.10 Stamp Duty and Registration Fee	• All fees subject for payments to the stamp duty and registration fee shall be borne by the Requiring Body; • The land for house shall be free from all encumbrances; and • The land or house allotted may be in the joint names of wife and husband of the affected family.

Source: JICA Survey Team

(2) National Rehabilitation and Resettlement Policy (NRRP), 2007

This policy was prepared by the Department of Land Resources, Ministry of Rural Development, and Government of India, and stipulates the minimum benefits to be ensured for persons displaced due to acquisition of land for public purposes. The objectives of the Policy are:

- To minimize displacement and to identify the non-displacing or least-displacing alternatives;
- To plan the Resettlement and Rehabilitation of PAFs (Project Affected Families), or PAHs (Project Affected Households) including tribal and vulnerable households;
- To provide improved standard of living to PAFs or PAHs; and
- To facilitate a harmonious relationship between Requiring Body/Competent Authority (CA) and PAFs.

The Policy is applicable to projects displacing 400 or more families in plain areas, or 200 or more families in tribal or hilly areas, Desert Development Program (DDP) blocks, areas mentioned in Schedule V and Schedule VI of the Constitution of India.

Main points of the policy are shown as below:

- Recognizes apparent need for additional R&R (Rehabilitation and Resettlement) benefits which must be beyond compensation of loss of land or structure;
- SIA (Social Impact Assessment) as mandatory component where a project is likely to cause impact 400 or more families (in plain areas), or 200 or more families in tribal or hilly areas;

- Detailed R&R planning in case anticipated displacement is more than 400 families in plains (200 families in hilly/tribal areas). The plan to have details such as extent of land to be acquired with names and identification of affected families, village wise list of affected persons, their profile, agricultural labourers as affected persons, people with livelihood affected, list of occupiers, public utilities, comprehensive list of benefits and packages to be provided to affected persons;
- Special care to protect rights of vulnerable society such as SC (Scheduled Cast) and ST (Scheduled Tribe) community sensitivity;
- R&R cost (arising out of benefits and packages beyond compensation) will be included as part of project cost;
- Compensation and resettlement activities to be done well in advance of ouster of affected families;
- R&R (Rehabilitation and Resettlement) benefits to be extended to all affected families. Benefits includes possible allotment of house site, one time assistance for house construction to BPL families (quantum aligned with existing house construction schemes by state), Replacement cost basis or land for land approach for PAFs who have become landless or marginal account of project impacts. Stamp duty and other fees to be borne by requiring body. Provisions of assistance for land development, cattle shed, shifting allowance (on actual cost basis), assistance to rural artisans, self-employed for construction of working shed/shop. Conditional provision for employment of those rendered jobless or rehabilitation grant, subsistence allowance for displaced PAFs; and
- Requirement of developing of tribal development plan and recommended consultation with tribal advisory council where project entails displacement of 200 or more ST families. Consultation with Gram Sabha or Panchayats for land acquisition in scheduled areas.

(3) Gaps Between JICA Policy and Indian Legislative System on Resettlement and Land Acquisition

The gap of JICA Guideline and the Indian legal system on land acquisition and resettlement as per the Indian LARR and NRRP is shown in **Table 11.9.3.** .The project will basically follow the Indian policy listed in **Table 11.9.3**.

Table 11.9.3 Gap between JICA Guideline and Indian Legislative Policy

Sl. No.	JICA Guidelines (2010)	Indian Applicable Policy (as per LARR and NRRP)	Gap between JICA's Guidelines and Indian LARR	Policy by the Project
1	Involuntary resettlement should be avoided wherever possible	• NRRP aims to minimize large scale displacement. • NRRP Encourages projects to be set up on waste land, degraded land, Un-irrigated land. (NRRP 2007, #1.4, Chap 1)	None	The project will follow the Indian applicable policy as per the LARR and NRRP.
2	When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken.	If unavoidable, Govt. to consider different alternatives to minimize displacement, total land acquired and total agricultural land acquired for non agricultural use (NRRP2007, #1.4, Chap 1), LARR has provision for compensation for losses incurred.	None	- Ditto -
3	People who will be settled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels.	Provisions made for R&R* benefits to all; but subject to condition that non titleholders must be residing or drawing livelihood in the affected area *for a period not less than 3 years preceding date of declaration of the affected area.* (NRRP, #3.1.b.iii). *R&R: Rehabilitation and Resettlement	Yes. • Non titleholders need to be residing continuously or drawing livelihood from the affected area for a period not less than 3 years preceding the date of declaration. • R&R benefits such as housing improvement, development benefits, loss of crops, trees, transitional support etc to be provided only if residing/ drawing livelihood for a continuous 3 year period in the area, preceding declaration of 'affected area'	- Ditto -
4	Compensation must be *based on the full replacement cost* as much as possible	Compensation made on market rate as determined or recognized by state	Yes.	- Ditto -
5	Compensation and other kinds of assistance must be provided prior to displacement	Provisions are covered in NRRP	None	- Ditto -
6	For projects that entails large-scale involuntary resettlement, RAP (Resettlement Action Plans) must be prepared and made available to the public.	Requirement for RAP is mentioned subject to number of displaced exceeding 400 families in plains or 200 in hilly/tribal areas or Desert Development Programme (DDP) blocks.	Yes, Numerical condition (400 in plain area, 200 in tribal, hilly or DDP blocks) attached.	- Ditto -
7	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance.	Specific mention provided in NRRP.	None	- Ditto -

Sl. No.	JICA Guidelines (2010)	Indian Applicable Policy (as per LARR and NRRP)	Gap between JICA's Guidelines and Indian LARR	Policy by the Project
8	When consultation held, explanation must be given in a form, manner, and language that are understandable to the affected people.	• The draft Rehabilitation and Resettlement Scheme prepared shall be made known locally by wide publicity in the affected area and discussed in the concerned Gram Sabhas or Municipalities and in website. Section: 16. (4) • The approved Rehabilitation and Resettlement Scheme to be made available in the local language to the Panchayat, Municipality or Municipal Corporation and in website. Section: 18.	None	- Ditto -
9	Appropriate participation of PAPs (Project Affected Peoples) must be promoted in planning, implementation, and monitoring of RAP (Resettlement Action Plans)	Provisions covered	None	- Ditto -
10	Appropriate and accessible grievance mechanisms must be established for the PAPs and their communities.	Specified	Yes. R&R Committee to be set up only if in the project area over 400 families (in plains) or 200 in tribal/hilly areas are to be displaced.	- Ditto -
11	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits. (WB OP4.12 Para.6)	Specified under NRRP for identification of all PAPs.	None	- Ditto -
12	Eligibility of benefits includes, the PAPs who have formal legal rights to land), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP4.12 Para.15)	Specified-R&R benefits to non-titleholders provisioned by subject to them residing/ drawing livelihood for period not less than 3 years in the project affected area (from the date formal declaration)	Yes, Non-titleholders if residing or drawing livelihood for a period less than 3 years are not eligible for R&R benefits	- Ditto -

Sl. No.	JICA Guidelines (2010)	Indian Applicable Policy (as per LARR and NRRP)	Gap between JICA's Guidelines and Indian LARR	Policy by the Project
13	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WB OP4.12 Para.11)	Specified	None	- Ditto -
14	Provide support for the transition period (between displacement and livelihood restoration). (WB OP4.12 Para.6)	Specified	Yes. No such benefits provision for non-titleholder residing /drawing livelihood for a period less than 3 years	- Ditto -
15	Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc. (WB OP4.12 Para.8)	Mentioned for vulnerable groups as defined under NRRP. Specific mention of additional provisions for SC (Scheduled Cast) and ST (Scheduled Tribes) community mentioned under #7.21 of the NRRP. Requirement of a separate tribal development plan to be prepared if number of tribal displaced families exceeds 200 families.	None	- Ditto -

Source: JICA Survey Team

11.9.3 Scope of Impact of Land Acquisition and Resettlement

Since the components of the proposed projects have not been approved by NMCG, the process of the land acquisition and their relevant surveys cannot be initiated. Therefore, the baseline data on the PAPs (Project Affected Persons) and PAHs (Project Affected Households) to identify the scope of the impact by the land acquisition cannot be obtained in this survey. The issues should be clarified after the proposed projects are approved by NMCG.

11.9.4 Concrete Measures on Compensation and Support

Since the components of the proposed projects have not been approved by NMCG, the process of the land acquisition and their relevant surveys cannot be initiated. Therefore, the concrete measures on compensation and support for the PAPs cannot be identified. The issues should be clarified after the proposed projects are approved by NMCG.

11.9.5 Grievance Mechanism

From the same reason as mentioned before, the specific grievance mechanisms cannot be identified. The issues should be clarified after the proposed projects are approved by NMCG.

11.9.6 Implementation Structure for Land Acquisition and Resettlement

From the same reason as mentioned before, the implementation structure for the land acquisition cannot be identified. The issues should be clarified after the proposed projects are approved by NMCG.

11.9.7 Implementation Schedule for Land Acquisition and Resettlement

From the same reason as mentioned before, the implementation schedule for the land acquisition cannot be identified. This issue on holding SHMs will be a pending issue in this survey.

11.9.8 Cost and Budget for Land Acquisition and Resettlement

From the same reason as mentioned before, the cost and budget for the land acquisition cannot be identified. This issue on holding SHMs will be a pending issue in this survey.

11.9.9 Project Proponent's Monitoring System for Land Acquisition and Resettlement

From the same reason as mentioned before, the monitoring system for the land acquisition cannot be identified. This issue on holding SHMs will be a pending issue in this survey.

11.9.10 Consultation Meetings for Land Acquisition and Resettlement

The SHMs (Stakeholder Meetings) for the project could not be held because of the reasons that 1) the project proponent (NMCG) could not approve the project scopes and its components as shown below 2) problems of allocation of responsible personnel for the project;

Varanasi:

- The DPRs for District 3 of the proposed projects have not been approved by NMCG.
- Although there is planned one (1) pump station in District 3, it is impossible to foresee whether the land acquisition of the project sites will be actually realized or not.

Ramnagar:

- NMCG has not approved the sewage collection methods
- The DPRs of the proposed projects have not been approved by NMCG.

- It is impossible to foresee whether the land acquisition of the project sites will be actually realized or not.

Mughal Sarai:

- The DPR was not submitted and excluded from the project scope.

Mirzapur:

- NMCG has not approved the sewage collection methods
- The DPRs of the proposed projects have not been approved by NMCG.

Chunar:

- NMCG has not approved the sewage collection methods
- The DPRs of the proposed projects have not been approved by NMCG.

Ghazipur:

- NMCG has not approved the sewage collection methods

Saidpur:

- NMCG has not approved the sewage collection methods
- The proposed project was excluded from the project scope.

Above issue on holding SHMs will be a pending issue in this survey.

11.9.11 Variety of Baseline Data

Most of baseline data is addressed to Varanasi since the city is famous and various kind of data is available. However, data of the other project sites are also necessary. Availability of date is not sure in project area besides Varanasi, but it is necessary to collect in further investigation.

11.10 Environmental Checklist / Monitoring Form

11.10.1 Environmental Checklist

The environmental checklist which should be prepared in the JICA form is shown in **Table 11.10.1.**

Table 11.10.1 Environmental Checklist

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 are not required for the proposed project as per the Indian Environmental Notification 2006 and its revision in 2009. (b) - Ditto - (c) - Ditto - (d) For the implementation of the project, the following permissions will be necessary; • Crossing of Railways • Excavation of underground road area • Discharge of treated wastewater • Permission for tree cutting • Power receiving
	(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 -, However, as per JICA Guideline, consultation meetings will be necessary for the PAPs (Project Affected People) by the land acquisition.
	(3) Examination of Alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) The location of project sites is basically based on DPR. The treatment method of the sewage was reviewed for the proposal of the DPR.
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 emission standard 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 lands.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
	(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 follow 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 the impacts on aquatic environments, such as aquatic organisms?	(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 nearby area. Then, the improvement of the lake water is expected in the future.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
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) There will be no resettlement. Several sites of pumping stations and Ramnagar STP site require a land acquisition. However, the concrete compensation measures have not been approved by NMCG. (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, UPJN will make a monitoring for the process of land acquisition. (j) Resettlement is not expected. However, in case of land acquisition, UPJN 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 odour.
4 Social Environment	(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.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
	(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 is 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 lands and resources respected?	(a) N (b) N	(a) The project does not relate to such ethnic minorities nor indigenous people. (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.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
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) N/A (c) Y (d) Y	(a) At construction phase, there will be some potential adverse impact on hydrology, social infrastructure / service, infectious diseases, working environment / safety, air pollution, waste, noise and accident. Mitigation measures and environmental monitoring will be established for the examination of the contractor's activities to mitigate these impacts. (b) Adverse impact on ecosystem will not be estimated by the project. (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.
	(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.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations
6 Note	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) Y	(a) The consumption of electricity and disposal of treated sludge may generate GHGs at operation phased. However, mitigation measures will be taken for that.

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

11.10.2 Monitoring Form

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

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

The monitoring form for the projects is shown as below.

(1) Mitigation Measures

1) At Construction Phase

Hydrology（Drainage / Soil Erosion）

Item	Unit	Measured Value（Mean）	Measured Value（Max.）	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Drainage / Soil Erosion		• Contractor's practice for drainage control • Status of soil erosion				• Construction sites • Visual inspection • Examination of daily or monthly report • Monthly

Air Quality（Dust）

Item	Unit	Measured Value（Mean）	Measured Value（Max.）	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Dust		• Contractor's practice for dust control				• Construction sites • Visual inspection • Examination of daily or monthly report

Waste

Item	Unit	Measured Value（Mean）	Measured Value（Max.）	Country's Standards	Referred International Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Waste		• Type of construction debris • Amount of construction debris • Amount of excavated soil • Contractor's management for hazardous wastes				• Construction sites • Visual inspection • Examination of daily or monthly report

Noise / Vibration

Monitoring Item	Measured Value (Mean)	Measured Value (Max.)	Standards	Remarks (Measurement Point, Frequency, Method, etc.)
• Noise Level			Indian standard*	1) Measurement Point Facility boundaries at the following facilities; • Dinapur STP • Mirzapur STP • Vindhyachal STP • Ghazipur STP • Ramnagar STP • Chunar STP 2) Frequency • Monthly

* Indian standard as per Schedule III under the Noise Pollution (Regulation and Control) Rules, 2000 and amendment 2002

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 six (6) am to 10 p.m.
Note 2: Night time is reckoned in between 10 p.m. to six (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, loudspeakers 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.

2) At Operation Phase

Water Quality（Effluent）

Effluent discharge after treatment

Monitoring Item	Measured Value (Mean)	Measured Value (Max.)	Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
pH			6.0-9.5	1) Effluent at the following STPs; • Dinapur STP • Mirzapur STP • Vindhyachal STP • Ghazipur STP • Ramnagar STP • Chunar STP 2) Frequency: Monthly
BOD			<10	
COD			< 50	
TSS			< 10	
NH4-N			< 5	
T-N			< 10	
Phosphorus			< 2	
Fecal Coliform (MPN/100 ml)			< 230	

* As per CPCB New Standards dated 27th April 2016

Soil Contamination

Monitoring Item	Measured Value (Mean)	Measured Value (Max.)	Standards	Remarks (Measurement Point, Frequency, Method, etc.)
• Soil Contamination				1) Method • Visual inspection • Interview with residents • Examination of daily or monthly report 2) Measurement Point Sewers 3) Monthly

Noise / Vibration

Monitoring Item	Measured Value (Mean)	Measured Value (Max.)	Standards	Remarks (Measurement Point, Frequency, Method, etc.)
Noise Level			Indian standard*	1) Measurement Point Facility boundaries at the following facilities; • Dinapur STP • Mirzapur STP • Vindhyachal STP • Ghazipur STP • Ramnagar STP

				• Chunar STP 2) Frequency • Monthly

* Indian standard as per Schedule III under the Noise Pollution (Regulation and Control) Rules, 2000 and amendment 2002

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 six (6) am to 10 p.m.
Note 2: Night time is reckoned in between 10 p.m. to six (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, loudspeakers 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.

Offensive Odor

Monitoring Item	Measured Value (Mean)	Measured Value (Max.)	Standards*	Remarks (Measurement Point, Frequency, Method, etc.)
Ammonia			1.0 ppm	1) Measurement Point Facility boundaries at the following facilities; • Dinapur STP • Mirzapur STP • Vindhyachal STP • Ghazipur STP • Ramnagar STP • Chunar STP 2) Frequency Monthly
Methyl mercaptan			0.002 ppm	
Hydrogen Sulfide (H_2S)			0.02 ppm	
Methyl sulfide			0.01 ppm	
Styrene			0.4 ppm	

Notes;

Offensive Odour Control Law, Law No. 91 / 1971 or latest amendment by Law No. 71 / 1995

(2) Social Environment

1) At Construction Phase

Resettlement (At Construction Phase)

Monitoring Item	Monitoring Results during Report Period
The monitoring item will be established later at the preparation of RAP.	

Social Infrastructure

Monitoring Item	Monitoring Results during Report Period
• Contractor's practice for traffic control • Complaints of surrounding residents	

Working Environment and safety

Monitoring Item	Monitoring Results during Report Period
• Contractor's practice for working environment and safety	

Accident

Monitoring Item	Monitoring Results during Report Period
• Contractor's practice for safety measure	

2) At Operation Phase

Working Environment and safety

Monitoring Item	Monitoring Results during Report Period
• EPC's practice for working environment and safety	

Accident

Monitoring Item	Monitoring Results during Report Period
• EPC's practice for safety measure	

11.11 Recommendation

The ESC study will be terminated while the project scopes have not been approved and identified. However, a further ESC study will be necessary for the issues as listed below;

- Clarification of implementation structure for the mitigation measures and environmental monitoring
- Resettlement and land acquisition for the STP sites and pumping stations
- Holding SHMs

CHAPTER 12 Financial and Economic Consideration

<Objective of the Study>

Financial and Economic Analysis of the projects were conducted in this Chapter.

<Result of the Study>

Survey Team defined the key benefit of the project to analyze EIRR as following five elements, benefit of improved water quality of Ganges river, WTP for Sewerage Treatment Service, Saved Medical Expenditure due to water related disease without the project, Saved Salary which would have been lost due to water related disease without the project and Agricultural Benefit of Treated Water for Irrigation (refer to 12.4.1 (1)). Survey Team estimated the EIRR of the entire project would be 11.19% slightly exceeding 10% and Survey Team concluded that this project as a whole is economically feasible. However, in some of the project components such as Chunar ID&T and Ramnagar ID&T, EIRR for each sub-project does not exceed 10% hurdle, due to relatively smaller number of population who will receive economic benefit with the project compared to other areas.

<HAM-PPP>

On 12.6, Survey Team analyzed the leading PPP project cases in water and other sectors in India, focusing on Hybrid Annuity Model (HAM). Based on the information as of March 2017, Survey Team established the key requirements to develop HAM-PPP finance modeling Survey Team performed case analysis on Mirzapur and Chunar project in line with assumption and other key conditions defined on RFP released on January 2017 by GOI. Under HAM-PPP model, Survey Team concluded that each project is not financially sustainable without annuity paid by government, and collected user tariff will not cover major part of O&M cost. In addition, Survey Team identified the following four key points to be discussed further, regarding the HAM-PPP model. First, Majority stake on SPV funded by Concessionaire; According to GOI, at least 51% of capital of SPV should be funded by awarded concessionaire, but the other 49% owner and required rate of capital cost is not defined clearly which may impact to concessionaire and lender's financials. Second, Timing of loan withdrawal; according to GoI, 40% of project cost are paid on the date of completion of construction and the other 60% are paid by annuity within 15 years, to SPV. In this case, when the cash loaned from lender are withdrawn for payment from debtor (GOI)'s bank account. It is necessary to determine how the fund flow should be after COD. This is another points to be discussed further. Third, 15 years of O&M activity done by SPV; Current information provided by GOI does not clearly stipulate the approach to calculate O&M Annuity. Lastly, Concessionaire's exit strategy; According to GOI, after 3 years of operation, concessionaire will be allowed to sell the capital share of SPV to O&M operator who currently operates the facility. Survey Team carefully considered the impact of HAM-PPP model, especially if this will attract potential bidders

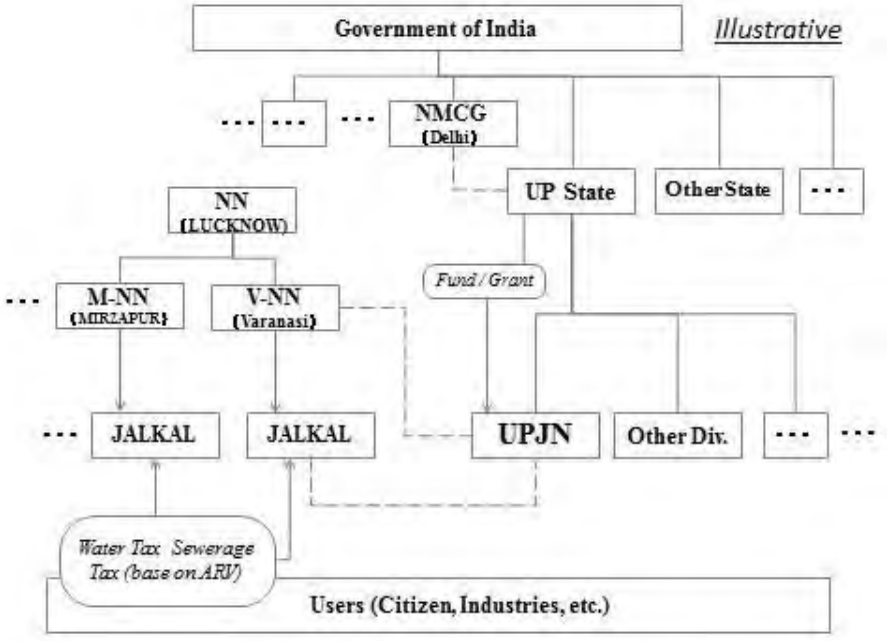
who should have sufficient financial stability to pay 40% of the construction cost at the beginning and to recover 60% of construction cost during the project period (15 years).

12.1 Introduction

12.1.1 Main stakeholders

The stakeholders in India for GANGA REJUVENATION PROJECT are mainly five:

- Executing Agency of the project: National Mission for Clean Ganga (NMCG)
- The state: Uttar Pradesh
- Coordinating/implementing agency: Uttar Pradesh Jal Nigam (UPJN)
- Municipal Corporation: Nagar Nigam
- Service provider of O&M in water/sewerage: Jal Kal Nagar Nigam (for each District)



Source: Drawing by JICA Study Team

Figure 12.1.1 Overall Structures among main Stakeholders

12.1.2 Roles and Responsibilities

Urban infrastructure service such as Water and Sewage are not maintained by one organization but are handled by two, UP Jal Nigam and Jal Kal. The UP Jal Nigam looks after the O&M of sewage pump stations and sewage treatment plants on behalf of Nagar Nigam. The UPJN, Varanasi division prepares the estimate for annual O&M and the same is then sent to Varanasi Nagar Nigam for review and counter signature. Once signed by the Nagar Nigam, the estimate is forwarded by UPJN, Varanasi office to the

UPJN head office in Lucknow. UPJN head office compiles such as O&M budgets received from various offices and then gets the funds from the State Government, which is then utilized for the O&M. The O&M budget is inclusive of electricity charges, and these are directly paid by the UPJN head office to the electricity board. The remaining amount is transferred to the respective office for O&M of STPs and pump stations. The O&M budget for Varanasi City sewage facilities for 2015-16 is Rs.252.5 million. The O&M budget is prepared as per the NGRBA (National Ganga River Basin Authority), Government of India, guidelines, which specify the staff and other O&M requirements for different capacity STPs and based on capital cost. The costs such calculated are used for tendering purpose. The entire loan from JICA for the GAP is taken by the Government of India, and the same is passed on to UPJN as grant. So UPJN does not repay the loan.

The Jal Kal operates under the Nagar Nigam and looks after O&M of all the water supply infrastructure (treatment plant to house connection) and underground sewer network (home connection to pump station or STP inlet). The current clear water production is 330 MLD, out of which 125 MLD is from surface source and balance 205 MLD is from tube wells (groundwater). Under JnNURM (Jawaharlal Nehru National Urban Renewal Mission), the entire water supply is proposed to be sourced from surface water. Total O&M cost is not recovered from the revenue collected. (Interviews with UPJN and Jal Kal)

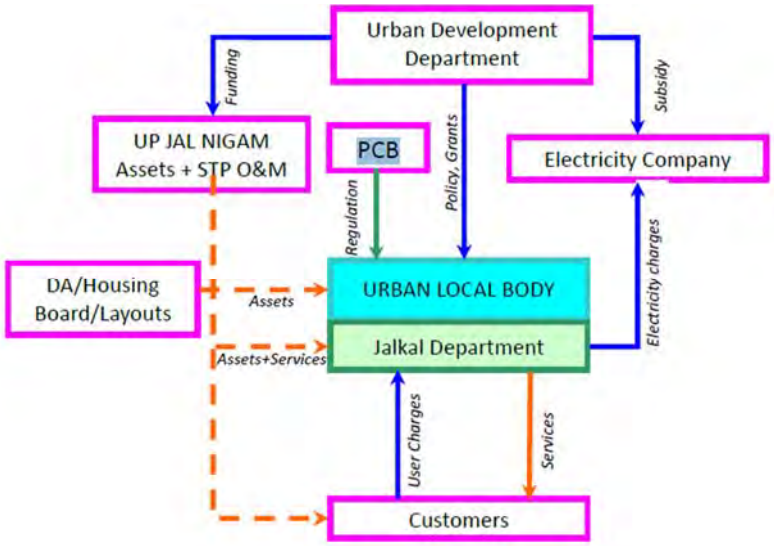
	Water Supply				Sewer			
	Plant (WTP)		Networks		Plant (STP)		Networks	
	Design& Construction	O&M	Design& Construction	O&M	Design& Construction	O&M	Design& Construction	O&M
UP JN	YES		YES		YES	YES	YES	
JAL KAL		YES		YES				YES

O&M: Operation and Maintenance

YES	NO

Source: Interview with UNJP and Jal Kal

Figure 12.1.2 Roles and Responsibilities in Varanasi (1)



Source: City Development Plan for Varanasi, 2041 (Issued in March 2015)

Figure 12.1.3 Roles and Responsibilities in Varanasi (2)

12.1.3 House Connection

There are two types of House connections, the connection with water pipe and/or the one with sewage pipe, and so theoretically, there are four patterns:

Table 12.1.1 Combination of Water and Sewage Connections

Type	Water Connection	Sewage Connection
1	YES	YES
2	YES	NO
3	NO	YES
4	NO	NO

Source: Interview with UNJP and Jal Kal

The picture taken in Varanasi below shows Type-1, the left thin pile is Water pipe and the right big pipe is for Sewage. Both systems are connected in this household. Water/Sewage tax and User-Charges varies depend upon each household environment.

Source: Pictures in Varanasi taken by JICA Study Team

Photo 12.1.1 How the connection of Water/Sewerage looks like

The connection of Water Supply

The connection of Water in Varanasi is 66% at 5th November 2015.

Table 12.1.2 House connection for Water in Varanasi

List of Tap & Nontap Houses for Water					
Ward	Total Houses (z)	Tap Houses (x)	Nontap Houses (y)	x/z	y/z
B	21,233	15,643	5,590	74%	26%
N	17,452	11,579	5,873	66%	34%
D	17,044	12,492	4,552	73%	27%
C	15,391	8,050	7,341	52%	48%
A	14,740	10,175	4,565	69%	31%
K	8,304	6,146	2,158	74%	26%
CK	6,670	4,275	2,395	64%	36%
S	18,992	12,096	6,896	64%	36%
SH	5,929	2,340	3,589	39%	61%
SN	11,358	8,572	2,786	75%	25%
J	13,123	8,508	4,615	65%	35%
	150,236	99,876	50,360	66%	34%

Source: The documents obtained from Jal Kal

The connection of Sewer

The connection of Sewer in Varanasi is 73% at 5th November 2015.

Table 12.1.3 House connection for Sewer in Varanasi

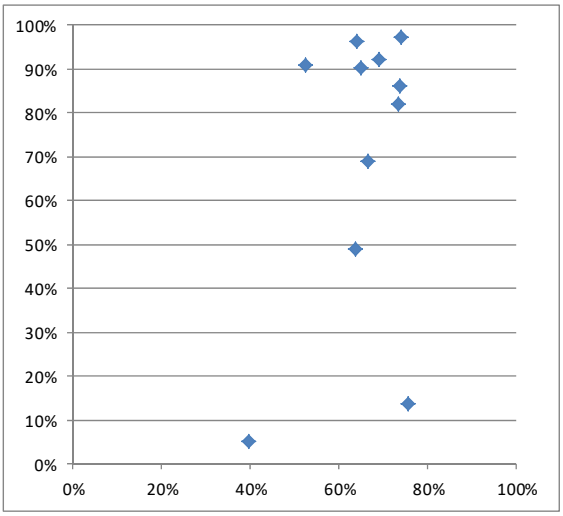
List of Tap & Nontap Houses for Sewer					
Ward	Total Houses (z)	Tap Houses (x)	Nontap Houses (y)	x/z	y/z
B	21,233	18,255	2,978	86%	14%
N	17,452	12,046	5,406	69%	31%
D	17,044	13,966	3,078	82%	18%
C	15,391	13,973	1,418	91%	9%
A	14,740	13,601	1,139	92%	8%
K	8,304	8,084	220	97%	3%
CK	6,670	6,413	257	96%	4%
S	18,992	9,323	9,669	49%	51%
SH	5,929	312	5,617	5%	95%
SN	11,358	1,564	9,794	14%	86%
J	13,123	11,855	1,268	90%	10%
	150,236	109,392	40,844	73%	27%

Source: The documents obtained from Jal Kal

The scatter diagram of Awards in Varanasi regarding the connections

From the above two tables of Water connection and Sewage connection, eleven Awards in Varanasi have scattered mapping in the following picture. About 70 % of eleven Awards, seven Awards, locate in the area that have higher connection in both Water and Sewage. Other four Awards seemingly will be necessary to be connected with water and sewerage connection.

(Vertical axis is Sewage-connection % and horizontal axis is Water-connection %)



	B	N	D	C	A	K	CK	S	SH	SN	J
W	74%	66%	73%	52%	69%	74%	64%	64%	39%	75%	65%
S	86%	69%	82%	91%	92%	97%	96%	49%	5%	14%	90%

Source: Analysis by JICA Study Team

Figure 12.1.4 Scatter diagram of 11 Awards in Varanasi regarding the connections

12.1.4 Tariff system and Connection

Jal Kal collects Tariff. The billing for water supply and sewerage is through the property tax (annual rental value – ARV – of the buildings) and is not volumetric. The revenue is through: (a) 12.5% of ARV as water tax, and (b) 4% of ARV as sewerage tax. The above noted water and sewerage taxes are collected through property tax from all households irrespective of whether the household has a water and/or sewerage connection, as long as the household is within the coverage area.

A household is said to be in the water supply coverage area if it is within 100m of a water main who is supposed to pay the water tax.

1) Tariff and its calculation

Tariff is charged to each household once a year (around in March). Table 12.1.4 shows the most updated 2015's Tariff system in Varanasi. "Water charge/tax" and "Sewage charge/tax" is about 4 to 1 (80%, 20%). Grand Total gradually increases in five classifications.

There are two names, Tax (water/sewage) and User-Charges in this Tariff system but both/either of them are levied at once from Table 12.1.4 (theoretically there are four types household which are with the same explanation of Table 12.1.1 as noted before)

If the household is connection "A" type and its ARV is Rs. 3568 (belong Serial No.5 of the Figure), the water tax is calculated Rs. 446 (3568 times 12.5%) and the Water charge is Rs.1089 (1535 deduct 446), or those total Rs.1535 is in the "Water tax/charge" of Serial No.5. Similarly, the sewage tax is calculated Rs. 143 (3568 times 4.0%) and then the Sewage charge is Rs.241 (384 deduct 143) which is the same Rs.384 in the "Water tax/charge" of Serial No.5. And then Rs.1535 and Rs.384 plus Rs.38 (Service charge) lead to total Rs.1957, or the Grand Total of No.5. Each household will pay one of each Grand Total basis, from No.1 toNo.5 patterns. In this Tariff system, the portion of the tax-based and the user-charge varies but both total amounts are always the same of one of each five Grand-totals if the household has both connections (water/sewage). However, if the ARV should be rather big and so its calculated tax (water/sewage) based on the ARV is bigger than the Grand-Total in the table, the calculated water/sewage tax is levied instead of from Tariff tables. For example, if the ARV is Rs.20000, then the water tax is Rs.2500 (2000 times 12.5%) which is higher that Rs.1918 of the table No.5, Rs.2500 will be charged instead of Rs.1918. (and the same logic for Sewage tax).

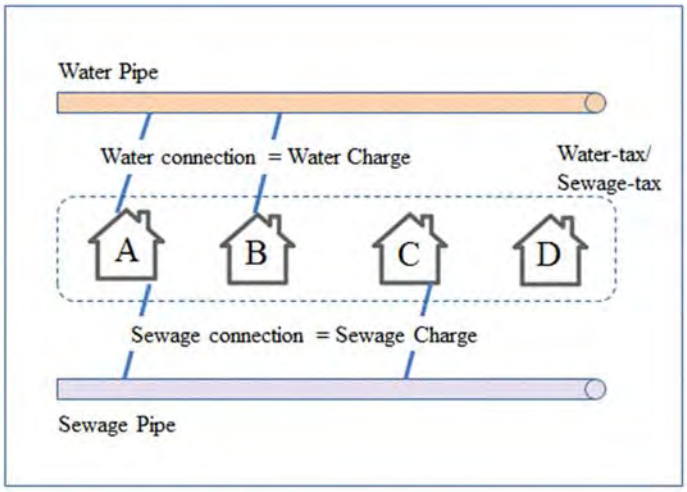


Figure 12.1.5 Connection for Water supply and Sewer

Table 12.1.4 Tariff system of 2015-16

JALKAL DEPARTMENT, NAGAR NIGAM, VARANASI							
TARIFF SYSTEM (Rs.)							
Previous Years (2015-16)							
Serial No.	Annual Valuation	Water Charge / Tax	Service Charge	Sewerage Charge / Tax	Grand Total	Discount	After Discount
1	01-360	575	38	144	**758**	72	685
2	361-2000	768	38	192	**998**	96	902
3	2001-3500	1151	38	288	**1477**	144	1333
4	3501-5000	1535	38	384	**1957**	192	1765
5	5001-	1918	38	480	**2436**	240	2196

Source: The documents from Jal Kal Varanasi

2) Water Tariffs

As noted in the above, the water tax is being collected based on the Annual Rental Value (ARV) of the buildings at the rate of 12.5% of ARV. In addition to the water tax, water charges, based on the ARV slab rate, are applicable for those customers with service connections. For tenants, connection about 15 mm will not be given. Following table shows the breakup of charges applicable for new water connections. ("Developing Strategy for Reduction of NRW" from Jal Kal)

Table 12.1.5 Connection Charges in Varanasi Jal Kal

No.	New Connection Charges	Rs.
1	Registration fee	100
2	Water Connection fee	450
3	Supervision fee	150
4	Ferrule charge	250
5	Minimum Development Fee (water)	1,600
	Total	2,550

Source: Varanasi Final Report from Jal Kal

3) The relationship of Tariffs and population of households

The combination of Tariff table and the number of household in 2013 is summarized in Table 13.1.8. The household in 2013 in Varanasi is 137,472 (while 150,236 at 5th November 2015). Class No.5 (ARV: over R.5001) is the most and class No.3 (ARV: Rs.361-2000) is the second in its population. The total Tariff amounts calculated by each Grand Total times each household numbers show Rs.232 million which is very close to annual total tariff income from audited financial report of Jal Kal 2013 (this will be noted later). It is can be said that half (50.8%) of total tariff revenue paid by the household whose ARV is over that Rs.5000. In others words, about 65% of households pay about 50% of total tariff revenue. (Household in No.5 pays at least Rs.2436, which is about twice of the average of other four classes, Rs.1281)

Table 12.1.6 Calculation Connection Charges in Varanasi Jal Kal

Serial No.	Annual Valuation	Minimum Water Tax	Service Charge	Sewerage Charge / Tax	Grand (a) Total	Household (b) (2013)		Tariff (a) x (b)	Ratio	
1	01-360	575	38	144	758	**13,663**	9.9%	Rs. 10,356,554	4.5%	
2	361-2000	768	38	192	998	**33,196**	24.1%	Rs. 33,129,608	14.3%	
3	2001-3500	1151	38	288	1477	**24,951**	18.1%	Rs. 36,852,627	15.9%	
4	3501-5000	1535	38	384	1957	**17,286**	12.6%	Rs. 33,828,702	14.6%	
5	5001-	1918	38	480	2436	**48,376**	35.2%	Rs. 117,843,936	50.8%	
						137,472	100.0%	Rs. 232,011,427	100.0%	(x)
								Rs. 227,986,770		(y)
								98.3%	(y) / (x)	

Source: Varanasi Final Report from Jal Kal

4) Water/Sewage Charge collection

Although the total amount of Charges from Sewage is less than Water, the collection ratio of Sewage is higher than that of Water. But both ratios seem to be almost the same % in recent year.

Table 12.1.7 Actual tariff collection at Jal Kal Varanasi

Lacs.	2012-2013	2013-2014	2014-2015
Non revenue water and Un accounted flow of Water			
Water Charges target (Rs)	2,952.25	2,688.00	2,688.00
Water Charges Collected (Rs)	1,524.94	1,539.36	1,928.30
Sewerage Charges target (Rs)	563.20	813.00	813.00
Sewerage Charges Collected (Rs)	476.18	513.06	620.04
Collection ratio			
Water	*52%*	*57%*	*72%*
Sewerage	*85%*	*63%*	*76%*

Source: Data obtained from Jal Kal

12.2 Existing Financial Situation

Under this Chapter we will discuss in brief the financial situation of various organizations that affect this Project and National Government (Government of India) and Government of Uttar Pradesh.

1. NMCG (National Mission for Clean Ganga)
2. State Government, in this case Uttar Pradesh
3. UP Jal Nigam
4. ULB (Urban Local Bodies): Varanasi Nagar Nigam and Jal Kal Varanasi
5. ULB: (Ramnagar, Chunar, Mirzapur and Ghazipur)

12.2.1 NMCG (National Mission for Clean Ganga)

JICA study team analyzed Income Statement and Balance Sheet of NMCG.

1) Income statement

The total amount has been rapidly increasing from 2011 to 2013 but 2014 was fell down from 2013. The total amount of Income and Expenditure of each year is the same, so no surplus. The Grant Utilized is a major source of NMCG income and Grant Unlisted is booked in the Balance sheet (see Table 12.2.1). The portion of Grants Untiled in NMCG Income compared with Grant Unlisted in the Balance Sheet is 3.2% (2011), 28.7% (2012), 40.2% (2013) and 14.6% (2014), or has been relatively increasing.

Table 12.2.1 Income/Expense Analysis of NMCG

	Description	2011-12	2012-13	2013-14	2014-15	Total	CAGR
A.	**INCOME**						
	Grants Utilised	37,449,325	809,359,418	1,607,374,611	741,057,488	3,195,240,842	170.5%
	Bank Interest & Others	23,075,069	43,148,370	76,402,409	134,471,781	277,097,629	80.0%
	TOTAL A)	**60,524,394**	**852,507,788**	**1,683,777,020**	**875,529,269**	**3,472,338,471**	143.7%
B.	**EXPENDITURES**						
	Under Institutional Development	33,823,201	72,309,998	110,550,105	164,488,255	381,171,559	69.4%
	Under Priority Infrastructure Development	-	766,200,000	1,560,546,000	682,694,300	3,009,440,300	-5.6%
	Under State SPMG's	3,371,709	13,997,790	12,680,915	28,346,714	58,397,128	103.3%
	TOTAL B)	**37,194,910**	**852,507,788**	**1,683,777,020**	**875,529,269**	**3,449,008,987**	
C.	**Excess of Income over Expenditure**	**23,329,484**	-	-	-		
D.	**Transfer to Capital Fund Account**	**23,329,484**	-	-	-		

Source: (Rs.) NMCG, Finance at Glance 2011, 2012, 2013 and 2014

2) Statement of financial position

The NMCG Balance sheet has been increasing for 35% per year (Note: the same amount of Grant-in-aid is booked in 2014, so it is netted out) Most of its Asset is current assets / loan / advances, and it has its own fixed asset, such as Computer or office equipment, which is small portion. "Advance" is a Grant which was moved from NMCG to SPMG but Unutilized. Since this Unutilized Grant has been increasing, it can be assumed that sanctioned projects to be started may be delayed or have to be waiting at each State or on-the-ground level.

Table 12.2.2 Balance Sheet Summary of NMCG

(Unit Rs.)

ASSETS	Fiscal Year (actual) 2011-12	2012-13	2013-14	2014-15	CAGR
1 Fixed Assets	254,415	7,105,681	11,867,043	20,439,439	
2 Current Assets, Loans & Advances etc.	1,903,075,018	2,959,505,659	4,178,073,199	5,989,498,897	46.5%
(Grant-in-Aid (Capital Assets/General))				*(1,331,765,000)*	
	1,903,329,433	**2,966,611,340**	**4,189,940,242**	6,009,938,336	46.7%
				4,678,173,336	35.0%

CAPITAL FUNDS & LIABILITIES	Fiscal Year (actual) 2011-12	2012-13	2013-14	2014-15	CAGR
1 Unutilised Grants	1,876,628,240	2,933,324,281	4,173,531,739	5,981,239,251	47.2%
Capital Funds	23,329,484	23,075,069	-	-	
2 Current Liabilities	3,371,709	3,106,309	2,840,553	3,038,767	-3.4%
Fixed Assets Reserves	-	7,105,681	13,567,950	25,660,318	
(Grant in Receivable)				*(1,331,765,000)*	
	1,903,329,433	**2,966,611,340**	**4,189,940,242**	6,009,938,336	
				4,678,173,336	

Source: NMCG, Finance at Glance 2011, 2012, 2013 and 2014

NMCG in 2014 has Current Asset abound Rs. 4,678 million. 44% of the total current asset at the Bank and 53% is Advance. It can be noted that NMCG is financially stable because almost half of the asset is cash. In Advance or 53% of total current asset, about 30% belongs to UP State and 70% belongs to other States. Regarding EAP (external aided project), EAP is 44% and Non-EAP is 56%. EAP to UP State in SMPG is 21% of all Advances.

Table 12.2.3 Current Asset of NMCG

(Unit Rs.)

		Bank	Advance	Other	Total	%	Advance
BOI	EAP	643,136,867			2,058,299,509	44.0%	
	Non-EAP	1,415,162,642					
SPMG UP	EAP		504,653,435		712,353,435	15.2%	21%
	Non-EAP		207,700,000				9%
SPMG Non-UP	EAP		840,754,151		1,723,141,951	36.8%	35%
	Non-EAP		882,387,800				36%
Other		107,352,098	54,523,371	22,502,972	184,378,441	3.9%	
Total		2,165,651,607	2,490,018,757	22,502,972	4,678,173,336	100.0%	100.0%
		46%	53%	0%			

SPMG UP	712,353,435	29%	EAP	1,988,544,453	44%
SPMG Non-UP	1,723,141,951	71%	Non-EAP	2,505,250,442	56%
	2,435,495,386			4,493,794,895	

Source: NMCG, Finance at Glance 2011, 2012, 2013 and 2014

More details about SPMG/EPA/Non-EAP from 2013and 2015 are noted in the Table 12.2.4. Regarding UP State, EAP is about 40% of Advance in 2015 and Non-EAP to the UP was very few.

Table 12.2.4 SPMG/EPA/Non-EAP of NMCG

(Unit Rs.)

	2013/3/31	2014/3/31	2015/3/31	2015/3/31
(5) Advances to SPMGs EAP				
(i) SPMG Uttrakhand	6,648,101	54,721,710	47,311,510	4%
(ii) SPMG Uttar Pradesh	12,375,500	311,837,135	504,653,435	38%
(iii) SPMG Bihar	6,000,000	473,600,000	561,530,000	42%
(iv) SPMG Jharkhand	4,577,900	65,762,214	70,753,714	5%
(v) SPMG West Bengal	3,459,000	167,158,527	161,158,927	12%
	33,060,501	1,073,079,586	1,345,407,586	
(6) Advances to SPMGs Non EAP				
(i)SPMG Bihar			197,108,100	18%
(ii)SPMG Uttrakhand			5,095,700	0%
(iii)SPMG Uttar Pradesh		85,000,000	207,700,000	19%
(iv)SPMG West Bengal		321,875,000	680,184,000	62%
	0	406,875,000	1,090,087,800	

Source: NMCG, Finance at Glance 2011, 2012, 2013 and 2014

12.2.2 Uttar Pradesh State Government

JICA study team analyzed Income Statement and Balance Sheet of Uttar Pradesh Government.

1) Budget of UP Government

Uttar Pradesh State's Budget of 2015-2016 is 302,677 Cr. rupees (Table 12.2.5). This budget size is 10.2% more than the budget of 2014-15 (274,704 Cr.). Tax revenue is increased from 157,501Cr. (2014) to 178,644 Cr. (2015), or 13.4% increase. The ratio of Tax revenue in Revenue of 2015 gets a bit higher than that of Non Tax Revenue compared in 2014. The Relocation from Loan in Capital Receipt is quite decreased from 490 Cr. (2014) to 263 Cr., or 46.4% decrease. The increase of Capital Receipt is lower (6.1%: from 44,153 to 46,843) and that of Receipt from Revenue (10.4%: from 226.418 to 249,880), which leads to the increase of Total Receipt is 9.7% (from 270,572 to 296,723). The ratio of Capital Receipt is decreased to 13.4% in 2015 from 16.3% in 2014. The ratio of Receipt of Revenue and Capital Receipt is around 85% to 15% for both years. Although the increase of Capital related expense surpass the increase of Revenue related (12.5% vv. 9.3%), the ratio of Revenue related expense and Capital related is not changed, around 70% to 30% for both years. The saving from Revenue increases by 17.7% from 34,124 Cr. (2015) from 28,993 Cr. (2015). However, the ratios of various kinds of Loss for both years are almost the same. Regarding the budget of 2015, total budget will increase and the Surplus is high of 13.66%, but the portion of Deficit in 2015 budget is rather higher than before.

2) Actual of UP Government

a) Income Statement

Both revenue and expenditures of UP State since 2008 have been increasing. (Figure 12.2.5)

From this 2008 to 2013 as actual data, the budget growth rate or Total expenditure is 11.7%. In that, Revenue expenditure is 13% growth and Capital expenditure is 6.8%. The Total Receipts is 11.5%, composing Tax Revenue for 13.8% growth and Non Tax Revenue for 13.4%. The portion of Tax Revenue of the each year budget is about 66% and Non tax is 20.5% and Capital receipts 13.5%. Revenue expenditure portion in the total expenditure is 82.1% and Capital expenditure is 17.9%. There is almost no surplus and deficit.

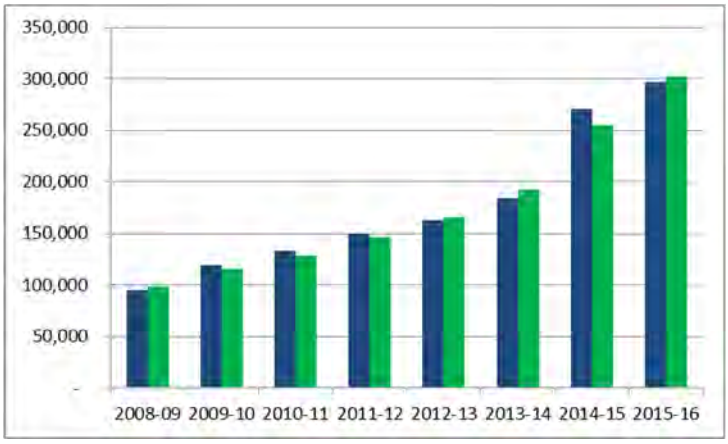
The total Tax Revenue ratio of its GDP in UP State is 22.3%, the one of Tax revenue is 14.2% and Non Tax revenue ratio is 4.8% (Table 12.2.6).

Table 12.2.5 Income Statement of Uttar Pradesh State

(Rs. In crores)

Items Revenue	2008-09 Actual	2009-10 Actual	2010-11 Actual	2011-12 Actual	2012-13 Actual	2013-14 Actual	2014-15 Budgeted	2015-16 Budgeted	Average	CAGR FY08-13	2008-13 (%)
(1) Tax Revenue	**59,565**	**65,674**	**84,574**	**102,964**	**115,596**	**129,359**	**157,502**	**178,644**	**85,675**	**13.8%**	66.1%
State's Own Tax Revenue	28,659	33,878	41,110	52,613	58,098	66,582	81,000	91,915	42,872	15.1%	
Fixed Share in Central Taxes	30,906	31,797	43,464	50,351	57,498	62,777	76,502	86,729	42,803	12.5%	
(2) Non Tax Revenue	**18,266**	**30,747**	**26,610**	**27,905**	**30,308**	**38,855**	**68,917**	**71,236**	**26,767**	**13.4%**	20.5%
State's Own Non Tax Revenue	6,767	13,601	11,176	10,145	12,970	16,450	20,232		10,932	16.0%	
Grants from the Government	11,499	17,146	15,434	17,760	17,338	22,405	48,685		15,835	11.8%	
(3) Capital Receipts	**17,538**	**22,782**	**21,879**	**19,785**	**16,239**	**15,489**	**44,154**	**46,843**	**19,645**	**-2.0%**	13.5%
Non Debt Capital Receipts	778	293	485	133	419	589	491	263	422	-4.5%	
Other Receipt which included to Advance from Reserve Bank of India	16,760	22,489	21,394	19,652	15,820	14,900	43,663	46,580	19,223	-1.9%	
Total Receipts (Revenue + Capital)	**95,369**	**119,203**	**133,063**	**150,654**	**162,143**	**183,704**	**270,573**	**296,723**	**132,086**	**11.5%**	
Expenditure											
(4) Revenue Expenditure	**75,969**	**89,374**	**107,676**	**123,885**	**140,724**	**158,147**	**197,425**	**215,756**	**107,526**	**13.0%**	82.1%
Plan Expenditure	17,291	15,701	21,040	22,616	25,878	31,657	43,720		20,505	10.6%	
Non Plan Revenue Expenditure	58,678	73,672	86,636	101,269	114,846	126,490	153,704		87,020	13.7%	
(5) Capital Expenditure	**23,153**	**26,033**	**21,241**	**22,550**	**24,837**	**34,336**	**57,406**	**86,931**	**23,563**	**6.8%**	17.9%
Capital Outlay	22,346	25,091	20,273	21,574	23,834	32,863	55,986		22,624	6.6%	
Loans and Advance	807	942	968	976	1,003	1,473	1,420		939	10.5%	
Total Expenditure	**99,122**	**115,407**	**128,917**	**146,435**	**165,561**	**192,483**	**254,831**	**302,687**	**131,088**	**11.7%**	
(6) Fiscal Deficit (Revenue-Expenditure)	(3,753)	3,796	4,146	4,219	(3,418)	(8,779)	15,742	(5,964)	998	15.2%	
(7) Total Revenue Receipts (1)+(2)	77,831	96,421	111,184	130,869	145,904	168,214	226,419	249,880	112,442	13.7%	
(8) Revenue Surplus (7)-(4)	1,862	7,047	3,508	6,984	5,180	10,067	28,994	34,124	4,916	32.5%	
(9) Revenue Surplus / Total Revenue(8)/(7)	2.39%	7.31%	3.15%	5.34%	3.55%	5.98%	12.81%	13.66%			

Source: Financial Statement of UP Sate by JICA Study Team



Figures 12.2.1 Revenue (blue) and Expenditure (green) of Uttar Pradesh State

Source: Data obtained by JICA study team

Table 12.2.6 Comparison of GDP and Budget of Uttar Pradesh

	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	2013-14	Average
GSDP (GDP in UP State)	491,302	523,394	600,286	685,292	782,285	862,746	976,297	
Tax Revenue Comapred to GSDP	12.1%	12.5%	14.1%	15.0%	14.8%	15.0%	16.1%	14.2%
Non-Tax Revenue Comapred to GSDP	3.7%	5.9%	4.4%	4.1%	3.9%	4.5%	7.1%	4.8%
Total Revenue Comapred to GSDP	19.4%	22.8%	22.2%	22.0%	20.7%	21.3%	27.7%	22.3%

Source: http://www.statisticstimes.com/economy/gdp-of-indian-states.php

b) Statement of financial position (balance sheet)

Asset of UP State has been increasing from 2008 to 2013 by 11.8% and its Liability is 6.6%. So the cumulative deficit is decreasing about 11.5% per year, which can imply in the near future no deficit. Annual growth rate (CAGR) of Capital expenditure of Water and Sewerage is about 30% which surpasses the total capital expenditure growth (13.2%).

Liability is mainly composed of three sources, Public Debt, Contingency Fund and Public Account (these three accounts are illustrated in the Figure 12.2.7). The portion of Public Debt is 62% and Public account is 35% (In Public Account, Provision or Pension occupies 42% of its account).

Table 12.2.7 Financial position of Uttar Pradesh

(Rs. In crores)

Asset	2008-09	2009-10	2010-11	2011-12	2012-13	2013-14	CAGR	
Cash	9,112	3,451	10,350	13,492	15,218	4,066	-12.6%	
Capital Expenditure	111,501	136,593	156,865	178,439	202,274	235,136	13.2%	
i)Investment in share of company, corporations in Non-financial Public Sector Undertakings (PSUs)	28,129	34,275	38,273	42,607	46,228	52,467	10.9%	
ii)Other Capital Expenditure	83,373	102,318	118,593	135,832	156,046	182,670	14.0%	
*Water and Sewerage**	*884*	*914*	*1,190*	*1,367*	*2,835*	*4,328*	*30.3%*	
Other Assets	9,021	9,670	10,194	11,307	11,844	14,096	7.7%	
Total Asset	129,635	149,713	177,410	203,238	229,335	253,298	11.8%	
Liability								
Public Debt	117,703	132,524	146,535	157,899	164,810	171,544	6.5%	62%
i)Internal Debt	97,339	113,077	128,025	140,389	148,399	156,208	8.2%	
ii)Loans and Advances from Central Government	20,364	19,447	18,510	17,511	16,412	15,336	-4.6%	
Contingency Fund	517	600	600	600	600	600	2.5%	0%
Public Account	69,707	69,197	78,250	85,330	94,810	110,165	7.9%	35%
i)Small Savings, Provident Funds, etc.	25,359	29,229	34,100	37,730	41,072	43,435	9.4%	
ii)Reserve Funds	16,116	16,210	26,096	31,584	35,970	43,924	18.2%	
iii)Deposits	28,232	23,758	18,054	16,016	17,769	22,806	-3.5%	
Suspense and Miscellaneous Balances	272	276	3,947	4,555	8,095	0	-100.0%	
Remittance Balances	4,555	3,190	642	434	1,419	1,322	-18.6%	
Total Liability	192,755	205,786	229,974	248,818	269,735	283,631	6.6%	
Cumulative excess of receipts over expenditure	-63,120	-56,073	-52,564	-45,580	-40,400	-30,333	-11.5%	

**: Included to Capital Investment*

Source: Financial Statement of UP Sate by JICA Study Team

3) Budget of UP Government

Uttar Pradesh State's Budget of 2015-2016 is 302,677 Cr. rupees. This budget size is 10.2% more than the budget of 2014-15 (274,704 Cr.). Tax revenue is increased from 157,501Cr. (2014) to 178,644 Cr. (2015), or 13.4% increase. The ratio of Tax revenue in Revenue of 2015 gets a bit higher than that of Non Tax Revenue compared in 2014. The Relocation from Loan in Capital Receipt is quite decreased from 490 Cr. (2014) to 263 Cr., or 46.4% decrease. The increase of Capital Receipt is lower (6.1%: from 44,153 to 46,843) and that of Receipt from Revenue (10.4%: from 226.418 to 249,880), which leads to the increase of Total Receipt is 9.7% (from 270,572 to 296,723). The ratio of Capital Receipt is decreased to 13.4% in 2015 from 16.3% in 2014. The ratio of Receipt of Revenue and Capital Receipt is around 85% to 15% for both years. Although the increase of Capital related expense surpass the increase of Revenue related (12.5% vv. 9.3%), the ratio of Revenue related expense and Capital related is not changed, around 70% to 30% for both years. The saving from Revenue increases by 17.7% from 34,124 Cr. (2015) from 28,993 Cr. (2015). However, the ratios of various kinds of Loss for both years are almost the same

Table 12.2.8 The State Budget of Uttar Pradesh

UP Government				
SUMMARY OF BUDGET （Cr.)				
	2013-2014 Actual Data	2014-2015 Budget Estimate	2014-2015 Revised Estimate	2015-2016 Budget Estimate
1 Receipt from Revenue (2 + 3)	168,213.75	226,418.77	223,997.46	249,880.23
2 Tax revenue(*)	129,358.77	157,501.55	151,391.31	178,644.11
3 Non Tax revenue(@)	38,854.98	68,917.22	72,606.15	71,236.12
4 Capital Receipt (5 + 6 + 7)	15,490.02	44,153.90	34,704.22	46,843.02
5 Relisation from Loan	589.57	490.96	540.68	263.40
6 Other receipt	0.00	0.00	0.00	0.00
7 Other receivables which included advance from Reserve Bank of India	14,900.45	43,662.94	34,163.54	46,579.62
8 Total Receipt (1 + 4)	183,703.77	270,572.67	258,701.68	296,723.25
9 Sundry Expenses (10 + 12)	137,561.36	179,665.45	164,909.17	195,966.90
10 Revenue Expenses	126,489.47	153,704.40	146,342.63	165,411.02
11 Interest Expenses	17,412.44	18,885.34	18,636.80	21,116.97
12 Capital Expenses	11,071.89	25,961.05	18,566.54	30,555.88
13 Payment / redemption of Loan which included advance from Reserve Bank of India	8,166.74	19,383.88	10,383.88	20,983.89
14 Expenses related Events	63,088.24	95,039.14	98,393.66	106,720.42
15 Related with revenue	31,657.40	43,720.48	45,247.60	50,345.16
16 Related with Capital Expenses	31,430.84	51,318.66	53,146.06	56,375.26
17 Total Expenditure (9 + 14)	200,649.60	**274,704.59**	263,302.83	**302,687.32**
18 Revenue Expenditure (10 + 15)	158,146.87	197,424.88	191,590.23	215,756.18
19 Capital Expenditure (12 + 16)	42,502.73	77,279.71	71,712.60	86,931.14
20 Saving from Revenue (1 - 18)	10,066.88	28,993.89	32,407.23	34,124.05
21 Fiscal Loss	23,679.54	28,410.98	28,380.81	31,559.80
22 Preliminary Loss (21 - 11)	6,267.10	9,525.64	9,744.01	10,442.83

(*) It's included state revenue tax as well as Central revenue Tax
(@) It's included state revenue tax as well as Central Grant

Source: Budget of Uttar Pradesh Government

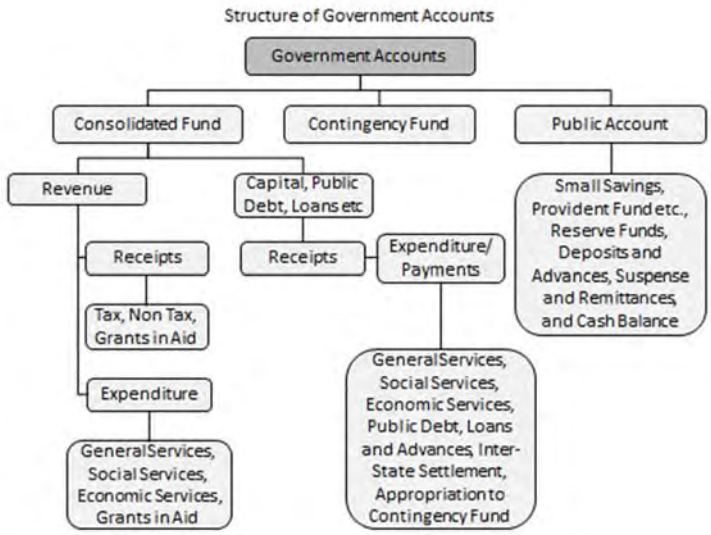
4) Budget/Actual of Grant 37

Grant 37 comes from The Ministry of Urban Development (MoUD) to each State including UP Government and is distributed to each district of the State. This contains the budget related to Water/Sewage, so this is the source of UP JN budget. The Revenue account growth per year (CAGR) is rather higher than Capital account. Revenue account growth surpasses Capital accounts; especially Non plan Revenue account has been increasing rapidly for both budget and actual.

Table 12.2.9 The total "Grant 37" of Uttar Pradesh

(Rs. In crores)		2009-10		2010-11		2011-12		2012-13		2013-14		2014-15		2015-16		CAGR	
		Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual	Budget	Actual	B)FY15	A)FY13
Revenue	Plan	-	361	1,003	307	635	275	148	85	2,438	3,512	3,512	0	2,928	-	24%	113%
Account	Non Plan	-	128	42	310	477	216	978	827	792	1,467	1,467	0	1,703	-	110%	125%
	R-total		**489**	**1,045**	**617**	**1,112**	**491**	**1,127**	**912**	**3,230**	**4,979**	**4,979**	**0**	**4,631**		35%	117%
Capital	Plan	-	877	2,040	1,373	1,682	2,030	3,388	2,650	1,645	1,467	1,467	0	1,520	-	-6%	19%
Account	Non Plan	-	15	0	0	0	0	0	0	0	141	141	0	0	-		112%
	C-total	-	**891**	**2,040**	**1,373**	**1,682**	**2,030**	**3,388**	**2,650**	**1,645**	**1,608**	**1,608**	**0**	**1,520**	-	-6%	22%
Total		-	**1,381**	**3,085**	**1,990**	**2,794**	**2,521**	**4,515**	**3,562**	**4,875**	**6,586**	**6,586**		**6,151**	-	**15%**	**68%**
Actual																	
Revenue/Capital	Budget			51%		66%		33%		196%		310%		305%			
	Actual		55%		45%		24%		34%		310%						
Actual/Budget	R-total			59%		44%		81%		154%							
	C-total			67%		121%		78%		98%							

Source: Financial Statement of Grant 37 of UP Government



Figures 12.2.2 Structure of Government account of UP State

Source: Finance Account, UP State

Water/Cleaning budget of Grant 37, Capital Account growth is small but Revenue Account growth is very high (59.3%) per year.

Table 12.2.10 Water/Cleaning in "Grant 37" of Uttar Pradesh

(Rs. In crores)

			2009-10		2010-11		2011-12		2012-13		2013-14		2014-15		2015-16		CAGR	
			B	A	B	A	B	A	B	A	B	A	B	A	B	A	B)FY15	A)FY13
Revenue Account	Water Supply and Cleaning	Plan		112	104	57	40	37	10	20	495	478	828		1,066		59.3%	103.1%
		Non Plan						3	3	3	4	4	4		4			
	Total			**112**	**104**	**57**	**40**	**40**	**13**	**23**	**499**	**482**	**832**		**1,070**		59.4%	1.037135027
Capital Account	Capital Expenditure on water supply and Cleaning	Plan		**126**	**586**	**440**	**672**	**246**	**586**	**371**	**315**	**323**	**366**		**650**		2.1%	-9.7%

12.2.3 Budgetary system in GOI and UP State Government

The financial sustainability of UP State Government can be known from the 14the commission report issued in 2016.

1) Transfers Recommended by the 14th Finance Commission

14th Commission report in 2016 says that Transfers Recommended by the 14th Finance Commission, the grant from central government to each state, shows about RS.596 billion from 2015-2020.

Table 12.2.11 Transfers Recommended by the 14th Finance Commission

	2014-15 (BE)	2015-16	2016-17	2017-18	2018-19	2019-20	Total (2015-20)
1 Tax Devolution to States	3,822,160	5,792,820	6,684,250	7,723,040	8,934,300	10,347,450	39,481,870
2 Total Grants to States from Finance Commission (A+B+C)	646,750*	888,650	1,006,460	1,031,010	1,110,630	1,336,780	5,373,540
A Post Devolution Revenue Deficit Grant to States	75,500	489,060	413,080	358,200	345,810	342,060	1,948,210
B Disaster Relief Grant to States	57,910	99,710	104,700	109,930	115,430	121,200	550,970
C Grants to Local Bodies to States	224,940	299,880	488,680	562,880	649,390	873,520	2,874,360
3 Aggregate Transfers to States from Finance Commission (1+2)	4,468,910	6,681,460	7,690,710	8,754,060	10,044,940	11,684,240	44,855,410
4 Divisible Pool**	12,116,630	13,792,430	15,914,880	18,388,200	21,272,150	24,636,790	94,004,440
5 Fiscal Space Available with the Union Government (4-3) of	7,647,720	7,110,960	8,224,160	9,634,140	11,227,210	12,952,560	49,149,040
6 Provision for other transfers (expected) to states (7-2)	1,973,500	2,350,040	2,902,630	3,496,650	4,056,620	14,779,430	0
7 Total Grants from the Union to States	3,675,290	2,862,140	3,356,500	3,933,640	4,607,290	5,393,400	20,152,970
8 Aggregate Transfers to States (1+7)	7,497,450	8,654,960	10,040,750	11,656,690	13,541,590	15,740,850	**59,634,840**
As a Percentage of Divisible Pool							
1 Tax Devolution to States	31.54%	42.00%	42.00%	42.00%	42.00%	42.00%	42.00%
2 Grants from FC to States	5.34%	6.44%	6.32%	5.61%	5.22%	5.43%	5.72%
3 Tax Devolution and FC Grants to States	36.88%	48.44%	48.32%	47.61%	47.22%	47.43%	47.72%
4 Fiscal Space with the Union of which	63.12%	51.56%	51.68%	52.39%	52.78%	52.57%	52.28%
5 Provision for other transfers (expected) to states	14.31%	14.77%	15.79%	16.44%	16.47%	15.72%	
6 Aggregate Transfers to States	61.88%	62.75%	63.09%	63.39%	63.66%	63.89%	63.44%

Source: 14th Commission report in 2016

2) Share of States

14th Commission report in 2016 also says that Share of States of Uttar Pradesh State is 17.96%. As the grant of 14th Commission from Government is about Rs.596 billion as noted in the previous table, this Grant to UP State from 2015 to 2020 is Rs.1,070,982 million. (Rs.596 billion times 17.96%)

Table 12.2.12 Share of States

States	Share of States	States	Share of States
Andhra Pradesh	4.31%	Manipur	0.62%
Arunachal Pradesh	1.37%	Meghalaya	0.64%
Assam	3.31%	Mizoram	0.46%
Bihar	9.67%	Nagaland	0.50%
Chhattisgarh	3.08%	Odisha	4.64%
Goa	0.38%	Punjab	1.58%
Gujarat	3.08%	Rajasthan	5.50%
Haryana	1.08%	Sikkim	0.37%
Himachal Pradesh	0.71%	Tamil Nadu	4.02%
Jammu & Kashmir	1.85%	Telangana	2.44%
Jharkhand	3.14%	Tripura	0.64%
Karnataka	4.71%	**Uttar Pradesh**	**17.96%**
Kerala	2.50%	Uttarakhand	1.05%
Madhya Pradesh	7.55%	West Bengal	7.32%
Maharashtra	5.52%	All States	100.00%

Source: 14th Commission report in 2016

3) Uttar Pradesh State Assessed Own Revenue Receipts and Revenue Expenditure

14th Commission report in 2016 shows that Uttar Pradesh State Assessed Own Revenue Receipts and Revenue Expenditure as the table below. Although Own Revenue Receipt has been increasing by about 14.3% from 2015 to 2010, Revenue Expenditure has surpassed which lead to Revenue Deficit Rs.5,373,350 million between 2015 and 2010. However, as noted before, the Grant of 14the Commission to UP State from 2015 to 2020 is Rs.1,070,982 million. (Rs.596 billion times 17.96%) which can well recover its Deficit.

Table 12.2.13 Uttar Pradesh State Assessed Own Revenue Receipts and Revenue Expenditure

Rs. million

		2015-16	2016-17	2017-18	2018-19	2019-20	2015-20	
A	GSDP	11,029,150	12,430,430	14,009,750	15,789,730	17,795,850	71,054,900	12.7%
B	**Own Revenue Receipts**	**1,148,420**	**1,308,500**	**1,493,480**	**1,707,480**	**1,958,430**	**7,616,330**	**14.3%**
1	Own Tax Revenue	918,060	1,040,530	1,179,340	1,336,680	1,515,000	5,989,610	13.3%
2	Own Non-Tax Revenue	230,360	267,970	314,140	370,810	443,440	1,626,720	17.8%
C	Revenue Expenditure	1,967,640	2,233,920	2,525,330	2,863,790	3,399,010	12,989,680	14.6%
1	Equalization	91,140	123,770	151,510	192,390	391,720	950,510	44.0%
2	Interest Payment	223,720	246,740	272,680	301,920	334,870	1,379,910	10.6%
3	Pension	283,790	312,170	343,390	377,730	415,500	1,732,580	10.0%
D	Pre-Devolution Revenue Deficit (+) / Surplus (-)	819,210	925,410	1,031,850	1,156,310	1,440,570	5,373,350	15.2%

Source: 14th Commission report in 2016

12.2.4 Urban Local Bodies (ULB)

JICA study team analyzed financial information of Urban Local Bodies

1) Varanasi Nagar Nigam (VNN)

JICA study team analyzed five years Income Statement (actual) from 2010 to 2014 and three years financial position (balance sheet) from 2010 to 2012. (All data is obtained from VMC. Income statement is from two sources, one is between from 2010 to 2013 and the other from 2013 to 2014. Since the Chart of Account (C/A) is different between two sources, the latest CA is complied with the previous years' C/A by allocation used the ratio of the previous years)

a) Income/Expense Analysis of VNN

The total Receipt (Revenue and Capital) increases 11.2% per year, total Expenditure (Revenue and Capital) does by 16.1%, and surplus -15.8%, however, the surplus is being accumulated by 23% per year (see "Closing Balance" of Income statement). The total Receipt growth is not steady, or the budget in 2013 was pretty larger than other years. Total Revenue receipt is less growth (16.7%) than Revenue expenditure growth (18.7%). And in total Revenue, the portion of Tax revenue is 21% from 2010-2014 or that of Non tax revenue is 79%, and this Not tax revenue growth (9%) surpasses that of Tax revenue (18.6%) per year. In Non tax revenue, about 93% comes from Grants and has been rapidly increasing by 22.5% per year. Although the financial statement shows seemingly sound as it has surplus but it is supported by Grants. In Revenue expenditure, there is Water Supply account whose portion is 34%, which is the largest one among Expenditure.

Per observation of the income and expenditure statement of VNN, it is noted that every year VNN records surplus, in terms of revenue receipt against revenue expenditure. Therefore, financial situation is rather healthy and it maintains relatively strong financial sustainability.

Table 12.2.14 Summary of Income & Expenditure of Nagar Nigam Varanasi

(Unit million Rs.)

	Fiscal Year					CAGR	Portion
Current Account Receipts	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	FY10-14	
Revenue Receipts	**1,162**	**990**	**1,291**	**2,072**	**2,152**	16.7%	
1 **Taxes Revenue**	253.5	252.8	308.4	430.6	358.4	9.0%	21%
2 **Non Tax Revenue**	905.9	733.9	974.1	1,636.5	1,793.8	18.6%	79%
Grants	*768.9*	*663.9*	*889.3*	*1,547.9*	*1,731.6*	*22.5%*	
3 **Suspense Account**	2.9	3.6	8.5	5.0	1.9	-9.8%	
Current Account Expenditure							
Revenue Expenditure	**852.3**	**1,160.9**	**1,245.2**	**1,957.2**	**1,690.6**	18.7%	
Water Supply, Drainage & Conservancy	*341.7*	*426.1*	*466.1*	*559.3*	*582.1*	*14.2%*	*34%*
Capital Account Receipts							
1 Capital Receipts	**713.3**	**2,758.2**	**1,065.0**	**3,067.9**	**715.9**	0.1%	
Capital Account Expenditure							
Capital Expenditure	**610.9**	**2,796.7**	**933.6**	**2,700.0**	**969.9**	12.3%	
Sewers & Public Toilets	*610.9*	*2,590.6*	*893.9*	*2,684.8*	*394.8*	*-10.3%*	
Total Receipts - Total Expenditure	*412.3*	*-209.1*	*177.3*	*482.8*	*207.6*	-15.8%	
Opening Balance	99.7	512.0	302.9	480.2	963.0		
Revenue Receipts Total	1,162.3	990.3	1,291.1	2,072.0	2,152.3	11.2%	
Capital Receipts Total	713.3	2,758.2	1,065.0	3,067.9	715.9		
Total	1,975.3	4,260.5	2,659.0	5,620.1	3,831.1		
Revenue Expenditure Total	852.3	1,160.9	1,245.2	1,957.2	1,690.6	16.1%	
Capital Expenditure Total	610.9	2,796.7	933.6	2,700.0	969.9		
Closing Balance	512.0	302.9	480.2	963.0	1,170.6	23.0%	
Total	1,975.3	4,260.5	2,659.0	5,620.1	3,831.1	18.0%	

Source: Financial data from Nagar Nigam Varanasi by JICA study team

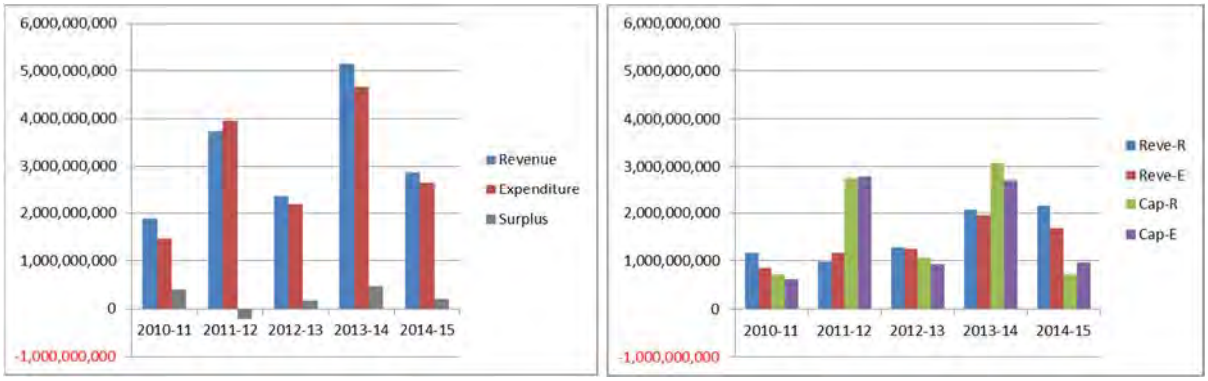


Figure 12.2.3 Revenue and Expenditure of VNN (Rs.)

Source: Financial data from Nagar Nigam Varanasi by JICA study team

b) Financial position (Balance Sheet) from 2010 and 2012 of VNN

The total balance sheet has been increased from Rs. 4,184 million to Rs. 7,744 million for these there years. In Asset side, about 60% is Fixed Asset and about 40% is Current Asset. In Current Asset, Loan, Advances and Deposits have been rapidly increasing, which occupies most of Current Asset. In Liability side, it can be noted that the plug between Asset and Liabilities is charged into the account called "Municipal (General) Fund". Regarding grants, they are Grants from Central government, grants from State government, Grant from Government agencies, grants from

financial institution, grants from international organization and others and VNN has grants from three sources, Grants from Central government (about 75%), Grants from State Government (about 23%) and others (about 2%), from other detailed information.

Table 12.2.15 Summary Balance sheet of VNN from 2010 to 2012

(million Rs.)

	Fiscal Year			CAGR	(%)
	2010-11	2011-12	2012-13	FY10-12	FY2012
Fixed Assets					
Fixed Assets	3,540	3,687	3,675	1.9%	47.5%
Capital Work In Progress	0	9	9		0.1%
Total Fixed Assets	3,540	3,696	3,684	2.0%	47.6%
Investments					
Investment-General Fund	0	80	80		1.0%
Investment-Other Fund	124	0	0		0.0%
Total Investments	124	80	80		1.0%
Current Assets, Loans and Advances					
Stock in Hand (Inventories)	7	105	156	366.7%	2.0%
Gross amount outstanding	51	74	72	18.7%	0.9%
Cash and Bank Balances	455	178	380	-8.6%	4.9%
Loan, Advances and Deposits	8	2,605	3,373	1907.5%	43.6%
Total Current Assets, Loans and Advances	521	2,962	3,981	176.4%	51.4%
Total Other Assets	0	0	0		
Total Assets	4,185	6,737	7,744	36.0%	100.0%
Liabilities					
Municipal (General) Fund	3,579	3,540	3,499	-1.1%	45.2%
Earmarked Funds	16	16	16	0.0%	0.2%
Reserves	12	188	188	290.8%	2.4%
Reserve and Surplus	3,607	3,744	3,703		47.8%
Grants, Contribution for Specific Purpose	363	2,871	3,957	230.4%	51.1%
Total Loans	0	0	0		
Current Liabilities and Provisions					
Deposits Received	6	6	11	34.9%	0.1%
Other Liabilities (Sundry Creditors)	209	117	73	-40.8%	0.9%
Total Current Liabilities and Provisions	215	122	84	-37.4%	1.1%
Total Liabilities	4,185	6,737	7,744	36.0%	100.0%

Source: Financial data from Mirzapur by JICA study team

c) Fixed Asset in 2010-11 VNN

As noted in the previous table, a large portion of balance sheet is fixed assets. In this fixed assets, it can be said that most of Fixed Asset is Land, or Depreciable property such as building or vehicles are rather less amount.

Table 12.2.16 Summary of Fixed Asset in 2010-11 of VNN

Rs. Million

Land	3,070.8	**Other Assets**	0.0
Buildings	227.8	Plant & Machinery	10.7
Infrastructure	0.0	Vehicles	62.4
Assets	0.0	Office & other	0.0
Road and Bridges	83.6	Equipment	3.3
Sewerage and	0.0	Lane	5.9
Drainage	43.1	Furniture, Fixtures	0.0
Water ways	1.5	Fittings and	0.0
Public lighting	11.9	Electrical	0.0
		Appliances	8.6
		Other Fixed Assets	10.0
		Total	**3,539.6**

2) Mirzapur

The financial information of Mirzapur Nagar Palika Parishad that JICA study team analyzed is the actual Income statement between 2011 and 2013 but Budgets/Estimations of 2014 and 2015. There is no information of Statement of financial position (Balance Sheet), but there is Surplus/Deficit account. This statement contains Water tax, water supply related information. (But no detailed information similar to Jal Kal Varanasi)

a) Income/Expense Analysis of Mirzapur

The total income of the budget (actual) has been increasing from 2011 to 2015 by 33.1%, each growth rate, Tax revenue is 25.5% growth and Non-tax revenue is 34.3%, so the growth rate of Non-tax revenue surpasses Tax revenue growth. The portion of Tax Revenue from 2011 to 2015 is about 12% and that of Non Tax Revenue is 88% among both revenues. This is because Grants occupy as much as 95.8% in Not Tax Revenue (the ratio between 2011 and 2014 or Actual). Although 2012 and 13 had Surplus but 2014 and 2015 will be deficit. The deficit ratio of 2015 budget (estimation) is about 4% of the budget. From these, it could be said that the financial stability of this ULB is not strong. The ratio of Water revenue (Water Tax and Water Price) of total income is about 4.9% which is rather high among the Tax Revenue, and it has been increasing 25.5% per year since 2011. Regarding Expenditure, the annual growth (CAGR) is 29% which is less than that of Total Income. Road (Cleaning and Construction) occupy high, 46% between 2011 and 2014 or Actual. The portion of Public Health and Comfort (or Water related) is 5.6% and its growth rate is very high as much as 75.6%.

Table 12.2.17 Summary of Income & Expenditure of Nagar Palika Parishad Mirzapur

(Unit In Rs.)

	2011-12	2012-13	2013-14	2014-15 Est	2015-16 Est	CAGR	2011-2013 (%)
Income							
Taxes Revenue							
Water Tax & Value	10,082,432	15,434,617	18,943,000	22,500,000	25,000,000	25.5%	4.8%
Stamp & Registration Fee	6,177,611	9,636,543	8,192,655	1,400,000	15,000,000	24.8%	2.6%
Property Tax	10,917,568	15,113,515	19,166,000	22,500,000	25,000,000	23.0%	4.9%
Other Tax	446,589	21,600	22,840	1,100,000	1,100,000	25.3%	0.1%
Total A)	**27,624,200**	**40,206,275**	**46,324,495**	**47,500,000**	**66,100,000**	24.4%	
Non Tax Revenue							
Water Price	199,075	319,344	428,901	400,000	1,200,000		0.1%
Other Income	6,085,187	5,238,807	2,564,402	42,332,000	77,132,000	88.7%	1.5%
Rent from Land & Building	1,325,720	1,405,631	1,367,065	2,500,000	2,500,000	17.2%	0.4%
State F.C. Grant	165,434,428	205,444,470	287,201,418	350,000,000	450,000,000	28.4%	71.6%
Central F.C. Grant	11,578,351	36,691,849	64,912,660	40,000,000	70,000,000	56.8%	12.3%
Backward Regions Grant	-	-	15,105,200	1,750,000	-	-	1.6%
Total B)	**184,622,761**	**249,100,101**	**371,579,646**	**436,982,000**	**600,832,000**	34.3%	
Total Income (A+B)	**212,246,961**	**289,306,376**	**417,904,141**	**484,482,000**	**666,932,000**	33.1%	
Expenditure							
General Government & Collection Expenses	45,501,946	43,519,641	52,938,756	61,700,000	82,200,000	15.9%	18.3%
Citizen Protection (Path Lighting & Material Maintenance)	12,490,818	6,714,885	5,835,488	14,100,000	20,000,000	12.5%	3.2%
Public Health and Comfort	15,765,224	6,220,557	21,310,863	62,500,000	150,000,000	75.6%	5.6%
Cleaning of Road, Drainage & Toilets	78,775,510	49,326,211	57,876,105	81,500,000	114,000,000	9.7%	24.0%
Public Works Road Construction & Salaries	41,438,647	44,644,681	83,994,752	211,500,000	268,300,000	59.5%	22.0%
Loan Recovery	19,155,909	21,110,378	48,373,343	20,000,000	22,500,000	4.1%	11.4%
Miscellaneous Expenses	38,183,668	30,107,452	51,082,355	35,800,000	38,150,000	0.0%	15.4%
Total Expenditure	**251,311,722**	**201,643,805**	**321,411,662**	**487,100,000**	**695,150,000**	29.0%	
Surplus/(Deficit) of Income - Expenditure	**(39,064,761)**	**87,662,571**	**96,492,479**	**(2,618,000)**	**(28,218,000)**	-7.8%	
Surplus Carried forward from Previous period	- 26,187,045	- 12,877,716	74,784,855	171,277,334	168,659,334		
Surplus Carried forward to Next period	- 12,877,716	74,784,855	171,277,334	168,659,334	140,441,334		

Source: Financial data from Mirzapur by JICA study team

b) Water related Income/Expense Analysis of Mirzapur

The actual financial data shows that Water Revenue and its expenditure almost balance, but the (expenditure) budget of 2014 and 2015 well surpasses its revenue.

Table 12.2.18 Water Income & Expenditure of Mirzapur

(Unit In Rs.)

	2011-12	2012-13	2013-14	2014-15 Est	2015-2016 Est
Taxes Revenue (1)					
Water Tax & Value	10,082,432	15,434,617	18,943,000	22,500,000	25,000,000
Water Price	199,075	319,344	428,901	400,000	1,200,000
	10,281,507	**15,753,961**	**19,371,901**	**22,900,000**	**26,200,000**
Expenditure (2)					
Water supply and capital expenditure			12,350,807	22,500,000	50,000,000
Water supply Installation Expenses Salaries				20,000,000	50,000,000
Water supply Relevant/Escort			8,960,056	20,000,000	50,000,000
Public Health and Comfort	**15,765,224**	**6,220,557**	**21,310,863**	**62,500,000**	**150,000,000**
(1) - (2)	(5,483,717)	9,533,404	(1,938,962)	(39,600,000)	(123,800,000)
Accumulation		9,533,404	7,594,442	(32,005,558)	(155,805,558)

Source: Financial data from Mirzapur by JICA study team

3) Ghazipur

The financial information of Nagar Palika Parishad Ghazipur that JICA study team analyzed is the actual Income statement between 2010 and 2014 and Statement of financial position (Balance Sheet) of 2008 and 2009. The Income statement contains Water Tax revenue. (But no detail information similar of Jal Kal Varanasi)

a) Income/Expense Analysis of Ghazipur

The actual total income has been increasing from 2010 to 2014 by 22%, each growth rate, Tax revenue is minus 16% growth and Non-tax revenue is 25%, so the growth rate of Non-tax revenue highly surpasses Tax revenue growth. The portion of Tax Revenue from 2010 to 2014 is 6% or that of Non Tax Revenue is 94%. In Non Tax revenue, Grants occupy as much as 89% (the actual ratio between 2010 and 2014). Tax Revenue has been decreasing from 13% in 2010 to 3% in 2014 which seems to be a problem. However, it has mostly Surplus except in 2010 and has been increasing in high number because Revenue Expenditure has been less than Revenue receipts since 2011 (Expenditure, the annual growth (CAGR) is 5.6%). Although Property tax has been increasing (18.5% per year), the water Tax has been almost the same amount from 2010 to 2014, whose portion is only 1.9% of Revenue. Regarding Expenditure, the portion of HR cost (Salary & Establishment) is almost 60%.

Table 12.2.19 Income & Expenditure of Nagar Palika Parishad Ghazipur

(Unit Rs.)

	Fiscal Year (Rs.)					CAGR	Total Revenue
	2010-11	2011-12	2012-13	2013-14	2014-15	FY10-15	FY10-14 (%)
Revenue Receipts	**97,294,952**	**110,490,107**	**144,104,431**	**214,802,686**	**216,980,069**	22.2%	
Taxes Revenue	12,203,595	6,914,058	11,412,274	8,708,511	6,069,568	-16.0%	
Property Tax	1,519,877	1,588,653	1,915,582	1,870,041	2,992,110	18.5%	1.3%
Stamp & Registration Fee	7,655,940	2,242,876	5,676,896	4,532,143	-	-100.0%	2.6%
Water Tax	3,021,253	3,027,758	3,759,853	2,269,864	3,055,869	0.3%	1.9%
Other Taxes (Entertainment, Vehicle)	6,525	54,770	59,942	36,464	21,590	34.9%	0.0%
Non Tax Revenue	85,091,357	103,576,049	132,692,157	206,094,175	210,910,501	25.5%	
Rent from Property of Nagar Palika	1,572,475	1,922,725	1,499,622	1,912,700	1,517,122	-0.9%	1.1%
Fees & Licenses	703,989	2,480,712	1,875,994	1,108,581	1,098,977	11.8%	0.9%
Mutation/Transfer		-	529,600	32,100	637,300		0.2%
Other Income	1,810,525	5,235,780	4,671,113	3,354,068	1,435,706	-5.6%	2.1%
State F.C. Grant	72,096,672	88,296,491	106,399,918	164,966,219	187,036,036	26.9%	79.0%
Central F.C. Grant	8,606,096	5,284,741	16,747,411	29,645,623	18,163,360	20.5%	10.0%
Security Deposits	301,600	355,600	968,500	108,485	1,022,000	35.7%	0.4%
UIDSSMT Plan	-	-	-	4,966,400	-		0.6%
Revenue Expenditure	**97,780,278**	**96,229,314**	**135,580,444**	**122,995,294**	**121,455,427**	5.6%	
Salary & Establishment	57,994,096	59,204,872	64,665,101	70,959,922	78,742,089	7.9%	57.8%
Operation & Maintenance	8,824,634	20,281,367	11,766,654	14,089,950	12,047,394	8.1%	11.7%
Tools & Plants for Health Department	128,550	3,282,250	4,893,514	2,453,077	1,878,786	95.5%	2.2%
Kanshiram Urban Housing Poor	16,554,096	-	-	-	-	-100.0%	2.9%
New Construction Pipe Line Handpump	865,896	4,896,225	8,831,107	2,844,173	5,747,619	60.5%	4.0%
Road Construction	13,413,006	8,564,600	5,293,568	27,681,772	23,039,539	14.5%	13.6%
UIDSSMT	-	-	40,130,500	4,966,400	-		7.9%
Surplus/Deficit	(485,326)	14,260,793	8,523,987	91,807,392	95,524,642	88.5%	26.7%
Rate of Surplus per Revenue	-0.5%	12.9%	5.9%	42.7%	44.0%		

Source: Financial data from Mirzapur by JICA study team

a) Financial position (Balance Sheet) of 2008 and 2009

Although a bit old, JICA study team could obtain Balance sheet of Mirzapur in 2008 and 2009. Form these, it is noted that, 1) about 70% of Asset is Current asset and most of it is Cash. 2) In Liability side, Grants portion is 32%, Current liability is 19% but Surplus is 50% (it seems that almost each year, ULB receives larger Grant than Expenditure or does not consume the received revenue. 3) It had Surplus in 2008 and 2009 while most each year in Income statement show Surplus as well. As the surplus in 2009 is Rs. 32 million and the surplus/deficit trend follows in the income statement, it can be assumed that accumulated surplus is Rs. 242 million in 2014. This surplus amount seems to be over its Revenue receipts in 2014, Rs. 216 million. 4) The size of balance sheet is rather small compared with the income statement. (Since CAGR of Revenue Receipts is 22.2% in Table 12.2.20, Revenue receipt in 2009 could be about Rs.75.7 million while Asset of this year is Rs. 46.9 million in Table 12.2.20)

Table 12.2.20 Water Income & Expenditure of Ghazipur

(Unit Rs.)

Description	2008-09	2009-10	CAGR	% Total Asset
Assets				
Fixed Assets (Net Block)	2,373,544	24,740,554	942.3%	33%
Gross Block	2,926,563	26,632,515	810.0%	
Less: Accumulated Depreciation	-553,019	-1,891,960	242.1%	
Current Assets, Loans & Advances	32,738,344	22,170,387	-32.3%	67%
Stock in Hand (Inventories)	1,260	69,066	5381.4%	
Gross amount outstanding	4,527,428	4,786,329	5.7%	
Receivables for Property Taxes	1,508,239	1,036,892	-31.3%	
Cash and Bank Balances	26,701,417	16,278,100	-39.0%	*52%*
Total	**35,111,888**	**46,910,941**	33.6%	
Liabilities				
Grants, Contributions for specific purposes	12,801,737	13,102,328	2.3%	32%
Current Liabilities & Provisions	14,008,118	1,305,367	-90.7%	19%
Deposits Received	247,600	95,251	-61.5%	
Other Liabilities (Sundry Creditors)	13,547,653	1,210,116	-91.1%	
Provisions	212,865	0	-100.0%	
Reserves & Surplus	8,302,032	**32,503,247**	291.5%	50%
Municipal (General) Fund	8,302,032	5,692,028	-31.4%	
Reserves	0	26,811,219		
Total	**35,111,888**	**46,910,941**	33.6%	

Source: Financial data from Mirzapur by JICA study team

Table 12.2.21 Estimated Surplus of Ghazipur

(Unit Rs.)

	2009-11	2010-11	2011-12	2012-13	2013-14	2014-15	CAGR FY09-14
Reserve and Suplus brought forward from Previous year		32,503,247	32,017,921	46,278,713	54,802,701	146,610,093	
Surplus on this year		(485,326)	14,260,793	8,523,987	91,807,392	95,524,642	
Reserve and Suplus brought forward to next year	32,503,247	32,017,921	46,278,713	54,802,701	146,610,093	242,134,735	65.2%

4) Ramnagar

The financial information of Nagar Palika Parishad Ramnagar that JICA study team analyzed is the actual Income statement between 2011 and 2014. There is no information of Statement of financial position (Balance Sheet), but there is Surplus/Deficit account. This statement contains Water Tax/Value, water supply related information. (But no detail information similar of Jal Kal Varanasi)

a) Income/Expense Analysis of Ramnagar

The actual total income has been increasing from 2011 to 2014 by 31.4%, each growth rate, Tax

revenue is minus 7% growth and Non-tax revenue is 31.4%, so the growth rate of Non-tax revenue much higher than Tax revenue growth. The portion of Tax Revenue from 2011 to 2014 is about 10% and that of Non Tax Revenue is 90%. This is because Grants occupy as much as 86.6% in Non Tax Revenue, which is 75.5% from State government and 11.1% from Central government (the ratio between 2011 and 2014 or Actual). Although it has Surplus for all three year, Ramnagar depends upon Grants and also this trend is obvious as times go-by, so it could be said that the financial stability of this ULB is not strong. Total expenditure has been increasing as 29.4% which is slightly faster than that of total income growth. The portion of Salary and Pension of Total expense is 41.8%, which seems to be high level.

Table 12.2.22 Summary of Income & Expenditure of Nagar Palika Parishad Ramnagar

(Unit Rs.)

Discription	Fiscal Year			CAGR	2012-14
	2012-13	2013-14	2014-15	FY12-14	(%)
Income					
Taxes Revenue					
Stamp & Registration Fee	6,959,183	3,742,121	5,973,255	-7.4%	7.9%
Water Tax	270,311	278,133	259,381	-2.0%	0.4%
Water Value	659,589	698,129	593,720	-5.1%	0.9%
Total A)	**7,889,083**	**4,718,383**	**6,826,356**	-7.0%	9.2%
Non Tax Revenue					
Other Income	2,359,920	3,290,194	3,150,133	15.5%	4.2%
State F.C. Grant	37,053,583	54,213,214	68,401,559	35.9%	75.5%
Central F.C. Grant	5,986,880	10,637,192	6,861,958	7.1%	11.1%
Total B)	**45,400,383**	**68,140,600**	**78,413,650**	31.4%	90.8%
Total Income (A+B)	**53,289,466**	**72,858,983**	**85,240,006**	26.5%	100.0%
Expenditure					
Revenue - Infrastructure, Road, Water Supply, Cleaning, Lighting	4,980,582	5,474,914	5,117,834	1.4%	7.7%
13th Finance Commission - Sewer, Road, Electricity,Cleaning	5,209,633	7,365,049	7,355,978	18.8%	9.9%
State Finance Commission - Salary, Pension etc	25,418,517	29,223,263	29,832,074	8.3%	41.8%
State Finance Commission - Road, Water, Sewer, Lighting, Cleaning, Drainage etc.	13,001,014	30,038,258	39,144,053	73.5%	40.7%
Total Expenditure	**48,609,746**	**72,101,484**	**81,449,939**	29.4%	100.0%
Surplus/(Deficit)	**4,679,720**	**757,499**	**3,790,067**	-10.0%	4.4%

Source: Financial data from Mirzapur by JICA study team

12.2.5 UP Jal Nigam Varanasi

JICA study team analyzed financial information of UP Jal Nigam Varanasi, the actual data from 2011 to 2014 for both Income Statement and Statement of financial position (Balance sheet). UP Jal Nigam Varanasi composes of four, Unit-1, Unit-2, Mirzapur and Dinapur.

1) Income Statement

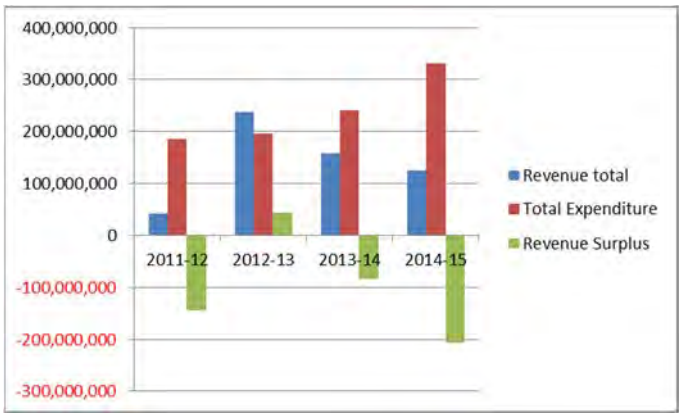
a) Overall findings

Revenue receipts have been increasing 45% per year while the growth of expenditure is 21.4%. Since basically the expenditure is larger than revenue, it often has deficit for each year and this negative growth rate is increasing (12.7%) per year. Looking at revenue/expenditure size, Varanasi Unit-2 is the largest (around 60-70% of total UPJN) and Mirzapur and Dinapur is rather small and both of them a similar business size. Among four areas, only Unit-1 has revenue surplus but all the other three locations have deficit for each year.

Table 12.2.23 Revenue and Expenditure of UP JN

(Rs.)	2011-12	2012-13	2013-14	2014-15	CAGR FY11-FY14	Portion
GPPU, Varanasi, Unit 1						
Revenue total	20,236,302	30,153,185	91,745,646	48,757,366	34.1%	34%
Total Expenditure	14,017,694	18,430,132	24,536,860	29,854,816	28.7%	9%
Revenue Surplus	6,218,608	11,723,053	67,208,786	18,902,551	44.9%	
GPPU, Varanasi, Unit 2						
Revenue total	12,338,387	204,410,392	56,467,895	48,219,724	57.5%	57%
Total Expenditure	135,166,584	137,031,566	166,610,549	222,571,202	18.1%	69%
Revenue Surplus	-122,828,197	67,378,826	-110,142,654	-174,351,478	12.4%	
Mirzapur						
Revenue total	108,767	206,824	5,386,190	16,372,877	432.0%	4%
Total Expenditure	19,006,738	22,245,207	31,398,318	52,080,250	39.9%	13%
Revenue Surplus	-18,897,971	-22,038,383	-26,012,128	-35,707,373	23.6%	
Dinapur						
Revenue total	7,952,368	3,055,803	3,156,951	10,726,852	10.5%	4%
Total Expenditure	17,205,690	17,635,295	17,385,608	26,873,543	16.0%	8%
Revenue Surplus	-9,253,322	-14,579,492	-14,228,657	-16,146,691	20.4%	
All total						
Revenue total	**40,635,824**	**237,826,203**	**156,756,682**	**124,076,820**	**45.1%**	
Total Expenditure	**185,396,706**	**195,342,200**	**239,931,335**	**331,379,811**	**21.4%**	
Revenue Surplus	**-144,760,882**	**42,484,004**	**-83,174,653**	**-207,302,991**	**12.7%**	

Source: Financial data from UP JN



Source: Financial data from JP JN

Figure 12.2.4 Revenue and Expenditure of UP JN (Rs.)

b) Some highlights of Income Statement

In Revenue receipt side, UP JN depends upon Centage Charges for its main revenue source and its growth is 55.2%. There is some small revenue such as Interest Income or other income.

Table 12.2.24 Revenue analysis of UP JN

(Rs.)	2011-12	2012-13	2013-14	2014-15	CAGR	Portion
GPPU, Varanasi, Unit 1						
Centage Charges	18,648,342	28,141,292	86,840,861	42,611,379		92%
Interest Income	1,311,679	1,127,145	4,374,394	5,915,348		7%
Other Income	276,281	884,748	530,391	230,639		1%
GPPU, Varanasi, Unit 2						
Centage Charges	2,213,852	200,008,202	51,104,997	34,968,244		90%
Interest Income	10,032,520	4,173,337	3,257,295	10,566,213		9%
Other Income	92,015	228,853	2,105,603	2,685,267		2%
Mirzapur						
Centage Charges	0	0	4,809,517	16,122,200		95%
Interest Income	75,504	115,558	473,363	160,969		4%
Other Income	33,263	91,266	103,310	89,708		1%
Dinapur						
Centage Charges	6,837,404	187,500	1,045,386	9,776,107		72%
Interest Income	140,652	277,193	63,439	321,062		3%
Other Income	974,312	2,591,110	2,048,126	629,683		25%
Each all total						
Centage Charges	**27,699,598**	**228,336,994**	**143,800,761**	**103,477,930**	55.2%	**90%**
Interest Income	**11,560,355**	**5,693,233**	**8,168,491**	**16,963,592**	13.6%	**8%**
Other Income	**1,375,871**	**3,795,977**	**4,787,430**	**3,635,297**	38.2%	**2%**
	40,635,824	**237,826,203**	**156,756,682**	**124,076,820**	45.1%	100%

Source: Financial data from UP JN

In expenditure side, the major expense is Salary & Reimbursement (37%) and Maintenance cost (61%) among all Expenditures. These growth rates are rather high, 29.1% for Salary and 17.4% for O&M. These costs varies among four areas; At Unit-1 Varanasi and Dinapur, most of the

expenditure is Salary which may mean these Units focus on planning and design work. But at Unit-2 and Mirzapur, the same thing is for Maintenance cost, which may mean most of the works there is for O&M works of STP and other sewage facilities.

Table 12.2.25 Expenditure analysis of UP JN

(Rs.)	2011-12	2012-13	2013-14	2014-15	CAGR	Portion
GPPU, Varanasi, Unit 1						
Salary & Reimbursements	12,771,431	16,680,261	22,139,901	27,145,109		91%
Other Miscellaneous Office Expenses	301,554	242,192	495,307	454,122		2%
Depreciation	1,611	1,558	1,506	1,457		0%
Maintenance of Ganga Action Plan Work	80,860	0	0	0		0%
Interest Expenses	862,238	1,506,121	1,900,146	2,254,128		8%
GPPU, Varanasi, Unit 2						
Salary & Reimbursements	28,929,152	39,609,841	40,105,573	72,444,864		27%
Other Miscellaneous Office	782,499	81,147	145,633	252,474		0%
Depreciation	7,896	7,896	7,896	7,896		0%
Maintenance of Ganga Action Plan Work	104,337,009	95,989,912	124,984,801	148,367,308		72%
Interest Expenses	1,110,028	1,342,770	1,366,646	1,498,660		1%
Mirzapur						
Salary & Reimbursements	3,524,090	3,901,747	3,897,113	6,880,550		15%
Other Miscellaneous Office	223,327	52,376	295	500		0%
Depreciation	311	144	0	0		0%
Maintenance of Ganga Action Plan Work	15,081,940	18,185,060	27,296,889	44,933,077		85%
Interest Expenses	177,070	105,880	204,021	266,123		1%
Dinapur						
Salary & Reimbursements	15,727,326	16,248,698	15,654,803	24,638,805		91%
Other Miscellaneous Office	322,440	333,416	420,346	635,417		2%
Depreciation	2,652	1,880	0	0		0%
Maintenance of Ganga Action Plan Work	0	0	0	0		0%
Interest Expenses	1,153,272	1,051,301	1,310,459	1,599,321		6%
Each all total						
Salary & Reimbursements	**60,951,999**	**76,440,547**	**81,797,390**	**131,109,328**	**29.1%**	**37%**
Other Miscellaneous Office	**1,629,820**	**709,131**	**1,061,581**	**1,342,514**	**-6.3%**	**0%**
Depreciation	**12,470**	**11,478**	**9,403**	**9,353**	**-9.1%**	**0%**
Maintenance of Ganga Action Plan Work	**119,499,809**	**114,174,971**	**152,281,690**	**193,300,385**	**17.4%**	**61%**
Interest Expenses	**3,302,608**	**4,006,072**	**4,781,272**	**5,618,232**	**19.4%**	**2%**
	185,396,706	**195,342,200**	**239,931,335**	**331,379,811**	**21.4%**	100%

Source: Financial data from UP JN

2) Statement of Financial position (Balance sheet)

a) Overall findings

Balance sheet of UP Jal Nigam Varanasi has been increasing from 2011 to 2014, Rs. 4,579 million to Rs. 6,699 million, or 13.5% increase per year. Major asset holder in this balance sheet is Varanasi Unit-2, 66% of its total. But as mentioned later, UP JN has very few fixed asset.

Table 12.2.26 The size of Balance Sheet, UP JN

(million Rs.)	2011-12	2012-13	2013-14	2014-15	CAGR FY10-FY14	Portion
Varanasi Unit 1	935.9	1,387.6	1,750.1	1,959.0	27.9%	26%
Varanasi Unit 2	3,132.9	3,176.5	4,510.4	4,285.2	11.0%	66%
Mirzapur	236.5	235.9	237.2	246.4	1.4%	4%
Dinapur	273.8	286.4	193.9	208.9	-8.6%	4%
Total Assets	**4,579.1**	**5,086.3**	**6,691.6**	**6,699.5**	**13.5%**	100%

Source: Financial data from UPJN

b) Some highlights of Balance Sheet

UP JN does not have much fixed asset since its business is design and construction work of water supply and sewer/sewage system; however it has large amount of WIP (work in progress), about 64% (41+23) in total asset. Also the growth rate is rather high, 13.4% and 25.3%. These four years, UPJN suffers a deficit but total own funds are approximately four times larger than accumulated deficit, and thus, financial situation of UPJN is health in total.

Table 12.2.27 Asset of UP JN

Asset (million Rs.)	2011-12	2012-13	2013-14	2014-15	Portion	CAGR
Capital WIP	1,833.8	2,335.1	2,632.5	2,674.3	41%	13.4%
Capital Work in Progress	896.1	1,113.1	1,455.4	1,763.7	23%	25.3%
Cash & Bank Accounts	800.7	449.9	1,595.0	1,153.4	17%	12.9%
GP Completed Projects	441.6	441.6	441.6	441.6	8%	0.0%
Accounts Receivable	212.0	411.3	337.9	427.7	6%	26.4%
Capital WIP & Inventory	269.3	281.7	184.7	199.5	4%	-9.5%
Fixed Deposits with Bank	125.1	53.0	44.0	39.0	1%	-32.2%
Loans & Advances	0.5	0.6	0.5	0.3	0%	-15.1%
Fixed Assets	0.1	0.1	0.1	0.1	0%	
Asset Total	**4,579.1**	**5,086.3**	**6,691.6**	**6,699.5**		

Source: Financial data from UP JN

The liability of UP JN Balance sheet mainly composes of two items, Own funds and Current Liabilities. Own Funds are almost the same amount of WIP in asset.

Table 12.2.28 Liabilities of UP JN

(Rs. Million)	2011-12	2012-13	2013-14	2014-15	CAGR FY11-FY14	Portion
Total Own Funds	2,823.8	3,090.3	3,518.3	3,700.6	9.4%	57%
Total Surplus/(Deficit)	-789.8	-747.3	-757.4	-954.9	6.5%	-14%
Current Liabilities	2,545.2	2,743.4	3,930.7	3,953.8	15.8%	57%
Total	**4,579.1**	**5,086.3**	**6,691.6**	**6,699.5**	13.5%	100%

Source: Financial data from UP JN

12.2.6 Nagar Nigam Jal Kal Varanasi

Jal Kal under Nagar Nigam operates and maintains the water supply system of Varanasi. (O&M of STP is taken care of by UP JN) Jal Kal is now a part of VMC, though it continues to have a large amount of autonomy with regards to administrative and financial functions. Jal Kal is also responsible for billing and collection of user charges.

1) Income Statement

The revenue of Jal Kal is Rs.241.9 million in 2013 and most of it is Water Supply, Rs.238.5 million, while Sewage is only Rs.3.4 million. The revenue has been increasing from 2011(April) to 2014(March) for 9.8% annually. The total revenue has been increasing but the Sewage Tax in 2013 is pretty lower than before two years. Each Sewage Tax of 2011 and 2012 is preciously 12.5% of each Total Income (e.g. 28,533,306/227,986,770 = 12.5% (2012)). The sewage tax in 2013 seems to be contained in the portion of Water Supply (238,501,115). So it may be assumed that Water /Sewage revenue in 2013 will be Rs. 211,684,473 and Rs. 30,240,639 each.

Although the revenue has been increasing, the Expenditure has been over Income, Jal Kal has deficit for every year. The expenditures are two to three times larger than income and its ratio gets worse toward the latest year. The largest share of the expenditure is Establishment Expenses (Salaries and Pension) and Electricity Charge, totaling about as much as 87.5% of total expenditures. The future labor demand is still strong. (Table 12.2.29 in the below) It can be said that current Jal Kal business model depends upon labor and electricity. Although electricity charge is recorded as liability in the financial statements, it is paid by UP State government, which is assured by Fifteenth Finance Commission. The CAGAR for the last three years is 22.2% for Establish Expense, 31.2% for Electricity charge and the 27% for Repair & Maintenance, thought the share of Repair & Maintenance is less than 10% of total expenditure. When if neglect of Electricity payment (since UPJN pays) and depreciation, Jal Kal gets Rs.241 million Revenue and pays Rs.321 million in 2013, so the cost recovery ratio is about 75%.

Table 12.2.29 Income statement of Jal Kal, Varanasi

Description	Fiscal Year (Rs.)						CAGR	Income (%) on FY13
Revenue Receipts	**2011-12**		**2012-13**		**2013-14**			
	Water	**Sewerage**	**Water**	**Sewerage**	**Water**	**Sewerage**		
1 Tax Revenue								
Water Tax	172,794,744	-	196,812,694	-	236,175,233	-	16.9%	99.0%
Sewer Tax	0	25,051,256	0	28,533,306	0	3,423,997	-63.0%	0.0%
2 Excess Water Charges	174,000	0	174,000	0	200,100	0	7.2%	0.1%
Meter Rent								
3 Pipeline Charges	219,640	0	159,663	0	181,025	0	-9.2%	0.1%
4 Other Income	2,380,243	0	2,307,107	0	1,944,757	0	-9.6%	0.8%
(I) Sub Total Income	**175,568,627**	**25,051,256**	**199,453,464**	**28,533,306**	**238,501,115**	**3,423,997**	9.8%	100.0%
Total Income		**200,619,883**		**227,986,770**		**241,925,112**		
	Fiscal Year							
Revenue Expenditure	**2011-12**		**2012-13**		**2013-14**		**CAGR**	**Income (%) on FY13**
	Water	**Sewerage**	**Water**	**Sewerage**	**Water**	**Sewerage**		
1 Establishment Expenses	152,391,924	7,362,546	264,990,534	7,982,037	230,526,193	7,950,124	22.2%	96.7%
2 Consumption of Stores	9,235,462	0	1,537,741	0	7,513,968	0	-9.8%	3.2%
3 Electricity Charges	202,006,700	0	217,831,300	0	347,766,144	0	31.2%	145.8%
4 Repair & Maintenance	10,155,208	36,001,145	11,327,702	23,727,991	21,512,487	52,971,060	27.0%	9.0%
5 Miscellaneous Expenses	595,699	0	1,206,570	0	504,249	0	-8.0%	0.2%
6 Interest Charges	390,166	18,625	390,166	18,625	390,166	18,625	0.0%	0.2%
7 Depreciation	7,342,192	1,326,667	7,488,968	1,345,011	8,092,949	2,741,884	11.8%	3.4%
(II) SubTotal Expenditure	**382,117,351**	**44,708,983**	**504,772,981**	**33,073,664**	**616,306,156**	**63,681,693**	26.2%	258.4%
Total Expenditure		**426,826,334**		**537,846,645**		**679,987,849**		
Revenue Deficit	**-206,548,724**	**-19,657,727**	**-305,319,517**	**-4,540,358**	**-377,805,041**	**-60,257,696**	39.2%	-158.4%
Total Deficit	**-226,206,451**		**-309,859,875**		**-438,062,737**			
Operating Margin (%)	-117.6%	-78.5%	-153.1%	-15.9%	-158.4%	-1759.9%		

Source: Actual Financial Statements of Jal Kal Varanasi

The Table below provides the number of filled and vacant posts at Jal Kal, Varanasi.

Table 12.2.30 The workforce at Jal Kal Varanasi

Detail of Centralized Service Group-1,2,3

No.	Designation	Sanction Post	Working Employees	Vacant Post
1	General Manager	1	1	-
2	Executive Engineer	5	3	2
3	Assistant Engineer	9	2	7
4	Junior Engineer	15	5	10

Detail of Non Centralized Service Group-1, 2

No.	Designation	Sanction Post	Working Employees	Vacant Post
1	Finance Officer	1	-	1
2	Account Officer	1	-	1

Detail of Non Centralized Service Group-G, GH

No.	Designation	Sanction Post	Working Employees	Vacant Post
1	Group - G	149	86	63
2	Group - GH	936	412	524

Source: Data from Jal Kal

2) Statement of Financial Position

The grand total assets and liability in 2013 is Rs.666 million which has been decreased from 2010 by 4.2% per year. Fix Asset portion is about 60% in 2013 and has been increasing by 3.7% annually. Current asset has been decreasing from 2010 to 2013. Current liabilities have been increasing by

15.7% per year for the last years because Jal Kal does not pay Electricity Charge causing deficit every year. And every single year shows the deficit between Rs. 2.3 million and Rs. 4.4 million, which leads to accumulated deficit as much as Rs. 30 million in 2013. Grant in Aid has been increasing, annually 10% increase, but Capital Fund has been all the same amount. Per observation of financial statement of Jal Kal, it is obvious that Jal Kal is not able to recover O&M cost especially for electricity with its user charge for sewerage collected. Without updating the payment process of electricity and improving the coverage of electricity cost against sewerage tariff, financial sustainability of Jal Kal remains weak.

Table 12.2.31 Statement of financial position of Jal Kal, Varanasi

	Fiscal Year (Rs.)				CAGR	Total Asset (%)
Assets	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**FY10-FY13**	**on FY13**
1 Fixed Assets	359,501,572	358,221,409	358,481,543	400,725,684	3.7%	60.2%
2 Interest on World Bank Loan	1,140,090	1,140,090	1,140,090	1,140,090	0.0%	0.2%
3 Current Assets	398,058,433	381,400,424	295,382,486	264,181,919	-12.8%	39.7%
Water Tax	73,237,500	75,624,130	14,809,030	18,176,223	-37.2%	2.7%
Excess Water Charges & Meter Rent	146,473,632	142,271,944	138,303,556	135,964,426	-2.5%	20.4%
Sewer Tax	131,446,462	114,380,690	78,992,047	24,214,035	-43.1%	3.6%
Other	46,900,839	49,123,660	63,277,853	85,827,236	22.3%	12.9%
Grand Total of Assets	**758,700,095**	**740,761,923**	**655,004,119**	**666,047,693**	-4.2%	100.0%

Description	**Fiscal Year**				**CAGR**	**Total Liability (%)**
Liabilities	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**FY10-FY13**	**on FY13**
1 Capital Fund	790,849,734	790,849,734	790,849,734	790,849,734	0.0%	21.5%
2 Grant in Aid	264,963,023	265,067,023	271,375,023	352,486,943	10.0%	9.6%
3 Loans & Advances	303,885,219	303,885,219	303,885,219	303,885,219	0.0%	8.2%
4 Current Liabilities	1,443,802,145	1,651,966,424	1,869,760,495	2,237,754,887	15.7%	60.7%
Total of Liabilities	**2,803,500,121**	**3,011,768,400**	**3,235,870,471**	**3,684,976,782**	9.5%	100.0%
Accumulated Deficit	- 2,044,800,026	- 2,044,800,026	- 2,271,006,477	- 2,580,866,352	8.1%	-70.0%
Deficit for the year		- 226,206,451	- 309,859,875	- 438,062,737	39.2%	-11.9%
Total of Deficit	**- 2,044,800,026**	**- 2,271,006,477**	**- 2,580,866,352**	**- 3,018,929,090**	13.9%	-81.9%
Grand Total of Liabilities and Deficit	**758,700,095**	**740,761,923**	**655,004,119**	**666,047,693**	-4.2%	18.1%

a) Analysis of Receivables

Analysis of 2012 and 2013 shows that total collection ratio (water and sewer) is about 70% to 80% although each ratio is different; Water tax collection is higher than that of Sewer.

Especially, the water tax collection in 2013 is pretty high (End-receivables divided by Addition is 8% or Collection (Additions/Collections) is 101%) Excess water charge & meter is very slow

moving. Although the collection status mentioned in the previous section (Figure 12.2.31) shows different from here, through those calculated numbers, we can think the collection ratio of water/sewer at Jal Kal these days is about 68%.

Table 12.2.32 Consumer Receivables of Jal Kal, Varanasi

Particulars (Rs.)	Beginning: Amount as on 2012/3/31	Additions: Raised during the year ended 2013/3/31	Collections: Collected during the year ended 2013/3/31	End: Amount as on 2013/3/31	End balance/ Addition	Collection
I. Water Supply Scheme		(y)		(x)	(x)/(y)	
1 Water Tax	75,624,130	196,812,694	255,687,794	14,809,030	8%	77%
2 Excess Water Charges & Meter Rent	142,271,944	174,000	1,940,000 4,142,388	138,303,556	79485%	4%
TOTAL	217,896,074	196,986,694	261,770,182	153,112,586	78%	75%
II. Sewerage Scheme						
1 Sewer Tax	114,380,690	28,533,306	63,921,949	78,992,047	277%	45%
Grand TOTAL (I+II)	332,276,764	225,520,000	325,692,131	232,104,633	103%	**69%**
		Raised during the year ended 2014/3/31	Collected during the year ended 2013/4/31	Amount as on 2014/3/31	End balance/ Addition	
I. Water Supply Scheme						
1 Water Tax		236,175,233	232,808,039	18,176,223	8%	101%
2 Excess Water Charges & Meter Rent		200,100	2,539,230	135,964,426	67948%	8%
TOTAL		236,375,333	235,347,269	154,140,649	65%	100%
II. Sewerage Scheme						
1 Sewer Tax		3,423,997	58,202,010	24,214,035	707%	6%
Grand TOTAL (I+II)		239,799,330	293,549,279	178,354,684	74%	**82%**

Source: Actual financial statement of Jal Kal, Varanasi

b) Analysis of fixed Assets

The fixed asset in 2013 is Rs. 400 million and its portion of the total balance sheet is 60%. This contains each fixed assets of Water supply and Sewer scheme in this year, Rs.165 and Rs.48.6 million respectively, so the portion of Water is77% and the one of Sewage is 23% among them. Regarding Sewage fixed asset, it has Pipes & Fittings and Machine. Pipes & Fittings are becoming outdated (accumulated Depreciation is 63.5%) while Machine's is not so. But Machine was newly bought this year, as much as Rs. 29 million, Machine as an asset is outdated as well (the accumulated depreciation would be 78.1%, in at simple math)

Table 12.2.33 Summary of Receipt & Payment, Jal Kal, Varanasi

	a	b	c = a + b	d	e	f = d + e	g = a - d	h = c - f	h/g	e/(a+b)	f/c
Descritpion of Assets (Rs.)	Acquisition Cost on 2013/3/31	Additions during FY201	Acquisition Cost on 2014/3/31	Accumulated Depreciation on 2013/3/3	Depreciation during FY2013	Accumulated Depreciation on 2014/3/3	Net Book Value on 2013/3/31	Net Book Value on 2014/3/31	Growth rate	Annual Depreciation rate	Accumulated Depreciation rate
1 Pipes & Fittings	42,181,216	5,754,190	47,935,406	29,308,800	1,131,276	30,440,076	12,872,416	17,495,330	35.9%	2.4%	**63.5%**
2 Sewer Cleaning Machine	8,123,894	29,332,110	37,456,004	4,737,849	1,610,608	6,348,457	3,386,045	31,107,547	818.7%	4.3%	16.9%
TOTAL(A)	50,305,110	35,086,300	85,391,410	34,046,649	2,741,884	36,788,533	**16,258,461**	**48,602,877.00**	198.9%	3.2%	43.1%
2 Sewer Cleaning Machine	*8,123,894*	*0*	*8,123,894*	*4,737,849*	*1,610,608*	*6,348,457*	*3,386,045*	*1,775,437*	*-47.6%*	*19.8%*	***78.1%***
TOTAL(B)	*50,305,110*	*5,754,190*	*56,059,300*	*34,046,649*	*2,741,884*	*36,788,533*	*16,258,461*	*19,270,767*	*18.5%*	*4.9%*	***65.6%***

3) Receipt & Payment

The total money inflow and its money outflow from 2011 to 2013 is almost the same amount (The money surplus in each year is slight in Table 12.2.34). In the three years, most of the money inflow (86%) comes from Water/Sewer Tax and the other is Grant/Loan (11%). In money outflow, most of it (72%) is paid out concerning employee/labor. “Pension Payment” as cash is being paid but this was not funded as pension liability in the past because the pension system in those days was not designed so. (Provident Fund Deposit is for future pension payment purpose whose pension system was designed recently). The second large portion of money outflow (27%) is related to Maintenance expense. To purchase the new Sewer Machine, Rs. 35 million as Fixed Assets (Sewage) was paid in 2013 when the Grant was rather larger than the other years. Inflow/Outflow ratio of each Water/Sewage varies through these years.

Table 12.2.34 Summary of Receipt & Payment, Jal Kal, Varanasi

		2011-12		2012-13		2013-14		
	Rs.	Water	Sewerage	Water	Sewerage	Water	Sewerage	
	Opening Balances	4,772,764	-	11,621,103	-	20,233,028	-	
	Inflow of Revenue							
1	Water Tax	168,468,114	-	255,687,794	-	232,808,039		
2	Sewer Tax	-	42,117,028	-	63,921,949		58,202,010	86%
3	Jal Sanyojan	558,700	-	455,050	-	461,700		
4	Development Charges	3,816,988	-	3,687,338	-	2,077,530		
5	Miscellaneous Receipts	2,141,810	-	2,032,167	-	1,777,071		
6	Pipeline Charges	219,640	-	159,663	-	181,025		
7	Bank Interest	21,173	-	59,275	-	79,117		11%
8	Loan from Nagar Nigam	4,000,000	-	-	-	8,500,000		
9	Grant in Aid Receipts/ Adjustment	104,000	-	7,619,000	-	81,111,920		3%
10	Adjustment NMP/NN	1,457,422	-	-	3,739,433	6,931,537		
	Each total Inflow	**180,787,847**	**42,117,028**	**269,700,287**	**67,661,382**	**333,927,939**	**58,202,010**	
A)	**Total Inflow**	**185,560,611**	**42,117,028**	**281,321,390**	**67,661,382**	**354,160,967**	**58,202,010**	
	Grand total Inflow		**227,677,639**		**348,982,772**		**412,362,977**	
	Outflow of Revenue							
1	Establishment Expenses	95,225,771	6,069,437	166,888,980	6,766,447	142,708,637	6,861,201	
2	Purchase of Stores	10,373,540	-	3,708,137	-	8,226,611	-	
3	Repairs & Maintenance	9,460,438	35,247,419	10,460,877	23,652,887	11,493,193	47,437,531	
4	Other Expenses	595,699	-	1,206,570	-	504,249	-	
5	Purchases of Fixed Assets	3,268,149	3,416,852	4,296,028	1,133,755	16,594,666	**35,086,300**	
6	Provident Fund Deposit	3,027,133	152,518	13,269,452	488,032	23,516,823	344,971	
7	Pension Payment	27,792,071	-	66,452,757	-	50,503,950	-	
8	Payment Against Deduction	18,031,344	1,170,973	19,655,354	737,712	22,442,705	690,411	
9	Capital WIP	703,696	-	3,664,329	-	1,398,008	-	
10	Payment to Deceased Employee	73,000	-	115,500	-	84,000		72%
11	Handpump Expenses	582,493	-	662,339	-	3,258,603		
12	Pipeline Expenses	866,003	-	279,590	-	12,294,220		27%
13	Payment/Adj to NMP	-	-	4,000,000	-			
14	Refund of Grant	-	-	1,311,000	-			1%
15	Payment Adjustment towards Electricity	-	-	-	-	1,940,000		
B)	**Each total Outflow**	**169,999,337**	**46,057,199**	**295,970,912**	**32,778,833**	**294,965,665**	**90,420,414**	
	Closing Balance	**11,621,103**	**-**	**20,233,028**	**-**	**26,976,898**		
	Total Outflow	**181,620,440**	**46,057,199**	**316,203,940**	**32,778,833**	**321,942,563**	**90,420,414**	
	Grand total Outflow		**227,677,639**		**348,982,773**		**412,362,977**	
	Inflow/Outflow	106%	91%	91%	206%	113%	64%	
	Inflow - Outflow (A - B)=	10,788,510	- 3,940,171 - 6,848,339	26,270,625	34,882,549 - 8,611,924	38,962,274	- 32,218,404 - 6,743,870	

Source: Actual financial statement of Jal Kal, Varanasi

Through the analysis of Income Statement, Balance Sheet and Receipt & Payment of Jal Kal, Varanasi, it can be said that Jal Kal can operate because it does not have to pay Electricity Charge or is supported by State Government. It depends upon Water/Sewage tax and charges and this collected money is consumed for paying the expenses for every year, mostly employee/labor expenses.

Figure 12.2.5 illustrates how Jal Kal operates in the financial point of views (in 2013):

A: Cash-flow basis, Jal Kal receives Rs.291 from Tax/Charge from users and Rs.90 from Government/ULB, totaling Rs. 392. And it spends Rs. 385, mostly to employees/Labors expense since electricity charge is not supposed to be paid by Jal Kal.

B-1) Income statement accrual basis: Jal Kal Revenue (Water/Sewage) is Rs. 242 and the total expenditure is Rs. 680. Although UPJN pays Electricity Charges, Jal Kal records it as liabilities. (W-2 Rs.348 from State/ULB is intentionally expressed in this figure) Although assumed that Rs. 348 of Electricity Charges is not here, it is still shortage of Income of Rs.80 as the deficit ((239+3) - (238+94) = - 80) The second large expense is employee/labors.

B-2) the similar view of B-1 but the chart is taken apart by Water/Sewage sectors. In here, the expense of water is over 4 times of Sewage. From all three Charts, Jal Kal business model depends upon Electricity and Labor works as the main expenditures and Water/Sewage as the major incomes. Revenue is much less than Expenditures. It is necessary to improve the productivity by trying to reduce those costs as well as to increase the income by higher collection ration and higher billing rate

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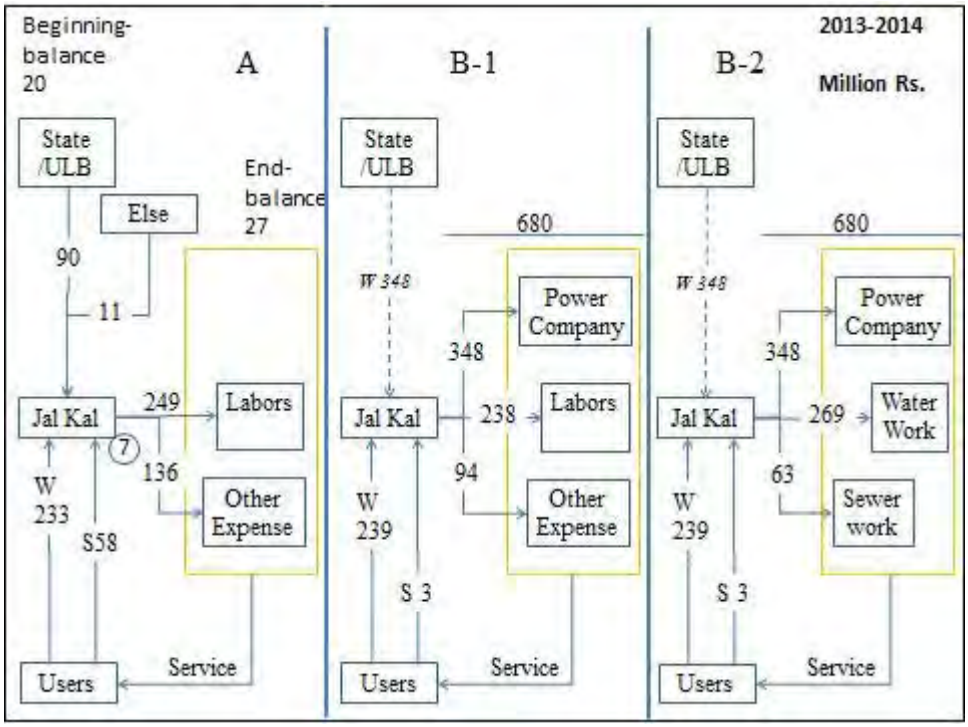


Figure 12.2.5 Income/Expenditure flows of Jal Kal Varanasi

12.2.7 Fund flow among stakeholder

As documented on Chapter 11, institutional structure of governmental organization is comprised of three layers, National level, State Level and Urban Local Body (ULB). NMCG in Government of India (GOI) is the key source of the fund to be provided to each State and ULB. GOI does not distribute the fund to State Government, but to each ULB directly, for the purpose of Capital Expenditure. As public infrastructure development program is sanctioned by GOI, respective fund is disbursed to each ULB based on the approved program or plan. This is the fund flow from GOI to ULB as Grant for Capital Expenditure. On the balance sheet of ULB, received amount is recorded as liability and transferred amount is recorded as asset (capital work in progress), until UPJN approved that capital investment project is completed as planned. After completed the capital development project, liability (H/O remittance) and Liability (Capital WIP) will be offset and written off from their balance sheet.

Once ULB received the fund from GOI, ULB transfers the fund to Head Office of Uttar Pradesh Jal

Nigam (UPJN), who is responsible for plan and manage the development project in each area/district in UP State. Head Office of UPJN allocates the money and distributes to respective district based on the sanctioned plan. And then each UPJN district remits the fund to each UPJN area organization to execute approved development program. Each area of UPJN keeps its own accounting record however; each area level of UPJN is too dependent on H/O remittance. For each area level UPJN organization, there is another source of the fund and its only way of earning income, is the Centage charge collected from Head office of UPJN. Centage can be received by 12.5% of completed capital development project during the year. Thus, revenue of area level UPJN depends on progress of the project and derived Centage income. That is why UPJN's operating income fluctuates year by year.

On the other hand, UP State Government also provides grant for both capital development and operation cost support for ULB. This grant is budgeted by State Government's general fund of Grant No37 for urban development. According to Study team's analysis, ULB spends the grant from UP state government more for making up the operational deficit rather than investing to capital development.

Between ULB and Jal Kal, there is a financial dependency in two ways, salary and wage expense reimbursement and fiscal deficit/surplus transfer. Jal Kal under ULB who operates water and sewerage service is relatively premature in terms of financial independence and institutional organization. Financial statement of ULB and Jal Kal are neither separated completely nor consolidated appropriately in a timely manner. In addition, employees of ULB also serve for Jal Kal and Jal Kal needs to bear their employees payroll expense such as salary, wage and pension. When Jal Kal records the fiscal deficit in a year, that amount should be recovered by general fund of ULB.

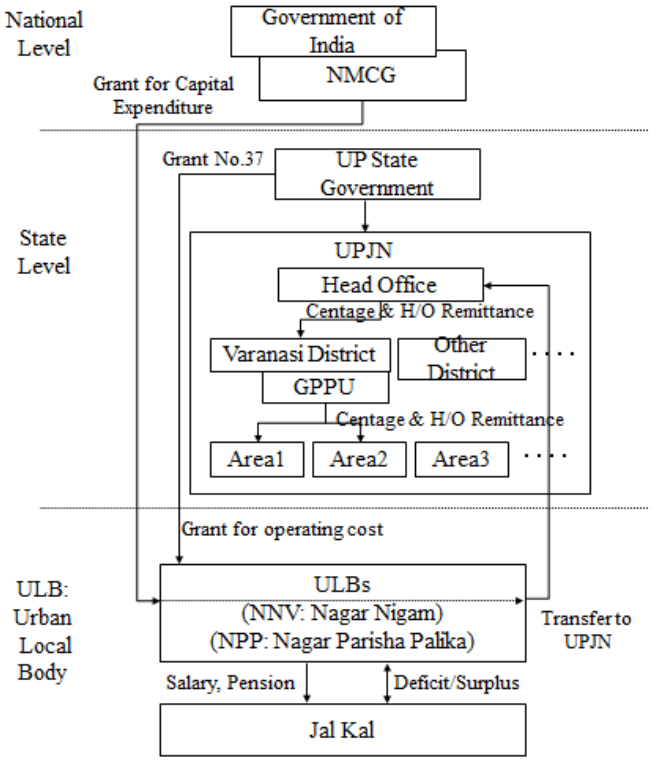


Figure 12.2.6 Fund flow among governmental organizations

12.3 Survey Results for Evaluation

12.3.1 Overview of Survey

Financial and economic survey was conducted in the following five areas: Varanasi, Mirzapur, Ghazipur, Ramnagar and Chunar. Sample size of this survey is in the following number of households: 150 households in Varanasi and individually 17 households in the other areas (representing Low Income Group-LIG, Middle Income Group-MIG, and High Income Group-HIG).

- •LIG: Living in their own houses in the areas lacking proper infrastructure, using the CTCs, source of income is unstable (Varanasi: 50 the other areas: 17)
- •MIG: Living in non-slums, in their own small houses, having definite source of income. Owner of at least one 2-wheeler (Varanasi: 50 the other areas: 17)
- •HIG: Living in their own houses, having at least one 4-wheeler (Varanasi: 50 the other areas: 17)

12.3.2 Findings of Fincancial and Economic viewpoints

Looking at the average monthly total earnings of the family in five regions, it can be said that the earnings in Varanasi is the largest (24,341Rs) number in all five areas, and Varanasi has the biggest gap (34,638Rs) of average monthly earnings between HIG and LIG.

Table 12.3.1 Average Monthly Earnings of the Family (Rs)

	All	LIG	MIG	HIG
1.Varanasi	24,341	8,502	21,380	43,140
2.Mirzapur	22,098	8,471	17,824	40,000
3.Ghazipur	21,080	10,500	21,353	30,765
4.RamNagar	19,765	9,588	18,941	30,765
5.Chunar	16,580	7,500	16,235	25,471

Source: JICA Study Team 2015

Table 12.3.2 Average monthly total expenditure of your household (Rs)

	All	LIG	MIG	HIG
1.Varanasi	24,340	8,500	21,380	43,140
2.Mirzapur	22,098	8,471	17,824	40,000
3.Ghazipur	20,824	10,353	21,353	30,765
4.RamNagar	19,765	9,588	18,941	30,765
5.Chunar	16,490	7,765	16,235	25,471

Source: JICA Study Team 2015

Regarding the average monthly expenditure on individual item in Varanasi, the food expenditures are the largest in all categories. Apart from savings and others, LIG spend on education secondly and health/treatment thirdly. MIG's second and fourth most spending items are education and cooking fuel. HIG's secondly and thirdly spending items are education and vehicle fuel.

Table 12.3.3 Average monthly expenditure on individual item (Varanasi) (Rs)

	All	LIG	MIG	HIG
1.(Food)	7,269	3,566	6,620	11,620
2.(Clothing)	1,553	465	814	3,380
3.(House Rent)	-	-	-	-
4.(House Tax)	129	87	97	204
5.(Electricity)	1,185	421	987	2,148
6.(Water/Sewerage service)	102	44	120	142
6.(Water)	-	-	-	-
7.(Sewerage service)	-	-	-	-

8.(Cooking Fuel)	947	561	1,027	1,252
9.(Vehicle Fuel)	1,710	260	930	3,940
10.(Health/treatment)	717	610	596	944
11.(Education)	2,877	621	2,056	5,954
12.(Saving)	3,549	920	3,382	6,344
13(Others)	4,306	945	4,760	7,212
(Total)	24,340	8,500	21,380	43,140

Source: JICA Study Team 2015

The question of average expenditure of the respondents are shown as below, and the food expenditures are the largest in all categories. Apart from savings and others, LIG spend on cooking fuel secondly and electricity thirdly. MIG's second and third spending items are clothing and education. HIG's thirdly and fourthly spending items are clothing and education.

Table 12.3.4 Average monthly expenditure on individual item (Mirzapur) (Rs)

	All	LIG	MIG	HIG
1.(Food)	7,637	3,676	6,412	12,824
2.(Clothing)	2,312	318	2,206	4,412
3.(House Rent)	0	0	0	0
4.(House Tax)	18	13	19	22
5.(Electricity)	863	512	918	1,159
6.(Water/Sewerage service)	19	15	21	21
6.(Water)	0	0	0	0
7.(Sewerage service)	0	0	0	0
8.(Cooking Fuel)	724	535	800	835
9.(Vehicle Fuel)	1,086	29	1,035	2,194
10.(Health/treatment)	125	218	71	88
11.(Education)	1,600	488	1,312	3,000
12.(Saving)	4,755	1,494	3,386	9,386
13(Others)	2,959	1,172	1,645	6,059
(Total)	22,098	8,471	17,824	40,000

Source: JICA Study Team 2015

The question of average expenditure of the respondents are shown as below, and the food expenditures are the largest in all categories. Apart from savings and others, LIG spend on cooking fuel secondly and clothing thirdly. MIG's second and third most spending items are clothing and electricity. HIG's secondly, and thirdly spending items are vehicle fuel and clothing.

Table 12.3.5 Average monthly expenditure on individual item (Ghazipur) (Rs)

	All	LIG	MIG	HIG
1.(Food)	8,127	5,088	8,647	10,647
2.(Clothing)	1,598	647	1,735	2,412
3.(House Rent)	0	0	0	0
4.(House Tax)	15	10	16	19
5.(Electricity)	1,275	529	1,259	2,035
6.(Water)	23	16	27	26
7.(Sewerage service)	875	671	924	1,029
8.(Cooking Fuel)	1,245	147	1,118	2,471
9.(Vehicle Fuel)	59	0	176	0
10.(Health/treatment)	1,218	476	1,088	2,088
11.(Saving)	4,964	2,181	4,999	7,714
12(Others)	1,480	588	1,529	2,324
(Total)	20,863	10,353	21,471	30,765

Source: JICA Study Team 2015

The question of average expenditure of the respondents are shown as below, and the food expenditures are the largest in all categories. Apart from savings, all 3 income groups spend on clothing in the second most money and LIG spend on cooking fuel thirdly. MIGs' third most spending items is vehicle fuel. HIG's thirdly spending item is vehicle fuel.

Table 12.3.6 Average monthly expenditure on individual item (Ramnagar) (Rs)

	All	LIG	MIG	HIG
1.(Food)	7,980	4,882	7,529	11,529
2.(Clothing)	2,069	912	2,118	3,176
3.(House Rent)	0	0	0	0
4.(House Tax)	0	0	0	0
5.(Electricity)	1,206	482	1,124	2,012
6.(Water/Sewerage service)	11	9	11	11
6.(Water)	998	694	824	1,476
7.(Sewerage service)	1,553	88	1,600	2,971
8.(Cooking Fuel)	20	29	0	29
9.(Vehicle Fuel)	1,151	306	1,071	2,076
10.(Health/treatment)	3,446	1,544	3,224	5,571
11.(Education)	1,371	759	1,441	1,912
12.(Saving)	19,804	9,706	18,941	30,765
13(Others)	7,980	4,882	7,529	11,529
(Total)	2,069	912	2,118	3,176

Source: JICA Study Team 2015

The question of average expenditure of the respondents are shown as below, and the food expenditures are the largest in all categories. Apart from savings and others, all 3 income groups spend on health/treatment in the second most money and LIG spend on water thirdly. MIGs' third most spending item is clothing. HIG's thirdly spending item is clothing.

Table 12.3.7 Average monthly expenditure on individual item (Chunar) (Rs)

	All	LIG	MIG	HIG
1.(Food)	6,696	4,324	6,412	9,353
2.(Clothing)	1,471	365	1,400	2,647
3.(House Rent)	0	0	0	0
4.(House Tax)	5	4	6	6
5.(Electricity)	1,082	400	1,082	1,765
6.(Water)	11	10	11	13
7.(Sewerage service)	774	571	709	1,041
8.(Cooking Fuel)	1,086	29	1,141	2,088
9.(Vehicle Fuel)	20	29	29	0
10.(Health/treatment)	1,116	276	1,029	2,041
11.(Saving)	2,899	1,269	3,029	4,399
12(Others)	1,320	488	1,353	2,118
(Total)	16,490	7,765	16,235	25,471

Source: JICA Study Team 2015

With regard to how much the individuals are willing to pay (WTP) for the improved water supply service, Mirzapur citizens can pay for the largest (89Rs) among all regions' and especially, the LIG's WTP is extremely high (126Rs). This trend is different from other areas.

Table 12.3.8 WTP for the improved water supply service per month (Rs)

	All	LIG	MIG	HIG
1.Varanasi	59.41	56.00	44.55	86.50
2.Mirzapur	89.00	126.00	52.00	-
3.Ghazipur	16.67	13.33	18.33	-
4.RamNagar	16.75	13.50	19.25	30.00
5.Chunar	12.40	10.00	-	14.00

Source: JICA Study Team 2015

When asked the WTP for the sewer connection to those who answered the present connection is unsatisfactory, in the condition that all issues are solved, Mirzapur people answered the largest amount (80.0Rs) in all regions. In Ghazipur and Chunar, it seems that the sewer connection hasn't been installed yet.

Table 12.3.9 WTP for the improved sewer user charge per month (Rs)

	All	LIG	MIG	HIG
1.Varanasi	56.83	57.50	40.29	84.29
2.Mirzapur	80.00	50.00	87.50	-
3.Ghazipur	-	-	-	-
4.RamNagar	23.33	-	23.33	-
5.Chunar	-	-	-	-

Source: JICA Study Team 2015

To those who do not have sewer connection and they would like to have in future, if asked how much they are willing to pay for connection of sewer to their house, the largest amount of their answer is 955.1Rs in Mirzapur followed by 893.8Rs in Varanasi and the smallest amount is 150.0 Rs in Ramnagar followed by 327.9Rs in Chunar. It can be said that the more income people receive, the more amount of money they are willing to pay for connection of sewer to their houses.

Table 12.3.10 WTP for connection of sewer to your house (Rs)

	All	LIG	MIG	HIG
1.Varanasi	893.75	430.00	1900.00	500.00
2.Mirzapur	955.13	637.50	858.33	1,522.73
3.Ghazipur	547.06	335.29	588.24	717.65
4.RamNagar	150.00	200.00	125.00	150.00
5.Chunar	327.94	125.00	411.76	447.06

Source: JICA Study Team 2015

Similarly, to those who do not have sewer connection and they would like to have in future, if asked how much they are willing to pay for sewer user charge per month, people in Varanasi and Mirzapur answered the amount of the fee (59.2Rs and 55.0Rs) about 11 times more than in Ramnagar. It can be said that the more income people receive, the more amount of money they are willing to pay for sewer user charge per month.

Table 12.3.11 WTP for monthly sewer user charge (Rs)

	All	LIG	MIG	HIG
1.Varanasi	59.19	58.13	40.00	200.00
2.Mirzapur	55.00	47.50	47.08	73.18
3.Ghazipur	10.40	6.88	10.59	13.53
4.RamNagar	5.00	5.00	5.00	-
5.Chunar	10.30	8.13	10.00	12.65

Source: JICA Study Team 2015

CTC is the complex of the community toilets. Looking at Table 12.3.10, it can be mentioned that the citizens in Mirzapur and Ramnagar pay for CTC usage per time more than in other areas.

Table 12.3.12 Current payment for CTC usage per usage (Rs)

	All	LIG	MIG	HIG
1.Varanasi	3.88	3.64	4.38	3.62
2.Mirzapur	4.52	4.10	5.00	4.33
3.Ghazipur	3.62	2.50	4.00	5.00
4.RamNagar	4.84	5.00	5.00	4.40
5.Chunar	4.09	4.33	4.00	3.50

Source: JICA Study Team 2015

To those who are not very satisfactory, if asked how much they are willing to pay for CTC when the condition of CTC has been improved, the ones in Varanasi answered the largest amount (6.2Rs) and the gap between HIG and LIG was the biggest (7.7Rs) as well.

Table 12.3.13 WTP for the improved CTC per usage (Rs)

	All	LIG	MIG	HIG
1.Varanasi	6.22	2.22	8.39	9.95
2.Mirzapur	4.71	4.40	5.00	5.00
3.Ghazipur	4.64	4.67	4.00	5.00
4.RamNagar	5.00	5.00	5.00	5.00
5.Chunar	5.00	5.00	5.00	5.00

Source: JICA Study Team 2015

When asked to those who know about the city service whether they pay the following taxes, and how much they pay for the tax, they answered the followings. The average of WTP for house tax and water tax in Varanasi is extremely high compared with other areas. On the contrary, the citizens in Ramnagar seem not to be willing to pay for house tax and can pay the smallest amount for water tax among 4

regions.

Table 12.3.14 WTP for House Tax (Rs)

	All	LIG	MIG	HIG
1.Varanasi	1,416.80	741.80	1,138.60	2,370.00
2.Mirzapur	216.35	154.41	223.76	270.88
3.Ghazipur	178.04	116.47	190.00	227.65
4.RamNagar	0.00	0.00	0.00	0.00
5.Chunar	63.29	41.47	71.53	76.88

Source: JICA Study Team 2015

Table 12.3.15 WTP for Water Tax (Rs)

	All	LIG	MIG	HIG
1.Varanasi	1,213.44	522.56	1,433.76	1,684.00
2.Mirzapur	230.67	180.29	257.88	253.82
3.Ghazipur	278.47	187.76	328.82	318.82
4.RamNagar	131.76	112.94	134.12	148.24
5.Chunar	135.12	118.29	132.35	154.71

Source: JICA Study Team 2015

Table 12.3.16 WTP for Sewage Tax (Rs)

	All	LIG	MIG	HIG
1.Varanasi	0.60	-	1.80	-
2.Mirzapur	-	-	-	-
3.Ghazipur	-	-	-	-
4.RamNagar	-	-	-	-
5.Chunar	-	-	-	-

Source: JICA Study Team 2015

12.3.3 Areas except Varanasi

(1) Mirzapur

These citizen survey outcomes were taken in December 2015 and analyzed in January 2016. The next section looks at the results of the questionnaire:

A. basic profile,
B. diseases,
C. water supply,
D. toilet facilities at HHs,
E. CTC usage, and
F. public outreach

a) Basic Profiles of each respondent

The respondents are 86% of male and 14% of female.

Occupations of the respondents are as follows. 52.9% has their own business, 9.8% government job, 11.8% private sector job, 11.8% daily wage, 0.0% family profession, 9.8% vending and 3.9% others. Business owners and government people are mostly found in higher income groups.

Table 12.3.17 Occupations of the respondents

	Total	LIG	MIG	HIG	Total	LIG (%)	MIG (%)	HIG (%)
1.Business	27	4	12	11	52.9	23.5	70.6	64.7
2.Govt job	5	0	2	3	9.8	0.0	11.8	17.7
3.Private job	6	2	2	2	11.8	11.8	11.8	11.8
4.Daily wage	6	6	0	0	11.8	35.3	0.0	0.0
5.Family profes-sion	0	0	0	0	0.0	0.0	0.0	0.0
6.Vending	5	5	0	0	9.8	29.4	0.0	0.0
7. Others	2	0	1	1	3.9	0.0	5.9	5.9
Total	51	17	17	17	100.0	100.0	100.0	100.0

Source: JICA Study Team 2015

The family number is about 8.8 per household, contains 3.2 male members, and 2.9 female members, and 2.7 children. The higher the income is the more family members in the house are. The gap is about 3.65 persons between the poorest and the richest.

Table 12.3.18 Average number of family members

	Total	LIG	MIG	HIG
1.Total No. of Family Member	8.8	7.8	7.2	11.5
2.Male Members (more than 18 years) :	3.2	2.7	3.0	4.1
3.Female Members (more than 18 years) :	2.9	2.5	2.2	4.1
4.Child Less than 18 years:	2.7	2.7	1.9	3.4

Source: JICA Study Team 2015

Regarding the education level of the respondent, the highest are 10+ (College) (25.5 %), followed by Read & Write (23.5%), 10^{th} grade (13.7%) and Grad school (13.7%). As expected, the higher the income, the higher the level of education.

Table 12.3.19 Education Level of the Respondents

	Total	LIG	MIG	HIG	Total	LIG (%)	MIG (%)	HIG (%)
1.(Read & Write)	12	7	4	1	23.5	41.2	23.5	5.9
2.(5th grade)	3	1	2	0	5.9	5.9	11.8	0.0
3.(10th grade)	7	0	4	3	13.7	0.0	23.5	17.7
4.10+ (College)	13	3	3	7	25.5	17.7	17.7	41.2
5.(Grad school)	7	0	3	4	13.7	0.0	17.7	23.5
6.(Post-grad school)	4	1	1	2	7.8	5.9	5.9	11.8
	51	17	17	17	100.0	100.0	100.0	100.0

Looking at the religion of the respondents, 82.4% are Hindu and 17.7% are Muslims. More Muslims are found in higher income families.

Table 12.3.20 Religion of the respondents

	N	LIG	MIG	HIG	All (%)	LIG (%)	MIG (%)	HIG (%)
1.(Hindu)	42	15	14	13	82.4	88.2	82.4	76.5
2.(Muslim)	9	2	3	4	17.7	11.8	17.7	23.5
3.(Christian)	0	0	0	0	0.0	0.0	0.0	0.0
4.(Others)	0	0	0	0	0.0	0.0	0.0	0.0
	51	17	17	17	100.0	100.0	100.0	100.0

Source: JICA Study Team 2015

The question of how long they have lived in the area, average is 42.4 years, and the higher income is, the longer settled years of the respondents are.

Table 12.3.21 Settled years of the respondents (yrs.)

Type	All	LIG	MIG	HIG
Year	42.4	38.4	41.4	47.4

Source: JICA Study Team 2015

The question of average income of the respondents are shown as below, and the average is 22,098 Rs. The richest families has as much as third times more incomes than the poorest ones, twice as big as the middle-income ones.

Table 12.3.22 Average monthly income of the respondents (Rs)

Type	All	LIG	MIG	HIG
Amount	22,098	8,471	17,824	40,000

Source: JICA Study Team 2016

The question of average expenditure of the respondents are shown as below, and the food expenditures are the largest in all categories. Apart from savings and others, LIG spend on cooking fuel secondly and electricity thirdly. MIG's second and third spending items are clothing and education. HIG's thirdly and fourthly spending items are clothing and education.

Table 12.3.23 Average monthly expenditure of the respondents (Rs)

	All	LIG	MIG	HIG
1.(Food)	7,637	3,676	6,412	12,824
2.(Clothing)	2,312	318	2,206	4,412
3.(House Rent)	0	0	0	0
4.(House Tax)	18	13	19	22
5.(Electricity)	863	512	918	1,159
6.(Water/Sewerage service)	19	15	21	21
7.(Cooking Fuel)	724	535	800	835
8.(Vehicle Fuel)	1,086	29	1,035	2,194
9.(Health/treatment)	125	218	71	88
10.(Education)	1,600	488	1,312	3,000
11.(Saving)	4,755	1,494	3,386	9,386
12.(Others)	2,959	1,172	1,645	6,059
(Total)	22,098	8,471	17,824	40,000

Source: JICA Study Team 2016

b) Disease

The question to see whether any of the family members had disease in the last one year, 15.7 percent answered yes, and 84.3 % no. The higher income they earn, the less disease incident rate is.

Table 12.3.24 Disease incident rate for the past one year

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.(Yes)	8	15.7	35.3	5.9	5.9
2.(No)	43	84.3	64.7	94.1	94.1

Source: JICA Study Team 2016

Those who answered yes in the disease question, they showed the specific diseases they had and the

most frequent one is paratyphoid (25.0%).

Table 12.3.25 Type of disease for the past one year

	All	LIG	MIG	HIG	All (%)	LIG (%)	MIG (%)	HIG (%)
1. (Paratyphoid).	2	2	0	0	25.0	33.3	0.0	0.0
2.(Cholera)	0	0	0	0	0.0	0.0	0.0	0.0
3.(Typhoid/Typhus)	0	0	0	0	0.0	0.0	0.0	0.0
4.(Dysentery)	0	0	0	0	0.0	0.0	0.0	0.0
5.(Dengue)	0	0	0	0	0.0	0.0	0.0	0.0
6.(Malaria)	0	0	0	0	0.0	0.0	0.0	0.0
7.(Flue)	0	0	0	0	0.0	0.0	0.0	0.0
8.Others	6	4	1	1	75.0	66.7	100.0	100.0
	8	6	1	1	100.0	100.0	100.0	100.0

c) Water supply service

Regarding the possession of the water supply service, 64.7% answered they have some type of water supply service. Looking at the income group, 70.6% LIG have water supply services, 52.9% for MIG and 70.6% for LIG.

Table 12.3.26 Possession of the water supply service

	All	All (%)	LIG (%)	MIG (%)	HIG (%)
1.Yes (go to 16)	33	64.7	70.6	52.9	70.6
2.No (go to 20)	18	35.3	29.4	47.1	29.4
3.Other sources					
1） Private source	10	55.6	55.6	25.0	25.0
2) Ground water	8	44.4	44.4	75.0	75.0

Source: JICA Study Team 2016

In regard to the amount of the water supply charge, the following results are acquired. 68.6% of them pay around 800* and 29.4% pay for nothing.

Table 12.3.27 Amount of the water supply charge

	All	LIG	MIG	HIG	All (%)	LIG (%)	MIG (%)	HIG (%)
1.(Around 800*)	35	10	10	15	68.6	58.8	58.8	88.2
2.(Around 1000)	1	1	0	0	2.0	5.9	0.0	0.0

3.(Around 1500)	0	0	0	0	0.0	0.0	0.0	0.0
4.(Around 2000)	0	0	0	0	0.0	0.0	0.0	0.0
5.(Around 2500)	0	0	0	0	0.0	0.0	0.0	0.0
6.(More than 2500)	0	0	0	0	0.0	0.0	0.0	0.0
7. Not paying	15	6	7	2	29.4	35.3	41.2	11.8
	51	17	17	17	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

*Note: *Units are in Indian Rupees.*

As for the question to see how you rate the water services you are mainly using, 76.5% answered very satisfactory, followed by relatively satisfactory (13.7%), average (3.9%).

Table 12.3.28 Rate of the water supply services

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.(Very satisfactory)	39	76.5	70.6	64.7	94.1
2.(Relatively satisfactory)	7	13.7	29.4	5.9	5.9
3.(Average)	2	3.9	0.0	11.8	0.0
4.(Relatively unsatisfactory)	1	2.0	0.0	5.9	0.0
5.(Very unsatisfactory)	2	3.9	0.0	11.8	0.0
	51	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

Regarding the questions which types of problems on the present main water supply, 15.7% claims that there is no transparency of water and 7.8% bad taste, 5.9% lack of water and 3.9% frequent interruption.

Table 12.3.29 Problems on the present main water supply (multiple answers)

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.(Bad taste (smell))	4	7.8	5.9	11.8	5.9
2.(Water is dirty (not transparent))	8	15.7	23.5	17.7	5.9
3.(Frequent stop of water service)	2	3.9	0.0	11.8	0.0
4.(Water amount is not enough)	3	5.9	5.9	11.8	0.0
5.(Insufficient water pressure)	0	0.0	0.0	0.0	0.0
6.(High Tariff)	0	0.0	0.0	0.0	0.0
7.(Others (please specify))	0	0.0	0.0	0.0	0.0
	17	33.3	11.8	17.7	3.9

Source: JICA Study Team 2016

When asked how much they are willing to pay (WTP) for the water services which all the above mentioned issues are solved, they answered 89.0 Rs per month. LIG and MIG are about the same, 126.00

Rs and 52.00 Rs respectively.

Table 12.3.30 WTP for the water supply services

	All	LIG	MIG	HIG
Rs/month	89.00	126.00	52.00	-

Source: JICA Study Team 2016

d) Toilet facilities

The questions asked whether they have a toilet in their houses, total 84.3% answered yes. While HIG answered 100.0% of them have a toilet in their houses, 58.9 % of LIG answered yes.

Table 12.3.31 Toilet possessions

	All	LIG	MIG	HIG
Yes	43	10	16	17
No	8	7	1	0
Yes (%)	84.3	58.8	94.1	100.0
No (%)	15.7	41.2	5.9	0.0
	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

The questions asked which disposal system was connected to their home toilets, 51.2 % of them answered that they are connected to a soak pit or trench, followed by direct discharge into ditch (25.6%), and sewer connection (23.3%).

Note: “Rate of Connection to the Existing Sewage System (Existing Connection Rate)” comes from this questioner survey. As it note before, in EIRR calculation, this the percentage in which the number of Sewer system owners is divided by total surveyors, not divided by who answered they have toilets, so this number is conservative. But here the percentage shows that the number of Sewer system owners is divided by who answered they have toilets. The same procedure is also adopted in other areas.

Table 12.3.32 Disposal system for the toilets

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.(Sewer connection)	10	23.3	10.0	31.3	23.5
2.Septic tank (connecting with a soak pit or trench)	22	51.2	30.0	56.3	58.8
3.Pit latrine (not using water)	0	0.0	0.0	0.0	0.0
4.(Direct discharge into ditch, drain or river)	11	25.6	60.0	12.5	17.7

5.Others	0	0.0	0.0	0.0	0.0
	43	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

When asked how they evaluate the pit latrine to those who answered sewer connection, 69.2% answered very satisfactory and 30.8% relatively unsatisfactory.

Table 12.3.33 Evaluation of the sewer connection

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1. Very satisfactory	9	69.2	100.0	42.9	100.0
2.Relatively satisfactory	4	30.8	0.0	57.1	0.0
3.Average	0	0.0	0.0	0.0	0.0
4.Relatively unsatisfactory	0	0.0	0.0	0.0	0.0
5.Very unsatisfactory	0	0.0	0.0	0.0	0.0
	13	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

When asked the WTP for the sewer connection to those who answered the present sewer connection is unsatisfactory, in the condition that all previous issues are solved, they answered 80.0 Rs.

Table 12.3.34 WTP for the sewer connection

	All	LIG	MIG	HIG
Rs/month	80.0	50.0	87.5	-

Source: JICA Study Team 2016

When asked to all persons who answered they have no sewer connection in their houses, whether they want to have a sewer connection in their house, the answers are as follows. Most of them want to have sewer connection.

Table 12.3.35 Sewage demand in non-sewer HHs

	All	All (%)	LIG	MIG	HIG
1.Yes	39	97.5	100.0	100.0	91.7
2.No	1	2.5	0.0	0.0	8.3
	40	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

To those who do not have sewer connection and they would like to have in future, if asked how much they are willing to pay for connection of sewer to their house, the average of their answer is 955.1 Rs.

Similarly, to those who do not have sewer connection and they would like to have in future, if asked how much are you willing to pay for sewer user charge per month, they answer that they pay average 55.0 Rs/month.

Table 12.3.36 WTP for connection and monthly fee (Rs)

	All	LIG	MIG	HIG
WTP for connection(Rs)	955.1	637.5	858.3	1522.7
WTP for monthly fee (Rs).	55.0	47.5	47.1	73.2

Source: JICA Study Team 2016

e) CTC usage

CTC is the complex of the community toilets, and if asked the WTP for CTC per usage, the respondents answered that they are willing to pay for 4.5Rs.

Table 12.3.37 WTP for CTC per usage

	All	LIG	MIG	HIG
Rs.	4.5	4.1	5.0	4.3

Source: JICA Study Team 2016

Q estion asked that how they evaluate the present public/community toilet service in the community, 17.7% answered relatively satisfactory, 11.8% relatively satisfactory and average.

Table 12.3.38 CTC's satisfaction rate of the respondents

	All	All (%)	LIG (%)	MIG (%)	HIG (%)
1.(Very satisfactory)	6	11.8	0.0	17.7	17.7
2.(Relatively satisfactory)	9	17.7	11.8	23.5	17.7
3.(Average)	6	11.8	23.5	11.8	0.0
4.(Relatively unsatisfactory)	2	3.9	5.9	5.9	0.0
5.(Very unsatisfactory)	4	7.8	17.7	5.9	0.0
6.(I don't know)	24	47.1	41.2	35.3	64.7
	51	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

When asked the reason that CTCs are not "very satisfactory", 45.7% answered that it is dirty, 23.9% overflow of wastewater is not good and 10.9% claims congestion.

Table 12.3.39 Reasons for dissatisfaction of the CTCs

	All	LIG	MIG	HIG	All (%)	LIG (%)	MIG (%)	HIG (%)
1.(Dirty)	21	10	8	3	45.7	38.5	50.0	75.0
2.(Overflow of wastewater)	11	6	4	1	23.9	23.1	25.0	25.0
3.(Congestion)	5	4	1	0	10.9	15.4	6.3	0.0
4.(Long distance to the toilet)	0	0	0	0	0.0	0.0	0.0	0.0
5.(Charge is too high)	4	1	3	0	8.7	3.9	18.8	0.0
6.(I do not want to pay)	4	4	0	0	8.7	15.4	0.0	0.0
7. (Facility that we want to use is not installed (please specify :)	1	1	0	0	2.2	3.9	0.0	0.0
8.Others (please specify:)	0	0	0	0	0.0	0.0	0.0	0.0
	46	26	16	4	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

When asked the WTP for CTC per usage, the average is 4.7 Rs for all income groups.

Table 12.3.40 WTP for CTC per usage

	All	LIG	MIG	HIG
Rs.	4.7	4.4	5.0	5.0

Source: JICA Study Team 2016

f) Public outreach

Question asked if there are any community-based activities on sanitary programs in your community, 92.2 % of them answered that they know the activities, and 7.8 % of them says that they do not know whether the activities are existing or not. It can be said that the higher the income is, the more they know about these activities.

Table 12.3.41 Existence of the community-based activities on sanitary programs in your community

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.Yes	47	92.2	88.2	94.1	94.1
2.No	4	7.8	11.8	5.9	5.9

Source: JICA Study Team 2016

When asked to people who know about the city services whether they pay the following taxes, and how much do you pay for the tax, they answered the followings.

Table 12.3.42 Average amount of tax payment conditions

	All	LIG	MIG	HIG
1. House tax	216.4	154.4	223.8	270.9
2. Water tax	230.7	180.3	257.9	253.8
3. Sewage tax	0.0	0.0	0.0	0.0
4. E. P. E. tax	0.0	0.0	0.0	0.0
5. Education, Petroleum, and Environment	0.0	0.0	0.0	0.0

(2) Ghazipur

These citizen survey outcomes were taken in December 2015 and analyzed in January 2016. The next section looks at the results of the questionnaire:

A. basic profile,
B. diseases,
C. water supply,
D. toilet facilities at HHs,
E. CTC usage, and
F. public outreach

a) Basic Profiles of each respondent

The respondents are 92% of male and 8% of female.

Occupations of the respondents are as follows. 37.3% has their own business, 23.5% government job, 13.7% private sector job, 11.8% daily wage 9.8% vending and 3.9% others. Government and private job people are mostly found in higher income groups.

Table 12.3.43 Occupation of the respondents

	Total	LIG	MIG	HIG	Total	LIG (%)	MIG (%)	HIG (%)
1.Business	19	4	10	5	37.3	23.5	58.8	29.4
2.Govt job	12	1	4	7	23.5	5.9	23.5	41.2
3.Private job	7	0	3	4	13.7	0.0	17.7	23.5
4.Daily wage	6	6	0	0	11.8	35.3	0.0	0.0
5.Family profes-sion	0	0	0	0	0.0	0.0	0.0	0.0
6.Vending	5	5	0	0	9.8	29.4	0.0	0.0
7. Others	2	1	0	1	3.9	5.9	0.0	5.9
Total	51	17	17	17	0.0	0.0	0.0	0.0

Source: JICA Study Team 2015

The family number is about 8.8 per household, contains 3.5 male members, and 2.7 female members, and 2.6 children. The higher the income is the more family members in the house are. The gap is about 3.8 persons between the poorest and the richest.

Table 12.3.44 Average number of family members

	Total	LIG	MIG	HIG
1.Total No. of Family Member	8.8	6.5	9.5	10.3
2.Male Members (more than 18 years) :	3.5	2.5	3.9	4.2
3.Female Members (more than 18 years) :	2.7	1.7	3.2	3.2
4.Child Less than 18 years:	2.6	2.4	2.4	2.9

Source: JICA Study Team 2015

Regarding the education level of the respondent, the highest are 5th grade (29.4 %), followed by 10th grade (21.5%), grad school (15.7%) and post-grad school (15.7%) and college (10+) (11.8%). As expected, the higher the income, the higher the level of education.

Table 12.3.45 Education level of the respondents

	Total	LIG	MIG	HIG	Total	LIG (%)	MIG (%)	HIG (%)
1.(Read & Write)	3	3	0	0	5.9	17.7	0.0	0.0
2.(5th grade)	15	7	7	1	29.4	41.2	41.2	5.9
3.(10th grade)	11	2	6	3	21.6	11.8	35.3	17.7
4.10+ (College)	6	3	0	3	11.8	17.7	0.0	17.7
5.(Grad school)	8	1	2	5	15.7	5.9	11.8	29.4
6.(Post-grad school)	8	1	2	5	15.7	5.9	11.8	29.4
	51	17	17	17	100.0	100.0	100.0	100.0

Looking at the religion of the respondents, 92.2% are Hindu and 7.8% are Muslims. More Muslims are found in higher income families.

Table 12.3.46 Religion of the respondents

	N	LIG	MIG	HIG	All (%)	LIG (%)	MIG (%)	HIG (%)
1.(Hindu)	47	15	16	16	92.2	88.2	94.1	94.1
2.(Muslim)	4	2	1	1	7.8	11.8	5.9	5.9
3.(Christian)	0	0	0	0	0.0	0.0	0.0	0.0
4.(Others)	0	0	0	0	0.0	0.0	0.0	0.0
	51	17	17	17	100.0	100.0	100.0	100.0

Source: JICA Study Team 2015

The question of how long they have lived in the area, average is 43.6 years. The higher income is the longer settled years are.

Table 12.3.47 Settled years of the respondents (yrs.)

Type	All	LIG	MIG	HIG
Year	43.6	39.6	44.2	46.7

Source: JICA Study Team 2015

The question of average income of the respondents are shown as below, and the average is 20,824 Rs. The richest families has as much as third times more incomes than the poorest ones, twice as big as the middle-income ones.

Table 12.3.48 Average monthly income of the respondents (Rs)

Type	All	LIG	MIG	HIG
Amount	20,824	10,353	21,353	30,765

Source: JICA Study Team 2016

The question of average expenditure of the respondents are shown as below, and the food expenditures are the largest in all categories. Apart from savings and others, LIG spend on cooking fuel secondly and clothing thirdly. MIG's second and third most spending items are clothing and electricity. HIG's secondly, and thirdly spending items are vehicle fuel and clothing.

Table 12.3.49 Average monthly expenditure of the respondents (Rs)

	All	LIG	MIG	HIG
1.(Food)	8,127	5,088	8,647	10,647
2.(Clothing)	1,598	647	1,735	2,412
3.(House Rent)	0	0	0	0
4.(House Tax)	15	10	16	19
5.(Electricity)	1,275	529	1,259	2,035
6.(Water/Sewerage service)	23	16	27	26
7.(Cooking Fuel)	875	671	924	1,029
8.(Vehicle Fuel)	1,245	147	1,118	2,471
9.(Health/treatment)	59	0	176	0
10.(Education)	1,218	476	1,088	2,088
11.(Saving)	4,964	2,181	4,999	7,714
12.(Others)	1,480	588	1,529	2,324
(Total)	20,863	10,353	21,471	30,765

Source: JICA Study Team 2016

b) Disease

The question to see whether any of the family members had disease in the last one year, 3.9 percent answered yes, and 96.1 % no.

Table 12.3.50 Disease incident rate for the past one year

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.(Yes)	2	3.9	0.0	11.8	0.0
2.(No)	49	96.1	100.0	88.2	100.0

Source: JICA Study Team 2016

Those who answered yes in the disease question, they showed the specific diseases they had and the most frequent one is malaria (2.0%).

Table 12.3.51 Type of disease for the past one year

	All	LIG	MIG	HIG	All (%)	LIG (%)	MIG (%)	HIG (%)
1. (Paratyphoid).	0	0	0	0	0.0	0.0	0.0	0.0
2.(Cholera)	0	0	0	0	0.0	0.0	0.0	0.0
3.(Typhoid/Typhus)	0	0	0	0	0.0	0.0	0.0	0.0
4.(Dysentery)	0	0	0	0	0.0	0.0	0.0	0.0
5.(Dengue)	0	0	0	0	0.0	0.0	0.0	0.0
6.(Malaria)	1	0	1	0	2.0	0.0	5.9	0.0
7.(Flue)	0	0	0	0	0.0	0.0	0.0	0.0
8.Others	0	0	0	0	0.0	0.0	0.0	0.0
	1	0	1	0	2.0	0.0	5.9	0.0

c) Water supply service

Regarding the possession of the water supply service, 100.0% answered they have some type of water supply service.

Table 12.3.52 Possession of the water supply service

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.Yes (go to 16)	51	100.0	100.0	100.0	100.0
2.No (go to 20)	0	0.0	0.0	0.0	0.0
3.Other sources					
1) Private source	9.80	17.7	0.0	11.8	9.8
2) Ground water	0.00	0.0	0.0	0.0	0.0

Source: JICA Study Team 2016

In regard to the amount of the water supply charge, the following results are acquired. Overall, there are 100% for around 800.

Table 12.3.53 Amount of the water supply charge

	All	LIG	MIG	HIG	All (%)	LIG (%)	MIG (%)	HIG (%)
1.(Around 800*)	51	17	17	17	100.0	100.0	100.0	100.0
2.(Around 1000)	0	0	0	0	0.0	0.0	0.0	0.0
3.(Around 1500)	0	0	0	0	0.0	0.0	0.0	0.0
4.(Around 2000)	0	0	0	0	0.0	0.0	0.0	0.0
5.(Around 2500)	0	0	0	0	0.0	0.0	0.0	0.0
6.(More than 2500)	0	0	0	0	0.0	0.0	0.0	0.0
7. Not paying	0	0	0	0	0.0	0.0	0.0	0.0
	51	17	17	17	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

*Note: *Units are in Indian Rupees.*

As for the question to see how you rate the water service you are mainly using, 82.4% answered very satisfactory, followed by average (13.7%).

Table 12.3.54 Rate of the water supply services

	All	All (%)	LIG (%)	MIG (%)	HIG (%)
1.(Very satisfactory)	42	82.4	82.4	64.7	100.0
2.(Relatively satisfactory)	1	2.0	5.9	0.0	0.0
3.(Average)	7	13.7	11.8	29.4	0.0
4.(Relatively unsatisfactory)	1	2.0	0.0	5.9	0.0
5.(Very unsatisfactory)	0	0.0	0.0	0.0	0.0
	51	100.0	33.3	33.3	33.3

Source: JICA Study Team 2016

Regarding the questions which types of problems on the present main water supply, 11.8% claims that there is bad smell or taste.

Table 12.3.55 Problems on the present main water supply (multiple answers)

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.(Bad taste (smell))	6	11.8	11.8	23.5	0.0
2.(Water is dirty (not transparent))	1	2.0	0.0	5.9	0.0
3.(Frequent stop of water service)	1	2.0	0.0	5.9	0.0
4.(Water amount is not enough)	1	2.0	5.9	0.0	0.0
5.(Insufficient water pressure)	0	0.0	0.0	0.0	0.0
6.(High Tariff)	0	0.0	0.0	0.0	0.0
7.(Others (please specify))	0	0.0	0.0	0.0	0.0
	9	17.7	17.7	35.3	0.0

Source: JICA Study Team 2016

When asked how much they are willing to pay (WTP) for the water services which all the above mentioned issues are solved, they answered 16.67 Rs per month.

Table 12.3.56 WTP for the water supply services

	All	LIG	MIG	HIG
Rs/month	16.7	13.3	18.3	-!

Source: JICA Study Team 2016

d) Toilet facilities

The questions asked whether they have a toilet in their houses, total 88.2% answered yes. While both HIG answered 100.0% of them have a toilet in their houses, 82.4 % of MIG and LIG answered no.

Table 12.3.57 Toilet possessions

	All	LIG	MIG	HIG
Yes	45	14	14	17
No	6	3	3	0
Yes (%)	88.2	82.4	82.4	100.0
No (%)	11.8	17.7	17.7	0.0
	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

The questions asked which disposal system is connected to their home toilets; nobody is connected to sewer, followed by septic tanks (82.2%), and direct discharges to ditch, drain or river (17.8%).

Table 12.3.58 Disposal system for the toilets

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.(Sewer connection)	0	0.0	0.0	0.0	0.0
2.Septic tank (connecting with a soak pit or trench)	37	82.2	71.4	85.7	88.2
3.Pit latrine (not using water)	0	0.0	0.0	0.0	0.0
4.(Direct discharge into ditch, drain or river)	8	17.8	28.6	14.3	11.8
5.Others	0	0.0	0.0	0.0	0.0
	45	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

When asked how they evaluate the pit latrine to those who answered sewer connection, 100.0% answered very satisfactory.

Table 12.3.59 Evaluation of the sewer connection

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1. Very satisfactory	45	100.0	100.0	100.0	100.0
2.Relatively satisfactory	0	0.0	0.0	0.0	0.0
3.Average	0	0.0	0.0	0.0	0.0
4.Relatively unsatisfactory	0	0.0	0.0	0.0	0.0
5.Very unsatisfactory	0	0.0	0.0	0.0	0.0
	45	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

When asked to all people who answered they have no sewer connection in their houses, whether they want to have a sewer connection in their house, the answers are as follows. They all want to have sewer connection.

Table 12.3.60 Sewage demand in non-sewer HHs

	All	All (%)	LIG	MIG	HIG
1.Yes	51	100.0	100.0	100.0	0.0
2.No	0	0.0	0.0	0.0	0.0
	51	100.0	100.0	100.0	0.0

Source: JICA Study Team 2016

To those who do not have sewer connection and they would like to have in future, if asked how much they are willing to pay for connection of sewer to their house, the average of their answer is540.1 Rs.

Similarly, to those who do not have sewer connection and they would like to have in future, if asked how much are you willing to pay for sewer user charge per month, they answer that they pay average 10.4 Rs/month.

Table 12.3.61 WTP for connection and monthly fee (Rs)

	All	LIG	MIG	HIG
WTP for connection (Rs)	547.1	335.3	588.2	717.7
WTP for monthly fee (Rs).	10.4	6.9	10.6	13.5

Source: JICA Study Team 2016

e) CTC usage

CTC is the complex of the community toilets, and if asked the WTP for CTC per usage, the average of their answer is 3.6Rs.It can be said that the less income is, the less WTP for CTC is.

Table 12.3.62 WTP for CTC per usage

	All	LIG	MIG	HIG
Rs.	3.6	2.5	4.0	5.0

Source: JICA Study Team 2016

Question asked that how they evaluate the present public/community toilet service in the community, When asked the reason that CTCs are not “very satisfactory”, 19.6% answered that it is dirty, 9.8% overflow of wastewater is not good.

Table 12.3.63 Reasons for dissatisfaction of the CTCs

	All	LIG	MIG	HIG	All (%)	LIG (%)	MIG (%)	HIG (%)
1.(Dirty)	10	4	3	3	19.6	23.5	17.7	17.7
2.(Overflow of wastewater)	5	3	1	1	9.8	17.7	5.9	5.9
3.(Congestion)	0	0	0	0	0.0	0.0	0.0	0.0
4.(Long distance to the toilet)	0	0	0	0	0.0	0.0	0.0	0.0
5.(Charge is too high)	0	0	0	0	0.0	0.0	0.0	0.0
6.(I do not want to pay)	0	0	0	0	0.0	0.0	0.0	0.0
7. (Facility that we want to use is not installed (please specify :)	0	0	0	0	0.0	0.0	0.0	0.0
8.Others (please specify:)	0	0	0	0	0.0	0.0	0.0	0.0
	15	7	4	4	29.4	13.7	7.8	7.8

Source: JICA Study Team 2016

When asked the WTP for CTC per usage, the average is 4.6 Rs for all income groups.

Table 12.3.64 WTP for CTC per usage

	All	LIG	MIG	HIG
Rs.	4.6	4.7	4.0	5.0

Source: JICA Study Team 2016

f) Public outreach

Question asked if there are any community-based activities on sanitary programs in your community, 100.0 % of them answered that they know the activities.

Table 12.3.65 Existence of the community-based activities on sanitary programs in your community

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.Yes	51	100.0	100.0	100.0	100.0
2.No	0	0.0	0.0	0.0	0.0

Source: JICA Study Team 2016

When asked to people who know about the city services whether they pay the following taxes, and how much do you pay for the tax, they answered the followings.

Table 12.3.66 Average amount of tax payment conditions

	All	LIG	MIG	HIG
1. House tax	178.0	116.5	190.0	227.7
2. Water tax	278.5	187.8	328.8	318.8
3. Sewage tax	0.0	0.0	0.0	0.0
4. E. P. E. tax	0.0	0.0	0.0	0.0
5. Education, Petroleum, and Environment	0.0	0.0	0.0	0.0

(3) Ramnagar

These citizen survey outcomes were taken in December 2015 and analyzed in January 2016. The next section looks at the results of the questionnaire:

A. basic profile,
B. diseases,
C. water supply,
D. toilet facilities at HHs,

E. CTC usage, and
F. public outreach

a) Basic Profiles of each respondent

The respondents are 88% of male and 12% of female.

Occupations of the respondents are as follows. 51.0% has their own business, 21.6% government job, 2.0% private sector job, 9.8% daily wage, 2.0% family profession, 7.8% vending, 5.9% others. Business owners and government people are mostly found in higher income groups.

Table 12.3.67 Occupations of the respondents

	Total	LIG	MIG	HIG	Total	LIG (%)	MIG (%)	HIG (%)
1.Business	26	6	13	7	51.0	35.3	76.5	41.2
2.Govt job	11	0	2	9	21.6	0.0	11.8	52.9
3.Private job	1	1	0	0	2.0	5.9	0.0	0.0
4.Daily wage	5	4	1	0	9.8	23.5	5.9	0.0
5.Family profes-sion	1	1	0	0	2.0	5.9	0.0	0.0
6.Vending	4	4	0	0	7.8	23.5	0.0	0.0
7. Others	3	1	1	1	5.9	5.9	5.9	5.9
Total	51	17	17	17	100.0	100.0	100.0	100.0

Source: JICA Study Team 2015

The family number is about 8.2 per household, contains 3.27 male members, and 2.45 female members, and 2.47 children. The higher the income is the more family members in the house are. The gap is about 3.85 persons between the poorest and the richest.

Table 12.3.68 Average number of family members

	Total	LIG	MIG	HIG
1.Total No. of Family Member	8.2	6.5	8.0	10.1
2.Male Members (more than 18 years) :	3.3	2.7	3.4	3.8
3.Female Members (more than 18 years) :	2.5	1.9	2.5	2.9
4.Child Less than 18 years:	2.5	1.9	2.2	3.4

Source: JICA Study Team 2015

Regarding the education level of the respondent, the highest are the read & write (39.2 %), followed by

10th grade (23.5%), 5th grade (11.76%) and 10+ (College) (11.76%). As expected, the higher the income, the higher the level of education.

Table 12.3.69 Education Level of the Respondents

	Total	LIG	MIG	HIG	Total	LIG (%)	MIG (%)	HIG (%)
1.(Read & Write)	20	13	6	1	39.2	76.5	35.3	5.9
2.(5th grade)	6	1	3	2	11.8	5.9	17.7	11.8
3.(10th grade)	12	1	5	6	23.5	5.9	29.4	35.3
4.10+ (College)	6	1	2	3	11.8	5.9	11.8	17.7
5.(Grad school)	3	0	1	2	5.9	0.0	5.9	11.8
6.(Post-grad school)	4	1	0	3	7.8	5.9	0.0	17.7
	51	17	17	17	100.0	100.0	100.0	100.0

Looking at the religion of the respondents, 76.5% are Hindu and 23.5% are Muslims. More Muslims are found in higher income families.

Table 12.3.70 Religion of the respondents

	N	LIG	MIG	HIG	All (%)	LIG (%)	MIG (%)	HIG (%)
1.(Hindu)	39	14	14	11	76.5	82.4	82.4	64.7
2.(Muslim)	12	3	3	6	23.5	17.7	17.7	35.3
3.(Christian)	0	0	0	0	0.0	0.0	0.0	0.0
4.(Others)	0	0	0	0	0.0	0.0	0.0	0.0
	51	17	17	17	100.0	100.0	100.0	100.0

Source: JICA Study Team 2015

The question of how long they have lived in the area, average is 42.5 years, and the income doesn't relate to the settled years.

Table 12.3.71 Settled years of the respondents (yrs.)

Type	All	LIG	MIG	HIG
Year	42.5	41.6	45.2	40.6

Source: JICA Study Team 2015

The question of average income of the respondents are shown as below, and the average is 19,765 Rs. The richest families has as much as three times more incomes than the poorest ones, twice as big as the middle-income ones.

Table 12.3.72 Average monthly income of the respondents (Rs)

Type	All	LIG	MIG	HIG
Amount（Rs）	19,765	9,588	18,941	30,765

Source: JICA Study Team 2016

The question of average expenditure of the respondents are shown as below, and the food expenditures are the largest in all categories. Apart from savings, all 3 income groups spend on clothing in the second most money and LIG spend on cooking fuel thirdly. MIGs' third most spending items is vehicle fuel. HIG's thirdly spending item is vehicle fuel.

Table 12.3.73 Average monthly expenditure of the respondents (Rs)

	All	LIG	MIG	HIG
1.(Food)	7,980.4	4,882.4	7,529.4	11,529.4
2.(Clothing)	2,068.6	911.8	2,117.7	3,176.5
3.(House Rent)	0.0	0.0	0.0	0.0
4.(House Tax)	0.0	0.0	0.0	0.0
5.(Electricity)	1,205.9	482.4	1,123.5	2,011.8
6.(Water/Sewerage service)	10.6	9.4	11.2	11.2
7.(Water)	-	-	-	-
8.(Sewerage service)	-	-	-	-
9.(Cooking Fuel)	998.0	694.1	823.5	1,476.5
10.(Vehicle Fuel)	1,552.9	88.2	1,600.0	2,970.6
11.(Health/treatment)	19.6	29.4	0.0	29.4
12.(Education)	1,151.0	305.9	1,070.6	2,076.5
13.(Saving)	3,446.3	1,543.5	3,224.1	5,571.2
14.(Others)	1,370.6	758.8	1,441.2	1,911.8
(Total)	19,803.9	9,705.9	18,941.2	30,764.7

Source: JICA Study Team 2016

b) Disease

The question to see whether any of the family members had disease in the last one year, 3.9 percent answered yes, and 96.1 % no. The income doesn't relate to the disease incident rate.

Table 12.3.74 Disease incident rate for the past one year

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.(Yes)	2	3.9	5.9	0.0	3.9
2.(No)	49	96.1	94.1	100.0	96.1

Source: JICA Study Team 2016

Those who answered yes in the disease question, they showed the specific diseases they had and the most frequent one is malaria (50.0%) and others (50.0%).

Table 12.3.75 Type of disease for the past one year

	All	LIG	MIG	HIG	All (%)	LIG（%）	MIG (%)	HIG (%)
1. (Paratyphoid).	0	0	0	0	0.0	0.0	-	0.0
2.(Cholera)	0	0	0	0	0.0	0.0	-	0.0
3.(Typhoid/Typhus)	0	0	0	0	0.0	0.0	-	0.0
4.(Dysentery)	0	0	0	0	0.0	0.0	-	0.0
5.(Dengue)	0	0	0	0	0.0	0.0	-	0.0
6.(Malaria)	1	0	0	1	50.0	0.0	-	100.0
7.(Flue)	0	0	0	0	0.0	0.0	-	0.0
8.Others	1	1	0	0	50.0	100.0	-	0.0
	2	1	0	1	100.0	100.0	-	100.0

c) Water supply service

Regarding the possession of the water supply service, 98.0% answered they have some type of water supply service. Looking at the income group, 94.1% LIG have water supply services, 100.0% for MIG and HIG.

Table 12.3.76 Possession of the water supply service

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.Yes (go to 16)	50	98.0	94.1	100.0	100.0
2.No (go to 20)	1	2.0	5.9	0.0	0.0
3.Other sources					
1. Private source	1	100.0	100.0	0.0	0.0
2. Ground water	0	0.0	0.0	0.0	0.0

Source: JICA Study Team 2016

In regard to the amount of the water supply charge, the following results are acquired. Overall, there are 100% for around 800.

Table 12.3.77 Amount of the water supply charge

	All	LIG	MIG	HIG	All (%)	LIG (%)	MIG (%)	HIG (%)
1.(Around 800*)	50	16	17	17	100.0	100.0	100.0	100.0
2.(Around 1000)	0	0	0	0	0.0	0.0	0.0	0.0
3.(Around 1500)	0	0	0	0	0.0	0.0	0.0	0.0
4.(Around 2000)	0	0	0	0	0.0	0.0	0.0	0.0
5.(Around 2500)	0	0	0	0	0.0	0.0	0.0	0.0
6.(More than 2500)	0	0	0	0	0.0	0.0	0.0	0.0
7. Not paying	50	16	17	17	100.0	100.0	100.0	100.0
	50	16	17	17	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

*Note: *Units are in Indian Rupees.*

As for the question to see how you rate the water services you are mainly using, 80.0% answered very satisfactory, followed by relatively satisfactory (16.0%), average (4.0%).

Table 12.3.78 Rate of the water supply services

	All	All (%)	LIG (%)	MIG (%)	HIG (%)
1.(Very satisfactory)	40	80.0	81.3	76.5	82.4
2.(Relatively satisfactory)	8	16.0	18.8	11.8	17.7
3.(Average)	2	4.0	0.0	11.8	0.0
4.(Relatively unsatisfactory)	0	0.0	0.0	0.0	0.0
5.(Very unsatisfactory)	0	0.0	0.0	0.0	0.0
6. Don't know	0	0.0	0.0	0.0	0.0
	50	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

Regarding the questions which types of problems on the present main water supply, 15.7% claims that there is bad smell or taste and 9.8% no transparency of water.

Table 12.3.79 Problems on the present main water supply (multiple answers)

	All	All (%)	LIG (%)	MIG (%)	HIG (%)
1.(Bad taste (smell))	8	15.7	11.8	23.5	11.8
2.(Water is dirty (not transparent))	5	9.8	5.9	11.8	11.8
3.(Frequent stop of water service)	0	0.0	0.0	0.0	0.0
4.(Water amount is not enough)	0	0.0	0.0	0.0	0.0
5.(Insufficient water pressure)	0	0.0	0.0	0.0	0.0

6.(High Tariff)	0	0.0	0.0	0.0	0.0
7.(Others (please specify))	0	0.0	0.0	25.5	17.7
	13	25.5	17.7	25.5	17.7

Source: JICA Study Team 2016

When asked how much they are willing to pay (WTP) for the water services which all the above mentioned issues are solved, they answered 16.75 Rs per month. The average of individual income group is 13.50 Rs for LIG, 19.25 Rs for MIG and 30.00 Rs for HIG.

Table 12.3.80 WTP for the water supply services

	All	LIG	MIG	HIG
Rs/month	16.8	13.5	19.3	30.0

Source: JICA Study Team 2016

d) Toilet facilities

The questions asked whether they have a toilet in their houses, total 98.0% answered yes. While both MIG and HIG answered 100.0% of them have a toilet in their houses, 5.9% of LIG answered no.

Table 12.3.81 Toilet possessions

	All	LIG	MIG	HIG
Yes	50	16	17	17
No	1	1	0	0
Yes (%)	98.0	94.1	100.0	100.0
No (%)	2.0	5.9	0.0	0.0
	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

The questions asked which disposal system is connected to their home toilets, 96.0 % of them answered that they are connected to sewer, followed by septic tanks (2.0%), and direct discharges to ditch, drain or river (2.0%).

Table 12.3.82 Disposal system for the toilets

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.(Sewer connection)	48	96.0	100.0	88.2	100.0
2.Septic tank (connecting with a soak pit or trench)	1	2.0	0.0	5.9	0.0
3.Pit latrine (not using water)	0	0.0	0.0	0.0	0.0

4.(Direct discharge into ditch, drain or river)	1	2.0	0.0	5.9	0.0
5.Others	0	0.0	0.0	0.0	0.0
	50	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

When asked how they evaluate the pit latrine to those who answered sewer connection, 95.8% answered very satisfactory, 2.0% relatively unsatisfactory and 2.0% average. The lower the income is, the more the satisfaction exists.

Table 12.3.83 Evaluation of the sewer connection

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1. Very satisfactory	46	95.8	100.0	93.3	94.1
2.Relatively satisfactory	1	2.1	0.0	6.7	0.0
3.Average	1	2.1	0.0	0.0	5.9
4.Relatively unsatisfactory	0	0.0	0.0	0.0	0.0
5.Very unsatisfactory	0	0.0	0.0	0.0	0.0
	48	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

When asked the WTP for the sewer connection to those who answered the present sewer connection is unsatisfactory, in the condition that all previous issues are solved, they answered 17.5 Rs.

Table 12.3.84 WTP for the sewer connection

	All	LIG	MIG	HIG
Rs/month	17.5	-	23.3	0.0

Source: JICA Study Team 2016

When asked to all people who answered they have no sewer connection in their houses, whether they want to have a sewer connection in their house, the answers are as follows. They all want to have sewer connection.

Table 12.3.85 Sewage demand in non-sewer HHs

	All	All (%)	LIG	MIG	HIG
1.Yes	3	100.0	100.0	100.0	0.0
2.No	0	0.0	0.0	0.0	0.0
	3	100.0	100.0	100.0	0.0

Source: JICA Study Team 2016

To those who do not have sewer connection and they would like to have in future, if asked how much they are willing to pay for connection of sewer to their house, the average of their answer is 150.0 Rs. Similarly, to those who do not have sewer connection and they would like to have in future, if asked how much are you willing to pay for sewer user charge per month, they answer that they pay average 5.0 Rs/month.

Table 12.3.86 WTP for connection and monthly fee (Rs)

	All	LIG	MIG	HIG
WTP for connection (Rs)	150.0	200.0	125.0	-
WTP for monthly fee (Rs).	5.0	5.0	5.0	-

Source: JICA Study Team 2016

e) CTC usage

CTC is the complex of the community toilets, and if asked the WTP for CTC per usage, the respondents answered that 4.8Rs, and LIG and MIG is willing to pay higher than HIG.

Table 12.3.87 WTP for CTC per usage

	All	LIG	MIG	HIG
Rs.	4.8	5.0	5.0	4.4

Source: JICA Study Team 2016

Question asked that how they evaluate the present public/community toilet service in the community, 19.6% answered very satisfactory, 15.7% relatively satisfactory and 2.0% average.

Table 12.3.88 CTC's satisfaction rate of the respondents

	All	All (%)	LIG (%)	MIG (%)	HIG (%)
1.(Very satisfactory)	10	19.6	23.5	23.5	11.8
2.(Relatively satisfactory)	8	15.7	23.5	5.9	17.7
3.(Average)	1	2.0	0.0	5.9	0.0
4.(Relatively unsatisfactory)	0	0.0	0.0	0.0	0.0
5.(Very unsatisfactory)	0	0.0	0.0	0.0	0.0
6.(I don't know)	32	62.8	52.9	64.7	70.6
	51	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

When asked the reason that CTCs are not "very satisfactory", 15.7% answered that it is dirty, 3.9% overflow of wastewater is not good and 2.0% claims congestion.

Table 12.3.89 Reasons for dissatisfaction of the CTCs

	All	LIG	MIG	HIG	All (%)	LIG (%)	MIG (%)	HIG (%)
1.(Dirty)	8	3	2	3	15.7	17.7	11.8	17.7
2.(Overflow of wastewater)	2	2	0	0	3.9	11.8	0.0	0.0
3.(Congestion)	1	0	0	1	2.0	0.0	0.0	5.9
4.(Long distance to the toilet)	0	0	0	0	0.0	0.0	0.0	0.0
5.(Charge is too high)	0	0	0	0	0.0	0.0	0.0	0.0
6.(I do not want to pay)	0	0	0	0	0.0	0.0	0.0	0.0
7. (Facility that we want to use is not installed (please specify :)	0	0	0	0	0.0	0.0	0.0	0.0
8.Others (please specify:)	0	0	0	0	0.0	0.0	0.0	0.0
	11	5	2	4	21.6	29.4	11.8	23.5

Source: JICA Study Team 2016

When asked the WTP for CTC per usage, the average is 5.0 Rs for all income groups.

Table 12.3.90 WTP for CTC per usage

	All	LIG	MIG	HIG
Rs.	5.0	5.0	5.0	5.0

Source: JICA Study Team 2016

a) Public outreach

Question asked if there are any community-based activities on sanitary programs in your community, 98.0 % of them answered that they know the activities, and 2.0 % of them says that they do not know whether the activities are existing or not. It can be said that the higher the income is, the more they know about these activities.

Table 12.3.91 Existence of the community-based activities on sanitary programs in your community

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.Yes	50	98.0	94.1	100.0	100.0
2.No	1	2.0	5.9	0.0	0.0

Source: JICA Study Team 2016

When asked to people who know about the city services whether they pay the following taxes, and how much do you pay for the tax, they answered the followings.

Table 12.3.92 Average amount of tax payment conditions

	All	LIG	MIG	HIG
1. House tax	0.0	0.0	0.0	0.0
2. Water tax	131.8	112.9	134.1	148.2
3. Sewage tax	0.0	0.0	0.0	0.0
4. E. P. E. tax	0.0	0.0	0.0	0.0
5. Education, Petroleum, and Environment	0.0	0.0	0.0	0.0

(4) Chunar

These citizen survey outcomes were taken in December 2015 and analyzed in January 2016. The next section looks at the results of the questionnaire:

A. basic profile,
B. diseases,
C. water supply,
D. toilet facilities at HHs,
E. CTC usage, and
F. public outreach

a) Basic Profiles of each respondent

The respondents are 98% of male and 2% of female.

Occupations of the respondents are as follows. 43.1% has their own business, 17.7% government job, 5.9% private sector job, 13.7% daily wage, 3.9% family profession, 13.7% vending and 2.0% others. Business owners and government people are mostly found in higher income groups.

Table 12.3.93 Occupations of the respondents

	Total	LIG	MIG	HIG	Total	LIG (%)	MIG (%)	HIG (%)
1.Business	22	2	11	9	43.1	11.8	64.7	52.9
2.Govt job	9	0	2	7	17.7	0.0	11.8	41.2
3.Private job	3	1	2	0	5.9	5.9	11.8	0.0
4.Daily wage	7	7	0	0	13.7	41.2	0.0	0.0
5.Family profes-sion	2	1	1	0	3.9	5.9	5.9	0.0
6.Vending	7	6	1	0	13.7	35.3	5.9	0.0
7. Others	1	0	0	1	2.0	0.0	0.0	5.9

Total	51	17	17	17	100.0	100.0	100.0	100.0

Source: JICA Study Team 2015

The family number is about 7.47 per household, contains 3.10 male members, and 2.37 female members, and 2.00 children. The higher the income is the more family members in the house are. The gap is about 1.24 persons between the poorest and the richest.

Table 12.3.94 Average number of family members

	Total	LIG	MIG	HIG
1.Total No. of Family Member	7.5	6.5	7.2	8.7
2.Male Members (more than 18 years) :	3.1	2.5	3.3	3.5
3.Female Members (more than 18 years) :	2.4	1.8	2.3	3.0
4.Child Less than 18 years:	2.0	2.2	1.6	2.2

Source: JICA Study Team 2015

Regarding the education level of the respondent, the highest are 5th grade (27.5 %), followed by Read & Write (23.5%), 10th grade (13.7%) and 10+ (College) (13.7%) and Grad school (13.7%). As expected, the higher the income, the higher the level of education.

Table 12.3.95 Education Level of the Respondents

	Total	LIG	MIG	HIG	Total	LIG (%)	MIG (%)	HIG (%)
1.(Read & Write)	12	8	0	4	23.5	47.1	0.0	23.5
2.(5th grade)	14	5	8	1	27.5	29.4	47.1	5.9
3.(10th grade)	7	1	4	2	13.7	5.9	23.5	11.8
4.10+ (College)	7	3	1	3	13.7	17.7	5.9	17.7
5.(Grad school)	7	0	2	5	13.7	0.0	11.8	29.4
6.(Post-grad school)	4	0	2	2	7.8	0.0	11.8	11.8
	51	17	17	17	100.0	100.0	100.0	100.0

Looking at the religion of the respondents, 82.4% are Hindu and 17.7% are Muslims. More Muslims are found in higher income families.

Table 12.3.96 Religion of the respondents

	N	LIG	MIG	HIG	All (%)	LIG (%)	MIG (%)	HIG (%)
1.(Hindu)	42	13	15	14	82.4	76.5	88.2	82.4
2.(Muslim)	9	4	2	3	17.7	23.5	11.8	17.7
3.(Christian)	0	0	0	0	0.0	0.0	0.0	0.0
4.(Others)	0	0	0	0	0.0	0.0	0.0	0.0
	51	17	17	17	100.0	100.0	100.0	100.0

Source: JICA Study Team 2015

The question of how long they have lived in the area, average is 46.1 years, and the income doesn't relate to the settled years.

Table 12.3.97 Settled years of the respondents (yrs.)

Type	All	LIG	MIG	HIG
Year	46.1	45.4	47.7	45.3

Source: JICA Study Team 2015

The question of average income of the respondents are shown as below, and the average is 16,490 Rs. The richest families has as much as third times more incomes than the poorest ones, twice as big as the middle-income ones.

Table 12.3.98 Average monthly income of the respondents (Rs)

Type	All	LIG	MIG	HIG
Amount（Rs）	16,490	7,765	16,235	25,471

Source: JICA Study Team 2016

The question of average expenditure of the respondents are shown as below, and the food expenditures are the largest in all categories. Apart from savings and others, all 3 income groups spend on health/treatment in the second most money and LIG spend on water thirdly. MIGs' third most spending item is clothing. HIG's thirdly spending item is clothing.

Table 12.3.99 Average monthly expenditure of the respondents (Rs)

	All	LIG	MIG	HIG
1.(Food)	6,696	4,324	6,412	9,353
2.(Clothing)	1,471	365	1,400	2,647

3.(House Rent)	0	0	0	0
4.(House Tax)	5	4	6	6
5.(Electricity)	1,082	400	1,082	1,765
6.(Water/Sewerage service)	11	10	11	13
7.(Cooking Fuel)	774	571	709	1,041
8.(Vehicle Fuel)	1,086	29	1,141	2,088
9.(Health/treatment)	20	29	29	0
10.(Education)	1,116	276	1,029	2,041
11.(Saving)	2,899	1,269	3,029	4,399
12.(Others)	1,320	488	1,353	2,118
(Total)	16,490	7,765	16,235	25,471

Source: JICA Study Team 2016

b) Disease

The question to see whether any of the family members had disease in the last one year, 5.9 percent answered yes, and 94.1 % no. The higher income they earn, the less disease incident rate is.

Table 12.3.100 Disease incident rate for the past one year

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.(Yes)	3	5.9	11.8	5.9	0.0
2.(No)	48	94.1	88.2	94.1	100.0

Source: JICA Study Team 2016

Those who answered yes in the disease question, they showed the specific diseases they had and the most frequent one is malaria (33.3%) and others (66.7%).

Table 12.3.101 Type of disease for the past one year

	All	LIG	MIG	HIG	All (%)	LIG (%)	MIG (%)	HIG (%)
1. (Paratyphoid).	0	0	0	0	0.0	0.0	0.0	-
2.(Cholera)	0	0	0	0	0.0	0.0	0.0	-
3.(Typhoid/Typhus)	0	0	0	0	0.0	0.0	0.0	-
4.(Dysentery)	0	0	0	0	0.0	0.0	0.0	-
5.(Dengue)	0	0	0	0	0.0	0.0	0.0	-
6.(Malaria)	1	1	0	0	33.3	50.0	0.0	-
7.(Flue)	0	0	0	0	0.0	0.0	0.0	-
8.Others	2	1	1	0	66.7	50.0	100.0	-
	3	2	1	0	100.0	100.0	100.0	-

Source: JICA Study Team 2016

c) Water supply service

Regarding the possession of the water supply service, 98.0% answered they have some type of water supply service. Looking at the income group, 94.1% LIG have water supply services, 100.0% for MIG and LIG.

Table 12.3.102 Possession of the water supply service

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.Yes (go to 16)	50	98.0	94.1	100.0	100.0
2.No (go to 20)	1	2.0	5.9	0.0	0.0
3.Other sources					
1) Private source	0	0.0	0.0	0.0	0.0
2) Ground water	0	0.0	0.0	0.0	0.0

Source: JICA Study Team 2016

In regard to the amount of the water supply charge, the following results are acquired. Overall, there are 100% for around 800.

Table 12.3.103 Amount of the water supply charge

	All	LIG	MIG	HIG	All (%)	LIG (%)	MIG (%)	HIG (%)
1.(Around 800*)	50	16	17	17	100.0	100.0	100.0	100.0
2.(Around 1000)	0	0	0	0	0.0	0.0	0.0	0.0
3.(Around 1500)	0	0	0	0	0.0	0.0	0.0	0.0
4.(Around 2000)	0	0	0	0	0.0	0.0	0.0	0.0
5.(Around 2500)	0	0	0	0	0.0	0.0	0.0	0.0
6.(More than 2500)	0	0	0	0	0.0	0.0	0.0	0.0
7. Not paying	0	0	0	0	0.0	0.0	0.0	0.0
	50	16	17	17	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

*Note: *Units are in Indian Rupees.*

As for the question to see how you rate the water service you are mainly using, 90.0% answered very satisfactory, followed by average (6.0%).

Table 12.3.104 Rate of the water supply services

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.(Very satisfactory)	45	90.0	87.5	100.0	82.4
2.(Relatively satisfactory)	1	2.0	6.3	0.0	0.0
3.(Average)	3	6.0	6.3	0.0	11.8
4.(Relatively unsatisfactory)	1	2.0	0.0	0.0	5.9
5.(Very unsatisfactory)	0	0.0	0.0	0.0	0.0
	50	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

Regarding the questions which types of problems on the present main water supply, 5.9% claims that there is bad smell or taste and 3.9% no transparency of water.

Table 12.3.105 Problems on the present main water supply (multiple answers)

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.(Bad taste (smell))	3	5.9	5.9	0.0	11.8
2.(Water is dirty (not transparent))	2	3.9	5.9	0.0	5.9
3.(Frequent stop of water service)	0	0.0	0.0	0.0	0.0
4.(Water amount is not enough)	0	0.0	0.0	0.0	0.0
5.(Insufficient water pressure)	0	0.0	0.0	0.0	0.0
6.(High Tariff)	0	0.0	0.0	0.0	0.0
7.(Others (please specify))	0	0.0	0.0	0.0	0.0
	5	9.8	11.8	0.0	17.7

Source: JICA Study Team 2016

When asked how much they are willing to pay (WTP) for the water services which all the above mentioned issues are solved, they answered 12.40 Rs per month.

Table 12.3.106 WTP for the water supply services

	All	LIG	MIG	HIG
Rs/month	12.40	10.00	-	14.00

Source: JICA Study Team 2016

d) Toilet facilities

The questions asked whether they have a toilet in their houses, total 90.2% answered yes. While both MIG and HIG answered 100.0% of them have a toilet in their houses, 29.4% of LIG answered no.

Table 12.3.107 Toilet possessions

	All	LIG	MIG	HIG
Yes	46	12	17	17
No	5	5	0	0
Yes (%)	90.2	70.6	100.0	100.0
No (%)	9.8	29.4	0.0	0.0
	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

The questions asked which disposal system was connected to their home toilets, nobody answered that they are connected to sewer. 54.4% of people directly discharge into ditch followed by septic tanks (45.7%).

Table 12.3.108 Disposal system for the toilets

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.(Sewer connection)	0	0.0	0.0	0.0	0.0
2.Septic tank (connecting with a soak pit or trench)	21	45.7	41.7	41.2	52.9
3.Pit latrine (not using water)	0	0.0	0.0	0.0	0.0
4.(Direct discharge into ditch, drain or river)	25	54.4	58.3	58.8	47.1
5.Others	0	0.0	0.0	0.0	0.0
	46	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

When asked how they evaluate the pit latrine to those who answered sewer connection, 100% answered very satisfactory.

Table 12.3.109 Evaluation of the sewer connection

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1. Very satisfactory	46	100.0	100.0	100.0	100.0
2.Relatively satisfactory	0	0.0	0.0	0.0	0.0
3.Average	0	0.0	0.0	0.0	0.0
4.Relatively unsatisfactory	0	0.0	0.0	0.0	0.0
5.Very unsatisfactory	0	0.0	0.0	0.0	0.0
	46	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

When asked to all persons who answered they have no sewer connection in their houses, whether they

want to have a sewer connection in their house, the answers are as follows. They all want to have sewer connection.

Table 12.3.110 Sewage demand in non-sewer HHs

	All	All (%)	LIG	MIG	HIG
1.Yes	51	100.0	100.0	100.0	100.0
2.No	0	0.0	0.0	0.0	0.0
	51	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

To those who do not have sewer connection and they would like to have in future, if asked how much they are willing to pay for connection of sewer to their house, the average of their answer is 327.9 Rs. Similarly, to those who do not have sewer connection and they would like to have in future, if asked how much are you willing to pay for sewer user charge per month, they answer that they pay average 10.3 Rs./month.

Table 12.3.111 WTP for connection and monthly fee (Rs.)

	All	LIG	MIG	HIG
WTP for connection (Rs)	327.9	125.0	411.8	447.1
WTP for monthly fee (Rs).	10.3	8.1	10.0	12.7

Source: JICA Study Team 2016

e) CTC usage

CTC is the complex of the community toilets, and if asked the WTP for CTC per usage, the respondents answered that 4.1Rs, and the less income is the higher WTP for CTC is.

Table 12.3.112 WTP for CTC per usage

	All	LIG	MIG	HIG
Rs.	4.1	4.3	4.0	3.5

Source: JICA Study Team 2016

Question asked that how they evaluate the present public/community toilet service in the community, 9.8% answered very satisfactory, 3.9% relatively satisfactory and 7.8% average.

Table 12.3.113 CTC's satisfaction rate of the respondents

	All	All (%)	LIG (%)	MIG (%)	HIG (%)
1.(Very satisfactory)	5	9.8	23.5	5.9	0.0
2.(Relatively satisfactory)	2	3.9	0.0	5.9	5.9

3.(Average)	4	7.8	11.8	5.9	5.9
4.(Relatively unsatisfactory)	0	0.0	0.0	0.0	0.0
5.(Very unsatisfactory)	0	0.0	0.0	0.0	0.0
6.(I don't know)	40	78.4	64.7	82.4	88.2
	51	100.0	100.0	100.0	100.0

Source: JICA Study Team 2016

When asked the reason that CTCs are not "very satisfactory", 7.8% answered that it is dirty, 5.9% overflow of wastewater is not good and 2.0% claims congestion.

Table 12.3.114 Reasons for dissatisfaction of the CTCs

	All	LIG	MIG	HIG	All (%)	LIG (%)	MIG (%)	HIG (%)
1.(Dirty)	4	1	1	2	7.8	5.9	5.9	11.8
2.(Overflow of wastewater)	3	1	1	1	5.9	5.9	5.9	5.9
3.(Congestion)	1	1	0	0	2.0	5.9	0.0	0.0
4.(Long distance to the toilet)	0	0	0	0	0.0	0.0	0.0	0.0
5.(Charge is too high)	0	0	0	0	0.0	0.0	0.0	0.0
6.(I do not want to pay)	0	0	0	0	0.0	0.0	0.0	0.0
7. (Facility that we want to use is not installed (please specify :)	0	0	0	0	0.0	0.0	0.0	0.0
8.Others (please specify:)	0	0	0	0	0.0	0.0	0.0	0.0
	8	3	2	3	15.7	17.7	11.8	17.7

Source: JICA Study Team 2016

When asked the WTP for CTC per usage, the average is 5.0 Rs for all income groups.

Table 12.3.115 WTP for CTC per usage

	All	LIG	MIG	HIG
Rs.	5.0	5.0	5.0	5.0

Source: JICA Study Team 2016

f) Public outreach

Question asked if there are any community-based activities on sanitary programs in your community, 100.0 % of them answered that they know the activities.

Table 12.3.116 Existence of the community-based activities on sanitary programs in your community

	All	All (%)	LIG（%）	MIG (%)	HIG (%)
1.Yes	51	100.0	100.0	100.0	100.0
2.No	0	0.0	0.0	0.0	0.0

Source: JICA Study Team 2016

When asked to people who know about the city services whether they pay the following taxes, and how much do you pay for the tax, they answered the followings.

Table 12.3.117 Average amount of tax payment conditions

	All	LIG	MIG	HIG
1. House tax	63.3	41.5	71.5	76.9
2. Water tax	135.1	118.3	132.4	154.7
3. Sewage tax	0.0	0.0	0.0	0.0
4. E. P. E. tax	0.0	0.0	0.0	0.0
5. Education, Petroleum, and Environment	0.0	0.0	0.0	0.0

Source: JICA Study Team 2016

12.4 Economic Evaluation

12.4.1 Identification of Economic Benefits

1) Summary of Economic Benefits

Economic benefits that can be expected in this kind of project are (1) An amount of willingness of people to pay (WTP), (2) A saving amount of medical expenditure of people and saving in the subsidy amount spent by the Government on such medical institutions such as hospitals, clinics health centers etc. (3) Saving in the amount of salaries/wages of the people, etc. The latter two benefit categories will be derived as a result of decrease of suffering rate of water borne diseases due to improvement of water environment. (4) Increasing of agricultural productivity because of improved water quality.

Furthermore, there may be a lot of other kinds of socio-economic and/or environmental benefits like those which may be derived from increase of tourism since better environmental condition of Ganga review will attract more tourist in Varanasi and from conservation of Bio-diversity from clean water, but those benefits are considered as tangible here and are excluded in the calculation.

2) Willingness of people to pay (WTP) for improved water supply.

As noted in the previous chapter, JICA study team conducted economic and financial surveys in five

cities. The amount of WTP is not a basic unit for setting up a tariff system, but the basic unit for the socio-economic benefit. According the surveys, WTP for improved water supply varies upon each area due to its income/expenditure level and existence/nonexistence of sewage system. Each WTP data is used in EIRR calculation. As noted later, individual EIRR of Ramnagar and Chuar become rather low since those WPT are low amount.

Table 12.4.1 WTP for Water supply

Area / Income Group	Rate of Connection to the Existing Water Supply System (Existing Connection Rate)	Rate of Connection to the Existing Sewerage System (Existing Connection Rate)	Water Supply
			WTP for Improved Water Supply
	(%)	(%)	(Rs./year)
Varanasi			
Low Income Group	52.00%	63.33%	672
Medium Income Group	86.00%	88.00%	535
High Income Group	86.00%	98.00%	1,038
Overall Average	70.67%	74.70%	713
Mirzapur			
Low Income Group	70.59%	5.88%	1,512
Medium Income Group	52.94%	29.41%	624
High Income Group	70.59%	23.53%	-
Overall Average	64.71%	19.61%	1,068
Ghazipur			
Low Income Group	100.00%	0.00%	160
Medium Income Group	100.00%	0.00%	220
High Income Group	100.00%	0.00%	
Overall Average	100.00%	0.00%	200
Ramnagar			
Low Income Group	94.12%	94.12%	162
Medium Income Group	100.00%	88.24%	231
High Income Group	100.00%	100.00%	360
Overall Average	98.04%	94.12%	201
Chunar			
Low Income Group	94.12%	0.00%	120
Medium Income Group	100.00%	0.00%	-
High Income Group	100.00%	0.00%	168
Overall Average	98.04%	0.00%	149

Similarly, JICA study team surveyed waste water treatment service regarding its economics and financial views. The same can be mentioned that its WTP of Ramnagar and Chunar become rather low.

Table 12.4.2 WTP for Waste water treatment service

Area / Income Group	Waste Water Treatment Services				
	Average Amount Paid for the Existing Sewerage Treatment Services (Average Existing Charge)	Amount of Willingness to Pay (WTP) for **Improved** Sewerage Treatment Services	Amount of Willingness to Pay (WTP) for **newly established** Sewerage Treatment Services	Amount of Willingness to Pay (WTP) for Sewerage Treatment Services	Amount of Willingness to Pay (WTP) for **New** Sewerage Connection
	(Rs./year)	(Rs./year)	(Rs./year)	(Rs./year)	(Rs.)
Varanasi					
Low Income Group	527	690	698	693	408
Medium Income Group	1,434	483	480	483	1,900
High Income Group	1,704	1,011	2,400	1,039	500
Overall Average	1,222	682	710	689	660
Mirzapur					
Low Income Group	179	600	570	572	638
Medium Income Group	256	1,050	565	708	858
High Income Group	251	-	878	878	1,523
Overall Average	229	960	660	719	955
Ghazipur					
Low Income Group	186	N/A	81	81	335
Medium Income Group	324	N/A	127	127	588
High Income Group	314	N/A	162	162	718
Overall Average	275	N/A	124	124	547
Ramnagar					
Low Income Group	113	0	2,400	141	200
Medium Income Group	134	280	1,500	424	125
High Income Group	134	-	0	0	0
Overall Average	127	280	1,800	369	150
Chunar					
Low Income Group	118	N/A	99	99	125
Medium Income Group	132	N/A	120	120	412
High Income Group	154	N/A	152	152	447
Overall Average	135	N/A	124	124	328

3) Saving of Medical Expenditure

This kind of project may contribute to improve the people's living environment. If water quality is improved by a project, water borne diseases may decrease and, people's burden on medical expenditure and saving of the subsidy allocated by the Government for Hospitals operations and other medical center services will also decrease. This is an indirect socio economic benefit. In other words, it can be expected that the purchasing power or capability of the people could be increased due to improvement of water quality.

The social survey data, The Cost of Public sector is taken from the actual expenditure incurred by the state of Uttar Pradesh UP Finance account 2013-14, shows that expenditure of Health & Family Welfare is Rs. 547,094 lakhs and Family Welfare is Rs. 252,668 lakhs, so the total is about Rs. 79,976 million. As the total population of UP in 2011 census is 199 million, the public cost of annual medical service is estimated at Rs. 440.26.

Table 12.4.3 Detailed Statement of Revenue Expenditure by Minor Heads

(Rs. In lakhs)

Decription	Non Plan	Plan		Total
		State Plan	CSS/CP	
(b) Health & Family Welfare				
Urban Health Services	154,903.96	709.43	0.12	155,613.51
Urban Health Services Others	13,492.99	-	-	13,492.99
Rural Health Services Allopathy	167,779.71	2,032.47	-	169,812.18
Rural Health Services Other	46,024.19	0.67	-	46,024.86
Medical Education, Training & Research	94,627.14	29,780.41	-	124,407.55
Public Health	33,110.41	3,794.53	-	36,904.94
General	738.37	100.24	-	838.61
Sub Total (A)				**547,094.64**
Family Welfare - Sub Total (B)	**350.22**	**0.11**	**252,318.11**	**252,668.44**
Total				**799,763.08**
Actual Revenue Expenditure for FY 2013-14			Rs	**79,976,308,000.00**
Total Polulation as per 2011 census				199,812,341.00
Public Cost for Annual Medical Service per Person				**400.26**

Source: Uttar Pradesh UP Finance account 2013-14

4) Saving of Salaries/Wages

People suffering from water borne diseases have to keep off their work for long span of time. This results in loss of salary/wage for the number of days absent from work. The actual amount of saving after implementation of the project can be estimated with the average income per capita and the medical data discussed in the above paragraph. Water borne disease results in a loss of either earnings of an individual or would affect the productive output of an organization. This kind of losses concerning the salaries/wages could be mitigated if the water borne disease can be reduced.

The survey report "Economic Impacts of Inadequate Sanitation in India (2011) says the "Occurrence Number" is 750 million cases and "Time loss" due to water-borne diseases in whole India is 10,453 million years. (Water-borne diseases are Diarrhea, Helminthes, Trachoma, ALRI, Measles, Malaria and other water borne). As the total population in India (world-bank data) was 1,295,291,543 in 2014, the annual number and time loss of water borne disease case per person are estimated 0.58 cases/person/year and 2.96 days/person/year.

"The daily production value" is estimated by dividing GDP per capita (US$ 1,582 in 2014) by annual working days (250 days). Adopting the exchange rate of Rs. and US$ is Rs. 63.33 of 31th December in 2014, the "daily production value" is estimated to be Rs. 400.76. The "employment rate" is assumed to be 80% considering the economic condition of the project area. Therefore, the benefit of saved production value is calculated at Rs. 944 /year/person.

Table 12.4.4 Calculation of Annual number of cases/person/year & Time Lost

Step 1 Calculation of Annual number of cases/person/year & Time Lost days/person/year

Source:-Report 38/128	Occurrence Number	750.00	million cases
Source:-Report 38/128	Time Lost	10,453,000.00	years
Source:-(World Bank Data)	Total Population of India in 2014	1,295.00	million
		1,295,291,543	
	Annual Number	0.58	cases/person/year
	Time Lost	2.95	days/person/year
		2.9455	

Step 2:- Selection of Report

Both reports compared as second result has limitation the former (first)study is adopted.

Step 3:- Actual Formula for Calculation Benefit of reduction of production loss

=saved time lost * daily production value * employment rate

As per World Bank	i.e. GDP per Capita in Rs./year	GDP per capita (US $ 1582) in 2014, Annual working days 250	
	Exchange rate Dec 2014 (US $)	63.33	
	GDP per Capita per Day	100,190.43	
		400.76	
Step 4:-	**Daily Production Value**	**400.76**	**i.e. (Rs 400.76)**
	Employment Rate	**80%**	
	Time Lost as per Step 1	**2.95**	days/person/year
	Calculation	**944.37**	

5) Contribution to Increase the Productivity of Agricultural Crops

The new STP in each area will be able to discharge around 167.5 MLD of additional water in total which means additional 2,512.5 ha of irrigated land because one MLD of water can irrigate 15ha(*) of agricultural land. The additional agricultural benefit has been calculated as below:

15 ha x 149.5 MDL = 2,242.5 ha

(*: "An estimated based on this data shows that to irrigate 1000 hectares of land, a STP of 74.3 MLD capacity is needed" quoted from "Cleaning-up the Ganges", OXFORD book)

Table 12.4.5 Additional Agriculture benefit

	Capacity of New STP (MLD)	Incremental cropped area can be irrigated per MLD (ha)	Additional ha
1) Varanasi District 1		15	
2) Varanasi District 2		15	
3) Varanasi Ramana STP	50	15	750.0
4) Varanasi District 3 (A) Sewer (District 3 Comprehensive)		15	0.0
5) Dinapur & Bhagwanpur Rehabilitation&Upgrade of STPs	60	15	900.0
6) Mirzapur Part1 ID&T	18	15	270.0
7) Mirzapur Part2 Alternative 1	2	15	30.0
8) Chunar ID&T	6.5	15	97.5
9) Ramnagar ID&T	13	15	195.0
	149.5		2,242.5

Source: Calculation by JICA study team

According to the statistics (Source: Source- Agricultural Statistics at a Glance 2014 GOI, Ministry of Agriculture), the existing yields of paddy and wheat are the followings;

Table 12.4.6 Basic information about Agriculture (1)

A) Crop Calendar for Wheat & Paddy

State	Activity	Kharif Paddy	Rabi Paddy	Rabi Wheat
Uttar Pradesh	Sowing	Jun-Jul	Nov-Dec	Oct-Dec
	Harvesting	Oct-Nov	Apl- May	Apr-Apr

B) Existing Yields of Paddy and Wheat

According to statistics the existing yields of paddy and wheat are-

For 2013-14			Unit		
Paddy	India	2,424	kg/hectare	(=24.24 quintals/ha)	Area under Irrigation 58.7%
(For Irrigated area)	Uttar Pradesh	2,447	kg/hectare	(=24.47 quintals/ha)	Area under Irrigation 80.4%
Wheat	India	3,075	kg/hectare	(=30.75 quintals/ha)	Area under Irrigation 92.9%
	Uttar Pradesh	3,038	kg/hectare	(=30.38 quintals/ha)	Area under Irrigation 98.1%

Source: Agricultural Statistics at a Glance 2014 GOI, Ministry of Agriculture

Cost A2 includes all actual expenses in cash and kind incurred in production by owner and rent paid for leased in land. And cost C2 includes all actual expenses in cash and kind incurred in production by owner, interest on value of owned fixed capital assets (including Land). Rental value of owned Land (Net of land revenue), rent paid for leased in land and imputed value of fixed capital assets. FL -Family labor is imputed on the basis of statutory wage rate or the actual market rate whichever is higher.

Table 12.4.7 Basic information about Agriculture (2)

C) Minimum Support Prices (MSP)

FY 2014-15	Rs. per quintal
Paddy	**1,360**
Wheat	**1,400**

D) Cost of Cultivation & Cost of Production

Cost of Cultivation (Rs./Hectare)

Unit	Paddy	Wheat
A2+FL	28,147.45	26,001.27
C2	40,146.68	42,383.57

Cost of Production (Qtl/Hectare)

Unit	(Rs./Quintal)	
C2	957.83	930.55
Yield	39.47	37.52

Source: Agricultural Statistics at a Glance 2014 GOI, Ministry of Agriculture

Regarding Paddy, Minimum Support Price (MSP) of Paddy in 2014-15 is Rs. 1360/quintal and its production cost is Rs. 957.83/quintal, so the net income of Paddy is Rs. 402.17/quintal. Since yield of Paddy is 24.47/quintal/Ha, total income of paddy per ha is Rs. 9,841.1.

Table 12.4.8 Farmers Gross Income estimation of Paddy

Sr.No.	Particulars	Amount	Unit
A)	Paddy MSP	1,360.00	Rs/Quintal
B)	Production Cost of Paddy	957.83	Rs/Quintal
C)	**Net Income (A-B)**	402.17	Rs/Quintal
D)	Yield of paddy	24.47	Quintals/Ha
	Paddy Yield/hectare	(=24.47 quintals/ha)	
	(Table B Data)		
E)	**Total Income (Rs/ha) (C*D)**	9,841.10	
F)	Irrigated Land due to STP)in ha)	2,242.50	Ha
G1	**Total Income for new ha (E*F)**	22,068,666.53	

Regarding Wheat, MSP of Wheat in 2014-15 is Rs. 1450/quintal and its production cost is Rs. 930.55/quintal, so the net income of Wheat is Rs. 519.45/quintal. Since yield of Wheat is 30.38/quintal/Ha, total income of Wheat per ha is Rs. 15,780.89.

Table 12.4.9 Farmers Gross Income estimation of Wheat

Sr.No.	Particulars	Amount	Unit
A)	Wheat MSP	1,450.00	Rs/Quintal
B)	Production Cost of Wheat	930.55	Rs/Quintal
C)	**Net Income (A-B)**	519.45	Rs/Quintal
D)	Yield of Wheat	30.38	Quintals/Ha
	Wheat Yield/Hectare	(=30.38 quintals/ha)	
	(Table B Data)		
E)	**Total Income (Rs/ha) (C*D)**	15,780.89	
F)	Irrigated Land due to STP)in ha)	2,242.50	Ha
G2	**Total Income for new ha (E*F)**	35,388,648.07	

As calculated in the above, the total income of Paddy per ha is Rs. 9,841.1 and that of Wheat is Rs. 15,780.89. Since the additional agricultural area ha is 2,242.5 ha, total income of Paddy and Wheat is about Rs. 57.5 million for all investment areas.

Table 12.4.10 Income Summary of agricultural crops

E)Paddy/ha	9,841.10	G1) Income Paddy	22,068,666.53
E)Wheat/ha	15,780.89	G1) Income Wheat	35,388,648.07
E)Total/ha	**25,621.99**	**Total Income**	**57,457,314.59**

Table 12.4.11 Income Summary of agricultural crops for each area

	Capacity of New STP (MLD)	Incremental cropped area can be irrigated per MLD (ha)	Incremental income from cropped area newly irrigated (Rs. / year)
1) Varanasi District 1		15	0
2) Varanasi District 2		15	0
3) Varanasi Ramana STP	50	15	19,216,493.2
4) Varanasi District 3 (A) Sewer (District 3 Comprehensive)		15	0.0
5) Dinapur & Bhagwanpur Rehabilitation&Upgrade of STPs	60	15	23,059,791.8
6) Mirzapur Part1 ID&T	18	15	6,917,937.5
7) Mirzapur Part2 Alternative 1	2	15	768,659.7
8) Chunar ID&T	6.5	15	2,498,144.1
9) Ramnagar ID&T	13	15	4,996,288.2
	149.5		57,457,314.6

12.4.2 Estimation of Economic Cost

1) The Basic Conditions of Estimation of Economic cost

The Project total cost from DPRs is about Rs. 16,530 million from DPR. Evaluation (EIRR and FIRR) is calculated on the basic conditions of 1) Key information of the submitted DPRs, such as costs and population forecast, 2) Elimination of Comprehensive except Varanasi area (or just adoption of ID&T), 3) Lager "Alternative" is adopted, 4) So the Investments for IRR calculation is nine (mark X in the below table)

Table 12.4.12 Summary of Project Costs from DPR

	Million Rs.	IRR	Capital	O&M	Total (1)	Capital	O&M	Total (2)
Varanasi	District 1	X	3,192.71	94.89	3,287.60	3,192.71	94.89	3,287.60
Varanasi	District 2	X	4,784.34	136.02	4,920.36	4,784.34	136.02	4,920.36
Varanasi	District 3: RAMANA	X	1,240.64	325.54	1,566.17	1,240.64	325.54	1,566.17
Varanasi	District 3 (A)Sewers	X	1,754.39	49.92	1,804.31	1,754.39	49.92	1,804.31
Varanasi	Dinapur &Bhagwanpur	X	770.89	540.54	1,311.43	770.89	540.54	1,311.43
Mirzapur	Comprehensive		3,193.36	295.83	3,489.19			
Mirzapur	Part 1: ID&T	X	884.63	870.37	1,755.00	884.63	870.37	1,755.00
Mirzapur	Part 2: Alternative 1	X	182.85	184.78	367.63	182.85	184.78	367.63
Mirzapur	Part 2: Alternative 2		87.16	111.55	198.71			
Chunar	Comprehensive		1,164.78	90.52	1,255.30			
Chunar	ID&T	X	329.83	206.74	536.57	329.83	206.74	536.57
Ramnagar	Comprehensive		1,550.30	555.47	2,105.77			
Ramnagar	ID&T	X	427.65	553.72	981.37	427.65	553.72	981.37
Ghazipur	Comprehensive		1,763.92	280.33	2,044.25			
Ghazipur	ID&T	Waiting						
Saidpur	ID&T	Waiting						
			21,327.46	**4,296.21**	**25,623.67**	**13,567.93**	**2,962.52**	**16,530.45**

Source: Submitted DPR

2) Estimation of Economic cost and its methodology

a) Construction cost (Capital Cost)

First, Cost is divided into Capital cost and O&M cost from each DPR which includes future O&M cost occurring after each construction based on a certain increase ratio defined in the each DPR. Capital costs

are mainly seven items; "Basic Cost of Work", "Land acquisition Cost", "Centage Charge", "Cost of work on which no Centage charge is admissible", "Labor Cess", "Engineering Cost" and "Contingency cost". These seven costs are coming from nine DPR; however "Engineering Cost" is calculated by 15% of "Basic Cost of Work" from DPR.

All Basic Cost of Work occurs from 2017 (when construction begins) to 2019 or three year periods and the cost allocation is 30% for 1st year, 50% for 2nd year and 20% for the 3rd year of its total construction costs based on the assumption of DPR (e.g., Varanasi District 1)

All the sum of those seven costs is Financial Costs Excluding Price escalation, so then Price escalation is calculated by using 0.32% of Foreign(JICA) and 8.11% of Domestic (India). Domestic (India) is applied to Basic cost, land, half of Engineering cost and Administration (Cost of work on which no Centage is admissible) while the other half of Engineering cost is applied by 0.3% of Foreign-JICA. (Notes: Price escalation is not applied to O&M since it uses its own Price Escalation) So the sum of Financial Costs of excluding Price Escalation and Price Escalation is Financial cost including Price Escalation, which is later used when calculation of FIRR.

Table 12.4.13 Consumer price index in Japan from 2006 to2015

2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
100.7	100.7	102.1	100.7	100	99.7	99.7	100	102.8	103.6
									0.32%

It is necessary to have Economic Cost excluding Contingency and Price Escalation to have EIRR. This is composed of "Centage Charge", "Cost of work on which no Centage is admissible", "Labor Cess", "Adjusted Basic Construction Cost" and "Adjusted Engineering Costs". The last two items are Economics costs.

As mentioned above, the economic cost is also to be converted from the financial cost. So the first step is to have "Adjusted Basic Construction Cost (BCC)" from Basic Construction. In this case, a Standard Conversion Factor (SCF) for tradable equipment and materials, shadow price for land acquisition cost and/or housing compensation, and for labors for the construction works, cost of transfer items such as personal income tax and corporate income tax should be taken into account. The original BCC is deduced by certain logic considering tax increase (Beneficial to Economics) incurred by local labors, using certain percentage of Labor (30% or 50%), Material (50% or 70%), Individual Tax Rate (10%), Shadow Wage Rate of Unskilled Labor (50% (or a skilled worker is 100%)), Contactor Profit rate (10%) and Corporate Income tax rate (30.9). The percentage ratio of Labor and Material is 30:70 for STP type and 50:50 for others.

Similarly, "Adjusted Engineering Costs" is an adjustment of Engineering Cost. The original Engineering Cost is deduced by certain logic considering tax increase (Beneficial to Economics) incurred by local construction companies or vendors, using certain percentage of Contactor Profit rate (10%) and Corporate Income tax rate (30.9)

Through the calculation procedures in the above, Construction cost for Capital cost is Rs. 13,047.9 million.

Table 12.4.14 Economic Costs of Construction (Capital)

			30%	50%	20%
	Rs. million	2016	2017	2018	2019
Economic Cost (Excluding Contingency and Price Escalation	**13,052.3**		4,246.8	6,298.4	2,507.1
1) Varanasi District 1	3,093.2		936.1	1,540.8	616.3
2) Varanasi District 2	4,635.1		1,398.6	2,311.7	924.7
3) Varanasi Ramana STP	1,207.5		618.1	421.0	168.4
4) Varanasi District 3 (A) Sewer (District 3 Comprehensive)	1,670.8		512.6	827.3	330.9
5) Dinapur & Bhagwanpur Rehabilitation&Upgrade of STPs	749.8		232.0	369.9	147.9
6) Mirzapur Part1 ID&T	846.7		285.0	401.2	160.5
7) Mirzapur Part2 Alternative 1	175.0		57.5	83.9	33.6
8) Chunar ID&T	315.2		70.3	183.6	61.2
9) Ramnagar ID&T	359.2		136.6	159.0	63.6

Source: JICA Study team

b) O&M Cost

Regarding O&M (cost), this cost is supposed to start after the construction or since year of 2020. They are mainly Manpower Cost, Annual Repair Cost, Power Consumption Cost, DG Set Maintenance Cost and Chemical Cost for STP. Some of the facilities need 5 years and some for 10 years of its required O&M costs and there are two types of Price Escalation, 6% and 8% from DPRs. Regardless of the required years, each Escalation increase ratio is applied every year until 2050 from 2020. And similar to Capital costs in the above, O&M cost is also to be modified into Economic adjustment basis.

The original O&M Cost is deduced by certain logic considering tax increase (Beneficial to Economics) incurred by local labors, using certain percentage of Labor (0%, 50% or 100%), Material (0%, 50% or 100%), Individual Tax Rate (10%), Shadow Wage Rate (50%), Contactor Profit rate (10%), Corporate Income tax rate (30.9) and Standard Conversion Factor (SCF). The percentage ratio of Labor and Material is 30:70 for STP type and 50:50 for others.

Standard Conversion Factor (SCF) is used here as well to have economics cost of O&M. This is a calculation or the ratio between exports and imports amount which is applied to tradable material expenses and SFC is 96% in this case.

Table 12.4.15 Calculation of Standard Conversion Factor

Year	Import Amount *	Export Amount *	Import Duties (Custom Duties) *	Export Tax **	Export Subsidies **
2005-06	6,604.09	4,564.18	642.01	0.00	
2006-07	8,405.06	5,717.79	854.40	2.86	
2007-08	10,123.12	6,558.64	1,006.35	18.34	
2008-09	13,744.36	8,407.55	945.81	31.83	
2009-10	13,637.36	8,455.34	808.66	10.35	
2010-11	16,834.67	11,429.22	1,301.10	31.40	
2011-12	23,454.63	14,659.59	1,396.11	64.14	
2012-13	26,691.62	16,343.18	1,596.29	28.05	
2013-14	27,154.34	19,050.11	1,668.35	28.05	
	146,649.25	95,185.60	10,219.07	215.01	0.00

SCF=	0.960275945

Source: *: Handbook of Statistics on Indian Economy, Reserve Bank of India, 2015
**: Indian Public Finance Statistics 2013-2014

Through the calculation mentioned in the above, Total O&M cost from 2020 to 2050 is Rs. 24,611.2 million and the first ten years O&M cost is Rs. 3,315.7 million

Table 12.4.16 Economic Costs of O&M

	Million Rs.	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
O&M Cost - Economic Cost Adjustment	**24,611.2**				242.6	259.6	277.9	297.4	318.3	340.8	355.4	380.4	407.3	436.0	…
1) Varanasi District 1	1,338.7				10.9	11.7	12.7	13.7	14.8	15.9	17.2	18.6	20.1	21.7	…
2) Varanasi District 2	1,330.3				16.3	17.7	19.1	20.6	22.2	24.0	16.6	17.9	19.3	20.9	…
3) Varanasi Ramana STP	3,863.5				45.6	48.3	51.2	54.3	57.5	61.0	64.6	68.5	72.6	77.0	…
4) Varanasi District 3 (A) Sewer (District 3 Comprehensive)	640.3				5.2	5.6	6.1	6.5	7.1	7.6	8.2	8.9	9.6	10.4	…
5) Dinapur & Bhagwanpur Rehabilitation&Upgrade of STPs	6,323.1				74.6	79.0	83.8	88.8	94.1	99.8	105.8	112.1	118.8	126.0	…
6) Mirzapur Part1 ID&T	5,623.1				45.6	49.2	53.2	57.4	62.0	67.0	72.3	78.1	84.4	91.1	…
7) Mirzapur Part2 Alternative 1	1,161.8				9.4	10.2	11.0	11.9	12.8	13.8	14.9	16.1	17.4	18.8	…
8) Chunar ID&T	1,214.1				9.8	10.6	11.5	12.4	13.4	14.5	15.6	16.9	18.2	19.7	…
9) Ramnagar ID&T	3,116.2				25.3	27.3	29.5	31.8	34.4	37.1	40.1	43.3	46.8	50.5	…
	3,315.7														

12.4.3 Economics Evaluation of the project

1) The Conditions and premises for Economic valuation

The population is forecasted from the information of each DPR. The population forecast of Varanasi is based on the latest issued DPR and some of them are adjusted to avoid possible duplication of benefits 1) Varanasi District 1: Population project from District 1, 2) Varanasi District 2: Population project from Zone 2A of District 2, 3) Varanasi Ramana STP: Population project from District 3 or the sum of Zone3 and FSA4, 4) Varanasi District-3 (A) Sewer (District 3 Comprehensive): The same population of Ramana STP, 5) Dinapur & Bhagwanpur Rehabilitation &Upgrade of STPs: Population project from its

DPR but is compressed by using 0.35 (since 101.8 MD is to rehabilitation compared to current 288.0 MD, then 0.35 is from 101.8 divided by 288) When DPR has the population of FSA (future service area, including floating population), that number is not used in this report but the population of total its area zone is used because of conservatism.

Table 12.4.17 Population Projection in Varanasi city

	2011	2020	2035	2050
District 1	441,697	479,983	558,728	654,826
District 2				
Zone 2A	472,985	570,252	778,259	1,041,264
Zone 2B	*81,858*	*117,379*	*213,580*	*374,689*
Zone 2C	*108,342*	*146,074*	*237,359*	*369,855*
NSA2	*25,950*	*37,883*	*70,240*	*123,718*
NSA1	*43,146*	*63,255*	*117,226*	*204,966*
FSA1	*22,452*	*26,194*	*29,936*	*33,678*
	754,733	**961,037**	**1,446,600**	**2,148,170**
District 3				
Zone 3	84,984	104,052	144,863	196,337
FSA4	52,374	78,561	141,410	183,309
	137,358	**182,613**	**286,273**	**379,646**
District 4				
FSA2	90,204	106,252	125,579	146,801
FSA3	67,759	101,639	237,157	271,036
	157,963	207,891	362,736	417,837
Grand Total	**1,491,750**	**1,831,523**	**2,654,338**	**3,600,478**

The population forecast of other areas, Mirzapur, Chunar and Ramnagar is also based on their DPR; however the population of Mirzapur is adjusted to avoid possible duplication of benefits. Alternative is for rehabilitation, it is considered that the benefit of the population is under current capacity of 14 MLD. Since people use 135 liter /day/person, the population of this STP is calculated as 103,704 and this number will be the same until 2050. For ID&T of Mirzapur, “MIRZAPUR TOWN WITH FSA” is not used but “TOTAL MIRZAPUR ZONE”.

Table 12.4.18 Population Projection of Other Cities

	2020	2030	2035	2050
Mirapur DPR				
MIRZAPUR TOWN WITH FSA	**286,287**	**322,533**	**346,686**	**423,624**
TOTAL MIRZAPUR ZONE	251,262	268,710	287,863	347,938
Mirzapur Part2 Alternative 1	103,704	103,704	103,704	103,704
Chunar DPR	**48,000**	**55,000**	**63,000**	**80,000**
Ranmagar DPR	**64,070**	**78,478**	**87,122**	**118,503**

The number of Served Household is calculated by each population times house connection. Project life is set until the year of 2050 after completion of the construction works.
Discount rate of 10 % is applied.

2) Economic Evaluation

Economic costs and benefits throughout the project life are compared in terms of present values. If the total present value of economic costs equals that of economic benefits (when, B/C=1), the discount rate used to calculate the present value is called as “economic internal rate of return (EIRR)” and used as the main index of project evaluation to judge the project feasibility and/or viability. The other two indices are Net Present Value (NPV) and B/C Ratio.

The EIRR is calculated at 11.19 % and the B/C is 1.09 for 10% discount rate. There can be several other indirect socio-economic benefits of this project. These benefits derive from increase in number of tourists, conservation of the bio-diversity, and sales of treated water, etc. If these intangible benefits could be converted into monetary terms, economic feasibility of the project would become higher.

Regarding effectiveness of the project, the parameters of the evaluation can be those based on the EIRR calculation;

- WTP for Improvement for Water Quality
- WTH for Improvement for Sewage Treatment Services
- Saving Medical Expenditure
- Saving of Salaries Wages

Those target numbers in 2050 is simulated in the table below.

Table 12.4.19 Summary of EIRR

All Total (Unit: Rs. Million)

Year in Order	Fiscal Year	Economic Cost				Economic Benefit								Cash Balance
		Construction Cost	O&M cost	Replacement cost	Total	WTP for Improvement for Water Quality		WTP for Sewerage Treatment Services		Saving of Medical Expenditures	Saving of Salaries/ Wages	Agricultural Benefit Due to Treated Water Discharged for Irrigation	Total	
						Served HHs in Total	Basic unit: Rs./Y per HH	Connected HHs	Basic unit: Rs./Y per HH	Basic unit: Rs./Y per person	Basic unit: Rs./Y per person	25,622 Rs. /ha per year		
0	2016													
1	2017	4,247			4,247								0	-4,247
2	2018	6,298			6,298								0	-6,298
3	2019	2,507			2,507								0	-2,507
4	2020	0	243		243	211,693	290	198,013	245	1,001	187	57	1,780	1,538
5	2021		260		260	220,992	303	207,789	257	1,015	196	57	1,829	1,569
6	2022		278		278	230,657	316	218,016	269	1,030	206	57	1,879	1,601
7	2023		297		297	240,555	330	228,717	283	1,045	216	57	1,931	1,633
8	2024		318		318	250,842	344	239,915	296	1,059	227	57	1,984	1,666
9	2025		341		341	261,533	359	251,634	311	1,074	238	57	2,039	1,698
10	2026		355		355	272,644	375	263,898	326	1,089	249	57	2,096	1,741
11	2027		380		380	284,190	391	276,735	342	1,103	261	57	2,155	1,774
12	2028		407		407	296,189	408	290,173	358	1,118	274	57	2,216	1,808
13	2029		436		436	308,657	425	304,241	376	1,133	287	57	2,278	1,842
14	2030		467		467	321,613	443	317,868	392	1,148	300	57	2,341	1,874
15	2031		500		500	335,257	462	324,755	401	1,163	307	57	2,391	1,891
16	2032		535		535	347,243	479	331,887	409	1,179	313	57	2,439	1,903
17	2033		573		573	353,073	488	339,286	419	1,195	320	57	2,479	1,906
18	2034		614		614	358,976	497	346,973	428	1,210	328	57	2,520	1,906
19	2035		658		658	365,431	506	355,733	438	1,228	336	57	2,566	1,908
20	2036		705		705	370,529	512	364,576	449	1,246	344	57	2,608	1,904
21	2037		755	0	755	375,640	519	373,804	460	1,263	353	57	2,652	1,897
22	2038		809		809	380,764	526	383,449	472	1,280	362	57	2,697	1,888
23	2039		867		867	385,901	533	393,543	484	1,297	372	57	2,743	1,876
24	2040		929		929	391,052	540	404,126	497	1,314	382	57	2,790	1,861
25	2041		995		995	396,215	547	415,173	510	1,332	392	57	2,838	1,843
26	2042		1,067		1,067	401,393	554	422,955	518	1,349	399	57	2,878	1,811
27	2043		1,143		1,143	406,584	561	430,292	525	1,366	406	57	2,916	1,773
28	2044		1,226		1,226	411,789	567	411,789	525	1,384	389	57	2,923	1,697
29	2045		1,314		1,314	417,008	574	417,008	531	1,401	394	57	2,958	1,644
30	2046		1,409		1,409	422,242	581	422,242	538	1,419	399	57	2,994	1,586
31	2047		1,511		1,511	427,489	589	427,489	544	1,437	404	57	3,031	1,520
32	2048		1,620		1,620	432,752	596	432,752	551	1,454	409	57	3,067	1,447
33	2049		1,737		1,737	438,029	603	438,029	558	1,472	414	57	3,103	1,366
34	2050		1,863		1,863	443,560	610	443,560	564	1,490	419	57	3,141	1,278
Total		13,052	24,611	0	37,664		14,828		13,275	38,294	10,082	1,781	78,261	40,597
Net Present Value (Discount Rate at 10 %)					14,413								15,719	1,305
EIRR:														**11.19%**
B/C														1.09

Table 12.4.20 Effectiveness of the project

	WTP for Improvement for Water Quality		WTP for Sewerage Treatment Services		Saving of Medical Expenditures	Saving of Salaries/ Wages	Agricultural Benefit Due to Treated Water Discharged for Irrigation	Total
	Served HHs in Total	Basic unit: Rs./Y per HH	Connected HHs	Basic unit: Rs./Y per HH	Basic unit: Rs./Y per person	Basic unit: Rs./Y per person	25,622 Rs. /ha per year	
2020	211,693	290	198,013	245	1,001	187	57	1,780
2050	443,560	610	443,560	564	1,490	419	57	3,141
	210%	**210%**	224%	**230%**	**149%**	**224%**	N/A	176%

The EIRR of each detailed projects varies, some are rather higher however two indicate negative mainly due to lower WTP in those areas.

Table 12.4.21 EIRR of all nine detailed projects

All Total (Unit: Rs. Million)

Year in Order / Fiscal Year	Economic Cost				Economic Benefit							
	Construction Cost	O&M cost	Replacement cost	Total	WTP for Improvement for Water Quality: Served HHs in Total	WTP for Improvement for Water Quality: Basic unit: Rs./Y per HH	WTP for Sewerage Treatment Services: Connected HHs	WTP for Sewerage Treatment Services: Basic unit: Rs./Y per HH	Saving of Medical Expenditures: Basic unit: Rs./Y per person	Saving of Salaries/ Wages: Basic unit: Rs./Y per person	Agricultural Benefit Due to Treated Water Discharged for Irrigation: 25,622 Rs. /ha per year	Total	Cash Balance
All Total	13,052	24,611	0	37,664		14,828		13,275	38,294	10,082	1,781	78,261	40,597
Net Present Value (Discount Rate at 10 %)				14,413								15,719	1,305
EIRR:													**11.19%**
B/C													1.09
Varanasi 1													(Unit: Rs. Million)
Total	2,691	1,339	0	4,029		2,661		2,504	6,975	1,886	0	14,026	9,996
Net Present Value (Discount Rate at 10 %)				2,427								2,901	474
EIRR:													12.00%
B/C													1.20
Varanasi 2													(Unit: Rs. Million)
Total	4,037	1,330	0	5,367		3,777		3,549	9,833	2,672	0	19,831	14,464
Net Present Value (Discount Rate at 10 %)				3,569								3,832	263
EIRR:													10.71%
B/C													1.07
Varanasi Ramana STP													(Unit: Rs. Million)
Total	992	3,864	0	4,856		1,356		1,273	3,519	959	596	7,704	2,848
Net Present Value (Discount Rate at 10 %)				1,433								1,470	37
EIRR:													10.43%
B/C													1.03
Varanasi 3													(Unit: Rs. Million)
Total	1,445	640	0	2,085		1,356		1,273	3,519	959	0	7,108	5,023
Net Present Value (Discount Rate at 10 %)				1,293								1,333	41
EIRR:													10.30%
B/C													1.03
Dinapur & Bhagwanpur Rehab													(Unit: Rs. Million)
Total	646	6,323	0	6,969		2,903		2,737	7,668	2,061	715	16,086	9,116
Net Present Value (Discount Rate at 10 %)				1,497								3,574	2,077
EIRR:													40.38%
B/C													2.39
Mirzapur Part1 ID&T													(Unit: Rs. Million)
Total	699	5,623	0	6,322		1,903		1,249	3,620	650	214	7,637	1,315
Net Present Value (Discount Rate at 10 %)				1,328								1,447	120
EIRR:													12.57%
B/C													1.09
Mirzapur Part2 Alternative 1													(Unit: Rs. Million)
Total	146	1,162	0	1,308		669		424	1,287	221	24	2,624	1,316
Net Present Value (Discount Rate at 10 %)				276								535	259
EIRR:													28.25%
B/C													1.94
Chunar ID&T													(Unit: Rs. Million)
Total	267	1,214	0	1,481		73		113	775	171	77	1,209	(272)
Net Present Value (Discount Rate at 10 %)				381								228	-154
EIRR:													#NUM!
B/C													0.60
Ramnagar ID&T													(Unit: Rs. Million)
Total	277	3,116	0	3,393		128		152	1,098	503	155	2,036	(1,357)
Net Present Value (Discount Rate at 10 %)				643								398	-245
EIRR:													#NUM!
B/C													0.62

Source: JICA study team

As noted before, the total cost of the nine DPR is about Rs.16.530 million, 82% of it is total capital cost or 18 % is its O&M. Capital cost of STP is about 60% (its O&M is 40%) among those total SPT costs and the one of non-STP (sewage network) is about 97% (its O&M is 3%). EIRR of nine DPR is 11.19% composing of negative ones and higher ones (40.38%). The calculated EIRR of Dinapur & Bhagwanpur in Varanasi is rather high since lower investment amount while larger populations while it is vise-verse in Ramnagar and Chunar area.

Table 12.4.22 The evaluation summary of nine DPR

Rs. million			Capital	O&M	Total						
All nine DPR			Rs. 13,568	Rs. 2,963	Rs. 16,530		2020	2035	2050	NPV	1,305
										EIRR	11.19%
										B/C	1.09
Varanasi	District 1	N/W 228.5km	Rs. 3,193	Rs. 95	Rs. 3,288	Population	479,983	558,728	654,826	NPV	474
						SW Connection	74.70%	100.00%	100.00%	EIRR	12.00%
						Avg. HH	8.37	8.37	8.37	B/C	1.20
Varanasi	District 2	N/W 275.4km	Rs. 4,784	Rs. 136	Rs. 4,920	Population	570,252	778,259	1,041,264	NPV	263
						SW Connection	74.70%	100.00%	100.00%	EIRR	10.71%
						Avg. HH	8.37	8.37	8.37	B/C	1.07
Varanasi	District 3: RAMANA	STP 50 MLD	Rs. 1,241	Rs. 326	Rs. 1,566	Population	182,613	286,273	379,646	NPV	37
						SW Connection	74.70%	100.00%	100.00%	EIRR	10.43%
						Avg. HH	8.37	8.37	8.37	B/C	1.03
Varanasi	District 3 Sewers	N/W 120.3km	Rs. 1,754	Rs. 50	Rs. 1,804	Population	182,613	286,273	379,646	NPV	41
						SW Connection	74.70%	100.00%	100.00%	EIRR	10.30%
						Avg. HH	8.37	8.37	8.37	B/C	1.03
Varanasi	Dinapur & Bhagwanpur	80MLD 9.8MLD	Rs. 771	Rs. 541	Rs. 1,311	Population	618,016	618,016	618,016	NPV	2,077
						SW Connection	74.70%	100.00%	100.00%	EIRR	40.38%
						Avg. HH	8.37	8.37	8.37	B/C	2.39
Mirzapur	Part 1: ID&T	18MLD, 2MLD N/W, PS	Rs. 885	Rs. 870	Rs. 1,755	Population	251,262	287,863	347,938	NPV	120
						SW Connection	19.61%	62.21%	100.00%	EIRR	12.57%
						Avg. HH	8.82	8.82	8.82	B/C	1.09
Mirzapur	Part 2: Alternative 1	Exisiting 14MLD 4MLD	Rs. 183	Rs. 185	Rs. 368	Population	103,704	103,704	103,704	NPV	259
						SW Connection	19.61%	62.21%	100.00%	EIRR	28.25%
						Avg. HH	8.82	8.82	8.82	B/C	1.94
Chunar	ID&T	6.5 MLD 43km ITC MPS, IPS	Rs. 330	Rs. 207	Rs. 537	Population	48,000	63,000	80,000	NPV	-154
						SW Connection	20.00%	63.44%	100.00%	EIRR	#NUM!
						Avg. HH	7.47	7.47	7.47	B/C	0.60
Ramnagar	ID&T	10 MLD (STP) 32 MLD (MPS) xx km	Rs. 428	Rs. 554	Rs. 981	Population	64,070	87,122	118,503	NPV	-245
						SW Connection	94.12%	195.66%	100.00%	EIRR	#NUM!
						Avg. HH	8.20	8.20	8.20	B/C	0.62

12.4.4 Sensitivity analysis

We performed two types of sensitivity analysis, first one is to analyze the impact on change in economic benefit and economic cost (Table 12.4.27), the other is to analyze extension of construction period, change in economic cost and benefit (Table 12.4.28).

If economic cost increases with 10%, EIRR will be less than 10%, on the other hand, if economic benefit decreases with 10%, EIRR will also fall below 10%.

Table 12.4.23 Sensitivity analysis of EIRR: Change in Economic Benefit and Economic Cost

		Change in Economic Benefit						
		-15%	-10%	-5%	0%	+5%	+10%	+15%
Change in Economic Cost	+15%	7.08%	7.86%	8.59%	9.28%	9.95%	10.58%	11.19%
	+10%	7.68%	8.46%	9.19%	9.89%	10.55%	11.19%	11.81%
	+5%	8.32%	9.09%	9.82%	10.52%	11.19%	11.84%	12.47%
	0%	8.98%	9.75%	10.49%	11.19%	11.87%	12.53%	13.16%
	-5%	9.67%	10.45%	11.19%	11.91%	12.60%	13.26%	13.91%
	-10%	10.41%	11.19%	11.95%	12.67%	13.37%	14.05%	14.71%
	-15%	11.19%	11.99%	12.76%	13.49%	14.21%	14.90%	15.58%

According to sensitivity analysis we performed, one year of extension of construction period will result in 0.9% of negative impact to EIRR (EIRR with no change in base economic cost and benefit is 10.29% while base EIRR is 11.19%).
In addition, under this condition, if economic cost increases with 5%, EIRR will be less than 10%, on the other hand, if economic benefit decreases with 5%, EIRR will also fall below 10%.

Table 12.4.24 Sensitivity analysis of EIRR: Change in Economic Cost, Benefit and One Year Extension of Construction Period

		Change in Economic Benefit						
		-15%	-10%	-5%	0%	+5%	+10%	+15%
Change in Economic Cost	+15%	6.49%	7.22%	7.90%	8.54%	9.15%	9.73%	10.29%
	+10%	7.05%	7.78%	8.46%	9.10%	9.70%	10.29%	10.84%
	+5%	7.64%	8.36%	9.04%	9.68%	10.29%	10.87%	11.43%
	0%	8.26%	8.97%	9.65%	10.29%	10.90%	11.49%	12.05%
	-5%	8.90%	9.61%	10.29%	10.93%	11.55%	12.14%	12.71%
	-10%	9.57%	10.29%	10.97%	11.62%	12.24%	12.84%	13.42%
	-15%	10.29%	11.00%	11.69%	12.35%	12.98%	13.59%	14.17%

12.4.5 Revised Estimation of Economic cost and Economics evaluation

As a result of technical part of our survey, JICA survey team completed the final estimation of construction cost as documented on **17.7.2 Construction costs**. Therefore, we updated our economic analysis on feasibility of this program, based on input from **Table 17.7.1 Total Project Cost**. From economic analysis standpoint, EIRR is determined as 8.3%, which is slightly lower than hurdle rate of 10%. And net economic present value of the program is -3,537 JPY under 10% discount rate. Thus, the program is also not economically feasible under updated final construction cost estimation.

Table 12.4.25 Updated program level economic feasibility analysis

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Capital and Operational Cost	**552**	**401**	**11,679**	**12,074**	**7,392**	**625**	**557**	**555**	**594**	**636**	**636**	**636**	**636**	**636**	**636**
Initial Investment	552	401	11,679	12,074	7,392	141	39								
Eligible portion	476	382	11,123	11,499	6,824	134	38								
Non-Eligible portion	76	19	556	575	568	7	2								
O&M Cost						**484**	**518**	**555**	**594**	**636**	**636**	**636**	**636**	**636**	**636**
Economic benefit						**3,302**	**3,393**	**3,487**	**3,584**	**3,685**	**3,789**	**3,896**	**4,003**	**4,088**	**4,170**
Net economic value	**-552**	**-401**	**-11,679**	**-12,074**	**-7,392**	**2,677**	**2,835**	**2,932**	**2,990**	**3,048**	**3,152**	**3,260**	**3,367**	**3,452**	**3,534**

EIRR 8.3% NPV -3,537 million JPY 10.0% at discount rate of

	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	Total
Capital and Operational Cost	**636**	**636**	**636**	**636**	**636**	**636**	**636**	**636**	**636**	**636**	**636**	**636**	**636**	**636**	**636**	**47,796**
Initial Investment																
Eligible portion																
Non-Eligible portion																
O&M Cost	**636**	**636**	**636**	**636**	**636**	**636**	**636**	**636**	**636**	**636**	**636**	**636**	**636**	**636**	**636**	**15,517**
Economic benefit	**4,239**	**4,310**	**4,387**	**4,460**	**4,535**	**4,612**	**4,690**	**4,771**	**4,853**	**4,921**	**4,986**	**4,998**	**5,059**	**5,121**	**5,182**	**108,520**
Net economic value	**3,603**	**3,673**	**3,751**	**3,824**	**3,899**	**3,975**	**4,054**	**4,134**	**4,216**	**4,284**	**4,350**	**4,361**	**4,423**	**4,484**	**4,546**	**60,724**

12.4.6 Revised sensitivity analysis

We revised abovementioned two sensitivity analysis, first one is to analyze the impact on change in economic benefit and economic cost, and the other is to analyze extension of construction period, change in economic cost and benefit.

To reach 10% of EIRR, 10% increase of economic benefit and 5% decrease of economic cost are required.

Table 12.4.26 Updated program level economic feasibility analysis (1)

		Change in Economic Benefit						
		-15%	-10%	-5%	0%	+5%	+10%	+15%
Change in Economic Cost	+15%	5.07%	5.66%	6.23%	6.77%	7.30%	7.81%	8.31%
	+10%	5.53%	6.12%	6.70%	7.25%	7.79%	8.31%	8.81%
	+5%	6.01%	6.62%	7.20%	7.76%	8.31%	8.83%	9.35%
	0%	6.53%	7.14%	7.73%	8.31%	8.86%	9.40%	9.92%
	-5%	7.08%	7.70%	8.31%	8.89%	9.45%	10.00%	10.53%
	-10%	7.67%	8.31%	8.92%	9.51%	10.09%	10.65%	11.20%
	-15%	8.31%	8.95%	9.58%	10.19%	10.78%	11.35%	11.91%

In addition, under the case that construction period delays one year, EIRR will fall to 7.81%. According to updated analysis of this case, to reach 10% of EIRR, 15% increase of economic benefit or 15% decrease of economic cost is required.

Table 12.4.27 Updated program level economic feasibility analysis (2)

		Change in Economic Benefit						
		-15%	-10%	-5%	0%	+5%	+10%	+15%
Change in Economic Cost	+15%	4.79%	5.35%	5.89%	6.40%	6.89%	7.36%	7.81%
	+10%	5.23%	5.79%	6.33%	6.84%	7.34%	7.81%	8.27%
	+5%	5.69%	6.25%	6.80%	7.31%	7.81%	8.29%	8.76%
	0%	6.17%	6.74%	7.29%	7.81%	8.32%	8.80%	9.27%
	-5%	6.68%	7.26%	7.81%	8.34%	8.85%	9.34%	9.82%
	-10%	7.23%	7.81%	8.37%	8.91%	9.42%	9.92%	10.41%
	-15%	7.81%	8.40%	8.97%	9.51%	10.04%	10.55%	11.04%

12.4.7 Financial Evaluation of the project

The financial Capital cost of all is Rs. 15,285.5 million. The construction is from 2017 to 2019, supposed to take three years.

Table 12.4.28 Financial Capital Cost

	Rs.million	2017	2018	2019
	15,316.1	4,992.0	7,384.7	2,939.4
1) Varanasi District 1	3,613.1	1,092.0	1,800.8	720.3
2) Varanasi District 2	5,415.1	1,632.6	2,701.8	1,080.7
3) Varanasi Ramana STP	1,395.2	708.3	490.6	196.3
4) Varanasi District 3 (A) Sewer (District 3 Comprehensive)	1,980.1	605.6	981.8	392.7
5) Dinapur & Bhagwanpur Rehabilitation&Upgrade of STPs	871.4	268.5	430.7	172.3
6) Mirzapur Part1 ID&T	993.5	329.1	474.6	189.8
7) Mirzapur Part2 Alternative 1	205.6	66.7	99.2	39.7
8) Chunar ID&T	371.4	81.6	217.4	72.5
9) Ramnagar ID&T	470.8	207.7	187.9	75.2

Financial O&M cost is Rs. 34,392.4 million after the construction or will star from 2020 until 2050.

Table 12.4.29 Financial O&M Cost

	Rs. Million	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
	34,392.4				326.8	349.9	374.7	401.2	429.6	460.1	492.8	527.9	565.5	605.8	…
1) Varanasi District 1	1,995.0				16.2	17.5	18.9	20.4	22.0	23.8	25.7	27.7	29.9	32.3	…
2) Varanasi District 2	2,859.8				23.2	25.0	27.0	29.2	31.5	34.1	36.8	39.7	42.9	46.3	…
3) Varanasi Ramana STP	4,897.2				57.7	61.2	64.9	68.8	72.9	77.3	81.9	86.8	92.0	97.6	…
4) Varanasi District 3	1,049.7				8.5	9.2	9.9	10.7	11.6	12.5	13.5	14.6	15.8	17.0	…
5) Dinapur & Bhagwanpur	8,131.6				95.9	101.6	107.7	114.2	121.1	128.3	136.0	144.2	152.8	162.0	…
6) Mirzapur Part1 ID&T	7,410.8				60.1	64.9	70.1	75.7	81.7	88.3	95.3	103.0	111.2	120.1	…
7) Mirzapur Part2 Alternative 1	1,573.3				12.8	13.8	14.9	16.1	17.4	18.7	20.2	21.9	23.6	25.5	…
8) Chunar ID&T	1,760.3				14.3	15.4	16.6	18.0	19.4	21.0	22.6	24.5	26.4	28.5	…
9) Ramnagar ID&T	4,714.8				38.2	41.3	44.6	48.2	52.0	56.2	60.7	65.5	70.8	76.4	…
10) Ghazipur ID&T					0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Source: JICA Study team

Financial Benefit (Revenue) Due to Charge Collection for Sewerage Treatment Services is Rs. 397.

Table 12.4.30 Actual Amount of Payment in Average for Existing Sewerage Treatment Services

(Unit: Rs./Annum per HH)

	Varanasi	**Mirzapur**	**Ghazipur**	**Ramnagar**	**Chunar**	Saidpur	Total
Income Level/month	292,088	265,176	249,882	237,176	197,882		248,441
Actual Amount of Payment in Average for Existing Sewerage Treatment Services	1,222	229	275	127	135		**397**
Share rate to the Income/HH:	0.42%	0.09%	0.11%	0.05%	0.07%		0.16%

Financial IRR is not obtained since the NPV in itself is negative in this project. However, in this type of the project for development and improvement of public utility or social infrastructure so called as "public works", it may not be adequate to analyze cost recovering ability by financial benefit (revenue from collection of user charge). The required cost for sewerage services is much more than that for water supply services. Nevertheless, the charge for sewerage services is usually lower than that for water supply. Thus, generally sewerage projects cannot recover all O&M costs as well as initial capital outlay.

Table 12.4.31 Financial Evaluation of the project

(Unit: Rs. Million)

Year in Order	Fiscal Year	Financial Cost				Financial Benefit (Revenue) Due to Charge Collection for Sewerage Treatment Services		Cash Balance
		Construction Cost	OM cost	Re-place-ment cost	Total	Connected HHs	Basic unit: 397	
0	2016							
1	2017	4,992			4,992			-4,992
2	2018	7,385			7,385			-7,385
3	2019	2,939			2,939			-2,939
4	2020	0	327		327	201,227	60	-267
5	2021		350		350	211,315	63	-287
6	2022		375		375	221,885	66	-309
7	2023		401		401	232,963	69	-332
8	2024		430		430	244,574	73	-357
9	2025		460		460	256,746	77	-384
10	2026		493		493	269,508	80	-412
11	2027		528		528	282,891	84	-444
12	2028		565		565	296,927	88	-477
13	2029		606		606	311,652	93	-513
14	2030		649		649	326,001	97	-552
15	2031		695		695	333,666	99	-596
16	2032		745		745	341,652	102	-643
17	2033		799		799	349,986	104	-694
18	2034		856		856	358,697	107	-749
19	2035		918		918	368,580	110	-808
20	2036		984		984	378,653	113	-871
21	2037		1,055		1,055	389,229	116	-939
22	2038		1,131		1,131	400,350	119	-1,011
23	2039		1,212		1,212	412,063	123	-1,090
24	2040		1,300		1,300	424,418	126	-1,174
25	2041		1,394		1,394	437,259	130	-1,264
26	2042		1,495		1,495	445,363	133	-1,363
27	2043		1,604		1,604	453,026	135	-1,469
28	2044		1,720		1,720	434,855	130	-1,591
29	2045		1,846		1,846	440,410	131	-1,714
30	2046		1,980		1,980	445,985	133	-1,847
31	2047		2,124		2,124	451,578	135	-1,990
32	2048		2,280		2,280	457,192	136	-2,143
33	2049		2,446		2,446	462,825	138	-2,308
34	2050		2,625		2,625	468,717	140	-2,486
Total		15,316	34,392	0	49,709		3,311	-46,397
NPV (Discount Rate at 10 %)					17,643		827	-17,021
EIRR:								#NUM!
B/C								0.05

12.4.8 Revised Financial Evaluation of the project

We updated our financial evaluation on feasibility of this program, based on input from **Table 17.7.1 Total Project Cost** as a result of technical part of our survey. From financial evaluation standpoint, FIRR cannot be determined because both total cash flow and net present value of the program less than zero, and thus, the program is not financially feasible under updated project cost estimation.

Table 12.4.32 Revised Financial Evaluation of the project

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Capital and Operational Cost	**669**	**444**	**13,450**	**13,941**	**8,581**	**935**	**868**	**878**	**843**	**903**	**903**	**903**	**903**	**903**	**903**
Initial Investment	669	444	13,450	13,941	8,581	249	134	91							
Eligible portion	500	402	11,685	12,080	7,169	141	39	0							
Non-Eligible portion	104	42	1,731	1,792	1,321	17	3	0							
Interest during construction	0	1	35	70	91	91	91	91							
Front end fee	64	0	0	0	0	0	0	0							
O&M Cost						**686**	**735**	**787**	**843**	**903**	**903**	**903**	**903**	**903**	**903**
Operational Revenue						**119**	**125**	**131**	**137**	**144**	**151**	**159**	**166**	**170**	**174**
Net Cash Flow	**-669**	**-444**	**-13,450**	**-13,941**	**-8,581**	**-816**	**-744**	**-747**	**-705**	**-758**	**-751**	**-744**	**-736**	**-733**	**-729**

FIRR [-] NPV [-30,067] million JPY [10.0%] at discount rate of

	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	Total
Capital and Operational Cost	**903**	**903**	**903**	**903**	**903**	**903**	**903**	**903**	**903**	**903**	**903**	**903**	**903**	**903**	**903**	**59,564**
Initial Investment																37,559
Eligible portion																32,016
Non-Eligible portion																5,010
Interest during construction																470
Front end fee																64
O&M Cost	**903**	**903**	**903**	**903**	**903**	**903**	**903**	**903**	**903**	**903**	**903**	**903**	**903**	**903**	**903**	**22,005**
Operational Revenue	**178**	**183**	**188**	**193**	**198**	**204**	**210**	**216**	**223**	**227**	**231**	**222**	**224**	**227**	**230**	**4,631**
Net Cash Flow	**-724**	**-720**	**-715**	**-710**	**-704**	**-699**	**-693**	**-686**	**-680**	**-676**	**-672**	**-681**	**-678**	**-675**	**-672**	**-54,933**

12.4.9 Revenue Increase Measures

To make the project feasible, revenue increase is required to reduce the burden on the Local and State Government finances to O&M cost of the project. Following measures are proposed here to increase the revenue and thus make the operating agency partially self-sustainable.

1) Improvement of billing and bill collections
2) Sale of treated water or utilize the by-products of sewerage system
3) Others such as improvement of accounting system

The basic approach to increase revenue is 1) in the above, and to cover the O&M cost in this project through the billing by citizen, the target billing per year in this project is Rs. 2,550 which is about 6.42 times of the current level (Rs. 397) in all those districts.

Table 12.4.33 Suitable Charge to cover the O&M cost of the project

	Varanasi	**Mirzapur**	**Ghazipur**	**Ramnagar**	**Chunar**	Saidpur	Total
Income Level/month	292,088	265,176	249,882	237,176	197,882		248,441
Actual Amount of Payment in Average for Existing Sewerage Treatment Services	1,222	229	275	127	135		**397**
Suitable Charge Level for Sewerage Treatment Services to Be Needed to Balance Necessary Cost for OM/R Cost	7,840	1,468	1,764	815	864	0	**2,550**
Share rate to the Income/HH:	0.42%	0.09%	0.11%	0.05%	0.07%		0.16%

12.5 Economic Analysis

It follows that Economic analysis for Whole India, Uttar Pradesh State and the Districts that are offering DPR for this GANGA Rejuvenation Project in the State of Uttar Pradesh.

12.5.1 Uttar Pradesh State

India has GDP of $2.07 trillion in 2014 (data from World Bank) and the GDP of UP State is the 3rd biggest among India's states, or Cr. 976,297 Rs. in 2014 (the same)

1) Historical Trend of GDP

The economic condition in India and Uttar Pradesh State is examined in this chapter to determine the external conditions of the project. The historical trend of GDP increase rate during 2004-2015 periods is summarized in Table 2.2.1. The GDP of entire India at current prices as of 2015 is Rs125,412 trillion, while that of Uttar Pradesh state is Rs9,763 trillion, which corresponds to 7.8% of that of the entire country. The average increase rate of GDP at current for the last ten years is 14.1% at the national level and 15.5% at the state level, which shows the recent robust economic strength.

Table 12.5.1 Historical Trend of GDP Increase Rate during 2004-2015 Periods

Rs. Trillion	2004-05	2009-10	2014-15	Average increase rate 2004 to 2015
Whole India	29,715	61,089	125,412	15.5%
Uttar Pradesh State	2,608	5,233	9,763	14.1%
Share of Uttar Pradesh State	8.8%	8.6%	7.8%	—

Source: Ministry of Statistics and Program Implementation, on 20 Aug 2015

The sector-wise GDP amount is shown in the following table. The share of the services sector is 56% followed by the industry sector (21%) and manufacturing sector (12%) which is included to industry sector. In the comparison of sector-wise data for the entire country and for Uttar Pradesh State, sectors of Agriculture and Allied (+8%) has comparatively higher share in Uttar Pradesh State. ("Manufacturing" is included in "Industry" in the table)

Table 12.5.2 Historical Trend of Sector-wise GDP

Sector	Entire India		Uttar Pradesh	
	Share in 2013-14	Average Increase Rate, 2004-05 to 2013-14	Share in 2013-14	Average Increase Rate, 2004-05 to 2013-14
Agriculture and Allied	13.9%	3.9%	22.0%	3.2%
Industry	26.1%	6.8%	21.5%	5.8%
Manufacturing	*14.9%*	*7.3%*	*12.0%*	*5.4%*
Services	59.9%	9.1%	56.5%	8.9%
Total	100.0%		100.0%	

Source: Planning Commission of the Government of India, 2014

2) Poverty Condition

The Poverty line and Gini coefficient are summarized in below Tables.

Lorenz Ratio Estimated from MPCE (Monthly per Capita Expenditure) based on MRP (mixed recall period) shows that Lorenz Ratio increased by 1.4 % (or point) for rural area and 1.9 % for urban area in Whole India. In Uttar Pradesh, it is also increased by 1.4% in rural area and 6.6% for urban area from the year 2004-05 to 2011-12. So it shows the significant improvement of live-lihood in the Uttar Pradesh in Urban area. Regarding the Gini coefficient figure, in whole India, rural area decreased 0.6% (point) while urban has increased by 3.1%. In UP state, rural area in-creased 16% (point) while urban has decreased by 0.2%.

Table 12.5.3 Lorenz Ratio Estimated from MPCE

	2004-05		2009-10 (MRP)		2011-12 (MRP)	
	Rural	Urban	Rural	Urban	Rural	Urban
India	0.266	0.348	0.276	0.371	0.280	0.367
Uttar Pradesh	0.234	0.339	0.231	0.395	0.248	0.405

Source: Planning Commission of the Government of India, 2014

Table 12.5.4 Trend of Gini Coefficient

	1993-94		2004-05 (MRP)		2009-10 (MRP)	
	Rural	Urban	Rural	Urban	Rural	Urban
India	0.282	0.34	0.266	0.348	0.276	0.371
Uttar Pradesh	0.278	0.323	0.234	0.339	0.438	0.321

Source: Planning Commission of the Government of India, 2014

12.5.2 Each district

India has GDP of $2.07 trillion in 2014 (data from World Bank) and the GDP of UP State is the 3rd biggest among India's states, or Cr. 976,297 Rs. in 2014 (the same)

1) Uttar Pradesh

Uttar Pradesh is the most populous state in India with a population of almost 200 million, which is 16.5% of total Indian population (2011 census). Most of the state lies in the fertile Indo-Gangetic Plain, with its high natural soil fertility, abundant rainfall, and rich surface and groundwater resources. Despite this endowment, the state however is often characterized as a 'lagging state' with low per-capita income. State growth rates also lag national figures. During the 1990s economic growth faltered and Uttar Pradesh fell behind India's better performing states. Power shortages, low rates of capital formation and low productivity of existing irrigation systems and road networks, were some of the main causes of economic stagnation in the state. Currently, percent of population below poverty line is about 33% to 41% which belongs to the one of the worst states in India (Planning Commission of the Government of India 2014).

Uttar Pradesh also lags behind most Indian states across a number of human development indicators (e.g. literacy, infant mortality). Literacy rate is 67.7% and female literacy rate is 57.2%, which is quite low compared to male literacy rate (77.3%).

Table 12.5.5 Summary of Statistics in Uttar Pradesh State

Uttar Pradesh	2001	2011	Change %
Actual Population	166,197,921	199,812,341	20.2
Male	87,565,369	104,480,510	19.3
Female	78,632,552	95,331,831	21.2
Percentage of total Population	16.20%	16.50%	1.9
Female Sex Ratio (/1000)	898	912	1.6
Child Sex Ratio	916	902	-1.5
Density/km2	690	829	20.1
Area(Km2)	240,928	240,928	
Total Child Population (0-6 Age)	31,624,628	30,791,331	-2.6
Male Population (0-6 Age)	16,509,033	16,185,581	-2.0
Female Population (0-6 Age)	15,115,595	14,605,750	-3.4
Total Literate	75,719,284	114,397,555	51.1
Male Literate	48,901,413	68,234,964	39.5
Female Literate	26,817,871	46,162,591	72.1
Literacy	56.30%	67.70%	20.2
Male Literacy	68.80%	77.30%	12.4
Female Literacy	42.20%	57.20%	35.5

Source: Census of India 2011

2) Varanasi

Varanasi has Varanasi Municipal Corporation (VMC) and other many awards where Ramnagar, one of the DPRs, is included. The area is composed of Rural and Urban, and VMC is part of Urban. The total population in whole Varanasi in 2011 was about 3.7 million and the household was 560,162. Its population increase is almost the same of Uttar Pradesh's. The Density/Km2 of Varanasi is pretty higher than that of Uttar Pradesh.

Table 12.5.6 Summary of Varanasi

Varanasi	2001	2011	Change %
Actual Population	3,138,671.00	3,676,841	17.15
Rural		2,079,790	
Urban		1,597,051	
Male	1,649,187.00	1,921,857	16.53
Female	1,489,484.00	1,754,984	17.82
Percentage of Total Population			
Number of Households		560,162	
Female Sex Ratio (/1000)	903.00	913.00	
Child Sex Ratio	919.00	885.00	
Density/Km2	-	2,395.00	
Area/Km2	1,535.00	1,535.00	
Total Child Population (0-6 Age)	-	497,151.00	-
Male Population (0-6 Age)	-	263,762.00	-
Female Population (0-6 Age)	-	233,389.00	-
Total Literate	1,694,405.00	2,403,903.00	41.87
Male Literate	1,050,613.00	1,389,116.00	32.22
Female Literate	643,792.00	1,014,787.00	57.63
Literacy	66.12	75.60	9.48
Male Literacy	77.87	83.78	5.91
Female Literacy	53.05	66.69	13.64

3) Varanasi Municipal Corporation (VMC) and Ramnagar

VMC has five Zones and 90 awards while Ramnagar has 25 awards, and both are belong to Urban. Ramnagar is a town in India and is administered by the Ramnagar Municipal Board. It is located in the Varanasi district.

Table 12.5.7 Summary of VMC and Ramnagar

Data related to VMC	2011
Actual Population	1,198,491
Male	635,140
Female	536,351
Number of Households	190,835
Total Child Population (0-6 Age)	135,677
Male Population (0-6 Age)	72,442
Female Population (0-6 Age)	63,235
Total Literate	842,497
Male Literate	469,563
Female Literate	372,844
Literacy	70.30
Male Literacy	73.93
Female Literacy	69.51

Data related to Ramnagar NPP	2011
Actual Population	49,132
Male	26,071
Female	23,061
Number of Households	7,729
Total Child Population (0-6 Age)	6,090
Male Population (0-6 Age)	3,206
Female Population (0-6 Age)	2,884
Total Literate	34,400
Male Literate	19,484
Female Literate	14,916
Literacy	70.02
Male Literacy	74.73
Female Literacy	64.68

4) Mirzapur

Mirzapur is a city in Uttar Pradesh, India, roughly 650 km from both Delhi and Kolkata, almost 89 km from Allahabad and 57 km from Varanasi.

The basic data is in Table 13.5.4 aside from some important data in the below. (Those are from Nagar Palika Parishad Mirzapur, interviewed by JIA Study team)

- Total Length of Roads-294.69 km
- Households having Toilets-21,625
- Total Length of Sewerage Lines-14.87 Km
- Required Length of Sewers- 240 Km
- Sewer Suction Machines – 2 Nos.
- STP (2 nos.)- 18 MLD
- Water available for Irrigation purposes after treatment – 30 %
- Matters related to Sewer entrusted to – GPPU, UPJN
- Total number of Sewer Connections - 4,050
- Number of Households having no toilets-16,825

Table 12.5.8 Summary of Mirzapur

Mirzapur	2001	2011	Change %
Actual Population	2,116,042.00	2,496,970	18.00
Rural		2,149,403	
Urban		347,567	
Male	1,115,249.00	1,312,302	17.67
Female	1,000,793.00	1,184,668	18.37
Number of Households		38,185	
Female Sex Ratio (/1000)	897.00	903.00	
Child Sex Ratio	929.00	902.00	
Density/Km2	-	567.00	
Area/Km2	4,405.00	4,405.00	
Total Child Population (0-6 Age)	-	410,621.00	
Male Population (0-6 Age)	-	215,841.00	
Female Population (0-6 Age)	-	194,780.00	
Total Literate	935,101.00	1,428,683.00	52.78
Male Literate	622,631.00	865,837.00	39.06
Female Literate	312,470.00	562,846.00	80.13
Literacy	55.31	68.48	13.17
Male Literacy	69.59	78.97	9.38
Female Literacy	39.26	56.86	17.60

5) Mirzapur Vindhyachal (NPP) and Chunar

Mirzapur Nagar Palika Parishad and Chunar Palika Parishad are part of Mirzapur district. The size of population or household of Mirzapur NPP is about 10% of Mirzapur district.

Table 12.5.9 Summary of Mirzapur (urban) and Chunar

Mirzapur Nagar Palika Parishad	2011
Actual Population	234,871
Male	125,601
Female	109,270
Number of Households	38,185
Total Child Population (0-6 Age)	30,340
Male Population (0-6 Age)	16,151
Female Population (0-6 Age)	14,189
Total Literate	156,408
Male Literate	89,938
Female Literate	66,470
Literacy	66.59
Male Literacy	71.61
Female Literacy	60.83

Chunar Nagar Palika Parishad	2011
Actual Population	37,185
Male	19,647
Female	17,538
Number of Households	5,951
Total Child Population (0-6 Age)	4926
Male Population (0-6 Age)	2519
Female Population (0-6 Age)	2407
Total Literate	24674
Male Literate	14442
Female Literate	10232
Literacy	66.35
Male Literacy	73.51
Female Literacy	58.34

6) Ghazipur

Ghazipur city is governed by Municipal Corporation which comes under Ghazipur Metropolitan Region. The Ghazipur city is located in Uttar Pradesh state of India.

Table 12.5.10 Summary of Ghazipur (1)

Ghazipur	2001	2011	Change %
Actual Population	3,037,582.00	3,620,268	19.18
Rural		3,345,908	
Urban		274,360	
Male	1,537,141.00	1,855,075	20.68
Female	1,500,441.00	1,765,193	17.64
Number of Households		546,664	
Female Sex Ratio (/1000)	976.00	952	
Child Sex Ratio	934.00	908	
Density/Km2	-	1,072	
Area/Km2	3,377.00	3,377	
Total Child Population (0-6 Age)	-	558,559	-
Male Population (0-6 Age)	-	292,774	-
Female Population (0-6 Age)	-	265,785	-
Total Literate	1,444,871.00	2,197,549	52.09
Male Literate	914,230.00	1,293,553	41.49
Female Literate	530,641.00	903,996	70.36
Literacy	59.55	71.78	12.23
Male Literacy	74.87	82.80	7.93
Female Literacy	44.03	60.29	16.26

7) Ghazipur Nagar Palika Parishad

Ghazipur Nagar Palika Parishad is a part of Ghazipur district.

Table 12.5.11 Summary of Ghazipur (2)

Ghazipur Nagar Palika Parishad	2011
Actual Population	121,020
Male	63,513
Female	57,507
Number of Households	19,556
Total Child Population (0-6 Age)	15,139
Male Population (0-6 Age)	8,096
Female Population (0-6 Age)	7,043
Total Literate	88,656
Male Literate	49,359
Female Literate	39,297
Literacy	73.26
Male Literacy	77.71
Female Literacy	68.33

12.6 Case studies on PPP and SPV for HAM (Hybrid Annuity Model) discussion

JICA study team collected information of SPV (Special Purpose Vehicle) PPP in India and analyzed them.

12.6.1 Summary of Case Studies

1) Summary

Table 12.6.1 The reviewed Cases by JICA Study team

Case studies			Project name
No	Sector		
1	Water Supply	WTP	Nagpur WTP Rehabilitation
2	Water Supply	WTP	Mysore Water 24x7
3	Water Supply and Sewerage	WTP and STP	Salt Lake Sector V, Kolkata
4	Water Supply	WTP	Haldia Water Supply
5	Water Supply	WTP	Latur Water Supply
6	Water Supply	WTP	Karnataka Urban Water Supply Improvement
7	Water Supply	WTP	Khandwa Water Supply
8	Water Supply	WTP	Aurangabad Water Supply
9	Sewerage	WTP	Alandur

10	Sewerage	STP	Kolhapur
11	Solid Water Management	Others	Timarpur Okhla Integrated Municipal Solid Waste Management Project
12	Road	Toll Road	Vadodara Halol Toll Road, Gujarat
13	Road	Toll Road	Tuni Anakapalli Annuity Road Project
14	Road	Toll Road	Delhi Gurgaon Expressway
15	Road	Toll Road	Mahua Jaipur BOT Project, NHAI
16	Port	Port	Nhava Sheva International Container Terminal
17	Port	Port	Gangavaram Port
18	Port	Port	Kakinada Deep Water Port
19	Transportation	Subway	Mumbai Metro
20	Transportation	Subway	Hyderabad Metro
21	Transportation	Bus	Amritsar Intercity Bus Terminal
22	Electricity	Plant	Bhiwandi Electricity Distribution

2) Summary Comment

Point 1: Counter measure for future increase of O&M cost

Re-basement of future O&M cost is one of important point for sustainability of SPV and relating financial structure. How should we estimate long term projection of O&M cost, how to deal with future increase of O&M cost and how to share or how to reflect the annuity payment, which is the one of the key for success. In addition, if the user charge or revenue earned from the business which SPV is conceded to operate is linked to SPV's financial revenue, collectivity and affordability of user charge is vital for SPV structure's financial sustainability. In other words, coverage toll or user charge (tariff) collected against O&M cost, how we should manage this coverage, is very important.

Point 2: Lower cost of capital, interest rate

Another key point for successful PPP initiative is cost of capital including interest rate when SPV raise the fund to afford project cost. Every successful project is at least partially supported by lowered or zero rate cost of capital, such as low rate loan from parent company sponsor, or water connection deposit collected from users – general public.

It is recommended that SPV and HAM should be structured considering the most preferable capital structure that enables lowest cost of capital for SPV. Given that GOI is not going to provide sovereign guarantee for SPV's loan, it is really important for SPV to set best interest rate that SPV can afford and also attract lender to provide a loan to SPV, even if the principal and interest of the loan should be covered by upfront capital funding and later annuity payment by GOI.

Point 3: Reduction of Administrative cost for SPV

The more administrative cost increases in SPV, the less financially stable SPV achieve.

12.6.2 Case - Naba Diganta Industrial Township Authority

1) Background

Nabadiganta at Salt Lake Sector – V, the IT hub of Kolkata, has seen major developments over the last decade in sync with the IT boom happening across India. However, it had no organized water supply and sewerage system. In 2006, a water supply and sewerage project was conceived by Urban Development Department of Government of West Bengal, Kolkata Metropolitan Development Authority (KMDA) & Nabadiganta Industrial Township Authority (NDITA) to create infrastructures and provide services on BOT basis in PPP (Public Private Partnership) Model. KMDA and NDITA selected a private developer on a competitive basis. The private developer formed a SPV – the Naba Diganta Water Management Limited (NBWML). The SPV was required to undertake part-financing; design the specified components of the water supply and sewerage system; plan; undertake its construction; and operate and manage the system including the purchase of water, generation of bills and collection for the concession period. The influencing factors necessitating need for the project were I) Indiscriminate abstraction of ground water in Nabadiganta Area causing depletion of natural ground water resources, ii) Use of unhygienic arsenic contaminated ground water drawn from bore-wells and iii) Disposal of untreated sewage polluting environment. This project received approval of Jawaharlal Nehru National Urban Renewal Mission (JNNURM) of Government of India for its clear objectives to provide environmental sustainability and deliver hygienic water to Lakhs of employees working with IT industry. A Consortium Agreement was entered into by the participating private partners, JUSCO and VOLTAS. Under the guidance of the Operations Committee, JUSCO and VOLTAS designed and constructed their respective areas on EPC basis. Land pieces were provided by the State Government free of cost. Construction works started in April, 2008 and were completed in about 2½ years. This was a PPP project in Urban Infrastructure Sector in the state of West Bengal and India. NBWML sources clarified water from Kolkata Municipal Corporation (KMC) through NDITA, distributes clear water to its customers through water distribution network, collects sewage water through its sewer network and treats sewage at Sewage Treatment Plant before disposal. Billing for the services and collection of payments are also carried out directly by NBWML. The terms and conditions of services and payments between NBWML and its Customers are governed by User Agreements. Initially, JUSCO and VOLTAS were given contracts to operate and maintain their respective areas. In a recent move to bring synergy in operations and exercise better control, NBWML took over entire O&M of the plants and became independent. Post completion of the

construction works, the SPV was to undertake the operation and maintenance of the water supply system for a concession period of 30 years.

Table 12.6.2 Current infrastructure of Naba Diganta Water Management Limited (NBWML)

Water System
Underground Water Reservoir (1 Million Gallon) – 1 Unit Clear Water Pump House – 1 Unit Rising Water Main – 3.5 KM Elevated Service Water Reservoir (0.5 Million Gallon) – 1 Unit Water Distribution Mains – 20 KM Electrical Substation – 1 Unit
Sewerage System
Sewer Trunk Mains & Laterals – 18 KM Manholes – 700 Units Intermediate Pumping Station – 1 Unit Sewage Treatment Plant (2 Million Gallons per Day) – 1 Unit Electrical Substations – 2 Units

2) PPP Structure

The PPP contract for the project is a Concession Agreement for the development of the project on a BOT basis. The contract involves the following parties, viz., KMDA, NDITA and the consortium of private developers. As per the Concession Agreement, the private developer is required to undertake the development, design, engineering, financing, procurement, construction, completion, commissioning, implementation, management, administration, operation and maintenance of the Water Supply Network, Sewerage Network and the Sewage Treatment Plant (STP) at the site, viz., Sector V. Against the capital investment made, the private developer is permitted to charge the consumers a water supply-cum-sewerage tariff. The Concession Agreement requires the private developer to operate and manage the water supply and sewerage system for a time period of 30 years. As part of the pre-implementation activities, the private developer was required to prepare a Detailed Project Report for the project to be implemented. The detailed design of the capital works to be undertaken was to be provided by the private developer and, subject to approval from KMDA and NDITA; the works were to be implemented by the private developer. The grant under the JNNURM scheme is subject to approval of the DPR by the Ministry of Urban Development (MoUD). The tariff to be levied and the structure of the same will be determined by the private developer in consultation with KMDA, NDITA and the concerned stakeholders which include the

representatives of the IT offices located in Sector V. Post completion of the construction phase, the private developer is required to purchase the treated water from NDITA and supply water to all the connected units and collect sewage; the sewage then has to be disposed of following treatment. Further, the generation of bills and its collection is to be managed by the private developer. The private developer will retain the user charges so collected from the consumers. For undertaking the construction works, and for setting up the STP, the private developer will be provided the required land area free of cost. Additionally, the private developer is also not required to make any type of licensee fee payment or annuity payment to the KMDA or NDITA during the period of the contract. At the end of the tenure of the contract, the water supply and sewerage network has to be handed back to NDITA for future operations and maintenance.

3) Project Cost

The project cost was Rs.70.08 Crores in the end and it is said that Equity IRR is 16.4%, Average DSCR is 1.9, Minimum DSCR is 0.9, Debt Equity Ratio is 60.40 and NPV is Rs.1.4 Crore.

Table 12.6.3 Finance

Rs. million	The total project cost			Funnding Arrangement			
	Original Plan		Revise Plan	JNNURM	KMDA	NDITA	NBWML
Water Supply	Rs. 260.60		Rs. 260.60				
		Increase	*Rs. 78.70*	*35.0%*		*32.5%*	*32.5%*
sub total	Rs. 260.60	sub total	Rs. 339.30				
Sewage	Rs. 361.50		Rs. 361.50				
	Rs. 622.10		**Rs. 700.80**	35.0%			65.0%

Source: Information from PPP-Compendium of Case Studies Dec 2010

The construction works for the project commenced by May 2008. The construction activity was to be completed within a time period of 18 months. However, the period of construction activity has extended by another 6 months and is expected to complete by only August 2010. This extension has been due to the delay in handover of the required land area to the JUSCO-Voltas consortium for commencement of the construction works.

4) Project Capital

The equity is Rs. 184 million among Total Balance sheet, Rs.480 million at March 2015. The parent companies, JUSCO and VOLSAS are both of TATA Group.

Table 12.6.4 The Capital of NBWML

Par Value	10.0	Rs.		
Number of authorised shares	18,500,000	Shares		
Number of issued shares	18,450,000	Shares		
Value of paid-up shares	184,500,000	Rs.		
Share of JUSCO	13,653,000	Shares	74.00%	136,530,000 Rs.
Share of VOLTAS	4,797,000	Shares	26.00%	47,970,000 Rs.

Source: Financial Statement of NBMLS

5) Income Statement

It is said that the developer's initial estimate of tariff of Rs. 48/KL was reduced to Rs. 25/KL as the applicable water supply cum sewerage tariff. Of the Rs. 25/KL tariff, Rs. 15/KL was towards the provision of the water supply services and Rs. 10/KL for the sewerage services. And the water supply-cum-sewerage tariff has been estimated to be Rs. 25/KL. This tariff schedule is subject to a 10% increase every five years, so the latest tariff is Rs. 31.2 of FY2015 and the Rs. 33.9 of this year (FY2016). The revenue has been increasing and has turned profitable since FY2013.

Table 12.6.5 Income Statement of NBWML

	FY 2007 Mar-08	FY 2008 Mar-09	FY 2009 Mar-10	FY 2010 Mar-11	FY 2011 Mar-12	FY 2012 Mar-13	FY 2013 Mar-14	FY 2014 Mar-15	CAGR	
Revenue from operations				13.96	15.58	40.38	62.83	72.52	51%	22.5
Revenue from Construction Activities								6.00		0.0
Other Income				0.12	0.63	0.82	1.47	1.43	84%	0.7
Total Revenue				**14.09**	**16.21**	**41.19**	**64.30**	**79.95**	54%	23.1
Purchase of Water					2.11	5.18	8.15	8.94	62%	3.0
Purchase of Materials					0.00	0.00	0.00	2.75		0.0
Changes in stock of stock-in-trade					-0.03	0.00	-0.01	-1.76		-0.0
Operation and Maintenance Expenses				4.04	5.88	6.43	12.54	11.70	30%	6.1
Employee benefit expense			0.69	2.80	3.76	3.94	6.30	11.46	76%	2.4
Finance costs				6.36	22.53	17.55	10.18	5.63	-3%	-7.4
Depreciation and amortisation	0.38			5.04	18.54	15.89	21.26	21.32		5.4
Less: Tramsfer from capital reserve for capex							-7.23	-6.27		-7.2
Other Expense	0.06	1.41	0.65	3.35	17.67	19.68	11.98	11.84	115%	-7.7
Total Expense	**0.43**	**1.41**	**1.34**	**21.60**	**70.47**	**68.68**	**63.17**	**65.62**	105%	-5.5
Profit	**-0.43**	**-1.41**	**-1.34**	**-7.51**	**-54.27**	**-27.48**	**1.13**	**14.34**		28.6

Source: NBWML financial report 2008-2014

NBML buys the water from KMC by Rs.5 per KL (kilo litters). As "Purchase of Water" in FY2014 is Rs.8.94 million (Rs. 8,941,232) for example, its usage may be 1,788,246 KL so the Water supply revenue is Rs.32 million and Sewage revenue is Rs.21 million based on the tariff of the year (assuming Rs.29.85) while Revenue from operation is Rs.72.5 million. Some of this deference may come from authorized charge a one-time connection fee of Rs.10/- per sq. ft. of the

built up area by NBWML

Table 12.6.6 Revenue simulation of Water/Sewage

		105%	*105%*	*105%*	*105%*	*105%*	
	Rs. 25.00	*Rs. 26.13*	*Rs. 27.32*	*Rs. 28.55*	*Rs. 29.85*	***Rs. 31.20***	***Rs. 33.90***
FY 2009	**FY 2010**	**FY 2011**	**FY 2012**	**FY 2013**	**FY 2014**	**FY 2015**	**FY 2016**
	Rs. 25.00						
WS	*Rs. 15.00*	***Rs. 6,619,049***	***Rs. 16,975,830***	***Rs. 27,912,901***	***Rs. 32,025,085***		
SW	*Rs. 10.00*	***Rs. 4,412,700***	***Rs. 11,317,220***	***Rs. 18,608,600***	***Rs. 21,350,056***		
		Rs. 11,031,749	***Rs. 28,293,051***	***Rs. 46,521,501***	***Rs. 53,375,141***		
WS	60.0%	*Rs. 15.68*	*Rs. 16.39*	*Rs. 17.13*	*Rs. 17.91*		
SW	40.0%	*Rs. 10.45*	*Rs. 10.93*	*Rs. 11.42*	*Rs. 11.94*		
	Water Usage	Rs. 5.0	Rs. 5.0	Rs. 5.0	Rs. 5.0 /KL		
	Its Volume	422,145	1,035,748	1,629,240	1,788,246 KL		

Source: Calculation by JICA Study team from NBWML financial reports

Regarding the expenses from 2008 to 2014, a major cost is depreciation and finance cost following O&M cost and labor cost. (In EPC model, usually labor cost and labor cost is the major)

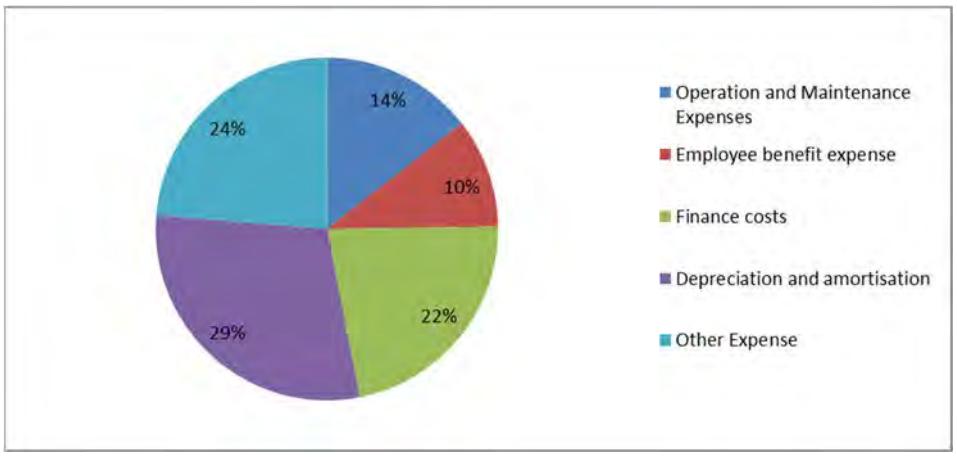


Figure 12.6.1 Expenses of NBWML

6) Balance Sheet

The audited financial report says that Grants-in-aid received from the Government as capital subsidy in the 'Build Operate Transfer' (BOT) project is deducted from the Fixed Assets which is showed the Table 12.6.2. This can explain that “Grants received and connection fee for Capital Expenditure” in Credit side has been increasing with the same proportion of depreciation. Finance cost can be assumed that SPV borrowed the money for the construction, 65% of the project cost.

Table 12.6.7 Balance Sheet of NBWML

Asset	FY 2007 Mar-08	FY 2008 Mar-09	FY 2009 Mar-10	FY 2010 Mar-11	FY 2011 Mar-12	FY 2012 Mar-13	FY 2013 Mar-14	FY 2014 Mar-15
Current Asset								
Cash and Bank Balances	0.50	1.84	11.13	10.95	8.85	8.03	21.30	47.21
Loans and Advances		1.40	1.20	1.28	0.68	1.00	3.62	1.63
Inventories					0.03	0.03	0.03	1.79
Trade receivables				6.83	2.91	4.57	6.17	6.73
Other				0.09	22.74	13.62	17.89	5.95
Non-current Asset								
Capital WIP	36.20	126.70	440.31					
Tangible Fixed assets				486.00	488.90	488.97	489.03	491.16
Accumulated Depreciation				-5.04	-26.25	-47.51	-68.77	-90.09
Long-term loans and advances					1.41	1.44	1.36	0.94
Other					34.07	53.69	49.94	15.00
Total Asset	**36.70**	**129.94**	**452.63**	**500.11**	**533.33**	**523.83**	**520.57**	**480.32**
Liability								
Current Liability								
Trade Payables		29.87	85.19	139.22	13.18	29.62	44.10	52.00
Other Liabilities	36.63	2.64	1.09	0.00	155.47	139.11	122.71	127.09
Short term provision				0.53	0.00	0.00	0.00	0.02
Non-current Liability								
Secured Loan		55.77	183.57	184.52	114.52	74.52	44.52	14.52
Other long-term liabilities			1.46	2.02	11.17	16.58	14.12	15.15
Long-term provisions					0.10	0.15	2.63	3.42
Equity								
Share Capital	0.50	43.50	184.50	184.50	184.50	184.50	184.50	184.50
Accumulated Deficit (Loss)	-0.43	-1.84	-3.18	-10.69	-64.96	-92.44	-91.31	-76.97
Capita Reserve*					119.36	171.79	199.30	160.59
Total Liability and Equity	**36.70**	**129.94**	**452.63**	**500.11**	**533.33**	**523.83**	**520.57**	**480.32**

Capita Reserve (Grants received and connection feefor Capital Expenditure)*

Source: NBWML financial report 2008-2014

It is also noted in the same report that "The Company has so far received an amount of Rs. 184,984,000 (31.03.14) from JNNURM and Rs.39,359,500 (31.03.14) from Naba Diganta Industrial Township Authority till 31st March 2015, which has been reduced from the project cost under Fixed Assets. Grant of Rs. 25,500,000 is yet to be received." So the Government grant is Rs. 249,843,500 in total. At the planning, as the project intimal capital cost was Rs.622,100,000 and 35% of it is to be funded into SPV, and the addition cost Rs.78,700,000 and 67.5% of it is to be funded into SPV, Rs.270,857,500 in totals is to be funded into SPV while the total project cost is around Rs.700,800,000. It can be assumed that actual construction cost was less since this received grant Rs.249 million is less that planned grant Rs.270 million. As the fixed asset shows the range between Rs.486 to 491 million, the difference from Rs.70.08 million (planning construction cost) will be other construction expenses.

7) Summary

This NBWML can be defined as successful case. The first three years after COD (commercial operation date), from 2011 to2013, was negative but from the 4th year, since 2013, it is profitable. The volume of water/sewage get increased while tariff get increased based on the concession agreement,

the revenue of operation has surpassed well over its expenses. So the accumulated deficit also started decreasing since 2013.

12.6.3 Case - Nagpur Environmental Services Limited (NESL)

1) Background

Nagpur is located in central India in the western State of Maharashtra. The city is home to 2.5 million13 people with approximately 850,000 (35 percent) living in slums. The city took ownership of the entire water supply value chain and since 2002 has initiated a series of outsourcing contracts for supply of labor, small maintenance activities, etc. The city also built two water treatment plants on a partial financing cum operations basis. The water supply function enjoys a relatively higher level of autonomy as compared to other cities with similar institutional structures, and the city's technical capacity is strong. The city has daily but intermittent supply of 2 to 12 hours. About 80 percent of citizens have access to piped water supply and about 77 percent of connections are metered. The city recovers about two-thirds of its operation and maintenance expenses through water tariffs. The operating losses are met through the general budget of the NMC. The percentage of NRW due to commercial losses alone is at approximately 23 percent. The state government has formally supported the PPP project and provided all the clearances necessary to help facilitate the process. The pilot project also helped build support among a segment of customers and NGOs who did not initially support the project. Concurrent with the PPP, the city incorporated a fully owned company called Nagpur Environmental Services Limited (NESL), a SPV. The water supply functions have been transferred to NESL. Key elected officials and executives of NMC constitute the board of NESL. The PPP contract is signed and supervised by NESL. But the real operation is transferred to the Operator, Orange City Water Ltd, which a 50:50 joint venture SPV company incorporated with stake of Vishwaraj Environment Pvt. Ltd and Veolia Water of France

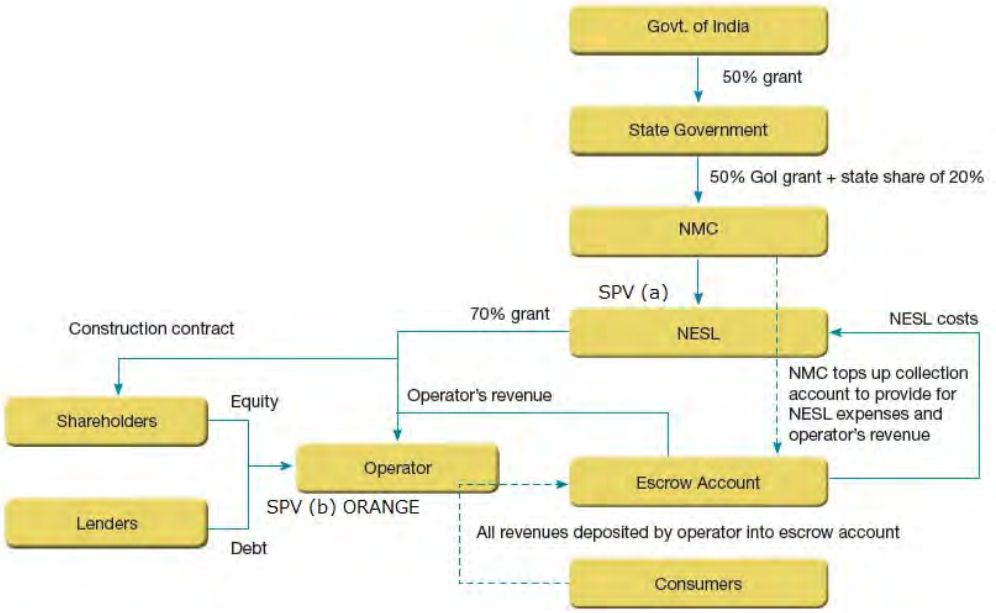


Figure 12.6.2 SPV Structure in Nagpur Water Supply (1)

2) PPP Structure

The contract is a 25 year performance improvement contract with a clause for extension based on mutual consent for up to another 25 years. The operator, Orange City Water Ltd. (another SPV, or OCWL), is responsible for billing and collection of revenue. The project includes the O&M of the existing distribution system and rehabilitation of a significant part of the network, including replacement of customer connections and meters. OCWL is required to implement an initial performance improvement project in five years, under a bill-of-quantities based contract. The revenues from user charges collected by OCWL will be transferred to an escrow account, which is used to make payments for the cost of electricity, raw water etc. and for payments back to OCWL. Any shortfalls in collections, which are anticipated since costs exceed current revenues, are covered by NMC from the general budget. JNNURM funded 70% of the initial capital investments, and the residual 30% were financed by OCWL while municipality is responsible for future capital expenditure. The performance requirements begin only at the end of the performance improvement project period (first five years). OCWL needs to raise 30% of capital cost for IPIP – initial performance improvement program. OCWL receives a fee based on the unit of water billed and collected while Municipal Corporation still have a right to set tariff table. OCWL rate is revised automatically every year for changes in price indices termed as standard adjustment. OCWL is guaranteed minimum revenue in 5 years even if the billed tariff is less than the stipulated threshold of 250 MLD. The rate is also subject to re-basement to deal with unpredicted event or inflation. Triggering event for such adjustment include change in law, force majeure, variance in projected revenue and cost due to overrun or delay in commencement of operations.

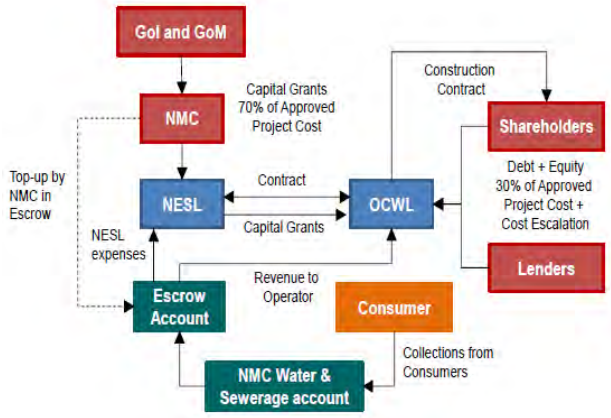


Figure 12.6.3 SPV Structure in Nagpur Water Supply (2)

3) Project Cost

The total investment of this project was Rs. 3,878.6 million. GOI funded 50%, and State Government funded 20% so that up to 70% of capital cost was covered by Government grant under JNNURM scheme. This capital cost was required for replacement of 429 km pipeline and replacement of all 320,000 water connections. In addition, under concession agreement (PPP contract), MNC would reimburse additional costs if the scope of Initial Performance Improvement Program (IPIP) to rehabilitate the facilities increases in order to achieve the performance standards.

4) Income Statement

Nagpur Environmental Service Limited (NESL) is a special purpose vehicle (SPV) fully owned by Nagpur Municipal Corporation (NMC), formed on October 28 2009 to plan, construct, manage and operate water distribution and supply in the areas of Nagpur Metropolitan Region for various household and commercial uses.

After two years of construction period, PPP based Nagpur water supply entered into commercial operation on 2012. There are two major source of revenue in NESL; one is support from NMC, in return for water tariff collected from users through escrow account of NESL by the operator contracted by separate concession agreement. The other is a miscellaneous income including interest received, etc. Tariff rate for Nagpur metropolitan city are frequently updated, tariff for Residential user starts from Rs.63.82/month, Commercial user Rs. 319.07/month, and minimum water charge shall applied to slum area.

Revenue increases by 4.7% from FY2012 to FY2014 whereas expense increases 14.8%, most of the expense comprised of operation fee paid to operator. Tariff rate is finally approved by NMC and support from NMC is very limited amount, and operating fee need to be agreed with operator. Therefore, NESL's financial stability is relatively weak and operation cost including administra-

tive expense cannot be recovered by its revenue from the beginning of its operation. This was resulted by several clauses which is disadvantageous in the concession agreement, having concession period of 25 years.

Table 12.6.8 Income Statement of NESL (SPV-a)

NESL - PL *Rs. thousand*	FY 2011 Mar-12	FY 2012 Mar-13	FY 2013 Mar-14	FY 2014 Mar-15	CAGR '12-'14
Profit and Loss Statement					
(I) Revenue from operations					
Domestic Turnover					
(iii) Sale or supply of services	0	18,544	18,412	18,753	
(II) Other income	742	13,146	16,135	15,989	
(III) Total Revenue (I+II)	742	31,689	34,546	34,742	4.7%
(IV) Expenses					
Payment to Auditors	17	28	28	29	
Finance cost					
Depreciation and amortization expense	6	67	47	81	
Other expenses	1,033	31,556	34,290	41,617	
Total expenses	1,055	31,651	34,365	41,727	14.8%
(V) Profit before exceptional and extraordinary items and tax (III-IV)	-313	38	181	-6,985	
(VII) Profit before extraordinary items and tax (V-VI)	-313	38	181	-6,985	
(IX) Profit before tax (VII-VIII)	-313	38	181	-6,985	
(X) Tax Expense				-2,168	
(1) Current tax					
(2) Deferred tax				-2,168	
(XI) Profit/(Loss) for the period from continuing Operations (IX-X)	-313	38	181	-4,817	
(XV) Profit/ (Loss) (XI+XIV)	-313	38	181	-4,817	
(XVI) Earnings per equity share before extraordinary items					
(1) Basic	0.00	0.76	3.63	-96	
(2) Diluted	0.00	0.00	3.63	-96	
(XVII) Earnings per equity share after extraordinary items					
(1) Basic	0.00	0.76	3.63	-96	
(2) Diluted	0.00	0.00	3.63	-96	

Source: NESL financial report 2011-2014

Orange City Water Private Limited is the SPV formed by Veolia Water (India) Private Limited and Vishwaraj Limited to perform water treatment service under PPP based concession agreement. The revenue from user charges collected by the operator will be transferred to an escrow account, which is used to make payments for the cost of electricity, raw water, etc. and for payments back to the operator. Any shortage in collection of water tariff, which would happen because operational costs, is larger than water charge revenue. It should be recovered by NMC from its general account. Operator's revenue increase year by year with CAGR of 8.0%, however, operating expense especially HR expense increased much larger than revenue and thus net profit of the operator increased two times. Some of the water service requires not only electricity and machinery but also skilled man power labor. So HR expense inevitably increases if the operator would not manage it effectively so

that operator maintains their service level to fulfill service standard.

Table 12.6.9 Income Statement of Orange City Water (SPV-b)

Orange - PL	FY 2011	FY 2012	FY 2013	
Rs. thousand	Mar-12	Mar-13	Mar-14	CAGR
Profit and Loss Statement				
(I) Revenue from operations				
Domestic Turnover				
(iii) Sale or supply of services		802,610	866,440	8.0%
(II) Other income		8,670	5,400	-37.7%
(III) Total Revenue (I+II)		**811,280**	**871,840**	7.5%
(IV) Expenses				
Operation Expense		668,030	663,020	-0.7%
Employee benefit Expenses		131,530	188,930	43.6%
Finance cost		2,520	7,080	181.0%
Depreciation and amortization expense		7,910	38,540	387.2%
Other expenses		44,080	62,880	42.6%
Total expenses		**854,070**	**960,450**	12.5%
(V) Profit before exceptional and extraordinary items and tax (III-IV)		-42,790	-88,610	107.1%
(VII) Profit before extraordinary items and tax (V-VI)		-42,790	-88,610	107.1%
(IX) Profit before tax (VII-VIII)		-42,790	-88,610	107.1%
(X) Tax Expense		-12,470	-23,720	90.2%
(2) Deferred tax		-12,470	-23,720	90.2%
(XI) Profit/(Loss) for the period from continuing Operations (IX-X)		-30,320	-64,890	114.0%
(XV) Profit/ (Loss) (XI+XIV)		**-30,320**	**-64,890**	114.0%
(1) Basic		-3,030	-6,490	114.2%

Source: Orange City Water Pvt. Ltd. financial report 2013-2014

According to recent report, NMC pays a higher rate of water cost to the operator for water treatment plant which the operator have a right to operate as defined by the contract and it has also handed over additional favors by not recovering the amount of exemption on import paid for plant equipment imported from abroad. MNC's losses after PPP scheme started have kept increasing to more than Rs. 10 Crore. However, cost coverage ratio increased by 9.9% and it kept improved. MNC implemented a tariff revision along with improved cost recovery levels. The operator's revenue model is per unit fee, which is different from user charges. MNC bears the cost of raw water supply, electricity, and water supply tariff retained with the MNC. User charges would not recover cost, and the city will need to provide a recovery payment through the general account without limitation of the recovery amount. In addition, project plan was not designed to address financing needs for change in scope or future expansion.

Table 12.6.10 Income Statement of NMC (ULB)

	Rs. thousand	2012-2013	2013-2014	2014-2015	CAGR
Revenue					
Water Dept		**956,270.00**	**1,069,846.00**	**1,194,794.00**	11.8%
Water rate	Arrears	94,928.00	106,539.00	114,518.00	9.8%
	Current	46,573.00	52,258.00	56,172.00	9.8%
Water by meter		814,769.00	911,049.00	1,024,104.00	12.1%
Sewer Dept		195,175.00	218,144.00	235,723.00	9.9%
Revenue Total		1,151,445.00	1,287,990.00	1,430,517.00	11.5%
Expense					
Water dept		**1,698,494.00**	**1,611,057.00**	**1,756,490.00**	1.7%
Capital expenditure		339,477.00	20,547.00	54,989.00	-59.8%
Payment to NESL		720,000.00	956,765.00	1,000,461.00	17.9%
Contingency		639,017.00	633,745.00	701,040.00	4.7%
Sewerage dept		**457,759.00**	**577,654.00**	**857,763.00**	36.9%
Salary for drainage staff		8,687.00	8,944.00	9,840.00	6.4%
Capital expenditure		53,695.00	75,799.00	130,572.00	55.9%
Contingency (Drainage)		3,091.00	3,593.00	10,424.00	83.6%
O&M drainage		14,496.00	13,448.00	33,207.00	51.4%
Salary for STP staff		6,470.00	4,470.00	5,894.00	-4.6%
Contingency (STP)		25,261.00	29,102.00	37,047.00	21.1%
Salary for conservancy		346,059.00	442,298.00	630,779.00	35.0%
Expense Total		**2,156,253.00**	**2,188,711.00**	**2,614,253.00**	10.1%
Profit/Loss		-1,004,808.00	-900,721.00	-1,183,736.00	8.5%
Cost Recovery Ratio					
Water		56.3%	66.4%	68.0%	9.9%
Sewerage		42.6%	37.8%	27.5%	-19.7%

Source: NMC Financial report 2012 - 2015

(2) Balance Sheet

NESL formed and owned by NMC has relatively small balance sheet compared to operator SPV because this SPV serves as a conduit in between NMC – executing agency and Operator- concessionaire and it should have small balance sheet and no significant financial resource should be retained in the conduit. As the balance in the Escrow account is ultimately owned by MNC, the SPV does not have significant amount of cash and cash equivalent.

Table 12.6.11 Balance Sheet of NESL (SPV-a)

NESL - BS	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	CAGR
Rs. thousand	Mar-10	Mar-11	Mar-12	Mar-13	Mar-14	Mar-15	'12-'14
I. Liability and Equity							
(1) Shareholders' funds							
(a) Share Capital	500	500	500	500	500	500	
(b) Reserves and surplus			-313	-275	-120	-4,980	325.20%
(c) Other current liabilities	36	42	314,509	339,198	665,928	388,732	7.05%
TOTAL Liability and Equity	**536**	**542**	**314,696**	**339,422**	**666,308**	**384,252**	6.40%
II. ASSETS							
(1) Non-current assets							
(a) Fixed assets							
(i) Tangible assets			201	134	127	149	5.49%
(ii) Intangible assets						2,168	
(e) Other non-current assets	36	106					
(2) Current assets							
(a) Current investments			10,211	180,000	180,000	180,000	0.00%
(b) Inventories							
(d) Cash and cash equivalents			4,938	1,020	982	17,190	310.48%
(f) Other current assets	500	436	299,345	158,268	485,199	184,744	8.04%
TOTAL Assets	**536**	**542**	**314,696**	**339,422**	**666,308**	**384,252**	6.40%

Source: NESL financial report 2009-2014

Operator SPV has significant amount of non-current liability and asset amounts to Rs. 3364 Million. This is the existing asset which is allowed to be used by the operator but ownership of these assets is not transferred to the operator. The project cost relating to rehabilitation of water service facility – IPIP are recorded on the Capital Work in Progress account and Intangible asset account which should be reverted to MNC when contract terminate.

Table 12.6.12 Balance Sheet of Orange City Water Supply (SPV-b)

Orange - BS	FY 2011	FY 2012	FY 2013	
Rs. thousand	Mar-12	Mar-13	Mar-14	CAGR
I. Liability and Equity				
(1) Shareholders' funds				
(a) Share Capital	100,000	100,000	100,000	0.0%
(b) Reserves and surplus	-1,681	488,374	1,023,510	109.6%
Profit (loss) for period		-30,317	-64,887	114.0%
Other additions to reserves (Government Grants)		520,372	600,023	15.3%
(a) Long-term borrowings		1,404,981	1,821,577	29.7%
(c) Other long term liabilities		2,796,700	3,364,055	20.3%
(d) Long term provisions		2,237	4,044	80.8%
(a) Short-term borrowings		86,169	132,227	53.5%
(b) Trade payables		495,866	697,269	40.6%
(c) Other current liabilities		246,373	132,222	-46.3%
(d) Short-term provisions		38	126	232.0%
TOTAL Liability and Equity	**98,319**	**5,620,738**	**7,275,029**	29.4%
II. ASSETS				
(1) Non-current assets				
(a) Fixed assets				
(i) Tangible assets		30,032	50,179	67.1%
(ii) Intangible assets		293,519	1,160,350	295.3%
(iii) Capital work-in progress		632,380	832,315	31.6%
(c) Deferred tax assets (net)		13,226	36,945	179.3%
(d) Long-term loans and advances		228,797	372,762	62.9%
(e) Other non-current assets		2,798,800	3,364,800	20.2%
(2) Current assets				
(a) Current investments		8,293	12,216	47.3%
(b) Inventories		0	0	
(c) Trade receivables		198,099	419,145	111.6%
(d) Cash and cash equivalents		246,338	21,166	-91.4%
(e) Short-term loans and advances		1,171,253	1,005,151	-14.2%
(f) Other current assets		0	0	
TOTAL Assets		**5,620,738**	**7,275,029**	29.4%

Source: Orange financial report 2008-2014

In addition to capital grant received from NMC, the Operator borrowed Term Loans of Rs. 1,08,33,00,000 in total referred below which is secured against mortgage of Building, hypothecation of all the movable assets & current assets of the company, Assignment/first charge on all rights, title, interest, benefits under material project documents, all insurance proceeds. Major conditions of the Term Loans are, quarterly instalments payable from October 2014 to July 2025 and Interest

rate: bank base rate plus 275 bps per annum = 13.00% during the year 2013-14. On the other hand, annual interest at 13.17 % to 13.53% is applied to the capital lease contract to procure automobile and it is to be repaid in 48 monthly installments.

Table 12.6.13 Borrowing of Orange (SPV-b)

Rs.thousand	FY 2012 Mar-13	FY 2013 Mar-14
Short term borrowing		
Cash Credit from IDBI Bank Limited	86,169	132,227
Total	86,169	132,227
Long term borrowing		
IDBI Bank Limited	490,700	698,180
Central Bank Of India	84,000	119,500
IIFCL	68,900	242,600
Shareholders	760,000	760,000
Vehicle Loan From L&T Finance Limited	1,381	1,297
Total	1,404,981	1,821,577
Other Current Liability		
IDBI Bank Limited (Current maturity of long term borrowing)	0	17,520
Central Bank Of India (Current maturity of long term borrowing)	0	3,000
IIFCL (Current maturity of long term borrowing)	0	2,500
Vehicle Loan From L&T Finance Limited	389	591
Mobilization advance received towards IPIP project	225,936	75,312
Liabilities towards purchase of Fixed Assets	1,036	1,578
Other	19,011	31,721
	246,373	132,222

According to the PPP contract, there are three types of fixed asset on operator's balance sheet, Return Asset, Optional Take-Back Asset and Own Asset. Return Asset is existing water facilities which is allowed operator to use for their water service and all of fixed assets built and constructed under IPIP program. Return Asset must be returned to NMC when concession period terminated. Return asset is recorded as intangible asset on the B/S, O&M Right - IPIP Acquisition, which amounts Rs. 1141million as on Mar 31, 2014. This asset should be amortized over concession period – 25 years from commencement date of its operation. Optional take back asset is recorded as tangible fixed asset, Furniture and fixtures, Vehicles, Computer Equipment, Other Equipment. For optional take back asset, NMC can decide if they have operator to return such asset to NMC after concession period. The other one is the owned asset, which is not directly relevant to water service and is not funded by capital cost contribution from government. Operator does not need to return such owned asset after concession period. Owned asset on the B/S are; Office Building (Owned), Other Building (Owned), Plant and equipment (Owned).

Table 12.6.14 Fixed Assets of Orange (SPV-b)

FY2013 - Orange Fixed Asset	Acquisition Cost (Gross)				Accumulated Depreciation				Net Book Value			
Rs.thousand	Begin	Addition	Deduction	End	Begin	Addition	Deduction	End	Begin	Addition	Deduction	End
Tangible assets												
Office Building (Owned)	821			821	3	13		16	818	-13		**805**
Other Building (Owned)	53			53	31	22		53	22	-22		**0**
Plant and equipment (Owned)	13,371	10,769		24,139	192	1,283		1,476	13,178	9,485		**22,664**
Furniture and fixtures	2,190	1,300		3,491	399	1,141		1,540	1,791	159		**1,950**
Vehicles	2,797	4,902		7,699	90	403		493	2,708	4,499		**7,206**
Computer Equipment	12,119	8,008		20,126	1,447	2,725		4,172	10,672	5,283		**15,954**
Other Equipment	1,075	1,329	76	2,329	232	532	35	728	843	797	40	**1,600**
Sub Total	32,426	26,308	76	58,658	2,393	6,121	35	8,479	30,032	20,187	40	**50,179**
Intangible Asset												
Computer Software	13,107	17,115		30,221	3,549	8,224		11,773	9,558	8,890		**18,448**
Other Intangible Asset (O&M Right - IPIP Acquisition)	286,288	882,134		1,168,422	2,327	24,194		26,521	283,961	857,941		**1,141,902**
Sub Total	299,395	899,249		1,198,644	5,876	32,418		38,294	293,519	866,831		**1,160,350**

Under concession agreement, Operator is able to call for adjustment rate of operating fee so that Operator can recover unfavorable material cost escalation within every five years. Operator calculates and recognizes long term receivable to recover negative impact of price escalation, which amounts Rs. 233million as on Mar 31, 2014.

Also, operator has significant amount of advance payment to related party constructor called Orange City Hydraulic Works Private Limited, Rs. 901 million as on Mar 31, 2014 for IPIP program construction work. It indicates that not only operator but also ULB need to have a right and co-obligation of monitoring to ensure construction is performed as intended on DPR, when concessionaire itself does not execute construction work and procure/outsource build work.

Table 12.6.15 Receivables of Orange (SPV-b)

Rs. thousand	FY 2011	FY 2012	FY 2013	
Long term loans and advances				
Security deposit (unsecured)		33,499	51,824	
Capital advance (unsecured)		7,516	15,086	
Loans and advances to related parties (Veolia Water (India) Private Limited)		54,181	35,059	
Prepaid expense		745	735	
Advance income tax paid		25,649	36,406	
Loans to NESL - Escalation against rehabilitation		107,208	233,652	63%
Sub Total		228,797	372,762	
Current		0	0	
Security deposit (unsecured)		2,175	3,762	
Loans and advances to related parties (Veolia Water (India) Private Limited)		19,123	19,123	
Loans and advances to related parties (Orange City Hydraulic Works Private Limited)		1,105,000	901,403	90%
Prepaid expense		2,018	1,673	
VAT receivables		1,770	4,059	
Advance recoverable		41,000	74,577	
Accrued interest		168	555	
Sub Total		1,171,253	1,005,151	

1) Summary

On this PPP structure, it is doubtful that the value for money is realized. As we analyzed above, there are several issues which keep this project from success, including irregularities in concession agreement which is too advantageous to operator.

- Low non-performing revenue reduction

  The maximum revenue that can be withheld through liquidated damages for failure to perform is only 5% of annual revenues. In addition, first five years of operation this non-performing revenue reduction shall not be applied.

- Subsequent adjustment of capital expenditure

  Operator is compensated for rehabilitation works based on the concession agreement which includes cost rate per item of the works and materials, which provides for future price escalation in costs linked to price index. In addition, capital expenditure during the time of bidding is subject to revision by the operator, in order to fulfill performance standard.

- Periodic operating fee “re-base” clause

  Operator has the right for a rate revision if it finds excessive cost are required to achieve or maintain performance parameters, in addition to the periodic rate rebasing. The rate is subject to periodic rebasing every five years, which takes into account all costs and expenditure and revision of performance standards as determined by the operator. Therefore, due to rebasing

clause, operator has the right to update operating fee rate for their cost recoverable level. And commercial risk is not completely transferred to operator.

12.6.4 Case - GTAEPL (GMR Tuni Anakapalli Expressways Private Limited)

1) Background

The project, Anakapalli-Tuni Road, is widening of Tuni-Anakapalli section of NH-5 from km 300.0 to km 359.2 (Golden Quadrilateral Corridor) in Andhra Pradesh. This was amongst the first set of projects considered for the BOT (Annuity) model. This project is a road expansion project undertaken by the National Highways Authority of India (NHAI) as one of the several projects under the Golden Quadrilateral program. The project's scope was to strengthen the existing two lanes and widen it to a four lane dual carriageway of an aggregate 59 km stretch between Tuni and Anakapalli on National Highway (NH) 5 (Chennai to Kolkata) in Andhra Pradesh on PPP basis. Keeping in mind the lack of attractiveness in tolling the road, NHAI decided to take up the project on the Build Own Transfer (BOT) Annuity model. The toll is collected by NHAI.

2) PPP Structure

The Project was awarded by NHAI on a BOT (Annuity) basis. The annuity model involves the payment (Rs.294.8 million) of a fixed semi-annual sum by the NHAI to the concessionaire during the concession period to compensate him for the capital cost and operational and O&M expenses of the project plus a certain percentage of returns thereon. (Details in the chart later)

Table 12.6.16 PPP information of GTAEPL (Ministry of Finance, Government of India)

Sector	Transport
Sub-Sector	Roads and bridges
Project Capacity	58.947 KM (Kilometer)
Location	Andhra Pradesh
Type of PPP	Build-Operate-Transfer (BOT) Annuity
Project Status	Operational
Nodal Authority	Centre
Concession Duration (In Months)	210
Bid Parameter	Not Available
Government/Non Government	Government
Any Other Information	Not Applicable
Name Of Authority	National Highways Authority of India (NHAI)
Project Concessionaire	GMR Tuni - Anakapalli Expressways Private Limited

Table 12.6.17 Timeline of GTAEPL (Ministry of Finance, Government of India)

Concession Agreement Signing Date	9-Oct-01
Financial Closure Date	1-Jun-02
Apointed Date	9-May-02
Construction Completion Date (as per Concession Agreement)	8-Nov-04
Construction Completion Date (Actual)	24-Dec-04
Date to Start of Commercial Operation (as per Concession Agreement)	8-Nov-04
Date to Start of Commercial Operation (Actual)	24-Dec-04
Concession End Date (as per Concession Agreement)	9-Nov-19

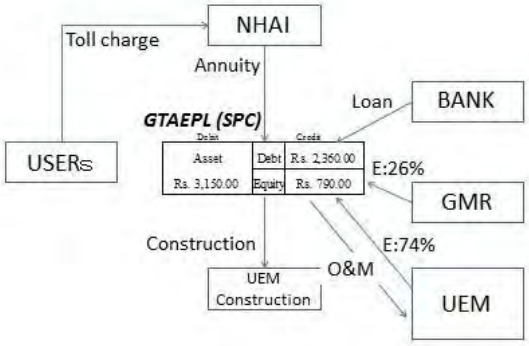


Figure 12.6.3 SPV Structure of GTAEPL

3) Project cost

The estimated project cost of the project was Rs. 3,150 million. O&M fee is Rs.1.25 million per month and a periodic fee of Rs.75 million. The O&M fee and the periodic fee are escalated by 1.5% per annum, 1 year from the date of commencement of operations. But the actual project cost became Rs. 2,950 million.

4) Project cost

The estimated project cost was Rs.3150 million. The term loan component was Rs.1540 million, non-convertible debentures component was Rs.820 million and the equity Rs.790 million or Rs.10-/share time 7.9 million issues. The project was funded on a debt-equity ratio of 3:1. ICICI Bank was the lead banker and the lending consortium included several public sector banks such as State Bank of India, Union Bank of India, Indian Overseas Bank, Jammu & Kashmir Bank, Bank of India, Punjab National Bank, and Industrial Investment Bank of India, State Bank of Mysore. The average spread of the loan ranged from 12.5% to 12.75%. The loan tenure was 13.5 years, including a construction period of 2.5 years. NHAI also gave an irrevocable revolving letter of credit for

Rs.294.8 million throughout the concession period. This provided comfort to the bankers.

Table 12.6.18 Financing of GTAEPL

Rs.million

Loan	Term loan	Rs. 1,540.00		Rs. 2,360.00	75%
	debenture	Rs. 820.00			
Equity	GMR	Rs. 584.60	74%	Rs. 790.00	25%
	UEM*	Rs. 205.40	26%		
				Rs. 3,150.00	

UEM: United Engineers Malaysia (UEM) BerhadGroup

1) Financial planning model

From the information of the collected document (including audited financial report), it is assumed that the concession model may show the following tables, three patterns:

The condition of Table (A) is the project cost of Rs.3150 million as original estimation, O&M expense noted before, and installment repayment of Rs.3150 million for 13.5 years with the interest rate from 12.5% to 12.75%. In this case, cost surpasses the revenue or total annuity payment.

Table 12.6.19 Cost Annuity Simulation (A)

Rs.million				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	
Concession	**Oct (agreement)*																	**Nov (end)*	
Construction		**May (start)*	**Dec (end)*																
O&M			**Dec (start)*															**Nov (end)*	
Construction	3,150.00																		
	1,050.00	1,050.00	1,050.00																3,150.00
1.5%		O&M/month	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	
		Month	*2*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*11*	
		Monthly O&M cost	2.50	15.23	15.45	15.69	15.92	16.16	16.40	16.65	16.90	17.15	17.41	17.67	17.93	18.20	18.48	18.75	256.49
		Periodic fee	75.00	76.13	77.27	78.43	79.60	80.80	82.01	83.24	84.49	85.75	87.04	88.35	89.67	91.02	92.38	93.77	1,344.93
		O&M Total	77.50	91.35	92.72	94.11	95.52	96.96	98.41	99.89	101.38	102.91	104.45	106.02	107.61	109.22	110.86	112.52	1,601.41
12.63%																		Construction and OM cost	**4,751.41**
Repayment	505.44	505.44	505.44	505.44	505.44	505.44	505.44	505.44	505.44	505.44	505.44	505.44	505.44						6,570.68
	1,555.44	1,555.44	1,632.94	596.79	598.16	599.55	600.96	602.39	603.85	605.32	606.82	608.34	609.89	106.02	107.61	109.22	110.86	112.52	**11,322.09**
	Annuity	Semi annual (1st)		294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	
	Annuity	Semi annual (2nd)		294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	
Loan rate				**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**8,844.00**
12.50%																			
12.75%																			

The condition of Table (B) is the project cost of Rs.2950 million as actual construction cost, O&M expense noted before, and installment repayment of Rs.2950 million for 13.5 years with the interest rate from 12.5% to 12.75%. (In this model cost surpasses the revenue or total annuity payment). Still in this model, cost surpasses the revenue or total annuity payment.

Table 12.6.20 Cost Annuity Simulation (B)

Rs.million					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	
Concession	*Oct																		*Nov (end)	
	(agreement)																			
Construction		*May (start)		*Dec (end)*																
O&M				*Dec (start)*															*Nov (end)*	
Construction	2,950.00																			
	983.33	983.33	983.33																	2,950.00
1.5%		O&M/month		1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	
		Month		*2*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*11*	
		Monthly O&M cost		2.50	15.23	15.45	15.69	15.92	16.16	16.40	16.65	16.90	17.15	17.41	17.67	17.93	18.20	18.48	18.75	256.49
		Periodic fee		75.00	76.13	77.27	78.43	79.60	80.80	82.01	83.24	84.49	85.75	87.04	88.35	89.67	91.02	92.38	93.77	1,344.93
		O&M Total		77.50	91.35	92.72	94.11	95.52	96.96	98.41	99.89	101.38	102.91	104.45	106.02	107.61	109.22	110.86	112.52	1,601.41
12.63%																		Construction and OM cost		**4,551.41**
Repayment	473.35	473.35	473.35	473.35	473.35	473.35	473.35	473.35	473.35	473.35	473.35	473.35	473.35	473.35						6,153.49
	1,456.68	1,456.68	1,534.18	564.70	566.07	567.46	568.87	570.30	571.76	573.23	574.73	576.25	577.79	106.02	107.61	109.22	110.86	112.52	**10,704.91**	
	Annuity	Semi annual (1st)		294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	
	Annuity	Semi annual (2nd)		294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	
Loan rate				**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**8,844.00**
12.50%																				
12.75%																				

It is told that "In May 2005, GTAEPL raised further debt of about Rs.3720 million from a consortium of lenders through securitization of future annuity receivables (68% of annuity receivables) to be received from NHAI over a period of fifteen years. These funds were raised at a cost lower than the cost of project debt by about 3% and were used for prepayment of the project debt." And also, the audited financial report in 2015 says, "Indian rupee loan from back carries interest is 8.25%" So the condition of Table (C) is the project cost of Rs.2950 million as actual construction cost, but payback condition from 2002 to 2004 was about the interest rate of 12.63% (mathematical average of 12.5% and 12.75%.) but from 2005 to 2019 was 8.25% for the remaining 15 years. O&M expense is noted before. In this case, the revenue or total annuity finally surpasses the total cost (construction, OM and finance cost).

And Table (C) shows that 34% is construction cost, 18% is O&M cost and 48% is finance cost among all costs.

Table 12.6.21 Cost Annuity Simulation (C)

Rs.million					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	
Concession	*Oct																		*Nov (end)	
	(agreement)																			
Construction		*May (start)		*Dec (end)*																
O&M				*Dec (start)*															*Nov (end)*	
Construction	2,950.00																			
	983.33	983.33	983.33																	2,950.00
1.5%		O&M/month		1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.25	
		Month		*2*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*12*	*11*	
		Monthly O&M cost		2.50	15.23	15.45	15.69	15.92	16.16	16.40	16.65	16.90	17.15	17.41	17.67	17.93	18.20	18.48	18.75	256.49
		Periodic fee		75.00	76.13	77.27	78.43	79.60	80.80	82.01	83.24	84.49	85.75	87.04	88.35	89.67	91.02	92.38	93.77	1,344.93
		O&M Total		77.50	91.35	92.72	94.11	95.52	96.96	98.41	99.89	101.38	102.91	104.45	106.02	107.61	109.22	110.86	112.52	1,601.41
12.63%																		Construction and OM cost		**4,551.41**
Repayment	473.35	473.35	473.35	181.48	181.48	181.48	181.48	181.48	181.48	181.48	181.48	181.48	181.48	181.48	181.48	181.48	181.48	181.48	181.48	4,142.28
	1,456.68	1,456.68	1,534.18	272.83	274.20	275.59	277.01	278.44	279.89	281.37	282.87	284.39	285.93	287.50	289.09	290.70	292.34	294.00	**8,693.69**	
	Annuity	Semi annual (1st)		294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	
	Annuity	Semi annual (2nd)		294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	294.8	
Loan rate				**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**589.6**	**8,844.00**
12.50%																				
12.75%																				

2) Income Statement

The annuity per year is the sum of semi-annual annuity (Rs.294.8 million) or Rs.589. The revenue contains fairly amount of Interest Income as well. Since total expense is less than total revenue, the SPV is profitable and has taxable profit. On FY2014, O&M expense increased from Rs. million to Rs. 139.16 million, with more than 30 crores comparing to FY2013. According to Credit rating report issued by ICRA India, during 2013, one of GTAEPL's shareholder and O&M contractors for the project - United Engineers (Malaysia) Berhad (UEM) exited from this PPP scheme and terminated the fixed price O&M and major maintenance contract entered into with UEM group from the beginning of the project. As per observation, it was noted that the gearing of GTAEPL is high – fixed cost which cannot be reduced evenly if the level of production or service decreases. Therefore, revenue is stable but it is difficult to pursuit additional revenue opportunity besides annuity payment, controlling O&M expense not rising too high without lowering the service level is vital for the GTAEPL to earn predetermined amount of annuity payment. Generally, periodic maintenance expenditure will become larger as the carriage way – concession fixed asset gets old.

Table 12.6.22 Income Statement of GTAEPL (SPV)

Rs.million	FY 2013 Mar-14	FY 2014 Mar-15	Growth ('13-'14)	% of Total Revenue ('13)	% of Total Revenue ('14)
Incomet statement					
Annuity income from expressways	589.72	589.72	0.0%	86.5%	83.9%
Interest Income	90.91	110.30	21.3%	13.3%	15.7%
Other Income	1.35	2.71	100.9%	0.2%	0.4%
Total Revenue	**681.97**	**702.72**			
Operation and Maintenance Expenses	108.71	139.16	28.0%	15.9%	19.8%
Employee benefit expense	32.69	48.30	47.8%	4.8%	6.9%
Finance cost	186.29	161.15	-13.5%	27.3%	22.9%
Depreciation and amortisation	199.12	199.40	0.1%	29.2%	28.4%
Admin and Other Expense	85.24	80.37	-5.7%	12.5%	11.4%
Total Expense	**612.05**	**628.39**	2.7%	89.7%	89.4%
Profit before tax	**69.92**	**74.33**	6.3%	10.3%	10.6%
Profit on redemption of preference shares	31.25	0.00	-100.0%	4.6%	0.0%
Current tax expense	21.80	15.16	-30.4%	3.2%	2.2%
Profit after tax	**79.37**	**59.17**	-25.5%	11.6%	8.4%

Source: Financial statement of GTAEPL, period ended March 31, 2015

3) Balance sheet

The two years balance sheet, from 2013 to 2014 shows that accumulated depreciation in Debit and secured load from bank has largely decreased. Loan and advances in Debit and Trade payable in Credit has largely increased. And accumulated profit has increased. Cash and bank balance are

increased on FY2014 with 107.8 Crore supported by sufficient amount of annuity payment. Excessive money is deposited to intercorporate deposit which would be operated by GTAEPL's related party – GMR group.

Indian Rupee loan from banks carries interest rate at 7.5% plus fixed spread of 8.25% and thus 15.75% per annum in total. The loan is repayable in 29 unequal half yearly installments commencing from November 25, 2005. The loan is secured by way of mortgage of all the present and future immovable fixed asset of the company, hypothecation of movable fixed assets of the company and the annuity receivables, investments and so forth.

Most of the tangible fixed asset is comprised of carriage way, which in scope of the concession agreement. Carriageway is depreciated over the period of the 15 years from commercial operation date until the end of concession period on a straight line method. Any additions to the carriageway if any is also depreciated from the date of capitalization till the end of the concession period uniformly.

GTAEPL borrows a loan from two related parties, GMR Highway Limited – parent of the GTAEPL a Rs. 114.14 Million term loan with 1% of annual interest rate, and fellow subsidiary of GTAEPL a Rs. 324.8 million with 1% of annual interest rate, which is recorded as a non-current liability. 1% loan is extremely low rate and GTAEPL rely on such a favorable financial support to continue its operation.

Table 12.6.23 Balance Sheet of GTAEPL (SPV)

	Rs.million	FY 2012 Mar-13	FY 2013 Mar-14	FY 2014 Mar-15	Growth ('13-'14)
Asset					
Current Asset	Cash and Bank Balances		39.42	147.26	107.8
	Inventory		0.00	0.50	0.5
	Loans and Advances		251.40	862.08	610.7
	Other		314.80	385.07	70.3
Non-current Asset	Tangible Fixed assets		2,970.18	2,970.20	0.0
	Accumulated Depreciation		-1,843.71	-2,043.78	-200.1
	Non current investment		765.11	765.11	0.0
	Long term loans and advance		913.29	336.48	-576.8
	Other		135.93	0.00	-135.9
Total Asset			**3,546.42**	**3,422.92**	-123.5
			0.00	0.00	0.0
Liability			0.00	0.00	0.0
Current Liability	Trade Payables		50.02	293.94	243.9
	Other Liabilities		313.11	307.33	-5.8
	Short term provision		186.57	48.83	-137.7
Non-current Liability	Secured loan from bank		1,591.62	1,307.03	-284.6
	Loan from GMR Energy Ltd.		324.86	324.86	0.0
	Loan from GMR Highway Ltd.		114.14	114.14	0.0
	Other Liabilities		1.61	1.84	0.2
	Long term provision		2.60	4.56	2.0
Equity	Share Capital		10.00	10.00	0.0
	Accumulated Profit (Surplus)		951.88	1,010.39	58.5
Total Liability and Equity			**3,546.42**	**3,422.92**	-123.5
	Equity		*961.88*	*1,020.39*	*58.5*

4) Summary

The project plan in financial point of views seems to be fine and the current financial statements also shows that this SPV runs well, so the business model of GTAEPL looks well. It seems it has been progressing well without any financial issues.

12.6.5 Case - Haldia Water Management Limited

1) Background

Haldia is a municipality in West Bengal State which one of a major industrial center spreading about 125 km southwest of Kolkata adjacent to river mouth of the Hooghly River, one of the distributaries of the Ganges. The population in 2011 was 200,762.

Haldia is being developed as a major trade port for Kolkata, intended mainly for bulk cargoes. The industrial city has several major factories, including South Asian Petrochemicals Ltd, Indian Oil Corporation Limited (IOCL), Exide, Shaw Wallace, Tata Chemicals, Haldia Petrochemicals and Hindustan Lever, in addition to various light industries. The port has attracted Major International Petrochemicals Companies, like Mitsubishi Chemical Corporation (MCC). Mitsubishi Chemicals has the second largest terephthalic acid producing plant in Haldia.

The Haldia Township is bordered by the Haldi River an offshoot of the Ganges River. Haldia is served by rivers like Rupnarayan, Haldi and Hooghly that ensure abundant water supply for irrigation of the agricultural farms. Due to increasing water demand of industries, Haldia Development Authority augmented new Water Treatment Plant. For fulfillment of future demand, a new Water Treatment Plant was commissioned on BOT basis.

2) PPP Structure

Haldia Water Management won a global tender in 2008 to take over the then existing system, which now handles 25 million gallons daily, and build a similar facility within two years to cater to both industrial and domestic customers.

Jamshedpur Utilities and Services Co Ltd (JUSCO, Tata group) and Ranhill Utilities Berhard of Malaysia have jointly incorporated the Haldia Water Management Limited which is a joint venture and started the management of civic facility in Jamshedpur to provide water at Bengal's IT hub. Ranhill is one of the largest water distribution players in Malaysia.

When Haldia Water Management Ltd was incorporated, it was promoted by IDFC Projects Ltd which has signed a concession agreement with Haldia Development Authority for the project. The project was expected to meet the unfulfilled demand of large industrial units operating in the region aiming to be the first end-to-end, river-to-tap water project to be implemented in public-private partnership in India. Project work is expected to start on September 2009, with the first module scheduled to commission on

March 1, 2010. Expected to cost more than Rs 90 crore, the project was to be financed on a 70:30 debt-equity ratio.

The 25-year concession agreement involves construction, operation and maintenance of a 113.5 MLD water treatment plant on design-build-finance-operate (DBFO) basis.

Alongside, it also entails operation and maintenance of the existing 113.5 MLD WTP and of the entire distribution network that currently serves consumer in Haldia. Ranhil and Jusco will execute the EPC and O&M works based on the contract.

3) Project Cost

Jusco and Ranhill spent Rs 88 crore on building the new plant at Geonkhali, Haldia.

4) Project Capital

JUSCO has 60% of shares in capital and the remaining 40% is held by Ranhill, JUSCO's JV partner. Paid up capital has been increased as the project progressed.

Table 12.6.24 Balance Sheet of Haldia Water Management

	31-Mar-09	31-Mar-10	31-Mar-11	31-Mar-12	31-Mar-13	31-Mar-14	31-Mar-15
Par Value (Rs.)	10	10	10	10	10	10	10
Number of authorised shares	30,000,000	30,000,000	30,000,000	30,000,000	30,000,000	30,000,000	30,000,000
Number of issued shares	5,090,000	17,255,100	24,925,100	27,773,683	27,773,683	27,773,683	27,773,683
Number of paid-up shares	2,540,000	15,524,500	24,925,100	27,773,683	27,773,683	27,773,683	27,773,683
Value of paid-up shares (Rs.)	25,400,000	155,245,000	249,251,000	277,736,830	277,736,830	277,736,830	277,736,830
Shares capital held by JUSCO (60%)	15,240,000	93,147,000	149,550,600	166,642,100	166,642,100	166,642,100	166,642,100
Shares capital held by others (40%)	10,160,000	62,098,000	99,700,400	111,094,730	111,094,730	111,094,730	111,094,730

5) Income Statement

As on 2015, JUSCO and its Ranhill had giving up a water distribution contract in Haldia, due to lack of water demand in West Bengal's industrial sector. Haldia Water Management Ltd will hand over a pre-existing water distribution facility and a new one to the Haldia Development Authority (HDA) by March 30 2016, 20 years before the term's expiry, after suffering heavy losses in the past five years.

Haldia Water Management is foregoing the BOT contract not because the volume of business has not kept pace with expectations. The company has promised smooth transition to the HDA without any disruption in water supply. Around 220 people picked by contractors of the firm will work for the HDA. HAD has already floated a tender seeking a contractor to maintain the system for three months during which it intends to find another operator.

The company was supposed to pay around Rs 1,220 crore to the Haldia authority over the 25-year concession period and make a profit by supplying water to its customers.

Although Jusco and Ranhill spent Rs 88 crore on building the new plant at Geonkhali, the facility has been lying idle for almost two years as there are no takers for the water.

The situation was aggravated by the central environment ministry's ban on new industry because of the

high level of pollution at the port town from end-2009. The company has suffered losses of Rs 50 crore to Rs 60 crore running the existing unit. The unit was processing 14 to 15 million gallons of water a day when Haldia Water Management took over operations. As a result, on none of operation year Haldia water could not recover O&M expense from its water revenue.

Table 12.6.25 Balance Sheet of Haldia Water Management

Incomet statement	FY 2008 Mar-09	FY 2009 Mar-10	FY 2010 Mar-11	FY 2011 Mar-12	FY 2012 Mar-13	FY 2013 Mar-14	FY 2014 Mar-15	CAGR ('08-'14)	Growth ('13-'14)
Water Charges	131	356	431	463	458			-100%	0.0
Interest Income	0	1	0					-100%	0.0
Other Income			0	2	0	1	0		-0.9
Total Revenue	131	356	432	465	459	1	0	-66%	-0.9
Purchase of Water									0.0
Power Expense	26	78	98	109	163			-100%	0.0
License Fee	88	210						-100%	0.0
Preliminary Expense	2							-100%	0.0
Operation and Maintenance Expenses	23	84						-100%	0.0
Employee benefit expense	2	3	3	3	4	4	5	19%	0.3
Interest Expense		0	3	6	85	98	111		13.5
Depreciation and amortisation	0	0	0	0	0	0	0	48%	0.0
Impairment of Capital Asset			75	774	26	11	0		-10.9
Other Expense	13	12	345	450	552	5	2	-29%	-2.9
Total Expense	153	387	524	1,343	831	118	118	-4%	0.1
Profit before tax	-21	-31	-92	-878	-372	-117	-118	33%	-1.0
Current tax expense	0							-100%	0.0
Deferred tax expense	7	9	-16					-100%	0.0
Profit after tax	-14	-22	-109	-878	-372	-117	-118	42%	-1.0

6) Balance Sheet

As a result of consecutive fiscal deficit and decision to dismiss from this PPP structure, Haldia Water recognized impairment on its 88 crore intangible fixed asset on its balance sheet, rights to operate the water treatment plant. And its liability exceeds its asset from FY 2012, reflecting the provision for dissolution of the company and terminating the business once the court decision will be made. At the time Haldia Water returned the operation of WTP to HDA, Water Management sought to renegotiate the contract to make the project viable. But, as on June 2016, no such contract renewal or settlement of the dispute has been made.

Table 12.6.26 Balance Sheet of Haldia Water Management

Balance sheet		FY 2008 Mar-09	FY 2009 Mar-10	FY 2010 Mar-11	FY 2011 Mar-12	FY 2012 Mar-13	FY 2013 Mar-14	FY 2014 Mar-15	CAGR ('08-'14)	Growth ('13-'14)
Asset										
Current Asset	Cash and Bank Balances	11	51	69	5	28	4	2	-26%	-2.5
	Loans and Advances	5	40	31	58	115	113	110	66%	-2.9
	Trade receivables	57	81	94	140	626	27	26	-12%	-0.6
Non-current Asset	Capital WIP	19	199	726	849	875	886	886	90%	0.3
	Capital WIP impairment			-75	-849	-875	-886	-886		-0.3
	Tangible Fixed assets	0	0	0	0	0	0		-100%	-0.1
	Accumulated Depreciation	0	0	0	0	0			-100%	0.0
	Other	7	16	11	1				-100%	0.0
Total Asset		99	388	856	204	770	145	139	6%	-6.0
	Fixed asset netted against grant received									
Liability										
Current Liability	Trade Payables	88	139	81	133	411	413	414	29%	1.1
	Short term borrowing					165	165	165		0.0
	Current Maturity of long term borrowing						496	496		0.0
	Interest Payable						90	200		110.0
	Other Liabilities			184	321	1,310	213	214		0.5
Non-current Liability	Secured Loan		130	486	495					0.0
Equity	Share Capital	25	155	249	278	278	278	278	49%	0.0
	Accumulated Deficit (Loss)	-14	-36	-145	-1,022	-1,394	-1,511	-1,628	120%	-117.6
										0.0
										0.0
Total Liability and Equity		99	388	856	204	770	145	139	6%	-6.0

7) Summary

One of the reason why Haldia Water exited out from the PPP structure was, revenue has not been increased as HDA projected before inception, which taken into account by the company. As a result, cash flow forecast was also inaccurate because number of company newly settled to that area has not been increased that much due to sudden change (strengthened) in government's regulation around pollution and the general business situation.

While water treatment capacity increased to 30 million gallons a day, demand did not go beyond 24 to 25 million gallons a day, resulting significant under-utilization and short fall of revenue derived from water treatment operation.

Under the PPP agreement, the HDA was to have a predetermined annual guaranteed income of Rs 1,220 crore.

12.6.6 Case - Alandur Sewerage Project, Chennai, Tamil Nadu

1) Background

The Alandur Sewerage Project (ASP) was started on 1996 by the Alandur Municipality (AM). AM is located adjacent to Chennai, which forms a part of the Chennai Metropolitan Area. AM has population of approximately 165,000 on Census 2011 and is one of suburban area of Chennai, most of the area is utilized as residential building and commercial industries.

At the time the project was commenced, Alandur did not have an underground sewerage system and most of the sewage disposal relied on individual septic tanks. AM announced a plan to construct an

underground sewerage system and waste water treatment facility with the participation of the private sector, contribution from the public, and payment to be provided by the city. The proposal was 'transformational' as it involved a service never before made available by the municipality, with financial and management responsibilities being shared by the municipality, the residents, the private sector, and state government bodies.

Alandur project is characterized as following key points which distinguishes among other water and sewerage project; participation of residents sector not only Private and Public sector for sharing financial and management responsibilities.

2) PPP Structure

It was the first time for Indian Municipal water and sewerage sector to implement a project with the form of Public Private Partnership. STP was constructed on a BOT (Build, Operate and Transfer) basis. In addition to the construction of STP, the contractor was also responsible for operation and maintenance of the sewerage system for a period of five years from the date of completion of the construction with a fixed O&M fee, which is called BOQ (Bill of Quantities) basis. Besides construction, the contractor was required to undertake the O&M of the sewerage system for a period of years from date of completion of the project on a fixed fee basis. On the other hand, AM still had a right and responsibility around tariff collection and providing new connections even in the five years O&M phase.

PPP structure of the Alandur project was structured by three separate contracts as follows; EPC contract for STP, Works Contract for construction of the sewage network and O&M contract. For Works and O&M contract, World Bank's National Competitive Bidding (NCB-W2) was used as the template.

Land Lease Contract (in the nature of a BOT Agreement) for the STP, guidelines from the International Federation of Consulting Engineers (FIDIC) was used. Through this Agreement, the contractor would finance, build and operate the STP and would be required to recover the investment on the STP on the basis of a per unit rate payment from the municipality for treatment of sewage delivered. The municipality agreed to provide a minimum payment level per annum regardless of the volume of sewage actually delivered. It was designed to cover the company's minimum fixed operating cost and capital investment. Therefore, Alandur project's PPP structure was BOT-Annuity and annuity payment borne by AM.

The project comprised of three contracts; 1) A Works Contract for Sewerage Network, 2) O&M Contract - 5 years on Fixed Fee basis, 3) Lease Contract (BOT Agreement). Successful bidder was consortium of IVRCL Infrastructures and Projects Ltd and Va Tech Wabag Technologies Ltd. They incorporated a SPV named First Sewerage Treatment Plant Pvt Ltd (First STP) as the concessionaire company to sign BOT Agreement. First STP also signed contracts with its parents companies to implement the works for the project and for O&M of STP for 14 years. Also, AM leased the land on which STP was built to First STP.

3) Project Cost

Loans: The majority of financing to the municipality (59%) was made through loans provided by the Tamil Nadu Urban Infrastructure Development Corporation (TUFIDCO) and TNUIFSL (State Asset Management Co.). The loan provided by TUFIDCO was payable over eight years (after a two-year moratorium) at an interest rate of 5% per annum (as against prevailing market rates of 15% at that time). TNUIFSL's loan was set at a rate of 16% per annum payable over a period of 15 years with a five year moratorium. The term loan conditions resulted in the municipality assuming significant financial.

Table 12.6.27 Finance source of Alandur Project

	Rs. Million
Grant from TNUIFSL	30
Loan from TNUIFSL	60
Loan from TUFIDCO	160
Grant from TUFIDCO	10
Deposit from public	124
Interst from deposit	24.6
Total	408.6

Source: PPP - Compendium of Case Studies Dec 2010

The required capacity of sewerage system and STP to serve about 300,000 of estimated population was to start with 12 MLD and then maximum capacity was to be 24 MLD.

The cost of the project was estimated as Rs. 40.86 crore. To finance the municipality's portion of the capital cost, a package of loans (22Crores) and grants (4Crores) was structured with the loans from Tamil Nadu State Government organization. One of the key characteristic of this project financing was the initiative of collecting citizen's money totaling up to 12.4 Crores as connection deposit with inspiring citizen's awareness. On the other hand, the STP was financed entirely by the contractor.

One-time deposits for sewerage connection were charged to users with three categories (domestic, commercial, industrial). The connection charges for different categories of users were fixed as follows: Connection Charges, Domestic) 5,000 per house connection, Commercial) 10,000, Industrial) 10,000. A loan program to finance this connection deposit was offered by the bank. State government agreed to provide gap funding to bridge any shortfall in domestic connection payments. The public was also expected to contribute towards monthly sewer maintenance charges.

Grants: As no funds were available either with the municipality or with TNUIFSL to oversee and monitor the progress of the project, TUFIDCO provided a special grant from the Tamil Nadu urban development grant fund for this purpose, which worked out to nearly three per cent of the total project cost. GoTN agreed in principle to bridge the gap in the sewer account during the life of the project, after

providing for operations and maintenance (O&M) expenses, debt servicing and contribution to the sinking fund. In addition to the above, GoTN also agreed to fund the monthly operating costs of the system above the ` 150 per household sewer charge to a maximum of ` 30 per connection per month.

4) Project Capital

The equity of the SPV is Rs. 30 million among Total Balance sheet, Rs.151 million at March 2014. The parent companies, IVRCL and VA Tech Wabag Limited as engineering and mechanical area of servicer in the structure of PPP. As per the operation and maintenance contract, the STP facility is under direct control and supervision of VA Tech Wabag Limited for Operation and maintenance that have 5% stake in the Company.

Table 12.6.28 The Capital of First STP

Par Value (Rs.)	10
Number of authorized shares	3,000,000
Number of issued shares	3,000,000
Number of paid-up shares	3,000,000
Value of paid-up shares (Rs.)	30,000,000
Shares capital held by IVRCL Limited (95%)	28,500,000
Shares capital held by VA Tech Wabag Limited (5%)	1,500,000

5) Income Statement

Operating result of the First STP is stable and records a profit every year. One of the reasons of the periodic operational surplus is that, STP facility on their book has been already fully depreciated and the depreciation expense is not incurred anymore. The other reason is, their revenue is sufficient to cover O&M cost including power and fuel. In addition, on AMC's annual account for FY2014-2015, AMC would earn a financial surplus on their general fund account besides depreciation, and thus, entire O&M cost recovery rate is not low even though not all the sewerage service cost is recovered by user charges collected from individual and commercial/industrial users.

Table 12.6.29 The Income statement of First STP

Incomet statement of First STP Ltd	FY 2009 Mar-10	FY 2010 Mar-11	FY 2011 Jun-12	FY 2012 Mar-13	FY 2013 Mar-14	CAGR ('08-'14)
Revenue of sale of product	17	17	20	12	16	-1%
Interest Income			1	0	0	
Other Income		0				
Total Revenue	17	17	21	13	16	0%
MFG and Service cost	0	0				-100%
Power and Fuel	3	3	4	2	4	11%
Contract Cost	4	4				-100%
Administrative expense						
Operation and Maintenance Expenses	0					-100%
Employee benefit expense				0	0	
Interest Expense	0					-100%
Depreciation and amortisation	8	8	5			-100%
Other Expense	0	0	4	3	4	150%
Total Expense	15	14	13	5	8	-14%
Profit before tax	2	2	8	8	8	42%
Current tax expense	0	0	2	1	2	50%
Deferred tax expense						
Profit after tax	2	2	6	6	7	41%

6) Balance Sheet

Depreciation of fixed asset; The fixed assets are amortized equally over a period of 9 years from the date of commencement of commercial operations, being the period of operation of the project on BOOT basis. Nature of other non-current assets are, Land held for development, Advance tax, Deposit with tax statutory authority.

Due to restructuring of the parent company, the financial statements of First STP on FY2011 have been prepared for the fifteen months period commencing from April 1, 2011 to June 30, 2012, with due effect being given to the said restructuring. Thus P/L figures on these years are not comparable with those of the previous year.

One thing that makes First STP's balance sheet complicated is, intercompany transaction relating to land acquisition amounts 35.47 Acres not for construction of STP but for commercial/residential development. The economic development rights of the land have been vested with IVR Hotels and Resorts Limited for 11.67 Acres and RIHIM Developers Private Limited for 23.80 Acres , against Earnest Money Deposited of Rs.3,49,22,345 and Rs.4,27,34,273 respectively to these companies, subcontractors of build and construction of STP, totalling Rs. 77,656,618 which is the same amount of land account. In General, SPV should not have such an asset that does not relate to its primary business objective, development, operation and maintenance of STP system.

Table 12.6.30 The Balance sheet of First STP

(Amounts in million Rupee)

Balance sheet of First STP Ltd		FY 2009 Mar-10	FY 2010 Mar-11	FY 2011 Jun-12	FY 2012 Mar-13	FY 2013 Mar-14	CAGR ('08-'14)
Asset							
Current Asset	Cash and Bank Balances	0	5	11	6	1	21.2%
	Loans and Advances (to related party)					10	
	Loans and Advances (Prepaid)	16	0	0	0	0	-82%
	Loans and Advances (Other)				0	0	
	Trade receivables	21	0	0	40	42	19%
Non-current Asset	Capital WIP						
	Capital WIP impairment						
	Building	1	1	1	1	1	0%
	Acc. Depreciation: Building	-1	-1	-1	-1	-1	7%
	Plant and Machinery	54	54	54	54	54	0%
	Acc. Depreciation: Plant and Machinery	-41	-49	-54	-54	-54	7%
	Other tangible Fixed assets	1	1	1	1	1	0%
	Acc. Depreciation: Other	0	0	-1	-1	-1	7%
	Land held for development	78	78	78	78	78	0%
	Other	0	39	46	19	21	437%
Total Asset		128	127	135	143	151	4%
	Fixed asset netted against grant received						
Liability							
Current Liability	Trade Payables	3					-100%
	Short term borrowing						
	Current Maturity of long term borrowing						
	Interest Payable						
	Short term Provision		0	0	0	0	
	Other Liabilities	0	0	0	0	0	4%
Non-current Liability	Secured Loan						
	Earnest Money Deposit for land develop	78	78	78	78	78	0%
	Other Long term liability		0	2	4	5	
Equity	Share Capital	30	30	30	30	30	0%
	Accumulated Deficit (Loss)	17	19	25	31	38	23%
Total Liability and Equity		128	127	135	143	151	4%

7) Summary

Alandur Sewerage project can be considered as successful so far and financially sustainable. There would be several key factors for success:

Discipline of Municipality

Contractual obligations between AMC and the BOT operator forced AMC to ensure timely payment for fixed rate fee of management and waste water treatment services.

Thus, the loan as well as contractual obligations ensured strong fiscal discipline by the municipal body, by making it take difficult decisions on capital priorities, closely oversee the sewer system

Implementing an effective fee system

Despite the willingness to pay survey that indicated that public willingness was far below the tariff requirement to meet the capital and operational cost of the project, the municipal council, through its rigorous public outreach measures, managed to impose reasonable levels of connection charges and sewer fee on the public. The municipality also managed to collect the connection charges fairly well in time to pre-empt the need for the loan provided by State governmental organization. Also, the connection deposits were collected in two instalments to meet the financial needs for most of citizens.

Assurances on payment to the Private Sector Participant

AMC agreed to provide the BOT operator a minimum level of income by accepting the 'take or pay' condition in the Agreement. Thus, AMC assumed the risk of minimum payment to the operator while the private partner assumed all other responsibilities and risks of financing, constructing and operating the STP for a period of 14 years.

12.6.7 Case - Mahua Jaipur BOT Project, NHAI

1) Background

India has a National Highways network of 65,569 km which was 1.7 per cent of the total road network of the country, and it carried over 40 per cent of total traffic. The role of developing, maintaining and managing National Highways in India has been entrusted to the National Highways Authority of India (NHAI) which was established in 1988 by an Act of Parliament, namely NHAI Act 1988, as a body corporate to discharge its functions on business principles. NHAI is mandated to implement the National Highways Development Program (NHDP) which is the amongst the world's largest road development programs covering 55,225 km (as on 31 March 2013). The Action Plan for NHDP involves a total investment of 2,200 billion on concessions/contracts to be awarded by 2012.

NHDP projects are financed primarily from the following sources: 1) CESS levied on petrol and high speed diesel (Central Road Fund), 2) funds received for externally aided projects, 3) additional budgetary support, 4) market borrowings and plough back of revenue

Under the PPP arrangement, two main modes of execution were followed by NHAI:

- Build Operate and Transfer (BOT) - Toll basis.
- Build Operate and Transfer (BOT) - Annuity basis.

Source: Union Government (Commercial) Ministry of Road Transport & Highways No. 36 of 2014

2) PPP Structure

JMTPL (I) Corporation Project is a company who engaged NHAI road as PPP model, BOT toll basis. JMTPL is a public Ltd company in India & incorporated under the provisions of the Companies Act, 1956. The Company is a SPV created by IJN Rajasthan (Mauritius) Ltd. in pursuance of

NHAI, for BOT basis. Its takes reconstruction, strengthening, widening, rehabilitation, O&M of existing Mahua-Jaipur Highway.

3) Project Cost

JMTPL (I) Corporation Project is a company who engaged NHAI road construction in PPP model, BOT toll basis. The Concession Agreement was signed in September 2005. The Company was entitled for a grant from NHAI of Rs 594,000,000 during operations period. Provisional Completion Certificate issued in September 2009. The Company is entitled for a grant from NHAI of Rs 396,000,000 during the construction period which has been shown as Capital Reserve. In terms of the Concession agreement the same is to be treated as Equity Support to be retained as such till the end of the concession period.

Table 12.6.31 Engagement profile

(Rs. In million)

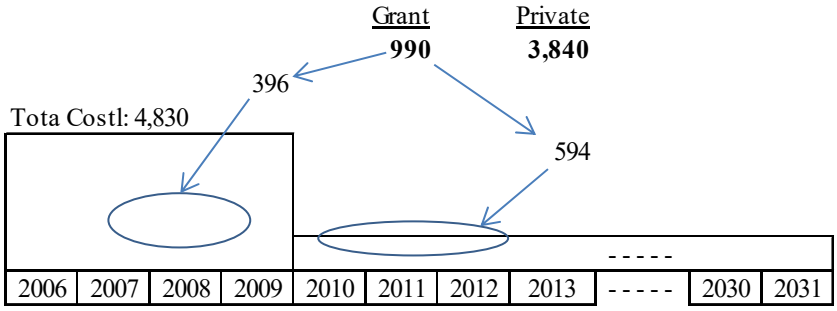
PARTICULARS	PROJECT COST	CONCESSION PERIOD	GRANT BY NHAI (VGF)	Share of Private Sector
MAHWA - JAIPUR (108 KM)	4,830	300 MONTHS	990	3840

Source: Union Government (Commercial) Ministry of Road Transport & Highways No. 36 of 2014

Table 12.6.32 Basic Time schedule of this Concession

Concession Agreement Signing Date Actual date on which the concession agreement is signed	25-Sep-05
Financial Closure Date Actual date on which financial closure is achieved	20-Mar-06
Apointed Date Actual date on which the project has started	20-Mar-06
Construction Completion Date (as per Concession Agreement) Construction completion date as per concession agreement	20-Mar-09
Construction Completion Date (Actual) Actual Construction completion date	26-Sep-09
Date to Start of Commercial Operation (Actual) Actual start date for commercial operation	26-Sep-09
Concession End Date (as per Concession Agreement) Date of end of concession as per the concession agreement	20-Mar-31

The Grant from NHAI is Rs. 990 million which is about 20% of the Total project cost. The company will pay Rs. 3,840 million or about 80% of the total cost.



Source: Drawing by JICA Study Team

Figure 12.6.4 The Total cost, cost portion and Grants.

4) Financial Performance

Most revenue from 2012 to 2014 comes from Toll operation while the Grant from NHAI is just 3%. In Expense of the same years, about 41% is Maintenance Expense but finance cost or interest expense is rather high, as much as 34%

Table 12.6.33 Engagement profile

Rs. Million

Performance Financial Results	**2013-14**	**2012-13**
Revenue		
Revenue from Operation		
Revenue from Toll Operation	961.2	870.2
Operating Grant from NHAI	22.2	33.9
Sub total	**983.4**	**904.1**
Other Income	31.0	18.3
Total Income	**1,014.3**	**922.4**
Expense	0.0	0.0
Maintenance Expense	686.6	365.4
Employee Benefit Expese	19.5	25.7
Other Expenese	156.8	159.4
Depreciation and Amortization	154.1	140.3
Interst	432.5	448.3
Total Expenses	**1,449.5**	**1,139.1**
Provision for Taxation	-435.2	-216.7
Balance Brought Forward	-979.8	-763.1
Balance carried to Balance Sheet	-1,415.0	-979.8

Source: Annual report of JMTPL (I) Corporation 2013-14

12.7 SPV Financial Modeling

12.7.1 Introduction

Government of India Cabinet leased 6th January 2016 that the Union Cabinet has approved the proposal for taking up Hybrid Annuity based PPP (Private Public Partnership) model under Namami Ganga Program which aims to reform the wastewater sector in India. This model will have two types of SPV (Special Purpose Vehicle), National-level SPV and ULB (Urban Local Body) -level SPV or the Project level SPV. In this chapter, the latter or ULB-level SPV is examined and analyzed.

HAM-PPP (Hybrid Annuity model) is different from current EPC model in the legal matters and various conditions in the agreement or the contracts. Similarly, HAM-PPP will show a different cash flow model or financial model. This section will provide the information of the financial model under HAM and also offer financial simulation based of DPR which is supposed to take HAM, 1) Mirzapur case, 2) Chunar case. Since these simulations cannot be conducted with the real information such as proposed cost from exact potential concessionaires nor the amount of equity or debts form stakeholders, the new simulation/calculation will be required in the future once the information will be obtained.

12.7.2 Base Conditions of Financial Modeling

1) Financial viewpoints in HAM

Although the key business function of Sewage system basically can be the same between the different structures, SPV model will show a different financial model from other non-SPV model.

In this section where HAM is to be simulated, it is defined at the beginning here about SPV scheme in the financial point of views. In the following simulation here in this section, the basic structure of this business model that affect financial model is considered as “To-be next model” in the Figure 50.1.1 below.

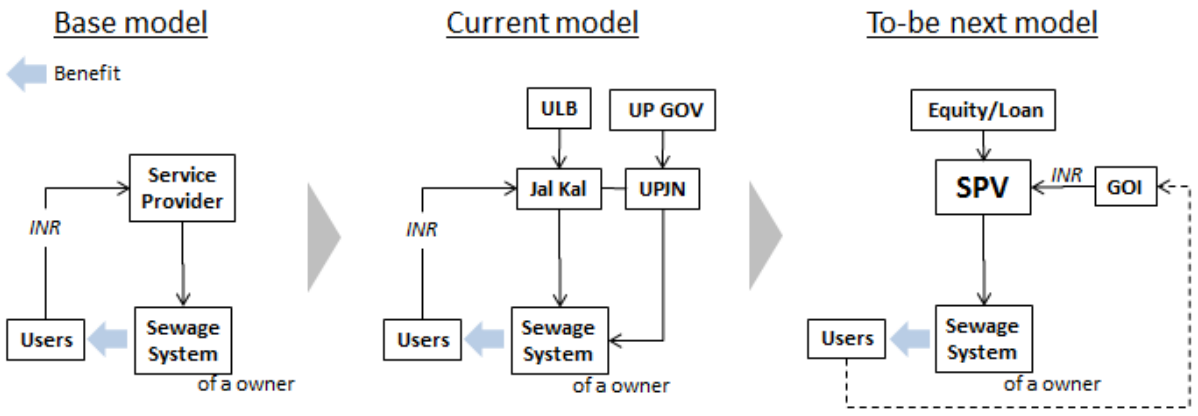


Figure 12.7.1 The basic structure of SPV of financial viewpoint

More in detail, the financial/accounting relationships/flow can be described in the following chart. Figure 50.1.2 based on “To-be next model” in the above. There are some important conditions in

the financial point of view to consider HAM. The simulation in the section depends upon those;

- The size of balance sheet, amount of debt and equity is not predetermined as a rule so the debt/equity ratio is not predetermined while the majority of the equity holder should be Central Government or Government of India. (See Ref.2 in the below as another case).
- It can be probable that private company (Concessioner) or others puts equity in SPV.
- SPV can contract business agreements (design/build/O&M, etc.) with outside vendors however SPV in itself can do so.
- Debt or loan will be paid back with its interest to lenders (note: The below Figure does not show this flow, SPV to lenders)
- It is not always necessary that Government itself collect tariff from users but it should belong to GOI in accounting/financial perspective, as one of sources of Annuity from GOI.
- Escrow account would be prepared by SPV, whose bank account would be for incoming tariff, Annuity, bonus and any other payments.

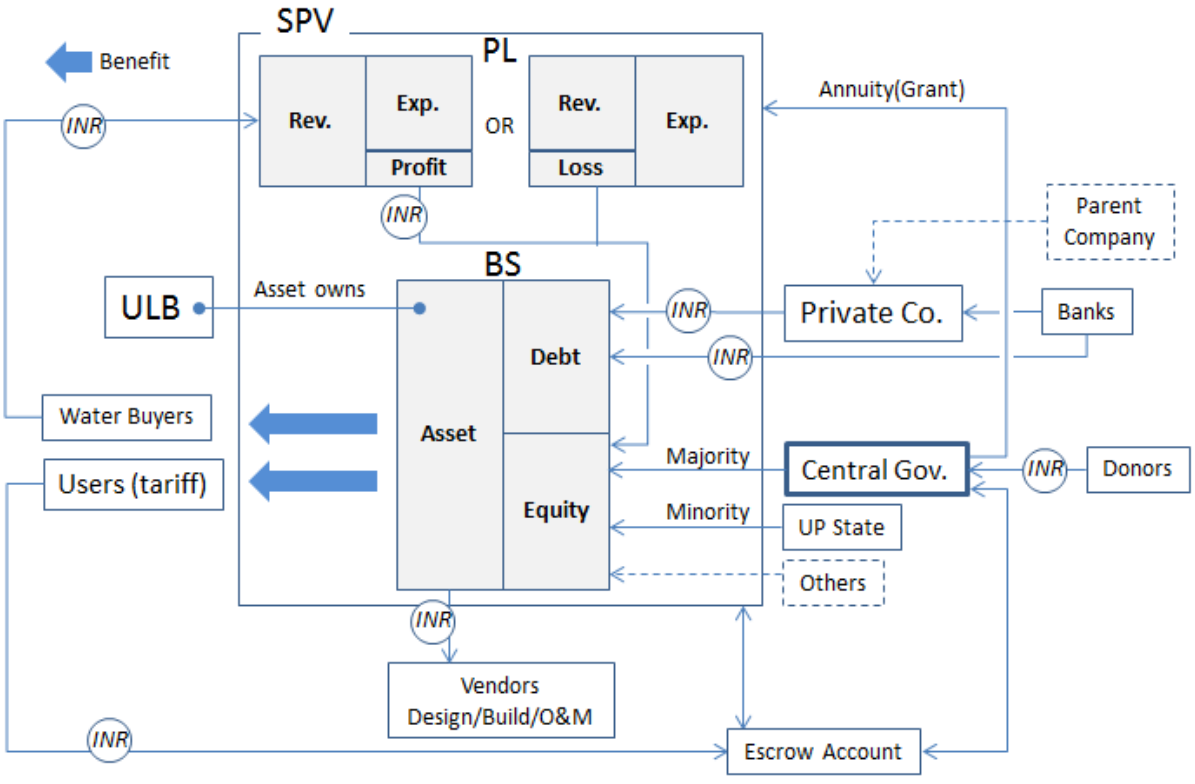


Figure 12.7.2 Financial viewpoints under HAM

Ref.1: Smart City Guideline in India, for example, has this definition; "*The Smart City Mission will be operated as a Centrally Sponsored Scheme (CSS) and the Central Government proposes to give financial support to the Mission to the extent of Rs.48,000 crores over five years i.e. on an average*

Rs.100 crore per city per year. An equal amount, on a matching basis, will have to be contributed by the State/ULB; therefore, nearly Rupees one lakh crore of Government/ULB funds will be available for Smart Cities development."

2) The main basic rules in the financial viewpoints

Under the HAM structure depicted before, it is necessary to have the basis conditions in more details for having the financial simulation of HAM. These will determine the cash-flow or if bring anther cash-flow model once these will be changed. (Note: legal matters, organization structures or business contract matters are not referred here)

Table 12.7.1 The basic conditions of HAM related Finance/Accounting

Overall	
1	SPV is established by Government of India and State government under Companies Act 2013
2	Majority stake (at lesat 51%) comes from Government of India and the minority stake comes from State government
3	Equity from other parties is not particularly defined otherwise GOI has majority
Government	
1	Part of the capital investment (up to 40%) will be paid by government through construction linked milestones and the balance
2	Government pays to Annuity over the contract duration up to 20 years to SPV
3	Government receive sewage tariff from users, which can be a part of source of annuity.
4	This Annuity contains remaining capital investment (SPV's construction payment and its paid interest) and O&M cost in the contract
SPV	
1	SPV pays the capital investment (up to 60%) or construction cost along with necessary interest expense incurred
2	SPV pays O&M cost during the concession periods. O&M cost is the contracted amount in the agreement
3	SPV can sell the treated water for its revenue source, along with other salable materials such as sludge
4	SPV will receive Annuity from Government of India during the O&M concession period
5	SPV will transfer the assets (STP, sewer network, PS, etc.) to ULB at the end of the concession period
Others	
1	Annuity could be less amount if the service level of SPC will not meet the requirement in the agreement
2	Financial conditions including annuity could be modified if there is Force Majeure event

3) The basic structure under HAM-model

It is important to understand the pre-condition business framework under the new HAM when to have the cash flow model or financial model. As of today, there are two business models, one is related with focusing on STP and the other is focused on Sewer Network. Several models can be thought under HAM for the same way of either STP or Sewer Network in the illustrated in the table below. Other words, based on the model of business scheme, the financial model will vary so the financial simulation will show different results. So if the SPV will only work of STP and some MS, the business coverage is just for those facilities. If SPV will work on Comprehensive, composing of Sewer Network, STP and PS, etc., the financial will cover all of those. In this chapter, it is assumed that all key operational functions will belong to one single SPV (Model-Y for both STP/Sewer Networks) for doing the simple simulation.

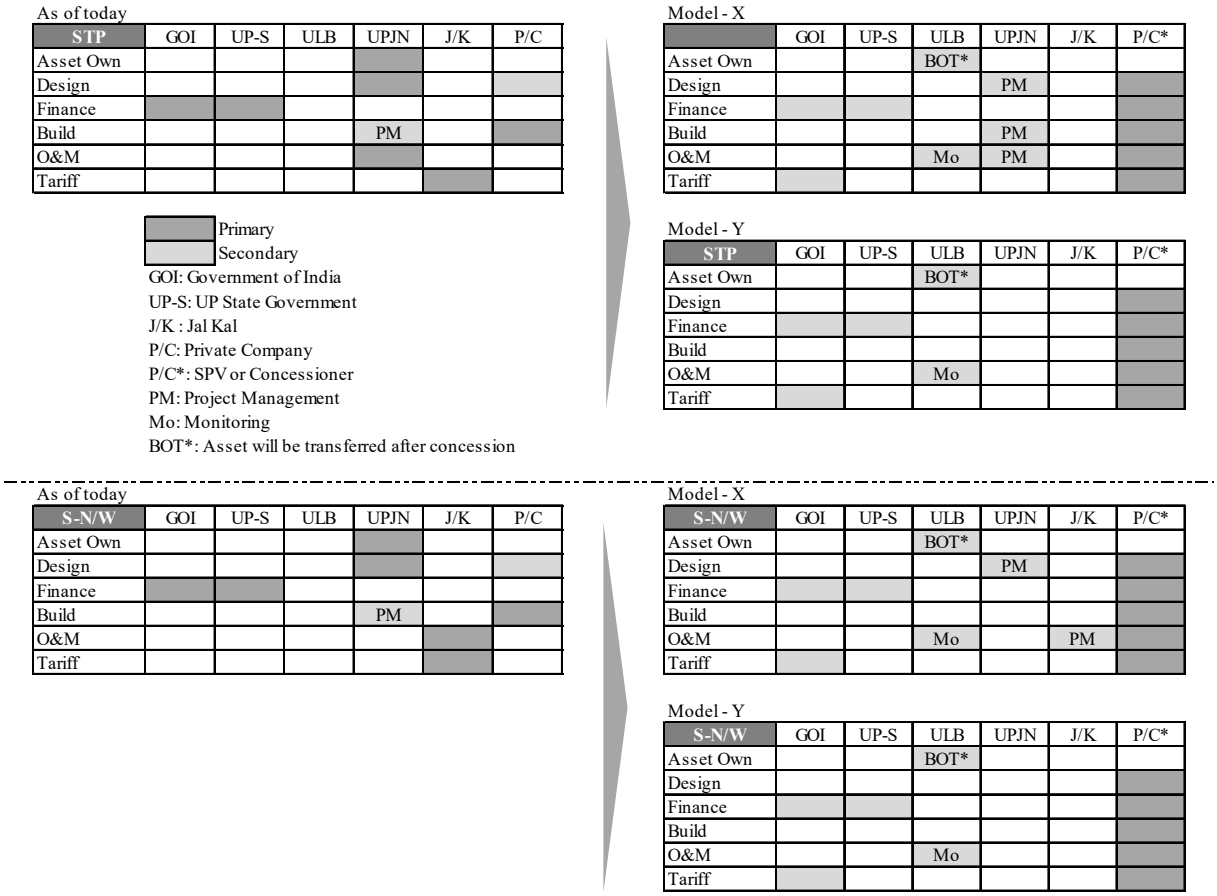


Figure 12.7.3 Theoretical Function map that earns Cash Flow at SPV

4) HAM types

In HAM for Sewage HAM, there can be thought two types of financial model, one: Annuity from GOI to SPV is fixed amount for every year, the other: Annuity is not always fixed but varies depend upon the year. The first typical case is NHAI who pays fixed amount Annuity including construction cost and O&M cost incurred by SPV. In the NHAI Agreement, "Model Concession Agreement for annuity based project", there is the saying,

"8.1 Annuity: Subject to the provisions of this agreement and in consideration of the concessionaire accepting the concession and undertaking to perform and discharge its obligation in accordance with the term, conditions and covenants set forth in this agreement, NHAI agrees and undertakes to pay the concessionaire, on each annuity payment date, the sum of Rs. (The Annuity)"

In here, "*Rs. (The Annuity)*" is the fixed amount that will be equally paid in the concession period. However, for Sewage, it can be thought that population will vary (basically increase trend for the DPR in this report) which will affect the O&M expenses. So JICA study team have financial simulation for both ways, flat Annuity model and variable Annuity model, in the later section.

5) Base Logic in HAM

Based on the assuming structure and key assumptions under HAM noted in before, the cash flow model or financial model can be illustrated. This explanatory model is flat type Annuity model and example here bases;

<Common conditions>

- The concession period is 20 years, and the construction takes two years for the 1st and 2nd year and O&M is from 3rd year until 20th year or 18 years.
- Construction cost (capital cost) is Rs.100 million and GOI will pay up-to 40% at commercial operating date (COB).
- So SPV pays 60% of this construction cost by itself by borrowing from lenders or banks will lend the loan to SPV or is appropriated by all equity.
- Lender interest rate is 10% and the payment is as Principal and interest equal repayment.
- O&M cost is Rs.5 million for all years. (for simplification, no inflation here)
- The sales of treated water is Rs.0.4 million/year, which is one of revenue sources to SPV
- Balance Sheet is omitted here (Only illustration of P/L);

Rs. million 0.00

Total construction cost Rs. 100.00 | Principal **Rs. 60.00** million
GOI 40% Rs. 40.00 | Rate 10.0%
SPV 60% **Rs. 60.00** | Term 20.0 years
Payment Rs. 7.0 per year

O&M Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenue side																				
Annuity	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Sales	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
Construction Period																				
Cost side																				
10	10																			
10	10																			
10	10																			
10	10	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
10	10	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*
50	50	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
SPV C/F per year																				
-30	-30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Depreciation	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
-30.0	-30.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
SPV C/F accumulation																				
-30.0	-60.0	-57.0	-54.0	-51.0	-48.0	-45.0	-42.0	-39.0	-36.0	-33.0	-30.0	-27.0	-24.0	-21.0	-18.0	-15.0	-12.0	-9.0	-6.0	-3.0	0.0
NPV																				
¥-31.3																				
-60.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
10%																				

Rs. 241.0
Rs. 0.0
Rs. 241.0
Rs. 141.0
Rs. 100.0
Rs. 241.0
Rs. 60.0

Year	Principal	Interest	Total
1	1.0	6.0	7.0
2	1.2	5.9	7.0
3	1.3	5.8	7.0
4	1.4	5.7	7.0
5	1.5	5.5	7.0
6	1.7	5.4	7.0
7	1.9	5.2	7.0
8	2.0	5.0	7.0
9	2.2	4.8	7.0
10	2.5	4.6	7.0
11	2.7	4.3	7.0
12	3.0	4.1	7.0
13	3.3	3.8	7.0
14	3.6	3.4	7.0
15	4.0	3.1	7.0
16	4.4	2.7	7.0
17	4.8	2.2	7.0
18	5.3	1.8	7.0
19	5.8	1.2	7.0
20	6.4	0.6	7.0
	60.0	81.0	141.0

Figure 12.7.4 Basic Cash-flow model under HAM (1)

<GOI>

- In this model, 40% of Construction cost, Rs.40 million is paid at COB by the Government of India.
- After construction, Annuity of about Rs.7 million/year from 3rd to 20 year (for 20 years) are paid by GOI, Rs.241 million in totals.
- This composes the construction cost and interest paid by SPV for its first two year, Rs.141 million. And this also composes O&M cost Rs.5 million/year, the total of Rs.100 million.
- No profit margin addition in this table.

<SPV>

- Pays 60% of Construction cost or Rs.60 million during this two year construction periods.
- Payment to lenders by SPV is about Rs.7 million/year (including principal and interest) times 20 (10%, 20years) or Rs.141 million in total.
- O&M Cost is incurred actual basis, but the planning here shows Rs.5 million/year from 3rd to 20th year in the concession period, Rs.100 million in total (no inflation rate reflected here)
- Sale of Treated water by SPV is zero in here.
- Total amount revenues belong to SPV is Rs.241 million (no other revenue)

This explanatory example in the above shows negative NPV (net present value) when the hurdle rate of 10%, simply because Annuity from GOI to SPV only covers construction cost, interest paid by GOI and O&M, no margin profit added. NPV can be zero and above if the Annuity will increase from Rs.12 million/month to Rs.15.1 million /month adding the sales of treated water of Rs.1 million/month by SPV while this is just an example

Rs. million	3.05																			
O&M Period	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*	*14*	*15*	*16*	*17*	*18*	*19*	*20*
Revenue side																				
Annuity	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1	15.1
Sales	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1	16.1
Construction Period																				
Cost side																				
10	10																			
10	10																			
10	10																			
10	10	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0	7.0
10	10	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*	*5*
50	50	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
SPV C/F per year																				
-30	-30	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1	4.1
Depreciation		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
-30.0	-30.0	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
SPV C/F accumulation																				
-30.0	-60.0	-53.0	-45.9	-38.9	-31.8	-24.8	-17.7	-10.7	-3.6	3.5	10.5	17.6	24.6	31.7	38.7	45.8	52.8	59.9	66.9	74.0	81.0
NPV																				
¥0.0																				
-60.0	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1	7.1
10%																				

Total construction cost	Rs. 100.00	
GOI	40%	Rs. 40.00
SPV	60%	**Rs. 60.00**

Principal	**Rs. 60.00**	million
Rate	10.0%	
Term	20.0	years
Payment	Rs. 7.0	per year

Rs. 302.0	
Rs. 20.0	
Rs. 322.0	
Rs. 141.0	
Rs. 100.0	
Rs. 241.0	
Rs. 60.0	

Year	Principal	Interest	Total
1	1.0	6.0	7.0
2	1.2	5.9	7.0
3	1.3	5.8	7.0
4	1.4	5.7	7.0
5	1.5	5.5	7.0
6	1.7	5.4	7.0
7	1.9	5.2	7.0
8	2.0	5.0	7.0
9	2.2	4.8	7.0
10	2.5	4.6	7.0
11	2.7	4.3	7.0
12	3.0	4.1	7.0
13	3.3	3.8	7.0
14	3.6	3.4	7.0
15	4.0	3.1	7.0
16	4.4	2.7	7.0
17	4.8	2.2	7.0
18	5.3	1.8	7.0
19	5.8	1.2	7.0
20	6.4	0.6	7.0
	60.0	81.0	141.0

Figure 12.7.5 Basic Cash-flow model under HAM (2)

This illustration is too simplified (not showing inflation rate that will increase O&M cost, etc.); however the important things to remember are;

1) Debt portion could be up-to 60% in SPV. Finance source varies but it probably is loan from lenders.

2) Annuity from GOI includes the capital cost paid by SPV (its interest and planned O&M cost) SPV O&M cost (in the agreement) and the profit margin.

3) SPV will earn profit through its operation as well and sales opportunities such as treated-water.

4) Sewage Tariff is the revenue of GOI (not belong to SPV) which will be a composition of Annuity

(not shown in the illustration in the above)

6) Debt / Equity - financial cost

SPV is to have the balance sheet to kick-off the project, which of course has debt/equity at the start of the project. Up-to 40% of capital cost is to be provided by the Government (GOI as majority and State as minority). This would be routed through the SPV at ULB level by the initial capital or Grant given thereafter. Hence the capital is or is not be equal to the Contribution of capital cost made by the Government. They will have a fixed capital and can show the receipts afterwards as capital grants/revenue grants depending on the purpose of grant for O&M construction. (Note: in Smart City Case in India, the shareholding is the minimum as prescribed and it will change according to the size of project, commercial/financing requirements. It is only minimum capital for ensuring capital base. But the capital ratio will always be 50:50 (State: ULB) to be maintained)

There can be various financing patterns regarding debt/equity and there is no golden rule to reach to the "best balance sheet model" since the project depends upon various factor, project size, concession periods, operational risks, borrowing rate, etc. (Ref: Total Cost of all Project in Pune Smart City Mission, Rs.3480 crore of which Contribution by GOI/State/ULB up-to Rs.1000 crore Deficits financed through Loans, Municipal Bonds and other options.)

However there are three major decisions that affect the balance sheet;

- The total of Public side is 51% at least. (The maximum of concessionaire is 49%). Public side composes of Central government, State Government, ULB. (In the explanatory figure, GOI (government of India is a majority stakeholder (over 51%) and ULB is omitted for simplification.
- State government is a minority stakeholder
- Capital investment up-to 40% is paid by central government.

Figure 20.2.6 explains some models.

Theoretically E1) and E2) does not need debt since it is financed by all Equity with no debt interest payment for the construction cost. But from A) to G) shows the model that needs debt.

A) Three shareholders, the equity portion is the highest at the beginning balance sheet by keeping GOI as majority, so the equity portion is 78.5% while debt portion is 21.5%. So the borrowing cost including interest will be the least (Rs.50.5 million in this model) Since GOI pays its all capital investment (as up-to 40%) as equity, no capital-grant will come later. B) Similar model of A) but shareholders are only GOI and State. Still the debt portion is the least so the payment total is the same of A). C) The equity from State is less so the debt portion will increase as well as its borrowing cost will increase. D) Similar model of C) but central government pays half of capital cost supported by government at the beginning as equity but the other half will come as capital-grant later. So the

debt portion will increase as well as its borrowing cost will increase.

E) Similar model of D) but less equity from government and more capital-grant later based of up-to 40% rule. F) Up-to 40% of capital cost is assured by government but most of it comes from capital grant later. During the construction period, SPV should actually borrow money more than Rs.59.1 million so the payment is close to the one of G). G) This shows an extreme, GOI pays very little equity, Rs.500,000 that is only the initial capital requirement with which a limited company in India is to be incorporated. It can be increased at any time. The reason they might have kept it to the basic minimum is to comply with minimum incorporation requirements. This will be increased appropriately whenever the grant/funds are released by the Government, and the same would be used to increase the share capital of the Company accordingly but this case intentionally shows that total capital investment is much less than up-to 40% of capital cost and that's all. The most of the finance cost should be covered by SPV. The finance cost is extremely high.

As noted before, the model omits ULB as a shareholder for the simplification

Beginning BS — Capital cost (construction cost) = Rs.100 million — Interest rate: 10% — Payment: 20 years

		Rs. million				DE	Ratio %			
		PC*	GOI	UPS	Total	Ratio	PC*	GOI	UPS	
E1)	**Debt**	0.0			0.0	0.0%				*Equity: GOI+UPS*
	Equity	49.0	50.0	1.0	100.0	100.0%	49.0%	50.0%	1.0%	51.0%
	later Grant		0.0							
	Capital cost	49.0	50.0	1.0	100.0		49.0%	50.0%	1.0%	
E2)	**Debt**	0.0			0.0	0.0%				*Equity: GOI+UPS*
	Equity	49.0	26.0	25.0	100.0	100.0%	49.0%	26.0%	25.0%	51.0%
	later Grant		0.0							
	Capital cost	49.0	26.0	25.0	100.0		49.0%	26.0%	25.0%	
A)	**Debt**	21.5			21.5	21.5%				SPV Debt 21.5
	Equity	19.0	40.0	19.5	78.5	78.5%	24.2%	51.0%	24.8%	Payment total 50.5
	later Grant		0.0							
	Capital cost	40.5	40.0	19.5	100.0		40.5%	40.0%	19.5%	
B)	**Debt**	21.5			21.5	21.5%				
	Equity	0.0	40.0	38.5	78.5	78.5%	0.0%	51.0%	49.0%	
	later Grant		0.0							
	Capital cost	21.5	40.0	38.5	100.0		21.5%	40.0%	38.5%	
C)	**Debt**	59.0			59.0	59.0%				SPV Debt 59.0
	Equity	0.0	40.0	1.0	41.0	41.0%	0.0%	97.6%	2.4%	Payment total 138.6
	later Grant		0.0							
	Capital cost	59.0	40.0	1.0	100.0		59.0%	40.0%	1.0%	
D)	**Debt**	59.1			59.1	73.9%				SPV Debt 59.1
	Equity	0.0	20.0	0.9	20.9	26.1%	0.0%	95.7%	4.3%	Payment total 138.8
	later Grant		20.0							
	Capital cost	59.1	40.0	0.9	100.0		59.1%	40.0%	0.9%	
E)	**Debt**	50.5			50.5	72.1%				SPV Debt 50.5
	Equity	0.0	10.0	9.5	19.5	27.9%	0.0%	51.3%	48.7%	Payment total 118.6
	later Grant		30.0							
	Capital cost	50.5	40.0	9.5	100.0		50.5%	40.0%	9.5%	
F)	**Debt**	59.1			59.1	96.9%				SPV Debt 59.1
	Equity	0.0	1.0	0.9	1.9	3.1%	0.0%	52.6%	47.4%	Payment total 138.8
	later Grant		39.0							
	Capital cost	59.1	40.0	0.9	100.0		59.1%	40.0%	0.9%	
G)	**Debt**	99.5			99.5	99.5%				SPV Debt 99.5
	Equity	0.0	0.26	0.25	0.5	0.5%	0.0%	51.0%	49.0%	Payment total 233.7
	later Grant		0.0							
	Capital cost	99.5	0.3	0.2	100.0		99.5%	0.3%	0.2%	

Principal Rs. 21.5 million
Rate 10.0%
Term 20.0 years
Payment Rs. 2.53 per year

Year	Principal	Interest	Total
1	0.4	2.2	2.5
2	0.4	2.1	2.5
3	0.5	2.1	2.5
4	0.5	2.0	2.5
5	0.5	2.0	2.5
6	0.6	1.9	2.5
7	0.7	1.9	2.5
8	0.7	1.8	2.5
9	0.8	1.7	2.5
10	0.9	1.6	2.5
11	1.0	1.6	2.5
12	1.1	1.5	2.5
13	1.2	1.3	2.5
14	1.3	1.2	2.5
15	1.4	1.1	2.5
16	1.6	1.0	2.5
17	1.7	0.8	2.5
18	1.9	0.6	2.5
19	2.1	0.4	2.5
20	2.3	0.2	2.5
	21.5	29.0	50.5

Figure 12.7.6 Several patterns for Debt/Equity Portion

Source: Created by JICA Study team

7) Revenue

Revenue is to be recognized to the extent that is probable that the economic benefit will flow to the SPV and the revenue can be reliably measured. The specific recognition criteria must be defined in a concession agreement for each project.

Sources of revenue in Sewage HAM are Annuity, the payment from GOI to SPV, and other possible sales such as treated water, sludge, etc. and others such as interest income; however the most of the

portion of the revenue for SPV is Annuity from GOI.

Annuity composes of mainly three; (1) Construction cost and its interest paid by SPV (up to 60 % of construction), (2) O&M Cost (estimate submitted by SPV in the agreement) and (3) profit margin for SPV. Annuity, the highest portions of revenue sources, is assumed from two ways of calculations, flat annuity (fixed amount annuity) and variable amount annuity (Escalable Annuity) as described before.

- Flat (fixed) Annuity

  Equal payment method (principal and interest) to lender which is as Capital-grant by GOI plus equal amount payment of O&M cost (this O&M cost submitted from SPV is converted into NPV basis and then divided by concession period to obtain equal amount of O&M cost per year). So the Annuity is calculated as equal (fixed) amount for every year.

- Variable Annuity (Escalable Annuity)

  The finance cost is the same logic as in flat annuity, so the fixed amount. But O&M cost varies depend upon O&M cost estimation proposed by SPV in the agreement, which is mostly related with population increase in Sewage HAM model. So the sum of them is variable (escalable), not fixed one, in the end.

- Common subject matters

  It is assumed that either fixed annuity or variable annuity will depend upon SPV monitoring items or KPI such as BOD, but not Volume processed by SPV since SPV doesn't control input or the Volume (**1)

  (Reference note; there could be another way in general that SPV is to be monitored its performance by the volume amount, especially the SPV handles STP. In this case, at the beginning of project formation, Annuity is directly calculated based upon O&M cost proposed but in the actual operation phase, the processed volume will be monitored for SPV performance. For example, if actual treated water processed by SPV will not achieve target volume (MLD), the annuity may be reduced since projected O&M cost will be excessive than planned (proposed) O&M cost. Vice versa, if SPV would process more MLD than planned MLD, Annuity of that period can be modified for having an additional fee to SPV.

  In the illustration below, new SPT can have 20 MLD as its capacity and will incur O&M expense of Rs.88 million at some years later while at the first year of this concession only require 15MLD capacity that will incur O&M expense of Rs.80. If the actual MLD will be under the planned MLD, the annuity would be less than defined since the service does not reach to the target volume. This type of method is adopted Desalination projects)

***1**: Source – An officer comment at NMCG (30th June 2016)*

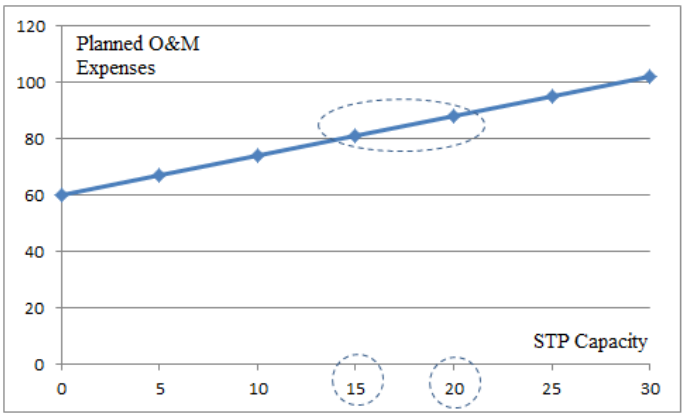


Figure 12.7.7 The base of revenue recognition (Illustrative)

Source: Created by JICA Study team

Under fixed Annuity model, Annuity amount is fixed one even if there is a gap between plan and actual MLD

(Reference note: In volume metric model, when there is a gap between plan and actual MLD, the O&M cost (gap or excessive or less), Annuity may be fixed by addition/deduction to the fixed Annuity.)

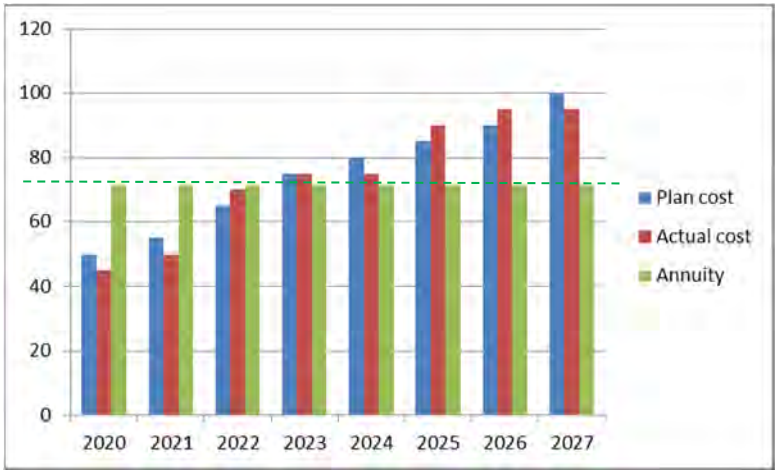


Figure 12.7.8 Fixed Annuity model (Illustrative)

Source: Created by JICA Study team

Similarly, under variable Annuity model, Annuity amount is not changed as noted in the agreement even if there is a gap between plan and actual MLD

(Reference note: In volume metric model, when there is a gap between plan and actual MLD, under variable Annuity model, when there is a gap between plan and actual MLD, the O&M cost gap (excessive or less), Annuity may be fixed by addition/deduction to each variable Annuity which is predetermined in the agreement. In volume metric model, for both fixed annuity or variable annuity,

Annuity will be paid depend upon volume that SPV processes, adding to other key monitoring KPIs)

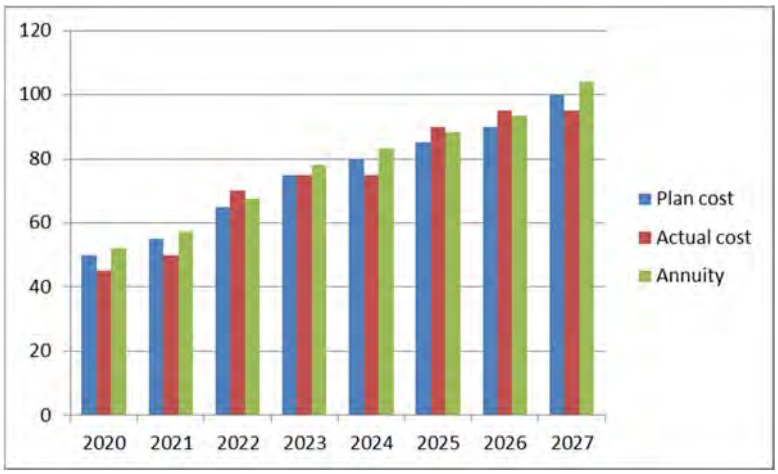


Figure 12.7.9 Variable (Escalable) Annuity model (Illustrative)

Source: Created by JICA Study team

8) O&M Cost

O&M costs are five items, Manpower Cost, Annual Repair Cost, Power Consumption Cost, DG Set Maintenance Cost and Chemical Cost for STP. In the simulation here, Manpower cost and power cost is examined by actual cost incurring at UP JP. It is concluded that Monthly Salary/Wages is adopted from DPR since required manpower is to be hired as an addition. (The actual cost incurring at UP JN is a bit higher than those in DPR. At UPJN, the workloads are; Design work: 15-20%, Build (Construction) Work: 50-55% and O&M: 30%)

Table 12.7.2 Actual labor Cost at UP JN in 2016 (budget)

		Unit 1 (Sewerage)				Unit 2 (STP)				Unit 3 (Electricity and Dinapur)			
		Head count	Total per annum (Rs. million)	Avg. per person	Per person per month	Head count	Total per annum (Rs. million)	Avg. per person	Per person per month	Head count	Total per annum (Rs. million)	Avg. per person	Per person per month
Class 1		2	Rs. 2.42	Rs. 1,210,200	Rs. 100,850	1	Rs. 0.78	Rs. 782,400	Rs. 65,200	0			
Class 2		5	Rs. 4.78	Rs. 955,680	Rs. 79,640	4	Rs. 2.88	Rs. 719,700	Rs. 59,975	3	Rs. 2.42	Rs. 806,400	Rs. 67,200
Class 3		25	Rs. 10.75	Rs. 429,936	Rs. 35,828	20	Rs. 7.86	Rs. 393,000	Rs. 32,750	20	Rs. 9.34	Rs. 466,800	Rs. 38,900
Class 4	Office	4	Rs. 1.41	Rs. 353,700	Rs. 29,475	3	Rs. 1.01	Rs. 336,800	Rs. 28,067	3	Rs. 1.05	Rs. 348,800	Rs. 29,067
	Field	30	Rs. 9.93	Rs. 330,920	Rs. 27,577	28	Rs. 8.74	Rs. 312,300	Rs. 26,025	57	Rs. 18.93	Rs. 332,105	Rs. 27,675
Total		66	Rs. 29.29	Rs. 443,782	Rs. 36,982	56	Rs. 21.28	Rs. 379,929	Rs. 31,661	83	Rs. 31.73	Rs. 382,308	Rs. 31,859
		Unit 4 Mirzapur				Unit 5 CU: Construction Unit				**Total**			
Class 1		0				1	Rs. 0.83	Rs. 826,800	Rs. 68,900	**4**	**Rs. 4.03**	**Rs. 1,007,400**	Rs. 83,950
Class 2		1	Rs. 0.96	Rs. 964,800	Rs. 80,400	2	Rs. 1.64	Rs. 822,000	Rs. 68,500	**15**	**Rs. 12.69**	**Rs. 845,680**	Rs. 70,473
Class 3		4	Rs. 1.49	Rs. 371,400	Rs. 30,950	10	Rs. 4.76	Rs. 476,400	Rs. 39,700	**79**	**Rs. 34.19**	**Rs. 432,835**	Rs. 36,070
Class 4	Office	0				3	Rs. 1.00	Rs. 333,600	Rs. 27,800	**13**	**Rs. 4.47**	**Rs. 344,031**	Rs. 28,669
	Field	28	Rs. 9.07	Rs. 324,000	Rs. 27,000	2	Rs. 0.61	Rs. 306,000	Rs. 25,500	**145**	**Rs. 47.29**	**Rs. 326,110**	Rs. 27,176
Total		33	Rs. 11.52	Rs. 349,164	Rs. 29,097	18	Rs. 8.85	Rs. 491,533	Rs. 40,961	**256**	**Rs. 102.67**	**Rs. 401,044**	Rs. 33,420

Source: JICA study team by data from UP JN of 2016

Table 12.7.3 Each labours for each work area at UP JN

Class	UPJN GPPU Post	Equivalent Category	Work Coverage
1	General Manager	Superintending Engineer	U1: Sewer line 142.5km, SPS x 2 (120 MLD and 18 MLD) and STP (120 MLD) for Comprehensive Sewerage Works in Trans-Varuna Area under JNNURM U2: Sewer line, SPS and STP (140MLD) for GAP1-2 funded by JICA and O&M of STP at Bhagwanpur U3: O&M for STP at Dinapur, Ghat SPS x5, Konia MOS U4: O&M for Mirzapur U5 (CU): Rehabilitation of Old Trunk Sewer and Existing STP and O&M such as Storm water drainage construction
2	Civil Project Manager	Executive Engineer	
2	Civil Project Manager	Executive Engineer	
2	E/M Project Manager	Executive Engineer	
2	Project Engineer	Assistant Engineer	
2	Project Engineer	Assistant Engineer	
3	Asst Project Engineer	Junior Engineer	
3	Support / Finance	Support / Finance	
4	Peon / 4th Class	Peon / 4th Class	
4	Supervisory	Supervisory	

9) Power consumption cost

The assumption is that electricity charge is paid by SPV under HAM while currently UPJN and Jal Kal do not but State government pays. Power consumption cost in DRP is calculated by Rs.5.5 /Unit Times total-KWH/ day for the year. JICA study team examined the actual billing from Electric Company to UP JP in 2016 (half year portion) which shows Rs.7.1/unit. So in the simulation of financial model, Rs.7.1 /Unit are adopted. The electricity charge is included in the simulation, which mean the SPV will pay as one of O&M cost although currently these bills are paid by the UP State of Government. The inflation rate is not used in the financial model later.

10) Interest Rate

In the following simulation, 13.2% is used for the bank borrowing rate. In the real simulation based on the proposals submitted from concessionaires, the rates will vary upon each project. And also, the rate may be from project finance rate calculated by the banks, not as the rate from corporate finance. Besides it could be possible that concessionaire will borrow much lower rate from its parents company or its group financing company.

Table 12.7.4 Bank Borrowing Interest rate

Reserve Bank of India Policy Rate (Bank Rate)	6.50%
Base Premium for commercial bank	3.45%
Spread for Larger business	2.75%
Long term Loan Premium +10 years	0.50%
Interest rate applied to simulation	**13.20%**

Source: Website of Reserve Bank of India and Central

11) Tax

Any Company registered under Indian Companies Act has to pay tax. He can be exempted from payment of income tax only if such a company performs a specified business as per the Income Tax Act 1961. There is no specific exemption for any government company from payment of Income

Tax as such. It can have exemption for certain years if it is into specified businesses but that is applicable for companies. Hence SPV as a government company has to pay tax at normal rates like for any company. Following SPV financial model has to include income tax in simulation. The basic tax rate for an Indian company is 30 percent which, with applicable surcharge and education cess, results in a rate of either 30.9% or 33.06 or 34.61%. (Education cess: Applicable at 3 percent on income tax (inclusive of surcharge, if any))

According to Tax regulations in India, there is no clear definition regarding tax exemption or tax refund during the course of procurement by the executing agency under the project supported by international corporation agency. It is recommended that tax treatment including exemption or refund should be clearly stated in E/N and L/A in detail as much as possible to ensure desirable tax treatment regarding domestic and foreign procurement. In addition, Base MOU, Project MOU and Bidding Condition Document should have clause to state tax treatment during the project work such as import tax on foreign procurement, VAT on domestic procurement, corporate income tax levied to SPV and individual income tax relating to technical advisor from abroad. Practically, when SPV procure goods or service from suppliers, SPV should agree with NMCG in writing to arrange with tax authority so that SPV can ensure tax exemption or refund during the project period.

12) Other conditions under HAM

There are now two funding sources, AMUR (Atal Mission for Rejuvenation and Urban Transformation) or NMCG, which will covers different scopes of DPR. The execution agency, UPJN can submit each DPR to AMRUT as well so that their project should be treated as in-scope of SAAP - State Annual Action Plan to get financed by State Government, not only to NCMG. So it is obvious that some of the projects submitted to UP state will be duplicated to NMCG project, while UPJN is not sure which project or mission will be accepted earlier.

The simulation in this chapter will be for the DPRs that we think belong to NMCG grant.

Table 12.7.5 Fund source and the adaptability

No.	Asset / Fund from	House Connection	N/W	PS (IPS)	STP (with MPS)	ID&T	Comprehensive Flag
1	AMRUT	(x)	X	X	X		X
2		(x)	X		X		X
3		(x)	X	X	*E*		X
4		(x)	X		*E*		X
5		X					
6	NMCG				X		
7				X	X		
8					X	X	
9				X	X	X	
10						X	
11				X		X	
12				X			

X: New Build (or work) *E: Existed* (x): Yes or No (whichever)

Source: Created by JICA Study team

Footnote: From UPJN officer's comments, UPJN Varanasi has already applied its DPRs to PDMC, Project Development Management Committee, of AMRUT as well and submitted to Service Level Improvement Plan to get approved for the DPRs relating following projects which most of their scope are duplicated to the project for NMCG-JICA. (updated cost Rs.19.5 million will be necessary to meet the new guidelines for water quality management)

Table 12.7.6 Application from UPJN to AMRUT

Varanasi (Rs. million)	Rs. 10.5
House Comm Chambers	Rs. 18.0
Secondary Sewerage Varanasi District 3	Rs. 38.4
Secondary Sewerage Varanasi District 2	Rs. 27.8
Secondary Sewerage Varanasi District 1	Rs. 15.5
50MLD DTP in Ramana	Rs. 110.2
Additional posible cost increase	Rs. 19.5

Source: Interviews at UP JN 2016

12.7.3 Trial Financial Modeling

Based on assuming structure, frameworks and preconditions mentioned so far, the following two cases are simulated as a trial for Mirzapur DPR.

1) Fixed Annuity model pattern

This explanatory example shows that Annuity model as fixed amount base is about Rs.258.7 million per year for the concession 20 years for Mirzapur project (ID&T and rehabilitation).

Principal	**Rs. 1,030.5**	million					O&M Cost			
Rate	**13.0%**	%				(g)	Inflation			
O&M	**20.0**	years					**5.00%**	10%	Cost of capital	
Payment	Rs. 146.69	per year								
	(a)	(b)	(c)	(d)	(e)	(f)				
Year	Principal	Interest	Total	OM	Profit	Annuity				
1	12.7	134.0	146.7	**110.0**	2.0	**258.7**	**72.8**			
2	14.4	132.3	146.7	110.0	2.0	258.7	76.5		NPV-O&M	
3	16.3	130.4	146.7	110.0	2.0	258.7	80.3	(m)	882.2	
4	18.4	128.3	146.7	110.0	2.0	258.7	84.3			
5	20.8	125.9	146.7	110.0	2.0	258.7	88.5		Installment	
6	23.5	123.2	146.7	110.0	2.0	258.7	93.0	(n)	110.0	
7	26.5	120.2	146.7	110.0	2.0	258.7	97.6			
8	29.9	116.7	146.7	110.0	2.0	258.7	102.5		NPV-OM	
9	33.8	112.9	146.7	110.0	2.0	258.7	107.6	(o)	882.2	
10	38.2	108.5	146.7	110.0	2.0	258.7	113.0			
11	43.2	103.5	146.7	110.0	2.0	258.7	118.6			
12	48.8	97.9	146.7	110.0	2.0	258.7	124.6			
13	55.2	91.5	146.7	110.0	2.0	258.7	130.8			
14	62.4	84.3	146.7	110.0	2.0	258.7	137.3			
15	70.5	76.2	146.7	110.0	2.0	258.7	144.2			
16	79.6	67.1	146.7	110.0	2.0	258.7	151.4			
17	90.0	56.7	146.7	110.0	2.0	258.7	159.0			
18	101.7	45.0	146.7	110.0	3.0	259.7	166.9			
19	114.9	31.8	146.7	110.0	4.0	260.7	175.3			
20	129.8	16.9	146.7	110.0	5.0	261.7	184.1			
	1,030.5	**1,903.4**	**2,933.9**	**2,199.6**	**46.0**	**5,179.5**	**2,408.4**		103.04873	
			57%	42%	1%					

Mirzapur	Capital	O&M	Total		Capital	O&M	Total			OM 1st
IDT	884.6	870.4	1,755.0			870.4	1,755.0			60.1
Alternative	182.8	184.8	367.6	Add		184.8	367.6	SPV	**60%**	12.8
	1,067.5	**1,055.2**	**2,122.6**	650	**1,717.5**	**1,055.2**	**2,122.6**		**1030.49**	**72.8**
	(h)			(i)	(j)				(k)	(l)

Figure 12.7.10 Cash flow chart under Fixed Annuity model (1)

Source: Created by JICA Study team

The basic conditions in this model are; (a) Principal of loan borrowed by SPV (b) Interest incurring from the debt and paid by SPV also (c) Total finance cost per year composing of Principal and its interest (d) O&M cost annualized for 20 years

(e) Profit embedded to SPV by GOI (f) Calculated Annuity paid by GOI to SPV (g) Inflation rate during this project (h) Capital cost of Mirzapur project from DPR

(i) Estimated additional to DPR cost of Mirzapur DPR (j) Capital cost that both GOI and SPV have to pay (k) The construction cost paid by GOI (up-to 60% in this case)

(l) The O&M cost of the 1st year of the operation from DPR (m) NPV of O&M cost proposed by SPV (n) The O&M cost portion among Annuity per year (o) NPV of 20 times even O&M cost from (d)

So the money flows can be drawn in the following tables.

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
	103																							
	103																							
103	103																							
103	103	103	147	147	147	147	147	147	147	147	147	147	147	147	147	147	147	147	147	147	147	147	Finance	2,934
103	103	103	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	110	OM	2,200
																								5,133

Flat (Fided)

Annuity(F)				257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257
SPV	124	207	83	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257
TTL cost	310	517	207	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257	257

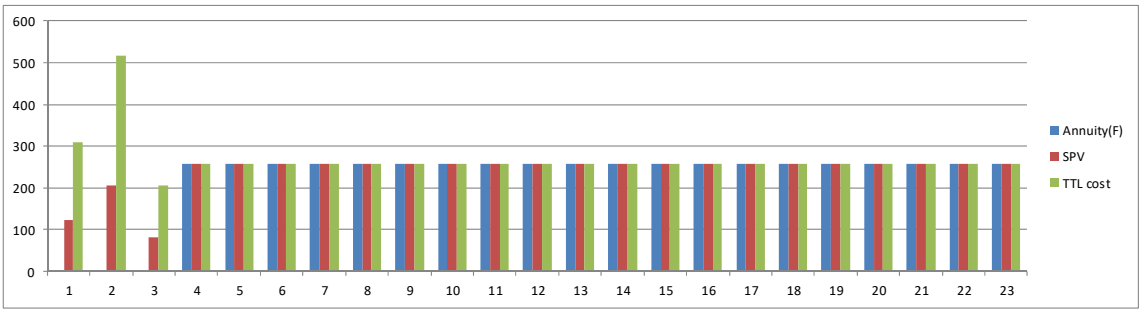


Figure 12.7.11 Cash flow chart under Fixed Annuity model (2)

Source: Created by JICA Study team

2) Variable Annuity pattern

This explanatory example shows that Annuity model as variable amount base in Mirzapur DPR. Since the population in Mirzapur will be increasing year by year, the O&M cost will be increasing aside from inflation increase. Compared with the previous model, fixed Annuity payment model, the total of Annuity, Rs.5388 million for 20 years are larger than Rs.5179 million of fixed Annuity model.

Principal	**Rs. 1,030.5**	million								
Rate	**13.0%**	%						O&M Cost		
O&M	**20.0**	years					(g)	Inflation		
Payment	Rs. 146.69	per year						**5.00%**	10%	Cost of capital
	(a)	(b)	(c)	(d)	(e)	(f)				
Year	Principal	Interest	Total	OM	Profit	Annuity				
1	12.7	134.0	146.7	72.8	2.0	**221.5**		**72.8**		
2	14.4	132.3	146.7	76.5	2.0	225.2		76.5		
3	16.3	130.4	146.7	80.3	2.0	229.0		80.3		
4	18.4	128.3	146.7	84.3	2.0	233.0		84.3		
5	20.8	125.9	146.7	88.5	2.0	237.2		88.5		
6	23.5	123.2	146.7	93.0	2.0	241.7		93.0		
7	26.5	120.2	146.7	97.6	2.0	246.3		97.6		
8	29.9	116.7	146.7	102.5	2.0	251.2		102.5		
9	33.8	112.9	146.7	107.6	2.0	256.3		107.6		
10	38.2	108.5	146.7	113.0	2.0	261.7		113.0		
11	43.2	103.5	146.7	118.6	2.0	267.3		118.6		
12	48.8	97.9	146.7	124.6	2.0	273.3		124.6		
13	55.2	91.5	146.7	130.8	2.0	279.5		130.8		
14	62.4	84.3	146.7	137.3	2.0	286.0		137.3		
15	70.5	76.2	146.7	144.2	2.0	292.9		144.2		
16	79.6	67.1	146.7	151.4	2.0	300.1		151.4		
17	90.0	56.7	146.7	159.0	2.0	307.7		159.0		
18	101.7	45.0	146.7	166.9	3.0	316.6		166.9		
19	114.9	31.8	146.7	175.3	4.0	326.0		175.3		
20	129.8	16.9	146.7	184.1	5.0	335.7		184.1		
	1,030.5	**1,903.4**	**2,933.9**	**2,408.4**	**46.0**	**5,388.3**		**2,408.4**		103.04873
			54%	45%	1%					

Mirzapur	Capital	O&M	Total		Capital	O&M	Total			OM 1st
IDT	884.6	870.4	1,755.0			870.4	1,755.0			60.1
Alternative	182.8	184.8	367.6	Add		184.8	367.6	SPV	**60%**	12.8
	1,067.5	**1,055.2**	**2,122.6**	650	**1,717.5**	**1,055.2**	**2,122.6**		**1030.49**	**72.8**
	(h)			(i)	(j)				(k)	(l)

Figure 12.7.12 Cash flow chart under Variable Annuity model (1)

Source: Created by JICA Study team

The explanation or key parameters are almost same mentioned in fixed Annuity model in the above. The O&M cost varies by each year and these different cost will be covered by each year Annuity which is not same one for this concession period.

And the money flows can be drawn in the following tables.

			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20		
	103																							
	103																							
103	103																							
103	103	103	147	147	147	147	147	147	147	147	147	147	147	147	147	147	147	147	147	147	147	147	Finace	2,934
103	103	103	73	76	80	84	89	93	98	102	108	113	119	125	131	137	144	151	159	167	175	184	OM	2,408
																								5,342

Variable																						
Annuity(V)				220	223	227	231	235	240	244	249	254	260	265	271	277	284	291	298	306	314	322	331
SPV	124	207	83	220	223	227	231	235	240	244	249	254	260	265	271	277	284	291	298	306	314	322	331
TTL cost	310	517	207	220	223	227	231	235	240	244	249	254	260	265	271	277	284	291	298	306	314	322	331

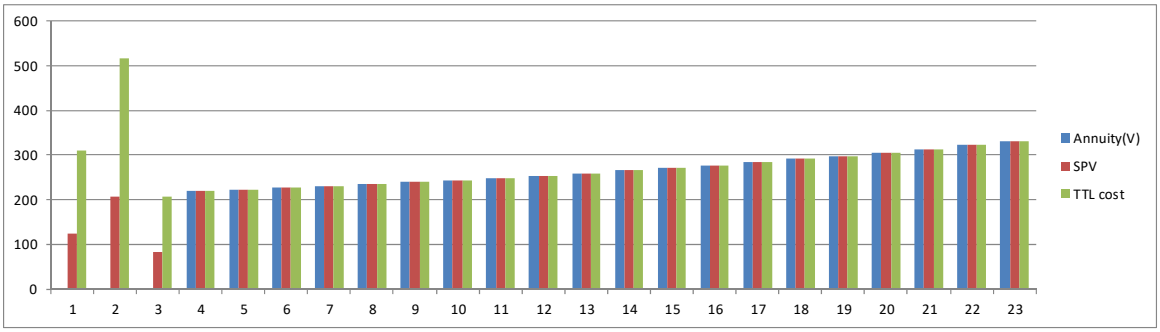


Figure 12.7.13 Cash flow chart under Variable Annuity model (2)

Source: Created by JICA Study team

12.7.4 HAM Financial Model (1) - Mirzapur

1) Precondition for financial modeling in Mirzapur

There are four DPR proposed from Mirzapur, A) Comprehensive, Rs.34.9 million, B) ID&T (Rs.17.55 million), C) Rehabilitation and process up-gradation of existing STP, either one of Rs.3.7 million or the other Rs.1.98 million. Based on the Fund adaptability noted before regarding AM-RUT and NMCG, the finance model of Mirzapur is simulated based on B) with the larger one of C), or not A) since it is considered the funding from NMCG.

However Nagar Palika Parishad Mirzapur or UPJN Mirzapur is eager to obtain any funding when it comes to regardless the fund source, which might lead to Comprehensive scheme instead of IT&D and rehabilitation if AMRUT grant will be approved earlier that NMCG. For now, it is said that Mirzapur will be granted Rs.5 million out of Rs.21.476 million on SAAP as part of Comprehensive DPR by AMRUT.

2) The Cost of Mirzapur

The cost of DPR for financial simulation is from ID&T and the rehabilitation of the larger one.

Table 12.7.7 The cost of ID&T of Mirzapur

A	**Basic cost**	
i	Basic Cost of work	725.88
ii	Contingency @2% of Basic cost	14.52
	Sub Total (A)	**740.40**
B	**Cost of Work on which no Centage is admissible**	**0.00**
i	Communication & Public Outreach	4.00
ii	Environmental and Management Plan (EMP)	8.00
iii	Governance and Accountability Action Plan (GAAP)	1.00
iv	Power Connection & Allied Works	26.08
v	Hiring of Godown and Site Office	1.85
vi	Cost of sewer cleaning equipments, Flushing Van	2.63
vii	TPI Charges @0.1% of Basic Cost ie Sub Total (A)	0.73
	Sub Total (B)	**44.29**
C	**Operation & Maintenance**	
i	Operation & Maintenance for first 10 years of commissioning of project	870.37
	Sub Total (C)	**870.37**
D	**Centage Charges**	
i	Centage charges @ 12.5 % of Basic Cost ie Sub Total A	92.55
	Sub Total (D)	**92.55**
E	**Labour Cess Charges**	**0.00**
i	Cess Charges @ 1% of Basic Cost ie Sub Total A	7.40
	Sub Total (E)	**7.40**
	Grand Total (A+B+C+D+E)	**1,755.00**

Source: Mirzapur DPR

Table 12.7.8 The cost of rehabilitation of Mirzapur

A	**Basic cost**	
i	Cost of work	**277.02**
ii	Contingency	5.54
	Sub Total (A)	**282.56**
B	**Cost of works on which no Centage is admissiable**	
i	Communication & Public Outreach	2.00
ii	Environmental and Management Plan (EMP)	2.00
iii	Governance and Accountability Action Plan (GAAP)	1.00
iv	Hiring of Godown and Site Office	1.33
v	Power Connection & Allied Works	2.51
vi	TPI Charges @0.1% of Basic Cost i.e. Sub Total (A)	0.28
	Sub Total (B)	**9.12**
C	**Operation & Maintenance**	
i	Operation & Maintenance for first 10 years of commissioning of project	206.74
	Sub Total (C)	**206.74**
D	Centage Charges	
i	Centage charges @ 12.5%of Basic Cost ie Sub Total(A)	35.32
	Sub Total (D)	**35.32**
E	Labour Cess Charges	
i	"@ 1%of Basic Cost ie Sub Total (A)	2.83
	Sub Total (E)	**2.83**
	Grand Total (A+B+C+D+E)	**536.57**

Source: DPR from Mirzapur

Footnote (remarks from UPJN): Some of the items in this ID&T are different from estimated costs in Comprehensive. Comprehensive DPR only covers the area inside the municipal border (internal Mirzapur city area) but some of the drain pipes are connected sub drain which collects sewer generated outside of municipal border. ID&T covers rather outside of internal Mirzapur city; the targeted are different although the mission is the same, stopping dirty water to come into Ganges River. AMRUT covers Comprehensive DPR but NMCG doesn't finance to Comprehensive DPR whose population is under 1 Lac, there is still be a way to deal with this conflict according to Chief Engineer of UPJN. That is, to align both kinds of DPR in terms of scope of work which is to be implemented separately and more harmonized manner to maximize the sewage treatment effectiveness and efficiency.

3) The detailed conditions for financial simulation for Mirzapur HAM

In the simulation, there are some conditions to be set. Those parameters can be modified based on assumption and actual offering data coming from potential concessionaries, which can give us different results. Those in the below are major parameters in the simulation sheet.

Table 12.7.9 Calculation Basis (1)

1	Fixed Asset Classification in the Construction Cost
	Construction cost should be allocated based on the Civil works and E&M works cost on each DPR.
	Civil works in DPR are allocated to Building
	E&M works in DPR are allocated to Plant and Machinery.
	Mirzapur : Building 58.6% Plant Machinery 41.4%
2	Useful life (depreciation years) of fixed asset
	Depreciation years is applied, shorter of O&M period or which is determined in the GAAP.
	Therefore, at latest on the end of 20th year of O&M period, all the fixed assets are fully depreciated and net book value should be zero.
	The fixed assets are assumed that there will be no residual value after the 20 years of O&M period ends.
3	VAT
	It is assumed that all of O&M cost incurred during the O&M period are procured domestically, and thus there is no imported goods and material and import duty is not included to this model as a cost.
	Only 12.5% of Central VAT is included to the model. VAT amount is excluded from P/L and the difference between input VAT and output VAT are deducted from cash flow as it is paid in the same year.
	Therefore, VAT Payable is not shown on the B/S in each year end.
4	TSA (Technical Service Advisor) Fee
	TSA Fee is estimated as 15% of Construction cost along with Engineering cost.
5	Share Capital / Equity registration fee
	1% of equity capital is required for Share Capital / Equity registration fee.
7	Equity of Capital set to 40% of total project cost
8	Working Capital Requirement
	It is assumed that approximately 2 months of O&M cost will incur through the O&M period.
9	Upfront fee of debt
	0.5% of debt is added as financial cost. Financing Cost is consisted of Upfront fee and Interest on construction period
10	Interests in Construction period
	Interests in Construction period are assumed to incur as if the loan proceeds will be withdrawn by 30%, 50% and 20% of total loan amount from 1st year to 3rd year of construction period.
	Interests in construction period is paid in each year when it incurs.
	Distribution of loan drawdown are assumed to be same as construction cost incurs, year 1 30%, year 50% and year 3 20%, as the construction cost are spread during 1st, 2nd and 3rd years in the ratio of 30%:50%:20% respectively.
	Therefore, there is no interest on interest as interest in each year is paid to creditor, under this assumption model.

Source: Assumption set by JICA Study Team

Table 2.7.10 Calculation Basis (2)

11	Interest rate
	13.2% (tentatively set as assumption)
12	Annuity payment
	Base model of this spreadsheet is based on 40% payment of the total Capital cost of the project upfront
	(over the construction period - three years) followed by annuity payments over the O&M period.
13	Insurance during the construction period
	Fee for Insurance during the construction period is borne by constructor not by SPV and thus, fee for insurance during construction period is not included.
14	Insurance during operation period (Operating Phase Insurance)
	It is assumed that 3.5% of net book value of fixed asset.
15	Land use rights fees
	It is assumed that there is no annual fee for land use right incurs, the land for STP can be used for free of charge, once it is acquired from landlord.
16	Transportation expense
	It is assumed that there is no transportation expense for treated water resale, because reuse of treated water is estimated as limited to irrigation and fertilizer manufacturer located close to STP.
17	Sales revenue of sludge and treated water.
	Assumed as zero.
18	O&M Cost Foreign
	No foreign purchase is assumed. Cost of O&M works are fully covered by domestic procurement.
19	Corporate income tax rate
	Corporate income tax rate is set as 30.09% - Standard rate of 30% plus 3% of education cess is multiplied to standard rate that comprises 30.09%.
20	Inflation rate
	Inflation rate which is used to indexation and O&M expense estimation is 5.05%, based on analysis of relevant item category in CPI and DPI in India.
21	Deferred tax
	It is assumed that there is only one source of temporary tax difference between financial accounting and tax accounting - difference of depreciation years.
22	Debt service
	For debt service in the annuity, total of principal and interest paid are equal in each year. Level payment or principal & interest equal payment is assumed.
	Debt service are paid semi-annually.
23	O&M Expense Manpower
	Manpower cost estimation is updated as follows:
	Indexed annual manpower cost is deducted by coverage of STP capacity by estimated sewerage water to be treated.
24	Operation Margin for SPV is set to be 2%

Source: Assumption set by JICA Study team

4) The simulation of Mirzapur ID&T and rehabilitation

Assumption and the simulation result show the followings:

- Construction will be from 2017 to 2019, three years. 30% of the construction will be done in the 1st year, 50% in the 2nd year and remaining 30% in 3rd year
- COD is in the year 2020, April 1st and this concession will be complete until 31st March 2040, 20 years.
- Annuity model is two type; Flat (Fixed) amount and Variable amount by Mirzapur DPR.

Table 12.7.11 The base data for simulation in Mirzapur

Operating year	1	2	3	4	5	6	7	8	9	10
Population	252,955	254,659	256,374	258,101	259,840	261,590	263,352	265,126	266,912	268,710
Household size	8.82	8.82	8.82	8.82	8.82	8.82	8.82	8.82	8.82	8.82
Sewerage Connection Rate	20%	21%	23%	25%	27%	29%	31%	34%	36%	39%
Connected population	49,604	53,934	58,641	63,759	69,323	75,373	81,951	89,104	96,880	105,336
Gross Sewage Generation per capita (lpcd)	135	135	135	135	135	135	135	135	135	135
Water to Sewerage conversion ratio	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Additional Sewerage water collected	110%	110%	110%	110%	110%	110%	110%	110%	110%	110%
Net Sewerage Water to be collected and treated (Litter/Day)	5,893,001	6,407,314	6,966,513	7,574,517	8,235,584	8,954,345	9,735,837	10,585,533	11,509,387	12,513,871
Net Sewerage Water to be collected and treated (MLD)	6	6	7	8	8	9	10	11	12	13
Net Sewerage Water to be collected and treated	5,893	6,407	6,967	7,575	8,236	8,954	9,736	10,586	11,509	12,514

m3:Cubic Meter lpcd: Litter per Capita Day

Operating year	11	12	13	14	15	16	17	18	19	20
Population	272,436	276,213	280,043	283,926	287,863	291,524	295,231	298,985	302,787	306,637
Household size	8.82	8.82	8.82	8.82	8.82	8.82	8.82	8.82	8.82	8.82
Sewerage Connection Rate	42%	46%	49%	53%	58%	62%	67%	73%	78%	85%
Connected population	115,340	126,294	138,289	151,423	165,804	181,346	198,344	216,935	237,270	259,510
Gross Sewage Generation per capita (lpcd)	135	135	135	135	135	135	135	135	135	135
Water to Sewerage conversion ratio	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Additional Sewerage water collected	110%	110%	110%	110%	110%	110%	110%	110%	110%	110%
Net Sewerage Water to be collected and treated (Litter/Day)	13,702,374	15,003,756	16,428,736	17,989,053	19,697,561	21,543,881	23,563,263	25,771,929	28,187,621	30,829,743
Net Sewerage Water to be collected and treated (MLD)	14	15	16	18	20	22	24	26	28	31
Net Sewerage Water to be collected and treated	13,702	15,004	16,429	17,989	19,698	21,544	23,563	25,772	28,188	30,830

Table 12.7.12 The simulation result Mirzapur Hybrid Annuity Model

	Annuity type	
	Flat (Fixed)	Variable
Annuity Total from GoI	242,514	241,978
Annuity Debt Service	124,458	124,458
Annuity O&M	118,056	117,520
Annuity O&M -User Tariff Coverage	11.43%	11.49%

At the last concession year or 2040 for Flat Annuity model, Equity will be 579,817, Legal Reserves/Thin Capitalization Requirement will be zero, Free Reserves will be -249,662, so Total Equity will be 330,154, and then Total Liabilities and Equity will be 127,905, while Total Liabilities and Equity for Variable Annuity model will be 451,451. (Thousand Rs.)

If HAM-PPP for Mirzapur should obtain its IRR as 5%, the Annuity from the GOI will be much larger than the simulation result in the above.

Table 12.7.13 The simulation result Mirzapur Hybrid Annuity Model (IRR 5%)

	Annuity type	
	Flat (Fixed)	Variable
Annuity Total from GoI	305,521	290,281
Annuity Debt Service	124,458	124,458
Annuity O&M	181,062	165,823
Annuity O&M -User Tariff Coverage	7.45%	8.14%

12.7.5 HAM Financial Model (2) – Chunar

1) Precondition for financial modeling in Chunar

There are two DPR proposed from Chunar, A) Comprehensive, Rs.1255.3 million, B) ID&T Rs.53.7 million. Based on the Fund adaptability noted before regarding AMRUT and NMCG, and the population of Chunar is under 1 Lack, the finance model of Chunar is simulated based on B), IDT. (If Chunar would have an approval from AMRUT earlier than from NMCG, it would adopt Comprehensive, but the simulation of it will not to be considered here since it's belong to AMRUT)

2) The Cost of Mirzapur

The cost of DPR for financial simulation is from ID&T and the rehabilitation of the larger one.

Table 12.7.14 The cost of ID&T of Chunar

i	Cost of work	**277.02**
ii	Contingency	5.54
	Sub Total (A)	**282.56**
B	**Cost of works on which no Centage is admissiable**	**0.000**
i	Communication & Public Outreach	2.00
ii	Environmental and Management Plan (EMP)	2.00
iii	Governance and Accountability Action Plan (GAAP)	1.00
iv	Hiring of Godown and Site Office	1.33
v	Power Connection & Allied Works	2.51
vi	TPI Charges @0.1% of Basic Cost i.e. Sub Total (A)	0.28
	Sub Total (B)	**9.12**
C	**Operation & Maintenance**	**0.00**
i	Operation & Maintenance for first 10 years of commissioning of project	206.74
	Sub Total (C)	**206.74**
D	Centage Charges	**0.00**
i	Centage charges @ 12.5%of Basic Cost ie Sub Total(A)	35.32
	Sub Total (D)	**35.32**
E	Labour Cess Charges	**0.00**
i	"@ 1%of Basic Cost ie Sub Total (A)	2.83
	Sub Total (E)	**2.83**
	Grand Total (A+B+C+D+E)	**536.57**

3) The simulation of Mirzapur ID&T and rehabilitation

Assumption and the simulation result show the followings:

- Chunar Building cost is 72.3% and Plant Machinery is 27.7% for DPR analysis.
- Construction will be from 2017 to 2019, three years. 30% of the construction will be done in the 1st year, 50% in the 2nd year and remaining 30% in 3rd year
- COD is in the year 2020, April 1st and this concession will be complete until 31st March 2040, 20 years.
- Annuity model is two type; Flat (Fixed) amount and Variable amount by Chunar DPR.

Table 12.7.15 The base data for simulation in Chunar

Operating year	1	2	3	4	5	6	7	8	9	10
Population	48,000	48,700	49,400	50,100	50,800	51,500	52,200	52,900	53,600	54,300
Household size	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Sewerage Connection Rate	20.0%	21.6%	23.3%	25.2%	27.2%	29.4%	31.7%	34.3%	37.0%	40.0%
Connected population	9,600	10,519	11,524	12,622	13,823	15,134	16,567	18,132	19,842	21,709
Gross Sewage Generation per capita (lpcd)	135	135	135	135	135	135	135	135	135	135
Water to Sewerage conversion ratio	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Additional Sewerage water collected	110%	110%	110%	110%	110%	110%	110%	110%	110%	110%
Net Sewerage Water to be collected and treated (Litter/Day)	1,140,480	1,249,681	1,369,055	1,499,531	1,642,121	1,797,929	1,968,156	2,154,113	2,357,226	2,579,052
Net Sewerage Water to be collected and treated (MLD)	1.14	1.25	1.37	1.50	1.64	1.80	1.97	2.15	2.36	2.58
Net Sewerage Water to be collected and treated	1,140	1,250	1,369	1,500	1,642	1,798	1,968	2,154	2,357	2,579

m3:Cubic Meter lpcd: Litter per Capita Day

Operating year	11	12	13	14	15	16	17	18	19	20
Population	55,000	55,615	56,231	56,846	57,462	63,000	64,133	65,267	66,400	67,533
Household size	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Sewerage Connection Rate	43.2%	46.6%	50.4%	54.4%	58.7%	63.4%	68.5%	74.0%	79.9%	86.3%
Connected population	23,748	25,935	28,320	30,920	33,755	39,969	43,943	48,298	53,067	58,291
Gross Sewage Generation per capita (lpcd)	135	135	135	135	135	135	135	135	135	135
Water to Sewerage conversion ratio	80%	80%	80%	80%	80%	80%	80%	80%	80%	80%
Additional Sewerage water collected	110%	110%	110%	110%	110%	110%	110%	110%	110%	110%
Net Sewerage Water to be collected and treated (Litter/Day)	2,821,283	3,081,078	3,364,384	3,673,300	4,010,110	4,748,357	5,220,479	5,737,751	6,304,376	6,924,939
Net Sewerage Water to be collected and treated (MLD)	2.82	3.08	3.36	3.67	4.01	4.75	5.22	5.74	6.30	6.92
Net Sewerage Water to be collected and treated	2,821	3,081	3,364	3,673	4,010	4,748	5,220	5,738	6,304	6,925

Table 12.7.16 The simulation result Chunar Hybrid Annuity Model

	Annuity type	
	Flat (Fixed)	Variable
Annuity Total from GoI	65,644	65,464
Annuity Debt Service	39,342	39,342
Annuity O&M	26,302	26,121
Annuity O&M -User Tariff Coverage	11.73%	11.81%

At the last concession year or 2040 for Flat Annuity model, Equity will be 183,285, Legal Reserves/Thin Capitalization Requirement will be zero, Free Reserves will be -32,160, so Total Equity will be 151,125, and then Total Liabilities and Equity will be 101,966, while Total Liabilities and Equity for Variable Annuity model will be 135,622 (Thousand Rs)

If HAM-PPP for Chunar should obtain its IRR as 5%, the Annuity from the GOI will be much larger than the simulation result in the above.

Table 12.7.17 The simulation result Chunar Hybrid Annuity Model (IRR 5%)

	Annuity type	
	Flat (Fixed)	Variable
Annuity Total from GoI	85,466	80,401
Annuity Debt Service	39,342	39,342
Annuity O&M	46,124	41,059
Annuity O&M -User Tariff Coverage	6.69%	7.51%

12.7.6 Disbursement procedure

There are two ways of disbursement methods; On-budget method and Off-budget method. Under On-budget method, Donors disburse the loan to budgetary account of borrower country which is a part of its general budgetary account system. On the other hand, under Off-budget method, the fund is disbursed to borrower country without through its budgetary system and is paid to supplier or executing agency's bank account by following procedures. For Donor's standpoint, Off-budget method is preferable since flow of the fund is transparent with specific project and its relating procurement to ensure accountability of disbursement. There are four disbursement procedures relating to Off-budget disbursement method; Commitment procedure, Reimbursement procedure, Special Account procedure and Transfer procedure.

1) Commitment procedure

Commitment procedure is basically used for foreign procurement settled by L/C based on loan agreement between Donor and Borrower country and based on procurement contract between executing agency and supplier. Advantage of this procedure for Donor's perspective is that, workload for administration and documentation handling is limited, and that evidence document for disbursement can be collected before cash delivery. From Borrower and SPV's point of view, it is advantageous that there is no administrative workload since L/C is submitted by supplier directly to supplier's bank account for payment. In addition, SPV does not need to pay to supplier before loaned money funded by donor. However, fee for L/C settlement should be paid by Borrower. Supplier outside of borrower country would prefer this payment procedure because payment is rather quick and ensured comparing to other procedure.

2) Reimbursement procedure

Reimbursement procedure is simplified process to pay for procured goods, service or project cost that SPV needs to pay the cost to supplier first then claim back to Donor through borrower country. Simplified procedure enables all stakeholders to have least workload during the disbursement process and it provides convenience especially for domestic procurement. Also, evidence document

can be collected in place before reimbursement. However, for SPV's stand point, payment must be made to supplier before get the fund from Donor. In contradiction to SPV, if the borrower country and SPV's financial condition are not good, payment to supplier before reimbursement would be delayed ant it may result in delay of the project. L/C is not involved and there is no need to pay the cost for L/C issuance and handling.

3) Special account procedure

Borrower country open bank account dedicated to use as Special Account in its domestic bank. And also Borrower country open Non-resident Yen account in the bank of Donor's country. After closing of L/A, Donor execute initial disbursement upon request from Borrower Country, to Borrower's Yen account. Then the fund initially disbursed is transferred to the Special Account. Supplier will receive payment after they submit the claim for payment with evidence. Once this procedure started, replenishment deposited to this Special Account is made by the similar procedure of Reimbursement. This procedure will provide flexibility to deal with financial demand from SPV or Supplier. However, the fund deposited in Special Account needs to be monitored with due care in terms of each step in the procedure because once money is transferred to the Special Account, further disbursement to supplier is handled by Borrower and SPV. Therefore, it can be the case where Donor fail to collect all of the evidence that prove the funded money are used for the project purpose only.

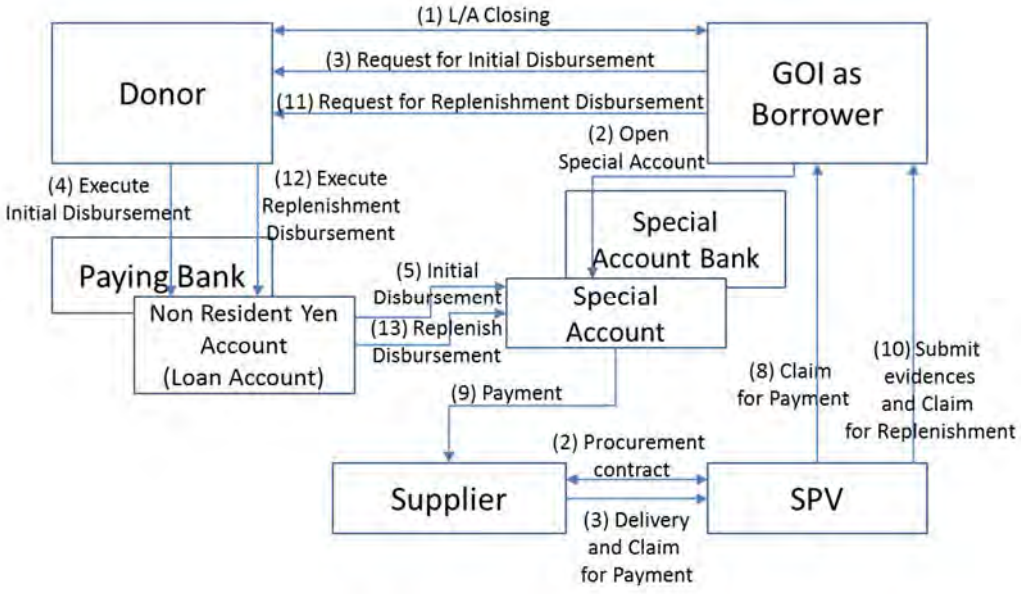


Figure 12.7.14 High level diagram of Special Account Procedure

4) Transfer procedure

Transfer procedure also disburse the money through Non-resident Yen Account of Paying Bank in

Donor's country. But the money is transferred to supplier directly and not through special account. The most important advantage of this procedure is, supplier can receive the cost for its goods or service according to the contract with SPV in a timely manner, no matter how SPV has financial difficulty. On the other hand, it is rather difficult to collect the evidence such as Receipt from supplier and SPV, owner of the Non-resident Yen account needs to bear relatively high cost for bank charge of the transfer.

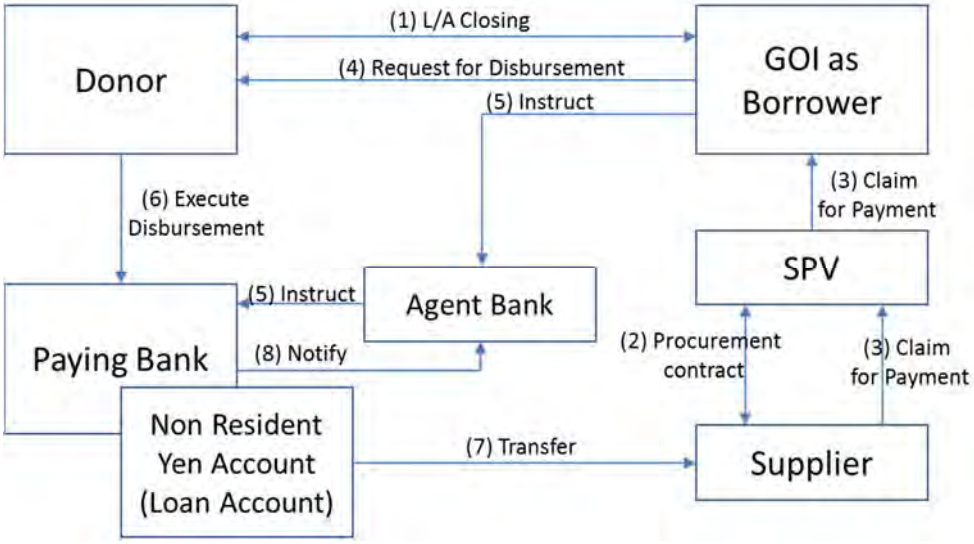


Figure 12.7.15 High level diagram of Transfer Procedure

5) Preferable disbursement procedure for this project

Each procedure has its own advantage and disadvantage; so if possible, it is proposed that Donor should consider using different procedure for different nature of payment. During the construction period, foreign procurement should follow Commitment procedure using L/C. Payment for domestic procurement can be handled by Transfer procedure. And once SPV enters to O&M period, Donor can choose Special Account procedure for Annuity payment by GOI to SPV, which comprises of capital cost and its interest portion. If such "combination" approach does not work for Donor, it is also recommended that we try to collect Hybrid Annuity Model which is not yet issued by GOI, since the template of Project MOU and Bidding document as basis of Hybrid Annuity Model are also the input for the choice of preferable disbursement procedure.

12.7.7 Risk and Control

Hybrid annuity model is different from traditional EPC project model, construction contract model and thus following risks would exist during the construction and O&M period.

Table 12.7.18 Risk and Control

Owners	Hybrid Annuity Model	Current EPC Model
Public - Sectors - GOI - State - ULB	- Transformation risk from current stakeholders to HAM - Possible financial burden (Interest amount paid to SPV later while Interest rate is supposed to be hedged) - Possibility that Annuity will be overpaying compared with actual O&M cost paid by SPV	- It had been observed that benefits accrued from substantial investments made under various past programs (Ganga Action Plan I & II, NGRBA, Yamuna Action Plan) were less than optimal. - According to Central Pollution Control Board (CPCB), almost 30% of the Sewage Treatment Plants (STPs) monitored in the 4 states of UP, Uttarakhand, Bihar & West Bengal was not operational and 94% were non-compliant with the prescribed effluent standards. - Hard to understand sewage performance in managerial accounting and finance point of view. - Cost increasing Risk in the current governance (UPJN, JALKAL, vendors)
Private Company (or SPV)	- Possibility that Annuity will be not enough to cover the actual O&M cost incurred by SPV in its operation (SPV's overpaying cost) - Risk not to find treated water sales	N/A
Lenders	- Bad debt risk since SPV is non-recourse finance structure. (GOI don't give sovereign guarantee to SPV)	N/A
Donors	- Possible project delay for GOI taking time to transform into HAM - Possible bad debt risk unless the loan repayment is guaranteed by GOI in loan the agreement (There is a risk of SPV bankrupt as a corporation)	N/A (need to confirm the current agreement with Government of India)

1) Sponsor risk

Risk Owner: Sponsors

Risk description:

Sponsor (e.g. GOI/State-Govt./ULB) will find the SPV does not achieve the business requirement

or the people in that area won't need Sewage system or the existence of the SPV such as due to extreme decrease of population. GOI (Annuity provider) cannot earn adequate tariff from users which leads to very low rate of return on its capital investment. GOI will find the private company or concessionaire doesn't support SPV enough, or find the lenders will have difficulty offering loan/debt to SPV that will endanger SPV operation.

For lenders as a sponsor, they will have difficulty to collect the loan/debt from SPV.

Counter measure to control risk – contract level:

Conduct through examinations on the project applicants (candidate private companies). There may be no risk controls for lenders if SPV is non-recourse model.

Counter measure to control risk – process level:

Contingent equity/loan commitment: Sponsors are to invest/lend specific additional amount equity/loans to SPV under critical cash flow issues or financial problems. To offer necessary supports to SPV who cannot have by itself: Law enforcement for potential buyers buy the treated water. Integrate SPV, Restructuring the areas.

2) Construction risk

Risk Owner: SPV or outside Constructor

Risk description: Constructor fail to complete construction within due date and within the budget. Especially this risk is resulted by delay in site acquisition, inappropriate site condition (defected geological structure, soil contamination, and discovery of archaeological remains, etc.), delay in legal permits, insufficient competence to undertake the work in technical and financial terms, cost overrun and inadequate performance on project completion.

Counter measure to control risk – contract level:

Land acquisition is responsible to Government (GOI/State-Govt./ULB). Define right to claim damages and other securities under the construction contract. Incentives to SPV when the construction will be complete earlier (e.g. Bonus)

Counter measure to control risk – process level:

Perform risk assessment to qualify if the constructors have sufficient experiences to complete construction. Limit the bid participants only for qualified vendors. Engineer of Executing Agency (i.e. UPJN/ULB) and the SPV's own staff also mitigate this risk by supervising the activities of SPV or construction contractor.

3) Input-Supply risk (Electricity)

Risk Owner: SPV

Risk description:

SPV fails to obtain 24x7 unceasing electricity supply which is necessary for operation of STP and PS. Electricity charge increases beyond the estimate which is the basis of planned O&M annuity in the agreement; this may be affected by UP State's annual Electricity tariff order (unit cost and additional surcharges).

Counter measure to control risk – contract level:

Agreement with State electricity corporation to ensure unceasing electricity supply along with the clause to stipulate the advanced payment of electricity charge, a discount when the electricity disruption so that SPV can encourage State electricity corporation to supply electricity with 7x24 basis safely.

SPV is to have the long term fixed rate contract with Electricity Corporation. Add the clause to stipulate exoneration from annual electricity tariff increase order on project level MOU with UP State.

Counter measure to control risk – process level:

Exclude the disruption hours of STP operation due to Electricity Corporation's fault from the scope of Annuity reduction

4) Operation risk

Risk Owner: SPV

Risk description:

Sewerage treatment performed lower than the standard in the agreement due to inadequate STP operation management. Treated water quality fail to meet CPCB standard. Problems of PS and leakage from SNW or SNW get broken.

Counter measure to control risk – contract level:

SPV closes the O&M contract with sufficient experience in terns STP operation and encourage O&M contractor to have minority equity stake on SPV. Include the clause in the O&M contract to stipulate SPV has the right to terminate the contract with poorly performing O&M contractor.

Counter measure to control risk – process level:

Put penalty for poorly performing O&M contractor. Termination of the contract with poorly performing O&M contractor

5) Technology risk

Risk Owner: SPV

Risk description:

STP system fail to operate as planned due to obsolescence or gradual decline in operating efficiency between maintenance of the STP or cycle of major maintenance is turned out to be shorter than

base projection of the project. Using new and untried technology whose performance cannot be checked against existing reference may fail to fulfill new water quality standard.

Counter measure to control risk – contract level:

Construction contractor provides long term performance guarantee.

Counter measure to control risk – process level:

Assess technology risk and its impact to project economics based on input from experts of the technology and past references to enhance accuracy of the future O&M cost estimate.

6) Revenue risk

Risk Owner: GOI

Risk description:

GOI would take the risk relating to shortfall of user tariff collected against the O&M cost incurred and thus, SPV does not have responsibility to collect the sewerage tariff or tax from users. On the other hand, SPV can earn additional revenue from sales of treated water and sludge as much as they sell it and SPV does not need to pay back the revenue to recover the shortfall of O&M cost and user tariff.

7) Interest rate risk and foreign exchange risk

Risk Owner: SPV (Interest risk), Contractor (Foreign currency exchange risk)

Risk description:

Increased interest may result insignificant difference between planned rate on base projection to calculate capital cost annuity and actual interest to be paid to lenders. Fluctuation of FX rate may result in increase of total project cost when SPV raises a loan from lender with currency other than Indian Rupee.

Counter measure to control risk – contract level

Interest rate hedging arrangement is put in place to mitigate interest rate risk when floating rate loan is used.

Arrange the finance in Rupee only and also set the payment currency to contractor is set to Rupee only.

Counter measure to control risk – process level

GOI may bear the Foreign exchange risk during the procurement from foreign supplier.

8) Cash flow risk

Risk Owner: SPV

Risk description:

Lack of sufficient fund balance in the separated account may result delay or reduce in annuity

payment in a timely manner.

Annuity payment is reduced by GOI as a sanction due to poor operation of STP system and failure to meet performance standard.

Counter measure to control risk – contract level:

Stipulate to establish separate account which has a fund of two years' worth liability on MOU. Select the O&M contractor with sufficient experience in terns STP operation and encourage O&M contractor to have minority equity stake on SPV. Include the clause in the O&M contract to stipulate SPV has the right to terminate the contract with poorly performing O&M contractor. Terminate the O&M contractor with poor performance.

Counter measure to control risk – process level:

Monitor the separated account has a fund of two years liability balance periodically. Monitor to ensure O&M contractor to operate the STP system as planned and fulfill the performance standard periodically.

9) Environment risk

Risk Owner: SPV

Risk description:

SPV and operator fails to treat and emit treated water and sludge adequately and it may result in hazardous impact to surrounded environment and effluent to rivers.

Counter measure to control risk – contract level:

Closely monitor environment protection rules. Hold a long term contract with vendor to treat adequate by-product of sewerage treatment.

10) Severe disaster risk

Risk Owner: SPV

Risk description:

Natural disaster such as monsoon, flood, Cyclone or big earthquake, mayhem may result in disruption of STP/PS/SNW system operation.

Counter measure to control risk – contract level:

Enter into insurance arrangement to cover the damage of such disasters.

11) Regulatory and political risk

Risk Owner: SPV

Risk description:

Change in law：Difficulty to meet the current standard of treated water quality with current facility design if further stringent regulation will be enforced by government. Change in Regime：Change

in GOI regime may result in disruption or delay of implementation of this new Hybrid Annuity model. And thus, each sewerage project may be disrupted, suspended or delayed. Miss-alignment or lack of coordination among governmental bodies in GOI: Lack of alignment and coordination by NMCG and PMO (Prime Minister Office) with related Ministries such as MoWR, RD, GR and MoUD and UP state Government which may result in miss-alignment of relating inter-dependent programs such as Smart city initiative, AMRUT, etc., especially in terms of scope of infrastructure development. Ministries fail to provide necessary support to implement this program.

Counter measure to control risk – contract level:

Hold Government support agreement to ensure legal framework of this program which is stipulated clearly on the base MOU among GOI and State. Contract political risk insurance and guarantee.

12.7.8 Other Considerations

1) SPV Candidates

It is not sure at this moment that who the SPV candidates are. The simulation in the following section is done by using not particular concessioners and vendors; however, there are some vendors in the past who applied to Design, Build and O&M for either new facilities or rehabilitation in Varanasi area: The **Table 12.7.17** shows Design and construction of 140 MLD sewage treatment plant (STP) at Dinapur including O&M for the years. Other vendors are listed in different tables

.

Table 12.7.19 For Design and Construction

1 M/S Passavant Orediger JV with HNB Engineer Pvt. Ltd.
2 M/S SPML JB with Waterleau.
3 M/S MIS Shivam-Consortiun.
4 M/S GSJ-SEPC Joint Venture.
5 M/S Shapporji Pallonji & Co.
6 M/S Tecpro Systems Ltd.
7 M/S Acciona Aqua S.A. L&T JV.
8 M/S VA Tech Wabag Ltd. JV with Bahadure & Co.
9 M/S Degremont and Degremont Ltd.
10 M/S GS Inima Environment SA
11 M/S Triveni Engineering & Industries Ltd.
12 M/S Cadagua JV with GEO Millaer
13 Corsan Corvian Construction SA.
14 Enviro Control Associated (I) Pvt. Ltd.
15 UEM India Pvt. Ltd.
16 Abeima Teyma

Table 12.7.5 For rehabilitation of old trunk sewer by trenchless technology

1 Insituform Technologies LLC.
2 Shriram EPC Ltd.
3 SPML India Ltd.
4 SPML Info Ltd.
5 GYPSYM

Table 12.7.6 For Sewage Pump Station and Rising Main Project

1 Gharpure Engineering and Construction, Pune
2 Larsen and Toubro Limited, Chennai
3 UEM India Private Limited, New Delhi
4 SPML India, Gurgaon
5 RK Engineers Sales Private Limited
6 Kirloskar Brothers, Pune

For projects which capital cost exceeds certain threshold defined by GOI guideline, ICB (International Competitive bidding) is required to decide constructor and vendors, not by NCB (National Competitive bidding).

2) Potential buyers of treated water

JICA study team tied pick up potential buyers of treated water through the Internet research. Once the SPV RFP (Request for proposal) will be ready, further research should be necessary for the concessionaires and ULB.

a) Mirzapur

Mirzapur district is one of the 34 districts in Uttar Pradesh currently receiving funds from the

Backward Regions Grant Fund programmer. It has Minor Minerals, Sandstone, Redstone and the total Forest Cover of 24% of geographical area.

- J P Associates Ltd Chunar, Mirzapur
- J P Chunar Cement Products Chunar, Mirzapur
- 2.5 Mn TPA Chunar Cement Factory (CCF), Mirzapur, UP
- R L J Concast Ltd Baragawn, Chunar, Mirzapur
- Santigopal Concast Ltd Baragawn, Vill DHauha Chunar, Mirzapur
- JHB Steel Ltd Vill. Dhauha, Chunar, Mirzapur
- Various Railway stations in the district or survey area

b) Chunar

- Purvanchal Co Operative Spinning Mill Ltd.
- Lord's Distillery Pvt Ltd.
- Sukhbir Agro Energy Pvt Ltd
- Various Railway stations in the district or survey area
- J P Associates Ltd
- J P Chunar Cement Products
- R L J Concast Ltd
- Santigopal Concast Ltd
- JHB Steel Ltd
- Various Railway stations in the district or survey area

CHAPTER 13 INSTITUTIONAL SET-UP FOR PROJECT IMPLEMENTATION

<Objective of the Study>

Successful setting up of organization for the project was studied in this chapter.

<Result of the Study>

Although the structure would be further considered depending on any decision in set-up by India side, but Survey team is suggesting that UPJN shall organize the Project Implementation Unit (PIU) in the UPJN Varanasi Zone office, set up as an independent office under the Office of the General Manager, UPJN Ganga Pollution Prevention Unit (UPJN-GPPU). The UPJN-GPPU implements centrally and state funded pollution prevention projects for the River Ganga. The proposed organization structure and staffing of PIU considers the application of organisational principles to ensure efficient and effective accomplishment of the Project objectives as delegated to it by the NMCG / SPMG and the particular SPV, together with organisational factors and practices existing in UPJN-GPPU. The engagement of the PIU staff will be governed by the Service Regulations of UPJN.

The successful implementation of the project depends on many factors, one of which is the readiness of the governmental organizations involved in project execution and implementation. It is important, therefore, to study the main stakeholders in Central and State government and in the Urban Local Bodies (ULB) which are involved in the Ganga Rejuvenation Project. Understanding these agencies' organisational mandates and functions provides the proper perspective when establishing the framework for project implementation as well as when assigning roles and responsibilities within the project implementation system.

This chapter is divided into six sections. The first section presents the Central, State and ULB level institutions with particular attention on their mandated functions and how these relate to the objectives of the Project. It also presents the administrative set-up, structure and staffing of these agencies. On the ULBs where sewerage facilities are to be constructed, focus is on the current structure and staffing of the Jal Kal, or the unit/ wing in charge of providing water supply and sewage / wastewater treatment services to the city and its immediate environs.

The second section addresses setting up the project implementation organisations for the smooth, project implementation within the time frame required. The current institutional framework in the water supply, sewerage and sanitation sectors in relation to this Project was established by properly situating the Central, State and ULBs actors operating within the sector. The organisations for project

implementation were thus determined, and their roles and responsibilities in project implementation defined and delineated. The project implementation system takes into account the recent Government policy initiative of reforming the wastewater sector, which includes Ganga wastewater projects under the NMCG through setting up Special Purpose Vehicle (SPV).

The third section discusses the Project Implementation Unit (PIU) at the State and ULB level. It proposes the organization structure, the personnel/ staffing requirements including the educational and experience qualifications for each post. For managing project implementation tasks effectively, duties and responsibilities for each post are also proposed and enumerated.

The fourth section takes up the Special Purpose Vehicle as the institutional tool for the Namami Gange progamme for integrating reforms the wastewater sector by taking up the Hybrid Annuity based PPP model for the wastewater sector in India to ensure performance, efficiency, viability and sustainability. Discussed are the proposed structuring of the ULB-level SPVs and their project-related roles and responsibilities from project development to implementation and operation.

The fifth section touches on the tasks of the proposed Project Management Consultants that would be engaged by the SPMG during the project formation stage, for the primary purpose ensuring proper, efficient and effective implementation of the specific projects identified during the project formation phase.

The sixth section discusses the procurement processes in GoI, the State of U.P. and how these could be streamlined given project requirements. Considerations on the procurement process by the SPV for the PPP concessionaire were also enumerated.

13.1 Relevant Government Agencies, Organization Structure and Staffing

The lead national government agency mandated to formulate policies, to plan programmes, and execute projects aimed at purifying the river Ganga is the Ministry of Water Resources, River Development and Ganga Rejuvenation (MoWR RD&GJ). Allocated under this Ministry are the National Ganga River Basin Authority (NGRBA) and the National Mission for Clean Ganga (NMCG), which is the operational wing of the NGRBA. The Ministry of Urban Development (MoUD) is a central government-level agency responsible for formulating policies, supporting and monitoring programmes, as well as coordinating the activities of various Central Ministries, State Governments and other nodal authorities as these relate to urban development, town and country planning and development, which include water supply, sanitation, and waste management, among others.

In Uttar Pradesh, the Urban Development Department (UDD) is state department in charge of the local bodies where the Project will be implemented. On the other hand, the U.P. Jal Nigam is the state

organization in charge of implementing sanitation/ sewerage schemes/ projects as well as in operating and maintaining sewerage treatment plants. The state society that has direct linkage with NMCG is the State Ganga River Conservation Agency (SGRCA) / State Level Program Management Group (SPMG).

The distribution of sewerage/ pollution control projects is based on the level of the urban local body in the state of Uttar Pradesh, as shown in **Table 13.1.1.**

Table 13.1.1 Distribution of Sewerage Projects Based on ULB Level

Nagar Nigam		Nagar Palika Parishad	
1	Varanasi	1	Ramnagar
		2	Chunar
		3	Mirzapur
		4	Ghazipur

13.1.1 Central Government Level

1) Ministry of Water Resources River Development and Ganga Rejuvenation (MoWR RD&GR)

The Ministry of Water Resources River Development and Ganga Rejuvenation is responsible for laying down the overall policy guidelines and programmes for the development and regulation of country's water resource as well as provides coordination and guidance in the water resources sector. Among its allocated functions are the formulation of national water development perspective and the determination of the water balance of different basins /sub-basins; planning for the development of ground water resources, as well as overseeing and supporting State-level groundwater development; policy formulation, planning and guidance with respect to minor irrigation development, administration and monitoring of the Centrally Sponsored Schemes; and operating the central network for flood forecasting and warning on inter-state rivers, and preparing flood control master plans for the Ganga and the Brahmaputra.

a) National Council for River Ganga (NCRG)

The National Council for Rejuvenation, Protection and Management of River Ganga, referred as the National Council for River Ganga (NCRG) or the National Ganga Council was established vide notification no. S.O. 3187(E) dated 7th October 2016 under EPA 1986. The new body is to act as an authority replacing the existing National Ganga River Basin Authority (NGRBA) for overall responsibility for superintendence of pollution prevention and rejuvenation of river Ganga Basin.

The Act provides for the organisation of a five-tier structure at national, state and district

levels to take measures for prevention, control and abatement of environmental pollution in river Ganga and to ensure continuous adequate flow of water so as to rejuvenate the river Ganga. The five-tier structure at national, state and district levels are the following: (i) The National Ganga Council under the chairmanship of Honourable Prime Minister of India; (ii) The Empowered Task Force (ETF) on river Ganga under the chairmanship of Honourable Union Minister of Water Resources River Development and Ganga Rejuvenation; (iii) The National Mission for Clean Ganga (NMCG); (iv) The State Ganga Committees; and (v) The District Ganga Committees in every specified district abutting river Ganga and its tributaries in the states.

The Empowered Task Force ensures that the Ministries, Departments and State Governments concerned have an action plan with specific activities, milestones, and timeliness for achievement of the objective of rejuvenation and protection of River Ganga, and a mechanism for monitoring implementation of its action plans. It will also ensure co-ordination amongst the Ministries and Departments and State Governments concerned for implementation of its action plans in a time bound manner.

At the State level, the State Ganga Committees have been created in each of the defined States as Authority, to function as Authorities in respect of each State and to perform the superintendence, direction and control over the District Ganga Protection Committees under their jurisdiction.

Similarly, the District Ganga Committees in each of the Ganga Bank Districts carry out the assigned tasks as an Authority at the district level, to take cognizance of local threats and needs of river Ganga and conceptualise such measures as necessary to ensure overall quality of water in river Ganga and monitor various projects being implemented.

b) National Mission for Clean Ganga

The National Mission for Clean Ganga (NMCG) was registered as a society on the 12th of August 2011 under the Societies Registration Act 1860. Since its establishment, it performed its mandate as the operational and implementation arm of National Ganga River Basin Authority (NGRBA) which was constituted under the provisions of the Environment Protection Act (EPA), 1986 until NGRBA's dissolution on the 7th October 2016.

The approval by the Union Government of the River Ganga (Rejuvenation, Protection and Management) Authorities Order, 2016 laid down NMCG's new institutional structure for policy and implementation in fast track manner, as well as empowered the NMCG to issue

directions and discharge its functions in an independent and accountable manner. It has also been decided to grant a Mission status to the Authority with corresponding powers under the Environment (Protection) Act, 1986 and provide adequate delegation of financial and administrative powers which will distinctly establish NMCG as both responsibility and accountability centre and effectively accelerate the process of project implementation for Ganga Rejuvenation.

NMCG complies with the decisions and directions of the National Ganga Council and implement the Ganga Basin Management Plan approved by it; coordinate and carry out all activities necessary for rejuvenation and protection of River Ganga and its tributaries.

The establishment of the National Council for Rejuvenation, Protection and Management of River Ganga (referred as National Ganga Council) vide notification no. S.O. 3187(E) dated 7th October 2016 under EPA 1986 paved the way for the organisation of a five-tier structure at national, state and district levels to take measures for prevention, control and abatement of environmental pollution in river Ganga and to ensure continuous adequate flow of water so as to rejuvenate the river Ganga. The five-tier structure at national, state and district levels are the following: (i) The National Ganga Council under chairmanship of Honourable Prime Minister of India; (ii) The Empowered Task Force (ETF) on river Ganga under chairmanship of Honourable Union Minister of Water Resources River Development and Ganga Rejuvenation; (iii) The National Mission for Clean Ganga (NMCG); (iv) The State Ganga Committees; and (v) The District Ganga Committees in every specified district abutting river Ganga and its tributaries in the states.

- *Objectives:* The twin objectives of NMCG are: (i) To ensure the effective abatement of pollution and rejuvenation of the river Ganga by adopting a river basin approach to promote inter-sectoral coordination for comprehensive planning and management; and (ii) To maintain minimum ecological flows in the river Ganga with the aim of ensuring water quality and environmentally sustainable development.
- *Structure:* The NMCG has a two tier management structure and is comprised of the Governing Council and Executive Committee, both of which are headed by a Director General, NMCG. The Director General (DG) of NMCG is an Additional Secretary in Government of India. Note that the Executive Committee has been authorized approve all projects up to Rs.1000 crore.
- Authority with powers to issue directions and also to exercise the powers under the Environment (Protection) Act, 1986 to enable it to carry out efficiently its

mandate. The NMCG will have a two-tier management structure with a Governing Council (GC), to be chaired by DG, NMCG. Below the GC, there will be an Executive Committee (EC) constituted out of the GC, to be chaired by the DG, NMCG.

c) Integrated Ganga Conservation Mission (Namami Gange)

The Integrated Ganga Conservation Mission, or the Namami Ganga Yojana programme, better known as the "Namami Gange" was launched as a flagship initiative of the Government. It has a total program cost of Rs20,000 Crore, with Rs 2100 Crores programmed for the year 2015-2016. It is implemented by NMCG and its state counterparts, or the SPMGs, and stresses on improved coordination mechanisms between various ministries and agencies at both the central and state governments. The pillars of Namami Gange program are the following: (i) Sewage treatment infrastructure, (ii) River surface (iii) cleaning, (iv) Afforestation, (v) Industrial effluent monitoring, (vi) River front development, (vii) Bio-diversity, (viii) Public awareness, and (ix) Ganga gram.

- *Objective:* The objective of Namami Gange is to further integrate efforts to clean and protect river Ganga in a comprehensive manner by focusing on pollution abatement interventions, namely interception and diversion (I&D) and treatment of waste water flowing through open drains via bio-remediation and appropriate in-situ treatment using innovative technologies, sewage treatment and effluent treatment plants.

  Equally important objectives of this programme come from lessons learned, and these are to involve people living on the banks of the river to attain sustainable results, and to involve States and grassroot level institutions such as ULBs and Panchayati Raj institutions in implementation.
- *Organization*: The three-tier mechanism was established for monitoring, center-state coordination and effective implementation of projects. It is comprised of a high-level task force (HLTF) chaired by the Cabinet Secretary and assisted by NMCG at the national level, State-level committees chaired by the Chief Secretary and assisted by SPMG, and District-level committees chaired by the District Magistrate.

  Due to the multi-sectoral, multi-dimensional and multi-stakeholder nature of the challenge of clean Ganga Mission, other key ministries are involved aside from the MoWR RD&GR, such as the Ministry of Urban Development, the Ministry of Environment, Forests and Climate Change, the Ministry of Roads and Highways, and the Ministry of Rural Development and Sanitation. The program envisages creating 100% sanitation infrastructure for 118 priority towns and 1657 Gram Panchayats located along the Ganga.

- *Implementation Activities*: The activities under Namami Gange are the following: i) Scheme for rehabilitation and up-gradation of existing STPs along Ganga; ii) Ensuring 100% sewerage infrastructure in identified towns alongside Ganga; iii) In-situ sewage treatment in open drains; iv) Support for preparation of DPRs; v) River front management for Ghat's developments in selected cities and towns; vi) Industrial pollution abatement at Kanpur on priority; vii) Action Plan for Char Dham Yatra – public amenities, waste disposal and sanitation; viii) Capacity building of urban local bodies; ix) Afforestation – conservation of flora; x) Conservation of Aquatic life – special attention on dolphin, turtles and ghariyals etc.; xi) Disposal of flowers and other puja material; xii) Ganga Vahini; xiii) GIS data and spatial analysis for Ganga basin; xiv) Study of communities depending on Ganga for their traditional livelihood; xv) National Ganga Monitoring Centre; xvi) Special guidelines for sand mining in Ganga; xvii) Assessment of special properties of ganga water; and xviii) Communication and public outreach activities.

  To assist and support implementation, the following ministries and agencies have been roped in – the Ministry of Tourism, to takes steps to minimize pollution by promoting eco-friendly tourism activities; the Ministry of Shipping, to develop sustainable shipping and river transport; the Ministry of Drinking Water and Sanitation, to prioritise open defecation-free villages along the river and create wastewater management facilities in those villages; the Human Resources Ministry, to set up a national-level institution or a university that offers courses on applied river sciences; AYUSH, to develop conservation plan for medicinal plants in the Gangetic region and ensure medicinal biodiversity; and Youth Affairs and Sports, to encourage youth, volunteers and sportspersons to engage in activities related to Ganga cleaning.

- *Lessons Learnt:* In the GAP II Project, the communities were involved in what was called the "non-sewerage component" through social programmes and/or public consultations, an example of which was in the selection of sites for public toilets and dhobi ghats. There were also public information dissemination / education programmes targeting the general community. The activities, which were designed by the GAP II Consultants, were basically carried out by NGOs and supervised by the Project Management Consultants (PMC).

  For the Ganga Rejuvenation Project, the ways to put lessons learned into practice from past programs are:

- Firstly is **to institutionalize stakeholder involvement** into the project implementation system, from the Central, State and ULB level governments and organizations based on and within the bounds or confines of their own legal mandates, and then provide these stakeholder institutions with roles and responsibilities in the project implementation system in order that Project objectives are realized and sustained.
- Secondly is **to aim for strategic stakeholder engagement**, meaning, to divide the stakeholders into "target markets" and to design specific activities and/or communication plans for each set of stakeholders with inputs coming from the stake-holders themselves in a consultative and participative bottoms-up approach, rather than to use generalized top-down methodologies.

- *Special Purpose Vehicle (SPV)*: Early this year, the policies and procedures and guidelines for taking up the hybrid annuity model for public-private partnership (HAM-PPP) are being finalized. This will entail establishing a Special Purpose Vehicle (SPV) to plan, structure, implement, manage operate and maintain such PPP projects and also develop a market for treated wastewater. The proposed SPV will be established under the Companies Act, 2013 providing it with a governance framework and enabling its functional autonomy.

  The SPVs would enter into a tripartite memorandum of agreement (MoA) with participating State Governments and concerned Urban Local Bodies for taking up individual projects. These MoAs will aim at introducing reforms and regulatory measures for recovery of user charges on 'polluters pay' principle, restrictions on usage of ground and fresh water for non-potable purposes through stricter monitoring and guidelines that promote reuse of treated wastewater.[1]

2) The Ministry of Urban Development (MoUD)

One key mandate of the Ministry of Urban Development (MoUD) is taking up schemes / creating facilities to manage water supply, sewage, drainage and sanitation facilities subject to the overall

1 http://economictimes.indiatimes.com/news/economy/infrastructure/cabinet-okays-ppp-model-for-wastewater-sector-under-namami-gange-plan/articleshow/50467900.cms

national perspective of water planning and coordination assigned to the Ministry of Water Resources River Development and Ganga Rejuvenation (MoWR RD&GR). As such, the MoUD is involved in the conservation of rivers and lakes by improving and renewing the infrastructure of the towns. It has conceptualised the whole town approach, while the pollution abatement of rivers uses the river-centric approach.

The infrastructure created by NGRBA / NMCG may be fully utilized by MoUD, particularly in merging of the schemes and/or dovetailing with those of MoUD at the appropriate level of competence. The Ministry is very active in undertaking urban reforms in the sector, and implementing initiatives for urban infrastructure in water supply, sanitation and drainage.

MoUD has been a force in implementing the National Urban Sanitation Policy (NUSP), issued in November 2008. The NUSP that envisions "all Indian cities and towns become totally sanitized, healthy and livable and ensure and sustain good public health and environmental outcomes for all their citizens with a special focus on hygienic and affordable sanitation facilities for the urban poor and women." The Ministry helps the states and cities in ensuring sanitation as a core responsibility of the Urban Local Bodies as envisaged in the 74th Constitutional Amendment Act of 1993 by encouraging State Governments to draft state sanitation strategies, and cities to formulate city sanitation plans in conformity with the national policy.

3) The Ministry of Environment, Forests and Climate Change (MoEF)

The Ministry of Environment, Forests and Climate Change is the nodal agency in the administrative structure of the Central Government for the planning, promotion, co-ordination and overseeing the implementation of India's environmental and forestry policies and programmes. Its primary concerns and objectives are geared towards the implementation of policies and programmes relating to the protection and conservation of the country's natural resources, such as flora, fauna, forests, wildlife and lakes and rivers; ensuring the welfare of animals; and the prevention and abatement of pollution. It is guided by the principles of sustainable development and enhancement of human well-being.

The Ministry's environmental role is evident in several comprehensive approaches to river conservation works by additionally emphasizing on catchment area treatment, addressing the biota component and maintenance of ecological properties of the river waters. It coordinates with the Ministry of Urban Development, the Ministry of Water Resources, Ganga Rejuvenation and River Development and other sectoral ministries namely, Ministry of Rural Development and the Ministry of Agriculture.

The Ministry's work is supported by its regional and subordinate offices, by autonomous organizations, authorities, boards and public sector undertakings, such was the Central Pollution Control Board. Its

mandates / objectives are well supported by a set of legislative and regulatory measures, aimed at the preservation, conservation and protection of the environment. Besides the legislative measures, the National Conservation Strategy and Policy Statement on Environment and Development, 1992; National Forest Policy, 1988; Policy Statement on Abatement of Pollution, 1992; and the National Environment Policy, 2006 also guide the Ministry's work.

a) Central Pollution Control Board

The Central Pollution Control Board (CPCB) advises the Central Government on any matter concerning prevention and control of water and air pollution and improvement of the quality of air. As such, it sets the environmental standards to be complied for air quality, water quality and noise; publishes technical and statistical data relating to water and air pollution and the measures devised for their effective prevention, control or abatement and prepares manuals, codes and guidelines relating to treatment and disposal of sewage and trade effluents as well as for stack gas cleaning devices, stacks and ducts. It plans and executes a nation-wide program for the prevention, control or abatement of water and air pollution while providing technical assistance and guidance to the State Boards, carry out and sponsor investigation and research relating to problems of water and air pollution, and for their prevention, control or abatement.

There are State Pollution Control Boards under the ambit of the CPCB. The state boards advise the Sate Governments and Governments of Union Territories with respect to the suitability of any premises or location for carrying on any industry which is likely to pollute a stream or well or cause air pollutions. It also lays down standards for treatment of sewage and trade effluents, as well as for emissions from automobiles, industrial plants, and any other polluting source. It evolves efficient methods for disposal of sewage and trade effluents on land; develops reliable and economically viable methods of treatment of sewage, trade effluent and air pollution control equipment. Assess the quality of ambient water and air, and inspect wastewater treatment installations, air pollution control equipment, industrial plants or manufacturing process to evaluate their performance and to take steps for the prevention, control and abatement of air and water pollution.

13.1.2 State Level

In the past decades, Uttar Pradesh (UP) has undergone drastic urbanization that put tremendous pressure on the civic amenities available under both the state and local administration. As such, urban local bodies (ULBs) were formed to cater to the ever-increasing demand for better services.

1) Urban Development Department (UDD)

Currently, there are 634 local municipal bodies in UP – 14 Nagar Nigams, 195 Nagar Palika

Parishads, and 426 Nagar Panchayats. Around 22% of State's total population resides in cities and towns under these ULBs which are responsible for the provision of drinking water, drainage, waste disposal, roads, footpaths and pavements, maintenance of parks and route signage etc.

The Urban Development Department (UDD), also known as Nagar Vikash, not only provides administrative control over the ULBs, but also executes the different development schemes and plans for the ULBs, including provision of financial assistance. The UDD is also entrusted to look into sanitation works, environment and pollution prevention of water bodies in the State, such as rivers lakes and ponds.

One of the units under the UDD is the Local Self Department (also known as Swayat Shasan Vibhag), under which are following departments or organisations are functioning:

- Directorate of Local Bodies (*Sthaniy Nikay*): GoI formed Rural-Urban Relationship Committee in 1971, although formal operations started in 1973. It is headed by a director that manages / controls / administers its functions including finance and compliance to rules and regulation for local bodies. The directorate also acts as an coordinative body to get information on the performance of the local bodies; functions as Nodal Agency for implementation of JnNURM projects, the State Government's model town planning programs etc.
- U.P. JAL Nigam
    - Construction and Design Services (CNDS)
    - Nagar Area Environment Study Centre
    - Ganga Pollution Prevention Unit (GPPU)
- Jal Kal
- Municipal Bodies / Urban Local Bodies

2) Uttar Pradesh Jal Nigam (UPJN)

The Uttar Pradesh Jal Nigam (UPJN) is a corporation that came into existence on the 18th of June 1975. Its area of operation extends to whole of Uttar Pradesh excluding Cantonment areas under the Uttar Pradesh Water Supply and Sewerage Act, 1975. The U.P. Jal Nigam Board consists of a Chairman appointed by the State Government and 11 other regular members, plus one permanent invitee specified in sub-section (2) of the Water Supply and Sewerage Act 1975.

- *Objective:* The basic objective of UPJN is the "development and regulation of water supply and sewerage services and for matters connected therewith". It is, therefore, the apex body responsible for formulation, execution, promotion, financing, setting standards

and fixing tariffs for implementation of water supply and sewerage services, sewage treatment and disposal, and river pollution abatement projects in the State.

- *Functions*: The important functions of UPJN are the following: (i) preparation, execution, promotion and financing the schemes for supply of water and for sewage disposal; (ii) providing all necessary services regarding water supply and sewerage to the State Government and local bodies; (iii) preparation of State plans for water supply, sewerage and drainage on the directions of the State Government; (iv) reviewing and advising on the tariff taxes and charges of water supply in the areas of Jal Sansthans and local bodies which have entered into on agreement with Jal Nigam under Section 46; (v) establishing State standards for water supply and sewerage services; (vi) establishing and maintaining a facility to review and appraise the technical, financial, economic and other pertinent aspects of every water supply and sewerage scheme in the State; (vii) managing, operating, and maintaining any water works and sewerage system if and when directed by the State Government on such terms and conditions and for such period as may be specified by the State Government; and (viii) assessing the requirements for manpower and training in relation to water supply and sewerage services in the State.
- *Tasks*: UPJN is also the principal implementing agency for river pollution control projects for the State. Its task is to prevent the direct flow of wastewater into important river bodies by diverting waste water/ domestic sewage flow to appropriate treatment sites before being allowed to drain out in river bodies. So far, 15 major towns located on the banks of the rivers Ganga, Yamuna and Gomti have been provided with wastewater treatment facilities for cleaning about 42 % of its domestic sewage flow.[2]
- *Organization and Staffing*: UPJN is divided into 14 zones, each headed by a Chief Engineer. The cities enumerated in the survey project fall under UPJN Varanasi Zone. There is also the Construction and Design Services (C&DS), the commercial wing of UPJN, which is headed by a Director. UPJN is a large organization, which has a total personnel complement of 16,145 officers and staff as shown in **Table 13.1.2**.

Table 13.1.2 Officers and Staff of Uttar Pradesh Jal Nigam (UPJN)

2 http://www.upjn.org/introduction.aspx

Serial No.	Designation	Available Posts	Elect / Mech Cadre against Col-2
1	Chairman	1	-
2	Managing Director	1	-
3	Finance Director	1	-
4	Chief Engineer – I	4	-
5	Chief Engineer – II	9	1
6	Superintending Engineer	51	8
7	Manager (E.D.P. Cell)	1	
8	Executive Engineer	199	32
9	System Analyst	2	
10	Chief Accounts Officer	1	-
11	Senior Accounts Officer	8	-
12	Chief Internal Audit Officer	1	-
13	Finance Analyst	1	-
14	Law Advisor	1	-
15	Law Officer	1	-
16	Manager (Ground Water)	1	-
17	Senior Hydro Geologist	1	-
18	Senior Geophysicist	1	-
19	Research Officer	2	-
20	Assistant Engineer	824	111
21	Accounts Officer	12	-
22	Assistant Accounts Officer	4	-
23	Divisional Accountant	253	-
24	Junior Engineer	2110	341
25	Junior Engineer (T) / Computer	154	19
26	Head Draughtsman	53	
27	Draughtsman	374	
28	P.A. (N.T.) / S. O.	34	-
29	Head Assistant	31	-
30	Library In charge	1	-
31	Senior Noter Drafter (Z)/ Circle/ H.Q. / H.C.	308	-
32	N.D. (Z / H.Q.)	561	-
33	Routine Grade Clerk (Z / H.Q.)	828	-
34	PA / PS (Zone / H.Q.)	33	-
35	Steno Grade - 3	89	-
36	Steno Grade - 4	142	-
37	Storekeeper	38	-
38	Telephone Operator / Lab Assistant	9	-
39	Driver	376	-
40	Group (Gha)	1452	-
	Sub Total	7973	-
	Regular Staff (Field)*	8172	
	Total	**16,145**	

Source: http://www.upjn.org/structure_directers_1.aspx. Retrieved 07 October 2015.

Abbreviations:
PA (NT) : Personal Assistant (Non-Technical)
ND : Noter Drafter
HQ : Head Quarter
PS : Personal Secretary
SO : Section Officer

- *Ganga Projects*: The Ganga Action Plan (GAP) was a program launched by GOI in 1985 for conservation of the water quality of holy River Ganga by preventing pollution due to

direct discharge of domestic sewage and industrial waste as well as pollution from non-point sources. The main objectives of the Ganga Action Plan are: (i) abatement of the pollution of the river, (ii) improvement of river water quality by interception and diversion of the drains and sewers falling into the river, (iii) treatment of the domestic sewage before disposal in the environment, (iv) prevention of toxic and hazardous wastes from identified industrial units from entering in to the river, (iv) control of non point pollution of the river from a host of human activities, and (v) conservation of the bio-diversity of the river by adopting an integrated river basin management approach.

Phase I GAP project involved the construction of three new sewage treatment plants in Varanasi with a combined installed capacity of approximately 101,800m³ a day. Currently in the works is Phase II GAP project, which primarily involves the construction of a new 140,000m³/d sewage treatment plant, laying of 34kms of sewers, rehabilitation of existing sewerage systems, and construction of three new pumping stations, namely Phulwaria, Chaukaghat and Saria. Other ancillary project activities include the construction of community toilet complexes, renovation of 26 selected bathing ghats, development of nine dhobi ghats, conduct of public participation and awareness campaigns and an institutional development program.

The UPJN Ganga Pollution Prevention Unit (GPPU) is the implementer of GAP projects, with the executing agency being the NGRBA / the National Mission for Clean Ganga. The Unit is headed by a General Manager with the equivalent rank of Superintending Engineer (Class 1). **Table 13.1.3** shows the personnel strength of the UPJN GPPU.

Table 13.1.3 Personnel Strength of UPJN GPPU

	UPJN GPPU Post	Equivalent Category	Number	Class	Pay Band	Pay Scale Range
1	General Manager	Superintending Engineer	1	1	4	37400-67000+8700
2	Civil Project Manager	Executive Engineer	1	1	4	37400-67000+8700
3	Civil Project Manager	Executive Engineer	2	1	3	15600-39100+5400
4	E/M Project Manager	Executive Engineer	1	1	3	15600-39100+5400
5	Project Engineer	Assistant Engineer	4	2	4	15600-39100+5400
6	Project Engineer	Assistant Engineer	12	2	3	15600-39100+5400
7	Asst Project Engineer	Junior Engineer	48-64	3	3	9300-34800+4200
8	Support / Finance	Support / Finance	40-48		3 & 2	• 9300-34800+4200 • 5200-20200+1900
9	Peon / 4th Class	Peon / 4th Class	12		1	5200-20200+1900
10	Supervisory	Supervisory	120-160		1	5200-20200+1900

Source: UPJN GPPU, 06 November 2015.

3) Uttar Pradesh State Ganga River Conservation Agency (SGRCA / SMPG)

The Uttar Pradesh State Ganga River Conservation Agency (UPSGRCA)[3] was organized under Society Registration Act 1869 (Act No. 21 of 1860). It was registered on the 17th of February 2011.

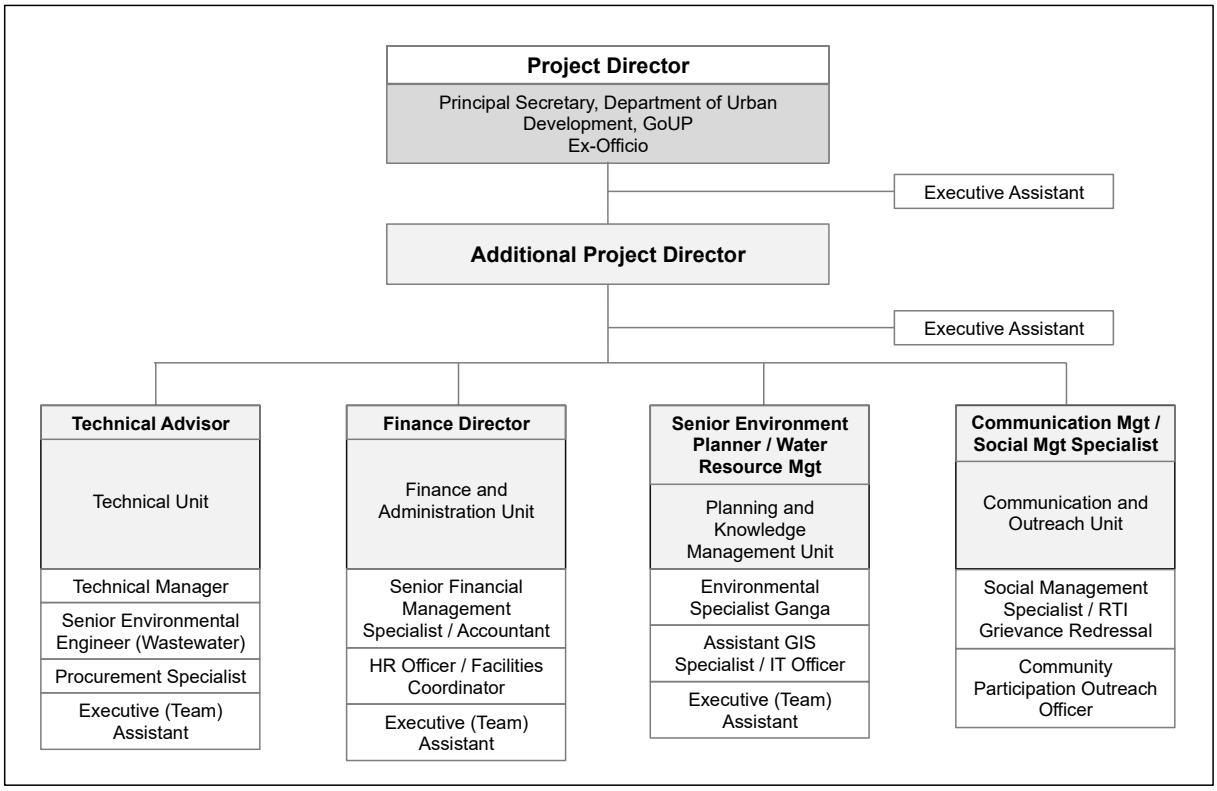
- *Objectives*: The main objective of SGRCA is to undertake measures for effective abatement of pollution of the river Ganga and the environmental and ecological improvement in the State of Uttar Pradesh. It coordinates and implements river conservation activities at the State level towards the comprehensive management of the river Ganga. The SGRCA also functions as the State Level Program Management Group (SPMG) for the implementation of projects sanctioned by NGRBA / NMCG in the State of Uttar Pradesh, although field works are to be carried out through State departments and organizations such as UPJN and the urban local bodies.

  Among its other objectives are: (i) To implement the River Basin Management Programme prepared and approved by the NGRBA and the UPSGRCA; (ii) To monitor the executed programme of NGRBA at State level; (iii) To supervise and coordinate the activities necessary for pollution control and treatment for maintaining the quality of water in river Ganga; (iv) To implement the recycling and reuse of water, rain water harvesting, decentralized sewage treatment system, water conservation and conservation procedures; (v) To facilitate State Government and/or local bodies in issues related to the land acquisition, removal of unauthorised encroachments, contracts for the purpose of implementation of instructions of NGRBA and UPSGRCA.

- *Organization Structure*: The organization structure of UPSGRCA is shown in **Figure 13.1.1**. Currently, there are 21 staff officers in the agency.[4]

3 In the exercise of the powers conferred by sub section 3 of section 3 of the Environment (Protection) Act 1986 (29 of 1986) the Central Government in continuation to Constitution of NGRBA on 20th February, 2009, vide notification No.1570 dated 30th September 2009 constituted the Uttar Pradesh State Ganga River Conservation Authority (SGRCA).

4 Interview with Mr. Jawed Ansari, 8 December 2015, Lucknow.



Source: http://www.sgrca.org/static/OrganizationStructure.aspx. Retrieved 05 October 2015.

Figure 13.1.1 Organization Structure of Uttar Pradesh State Ganga River Conservation Agency (UPSGRCA)

- *Functions*: To realize its objectives, UPSGRCA functions are focused on the following – ensuring that the State Government's consent on the programmes and structures of National Ganga River Basin Authority are obtained from the State Government's share in the programmes; generating public awareness by information, education and publicity drive regarding abatement of water pollution, control and treatment, environmental cleanliness in water of river Ganga; coordinating and implementing the activities of networking of sewerage and sewage treatment structures, remedial steps for treatment of wet land area, river conservation works including using other measures, development of river banks (river front) etc. at the State level.

  In addition, UPSGRCA also works on the appraisal of feasibility reports (FRs) and detailed project reports (DPRs) for programmes under NGRBA; manages funds related to land, acquisition for programmes/ projects and to get management of concerned contracts/ agreements; and prepares practicable suggestions, outlines and alternatives to make these projects financially self-supporting.

- *Project Implementation:* In the implementation of infrastructure projects, UPSGRCA selects the institutions that will undertake projects under the NGRBA programme, as well as selects private institutions for special purpose vehicles and/or the formation of SPVs.

  UPSGRCA has also responsibilities in guiding the concerned Nagar Nigams for capacity building for operation and maintenance (O&M) of their projects by suggesting practicable alternatives to make these projects financially self supporting in meeting the expenditure incurred O&M, including long term declaration of fixing of user charges for of such projects.

  In relation to river front development, UPSGRCA proposes works to improve the quality for river water after completion of River Pollution Controls Projects, so that local citizens and tourists visiting the city are attracted towards river banks. Towards this end, it suggests necessary methods for operation and maintenance of such projects to Nagar Nigams for utilization of Nagar Nigams' income generated from tourism and other commercial resources.

  It undertakes testing at the time of construction, commissioning, operation and maintenance to ensure the treatment of sewage is in accordance to standards prescribed by Government of India, the U.P. Government, the Central Pollution Control Board and U.P. Pollution Control Board; while getting River Pollution Control-related projects completed within stipulated time, cost and quality.

13.1.3 Urban Local Bodies

Three level local bodies have been constituted in accordance with the *74th Constitutional Amendment Act* (1992) in order to assure the participation of the public in (Government) power. These are the Mahanagar Nigam or Nagar Nigam (Municipal Corporation), the Nagar Palika Parishad (Municipal Board) and the Nagar Panchayat (Notified Area Council, City Council or Town Panchayat).

The 'Nagar Nigam' is formed in cities that have populations of more than one million. Its members are elected from the several wards of the specific city on the basis of adult franchise for a term of five years. The Mayor is the head of the municipal corporations; while the Municipal Commissioner is the chief executive officer and head of the executive arm of the municipal corporation. Therefore, all executive powers are vested in the municipal commissioner. Although the municipal corporation is the legislative body that lays down policies for the governance of the city, it is the commissioner who is responsible for the execution of the policies.

The 'Nagar Palika Parishad' is an urban local body that administers a city with population of 100,000 but less than 1,000,000.[5] Under the Panchayati Raj system, it interacts directly with the State Government, though it is administratively part of the district where it is located. Generally, smaller district cities and bigger towns have a Nagar Palika, a form of local self-government entrusted with duties and responsibilities enshrined in the *74th Constitutional Amendment Act* (1992).

The members of the Nagar Palika Parishad are elected representatives for a term of five years. The town is divided into wards according to its population, and representatives are elected from each ward. The members elect a president among themselves to preside over and conduct meetings. A chief officer, along with officers like an engineer, sanitary inspector, health officer and education officer who come from the state public service are appointed by the state government to control the administrative affairs of the Nagar Palika.

The 'Nagar Panchayat', a form of urban political unit, is comparable to a municipality but to a lesser degree, or with an urban centre with more than 11,000 and less than 25,000 residents. Each Nagar Panchayat has a committee consisting of a chairman with ward members. Membership consists of a minimum of ten elected ward members and three nominated members. The members of the Nagar Panchayat are directly elected by electoral from wards of the Nagar Panchayat for a term of five years.

These municipal bodies are vested with functions delegated to them by the State Governments under the municipal legislation, which relate to public health, which includes water supply, sewerage and sanitation, welfare, regulatory functions, public safety, public infrastructure works, and development activities, among others. It also points to sources of income, which are taxes on water, houses / property, markets, entertainment and vehicles paid by residents of the town and grants from the state government. The administrative set-up or structure of India is shown in **Figure 13.1.2.**

[5] However, there are exceptions, as previously Nagar Palikas were constituted in urban centers with population over 20,000 so all the urban bodies which were previously classified as Nagar Palika were reclassified as Nagar Palika even if their population was under 100,000.

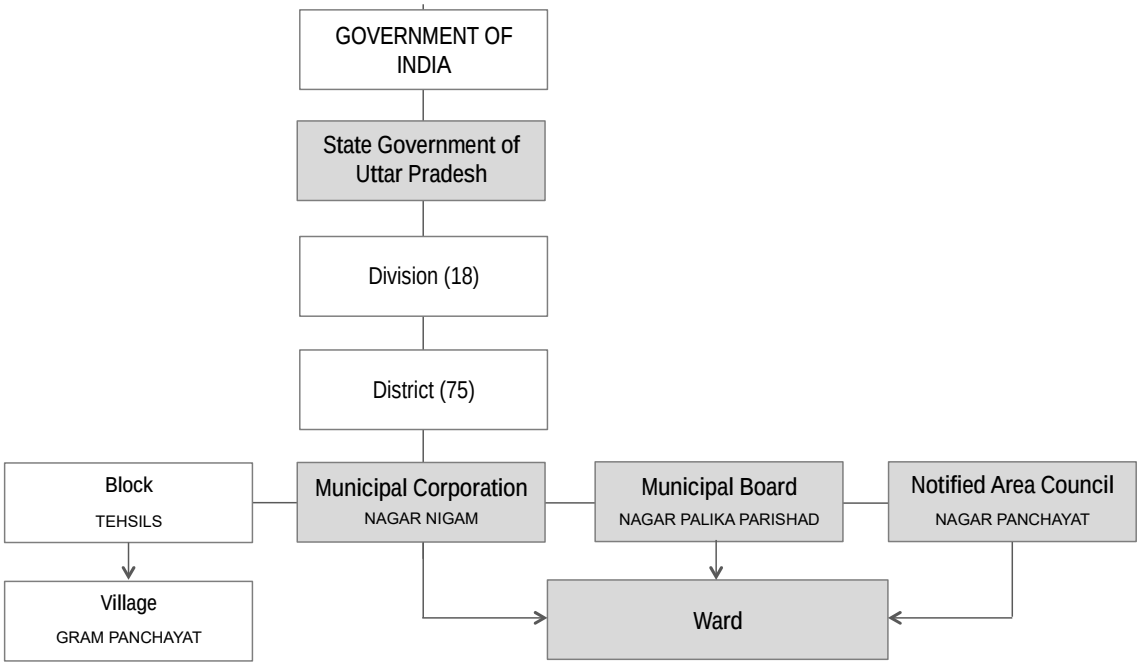


Figure 13.1.2 Administrative Structure (from National to State to ULB) in India

1) Varanasi Nagar Nigam (VNN)

Varanasi Nagar Nigam (also called Varanasi Municipal Corporation or VMC) was established on the 24th of January 1959 under the Act of the Uttar Pradesh Government or the Municipal Corporation Act of 1959 as a Nagar Mahapalika. In 1994, it was converted in to a Nagar Nigam under the Uttar Pradesh Government Act - 2. VNN has 90 wards under it and has within its jurisdiction some of the most densely populated areas in the world, providing basic services to rural and urban villages in its 79.79 sq. km. area.

The Twelfth Schedule of the Act gave urban local bodies like VNN five broad categories of mandates and functions – essential mandates which the ULBs must perform mandates; environmental management functions; planning functions, agency-type functions and functions relating to governance. Two essential municipal functions relating to water supply and sewerage are (i) Water supply for domestic, commercial and industrial purpose and (ii) Public health, sanitation, conservation and solid waste management. A related function, under "environmental management" is urban forestry, protection of environment and the promotion of ecological needs.

There are several activities performed by VNN as an urban local body. However, the major activities based on the above-mentioned mandates / functions directly related to water supply, sewerage and environmental protection are: (i) Managing service utilities like water supply, sewerage and sanitation, storm water drainage, city roads, street lighting and solid waste management; (ii) Maintenance of public gardens, parks, buildings, public area, parking spaces,

street lightings, crematoria and other public utilities; (iii) The assessment and collection of municipal taxes like property tax, water tax and sewer tax, etc.; (iv) Planning and implementation of infrastructure development projects, their progress and monitoring and quality control; (v) Slum improvement works, community facilities, toilets, etc.; (vi) Accounting and credit management including payroll; and (vii) Public relations and grievance redressal.

a) Jal Kal Varanasi (JKV)

Jal Kal Varanasi (JKV), also known as Jal Kal Vibhag, is presently one of VNN's departments and was formed with the merger of Varanasi Jal Sansthan6 with VNN in 2010.

- *Powers and Duties of JKV*: The duties of JKV are the same as when it was still an autonomous Jal Sansthan. These are: (i) Ensuring uninterrupted supply of drinking water in the city; (ii) Provision of proper sewerage facility to the citizens; (iii) Creating awareness among the citizens for conservation of water; (iv) Controlling infections in water supply; (v) Bringing transparency in the works (duties) of Jal Sansthan and to provide better facilities to the citizens; (vi) Placing, proceeding and executing the plans of water availability; (vii) Supervision of maintenance of the water availability processes; (viii) Preparing plans for sewer arrangement disposals related to sewerages etc., their progress, execution and enforcement, wherever necessary; and (ix) Cleaning the manholes and looking after the maintenance of sewer lines.

  In addition to the above, there are also water supply services that JKV provides to its customers in the areas of operation and maintenance of the facilities for water supply production and distribution up to individual house connection; operation and maintenance of the sewer networks, including connecting households and institutions to the sewer network; billing and collection for the services it renders, and also public information, education and communication services as it relates to raising awareness on water conservation and sanitation measures.

  There are powers vested also in JKV such as the execution of all the works related to water availability, sewer arrangement and sewer related disposal; the collection of land

6 Varanasi Jal Sansthan (VJS) was constituted under the *Water Supply and Sewerage Act 1975* (Section 18 (1) of UP Government in Lucknow) to provide its citizens with supply of pure drinking water and proper sewerage facilities.

and other property taxes, having an authorized right on them, and sustaining it; carrying out any construction works related to water supply or sewer arrangement; the improvement or amendment of tariffs for water availability and sewer arrangements; and recovering the taxes for these services whatever are decided.

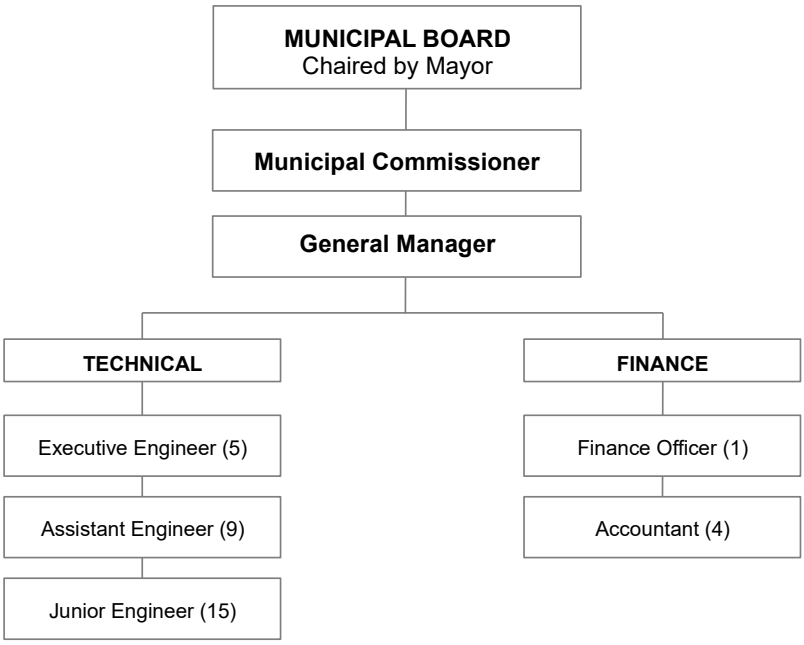
- *Functions of JKV*: The main functions of JKV are: (i) To plan, promote and execute schemes of and operate as efficient system of water supply; (ii) Where feasible, to plan, promote and execute schemes of, and operate, sewerage, sewage treatment and disposal and treatment of trade effluents; (iii) To manage all its affairs so as to provide the people of the area within its jurisdiction with wholesome water and where feasible, efficient sewerage service; and (iv) To take such other measures, as may be necessary, to ensure water supply in times of any emergency. In addition, JKV is also responsible for the collection of revenue in terms of water tax, water charges, sewer tax and sewer charges and bears all expenses related to the operation and maintenance of water supply and sewerage system.

  It should be noted that while the water supply system is fully operated and maintained by JKV, the sewerage system's operation and maintenance is shared by JKV and UPJN. Activities pertaining to O&M of the sewer network, connecting households to the system, and billing and collection of sewer charges are performed by JKV; while O&M of the sewage treatment plants and all major pumping stations are performed by UPJN.[7]

- *Organization and Staffing of JKV*: The organization structure and manpower requirement of JKV are still based on 1975 statistics when the population of Varanasi was five lakhs, which corresponded to the water supply and sewerage services' needs of the city at that time.[8] The current JKV organization is still established along the 40-year old structure; however, it takes into consideration the line of authority from VNN. As shown in **Figure 13.1.3**, the structure is delineated along two main areas/ divisions/ streams – technical and finance.

7 Uttar Pradesh Jal Nigam. *Detailed Project Report for Sewerage Treatment Plant Assi-BHU Sewerage District*, *Varanasi* (Volume I), p. 13.

8 Interview with JKV Executive Engineer/ Secretary, 04 November 2015.



Source: http://www.jalkalvaranasi.org/webpages.php?tag=Organisational_Structure. Retrieved 05 October 2015.

Figure 13.1.3 Organization Structure of Jal Kal Varanasi (JKV)

The technical area/ division is further subdivided into four water supply and sewerage zones, each headed by an executive engineer. Each water supply and sewerage zone has its own commercial, finance and accounting, and administrative staff. The finance area/ division/ stream consolidates the transactions of the water supply and sewerage zones.

For governing municipalities in the state of Uttar Pradesh, the Municipalities Act, 1916 was promulgated on 01 July 1916. The Act also contained provisions (Section 57 to 80 of the Act) regarding the recruitment of service staff of municipalities. In particular, centralized services in the municipalities are governed by provisions of Section 69-B of the Act (1916) and the Rules framed thereunder, as amended by UP Act No. 15 (1983) and UP Act No. 5 (1984). The provisions of 69-B Centralization of Services of Municipal Officers and Servants asserts that the State Government may at any time, by rules provide for creation of one or more services of such officers and servants as the State Government may deem fit, common to all or some Municipal Boards or to the Municipal Boards and prescribe the methods of recruitment. Service Rules for Centralized Services of Municipalities were framed applicable to municipalities covering the following services: (i) Administrative (Superior) and Administrative (Subordinate) services; (ii) Revenue (Superior) and Revenue (Subordinate) services; (iii) Engineering (Superior) and Engineering (Subordinate) services; (iv) Water works Electrical and Mechanical

Engineering (Superior); and Water works Electrical and Mechanical Engineering (Subordinate) services; (v) Accounts (Superior) and Accounts (Subordinate) services; (vi) Audit (Superior) and Audit (Subordinate) services; (vii) Public Relations service; and (vii) Palika Ministerial service.

The centralized cadre for all Urban Local Bodies of the state of UP is the source of the recruitment of officers. Accordingly, there are two types of personnel in terms of recruitment, selection and placement – Groups A and B cadre, recruited by the State Government (centralized) and Groups C and D cadre, hired by the Urban Local Bodies (decentralized). However, the senior and middle level employees (such as the engineers of JKV now merged with VNN) are regulated by the Rules and Regulations under the Director of Local Bodies UP under Urban Development Department, whereas the clerical and worker grades are regulated by VNN, which is also allowed to recruit personnel under contract basis, as and when necessary.

The categorization of employees from Group A to D as follows: Group A are those officers vested with executive power and decision making powers; Group B are officers with some supervisory/ managerial role; Group C are semi-skilled with no decision-making authority (eg. clerk, head clerk, assistant typist, telephone operator, etc.) and Group D are unskilled or semi-skilled (eg. peon, attendant, driver, gardener, etc.).

The current human resources configuration of JKV was carried over from the former Jal Sansthan, which was approved sometime in 1998. Since then, there has been no official change in the number of sanctioned posts for personnel Class 1 through 4 where Class 1 refers to gazetted top managerial officers; Class 2 refers to mid-level gazetted officers; Class 3 refers to non-gazetted technicians; and Class 4 refers to fourth class non-gazetted employees. Gazetted officers/employees are those whose transfer, appointment, promotion and superannuation are published on a yearly basis in the Official Gazette.

The total number of sanctioned posts per cadre is 30 under the centralized cadre, and 1,087 under the non-centralized cadre for a total 1,117 sanctioned posts. The distribution is shown in **Figure 13.1.3**.

Table 13.1.4 Distribution of Sanctioned Posts under JKV

Cadre	Post Includes	Sanctioned Post	Filled Post	Vacant Post
Centralized Recruited by State Government	General Manager	1	1	0
	Executive Engineer	5	3	2
	Assistant Engineer	9	2	7
	Junior Engineer	15	5	10

	Sub-total	30	11	19
Non-centralized Recruited locally by the GM's office	Administrative	2	0	2
	Class III (Clerks, Accounts Assistant, Supervisors)	149	86	63
	Class IV (Khalasi, Fitter, Plumber, Peon, Watchman)	936	412	524
	Sub-total	1087	498	589
	Total	**1117**	**509**	**608**

Source: Jal Kal Varanasi, 05 November 2015.

Table 13.1.5 shows that there are three categories of designations/ posts under Group A, two categories under Group B, 24 categories under Group C, and 37 categories under Group D.

Table 13.1.5 Sanctioned Posts' Categories Distributed according to Groups

Sr. No	**Groups A, B, C: Engineering Cadre** Designation / Post	**Sanctioned Post**	**Filled Post**	**Vacant Post**	**Pay Band**
1	General Manager (A)	1	1	0	15600-39100
2	Executive Engineer (A)	5	3	2	15600-39100
3	Assistant Engineer (B)	9	2	7	9300-34800
4	Junior Engineer (C)	15	5	10	5200-20200
	Sub-Total	*30*	*11*	*19*	
Sr. No	**Groups A & B: Accounts Cadre** Designation / Post	**Sanctioned Post**	**Filled Post**	**Vacant Post**	**Pay Band**
1	Finance Officer (A)	1	0	1	15600-39100
2	Accounts Officer (B)	1	0	1	9300-34800
	Sub-Total	*2*	*0*	*2*	
Sr. No	**Groups C** Designation / Post	**Sanctioned Post**	**Filled Post**	**Vacant Post**	**Pay Band**
1	Chemist	3	1	2	5200-20200
2	Pump House Superintendent	2	2	0	5200-20200
3	Stenographer	3	1	2	5200-20200
4	Lower Division Assistant (Clerk)	27	15	12	5200-20200
5	Junior Accounts Assistant (LDA)	8	4	4	5200-20200
6	Meter Inspector	1	0	1	5200-20200
7	Tax Inspector- II	35	28	7	5200-20200
8	Meter Reader	20	6	14	5200-20200
9	Metering Supervisor	6	0	6	5200-20200
10	Cashier	1	0	1	5200-20200
11	Draftsman	1	0	1	5200-20200
12	Personal Assistant	1	1	0	5200-20200
13	Office Superintendent	1	1	0	5200-20200
14	Chief Typist (Clerk)	2	2	0	5200-20200
15	Upper Division Assistant	12	10	2	5200-20200
16	Assistant Tax Superintendent	1	1	0	5200-20200
17	Tax Superintendent	1	0	1	5200-20200
18	Tax Inspector	11	7	4	5200-20200
19	Accountant	3	1	2	5200-20200
20	Assistant Accountant	2	2	0	5200-20200
21	Accounts Assistant (Clerk)	4	4	0	5200-20200
22	Accounts Auditor	2	0	2	5200-20200
23	Assistant Accounts Auditor	2	0	2	5200-20200
	Sub-Total	*149*	*86*	*63*	
Sr. No	**Group D** Designation / Post	**Sanctioned Post**	**Filled Post**	**Vacant Post**	**Pay Band**
1	Peon	42	40	2	4440-7440
2	Electrician	9	1	8	4440-7440
3	Car Driver	6	3	3	4440-7440
4	Carpenter	2	0	2	4440-7440
5	Pattern Maker	1	0	1	4440-7440

6	Meter Mechanic	2	0	2	4440-7440
7	Blacksmith	3	0	3	4440-7440
8	Sweeper/ Cleaner	4	2	2	4440-7440
9	Turner	6	3	3	4440-7440
10	Welder	1	1	0	4440-7440
11	Asst. Moulder	3	0	3	4440-7440
12	Junior Fitter	29	0	29	4440-7440
13	Fitter Helper	4	0	4	4440-7440
14	Valve Operator	262	104	158	4440-7440
15	Hammerman	3	0	3	4440-7440
16	Gardener	10	8	2	4440-7440
17	Storekeeper	3	0	3	4440-7440
18	Furnace Man	2	0	2	4440-7440
19	Watchman	29	26	3	4440-7440
20	Khalasi	176	178	(-) 2	4440-7440
21	Chlorine Doser	10	2	8	4440-7440
22	Painter	1	0	1	4440-7440
23	Office Attendant	2	2	0	4440-7440
24	Foreman	2	0	2	4440-7440
25	Chief Electrician	2	2	0	4440-7440
26	Shift In charge	5	0	5	4440-7440
27	Chief Fitter	2	2	0	4440-7440
28	Fitter	20	2	18	4440-7440
29	Moulder	1	0	1	4440-7440
30	Mechanical Filter Operator	4	0	4	4440-7440
31	Mason	3	0	3	4440-7440
32	Tandail	3	0	3	4440-7440
33	Chief Gardener	1	1	0	4440-7440
34	Chief Watchman	1	0	1	4440-7440
35	Chief Sweeper	2	0	2	4440-7440
36	Sweeper	10	3	7	4440-7440
37	Sewer Cleaner	270	32	238	4440-7440
	Sub-Total	*936*	*412*	*524*	
	TOTAL	**1117**	**509**	**608**	

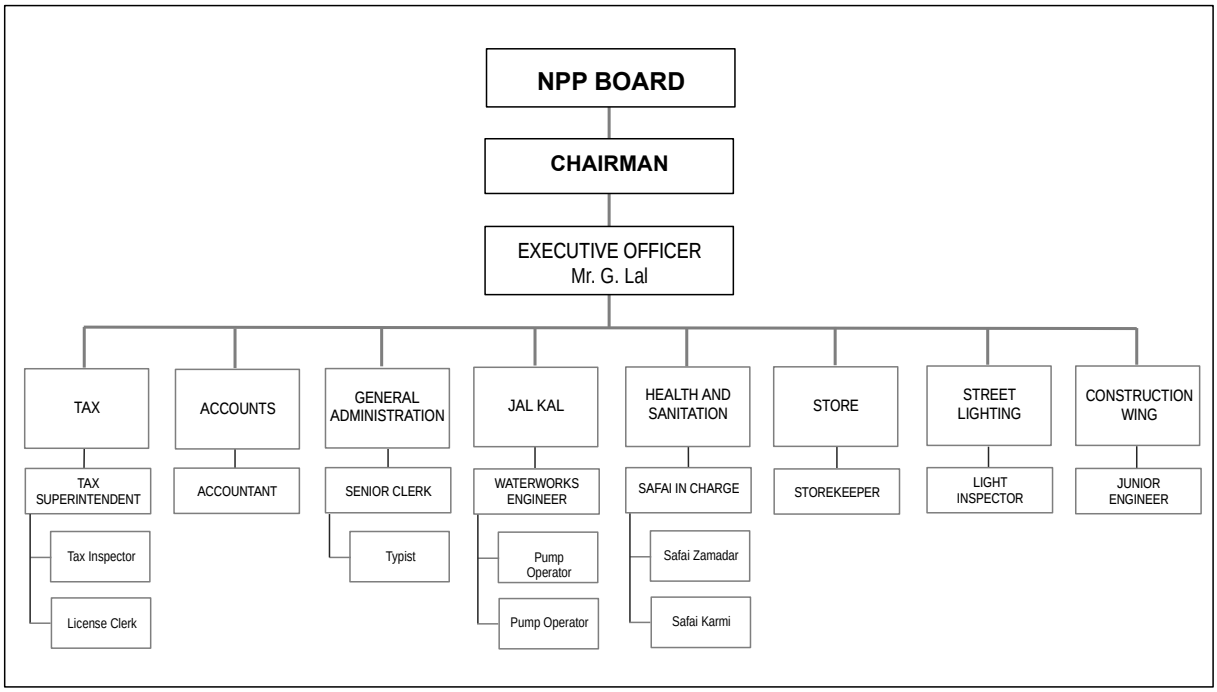
Source: Jal Kal Varanasi, 05 November 2015.

The personnel of JKV are treated as a "staff pool" in that they may have primary areas of assigned responsibility, but they can be rotated and/or assigned to other organisational areas depending on current needs and priorities. They can either be assigned to water supply operations or sewerage operations or both.

2) Ramnagar Nagar Palika Parishad (NPP)

Ramnagar is a Nagar Palika Parishad city in the district of Varanasi, Uttar Pradesh. Ramnagar city has a population of 49,132 (Census India 2011) and is divided into four wards for civic maintenance, which is further divided into 25 sections. It has total administration over 7,729 houses to which it supplies basic community services such as water supply and solid waste management services. Ramnagar is authorized to build roads within NPP limits and impose taxes on properties and collect water fees under its jurisdiction.

The administrative set-up of Ramnagar Nagar Palika Parishad is shown in **Figure 13.1.4**.



Data sourced from Ramnagar NPP on 04 November 2015

Figure 13.1.4 Organization Structure of Ramnagar Nagar Palika Parishad

The Jal Kal of Ramnagar currently provides only water supply services. It has the following facilities: 15 tube wells; one mini power tube well; 160 hand pumps; 80 public stand posts; six water tankers; 80 kms of distribution pipelines. The production capacity comes up to 158MLD

The Ramnagar Jal Kal is headed by a Junior Engineer, but the position has been left vacant. The Clerk now "heads" the Jal Kal as of this time. While there are 17 sanctioned posts, only 14 are filled. To augment staff, 10 assistant pump operators have been outsourced. See **Table 13.1.6** for the staffing of Jal Kal Ramnagar.

Table 13.1.6 Distribution of Posts under Jal Kal (Ramnagar)

S.L.	Category of Post	Number		Pay Band
		Sanctioned	Non-Sanctioned	
1	Junior Engineer	1 (vacant)	1	5200-20200
2	Clerk	1	2	5200-20200
3	Fitter	1	3	4440-7440
4	Pump Operator	1 (vacant)	4	4440-7440
5	Pump Attendant	1 (vacant)	5	4440-7440
6	Pump Driver	1 (vacant)	6	4440-7440
7	Cleaner	5	2	4440-7440
8	Gardener	2	7	4440-7440
9	Chowkidar	4		4440-7440
	Total	**17**	2	**8**

The main source of supply is groundwater. There are 6,987 piped water connections, with water supply coverage at 92% of the service area. Water tax is collected from the customers at 7.5% of property tax and the water fee is Rs.120 per annum per connection.[9]

The six water tankers at Jal Kal utilized to cater to customers during disruptions of water supply. These tankers also deliver water for construction requirements and social functions such as weddings. There charges are Rs.200 per tanker for domestic consumption and Rs.500 per tanker for commercial use.

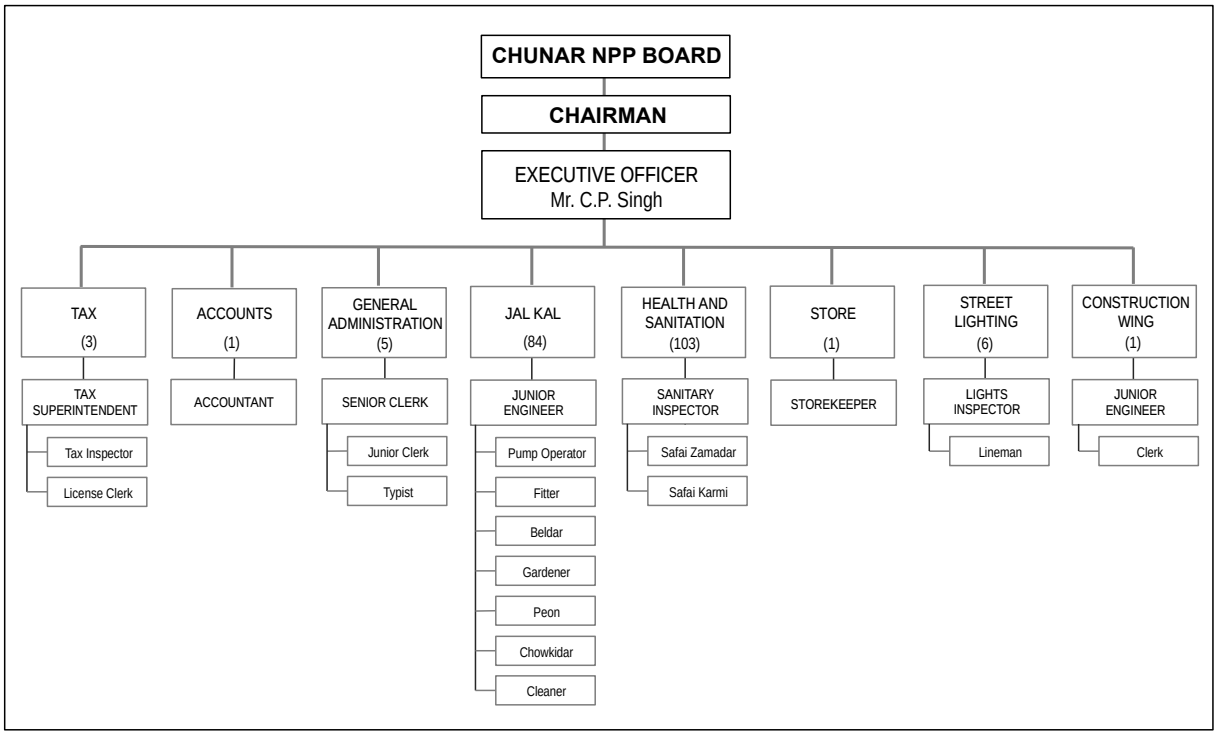
The clerk responsible for water supply receives customer complaints either in writing or through phone. These are all registered in a logbook. On the average 15-20 complaints are received during the monsoon season, while 3-5 complaints are received during other periods. Common complaints are "dirty" water and leakages.

3) Chunar Nagar Palika Parishad (NPP)

Chunar is a Nagar Palika Parishad city in the district of Mirzapur, Uttar Pradesh with a population of 37,185 (Census India 2011) that is spread over its 25 wards. Chunar NPP has total administration over 5,951 houses to which it provides basic community services under its jurisdiction, such as water supply and solid waste management, street lighting and roads and parks, and for which it also imposes and collects taxes on properties and services. It is also in charge of the construction repair and cleaning of street drains and storm water drains. There is no sewerage system in Chunar as of the present time.

Chunar is headed by an Executive Officer who is responsible for civic infrastructure in the city. The administrative set-up is presented in **Figure 13.1.5**.

[9] If the water tax for a household is Rs.180 and the water charge is Rs.120, the customer pays the higher amount of the two. In that case, the person pays Rs.180, which is going to be adjusted as Rs. 120 towards water tax, and Rs.60 towards water charge.



Data sourced from Chunar NPP on 20 November 2015.

Figure 13.1.5 Administrative Set-up of Chunar NPP

The total staff complement of 204 personnel in Chunar NPP is spread over eight functional divisions that are common to all NPPs. **Table 13.1.7** shows the summary of personnel per unit / division.

Table 13.1.7 Distribution of Personnel according to Wing, Chunar NPP

S.L	Name of Wing / Unit / Division	No. of Personnel
1	Tax	3
2	Accounts	1
3	General Administration	5
4	Jal Kal	84
5	Health and Sanitation	103
6	Store	1
7	Street Lighting	6
8	Construction	1
	Total	**204**

As on 30 October 2015

Chunar Jal Kal is comprised of 84 staff members and is headed by a waterworks engineer who holds the rank of a junior engineer. The distribution of staff according to post and number, including information on pay band, is shown in **Table 13.1.8**.

Table 13.1.8 Distribution of Posts for Chunar Jal Kal

S.L.	Category / Post	Number			Pay Band
		Sanctioned	Non-Sanctioned	Total	
1	Water Works Engineer	1		**1**	5200-20200
2	Pump Operator	4	42	**46**	4440-7440
3	Fitter	1		**1**	4440-7440
4	Beldar	2	26	**28**	4440-7440
5	Gardener	2		**2**	4440-7440
6	Peon	2		**2**	4440-7440
7	Chowkidar	3		**3**	4440-7440
8	Cleaner	1		**1**	4440-7440
	Total	**16**	**68**	**84**	

As on 30 October 2015

The source of water supply for Chunar Jal Kal is 29 tube wells. It has 8,375 domestic piped connections, which is equivalent to 95.4% coverage of its service area.[10] There are four tankers with a capacity of 4,000 liters used to supply water in times of disruptions, and also to cater to construction needs and social requirements during weddings and other functions. The cost of one full tanker delivery is Rs.450.

Chunar Jal Kal charges a water tax of 10% of the property tax, plus a water charge of Rs.180 per annum per connection.

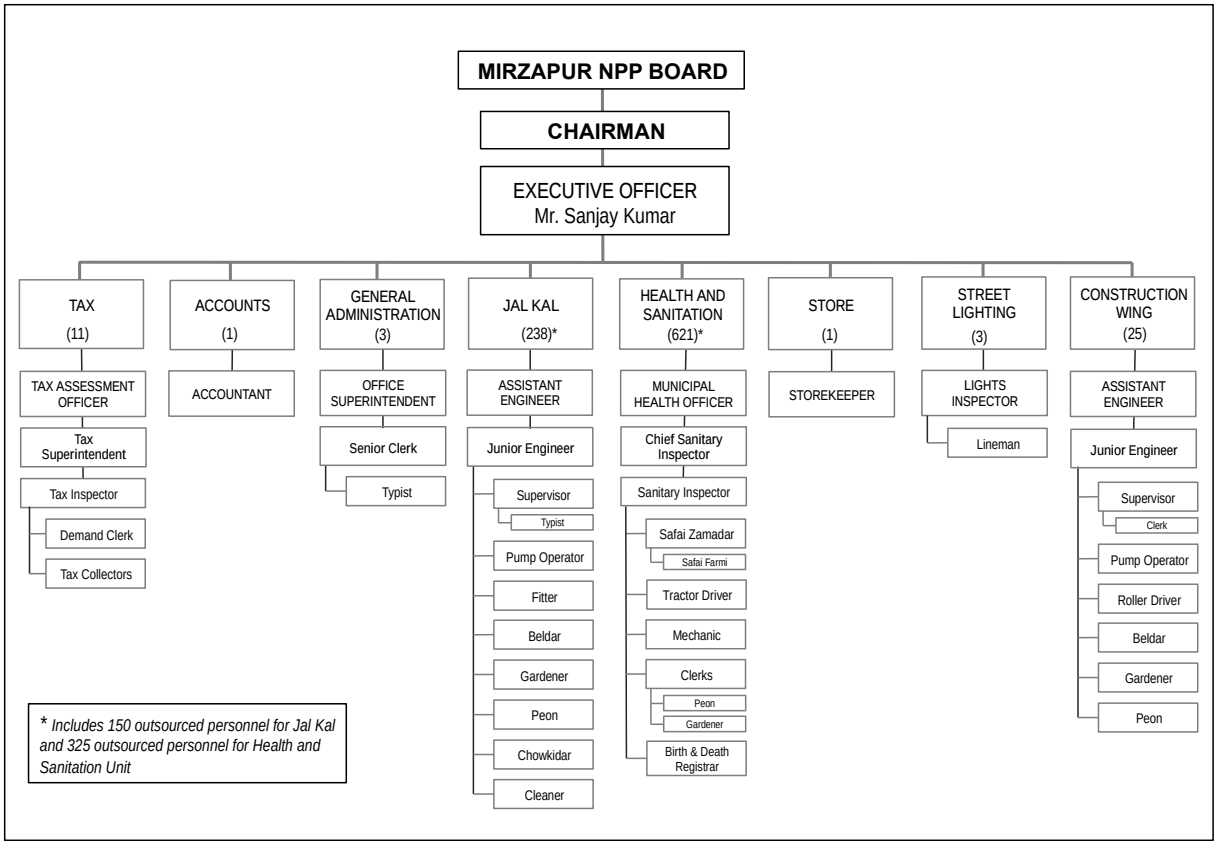
Customer complaints are received the by clerk responsible for water supply, and every complaint is logged in a complaint register. Customers either complain in writing, or via phone call. An average of 50 complaints are received every month, and the most common are “dirty” or turbid water during the monsoon season, leakage, and stand post breakdown.

4) Mirzapur Nagar Palika Parishad (NPP)

Mirzapur is a Nagar Palika Parishad city in the district of Mirzapur, Uttar Pradesh. It has a population of 234,871 (Census India 2011) and has 35 wards. Presently, Mirzapur NPP administers 38,185 houses to which it delivers basic community services like water supply and sewerage. It also provides street lighting, builds and maintains roads and parks under its jurisdiction. For civic maintenance, it constructs, repairs and cleans street and storm water drains. For all these services, the NPP imposes and collects taxes on properties and fees on its services.

[10] Interview with Shamsher Singh, Waterworks Engineer, Chunar Jal Kal 20 November 2015.

Mirzapur NPP is headed by an Executive Officer who has management and supervision over its personnel. The organisational / administrative set-up of Mirzapur NPP is presented in **Figure 13.1.6**.



Data sourced from Mirzapur NPP on 21 November 2015.

Figure 13.1.6 Organizational / Administrative Structure of Mirzapur NPP

There are 903 personnel in Mirzapur NPP, and they have been distributed in the eight wings / divisions as shown in

Table 13.1.9 Distribution of Personnel according to Wing, Mirzapur NPP

S.L	Name of Wing / Unit / Division	No. of Personnel
1	Tax	11
2	Accounts	1
3	General Administration	3
4	Jal Kal	238
5	Health and Sanitation	621
6	Store	1
7	Street Lighting	3
8	Construction	25
	Total	**903**

As on October 30, 2015

Mirzapur Jal Kal is headed by an Assistant Engineer. He takes charge of managing, operating and maintaining water supply facilities in the city composed of the surface and ground water sources (63 tube wells of production capacity of 20 MLD and 450 mini-tubewells with production capacity of 7 MLD), 11 overhead tanks, 355 kms of distribution pipelines and a 6 MLD water treatment plant.

The total number of staff of Mirzapur Jal Kal is 238 personnel, broken down into – 88 sanctioned and non-sanctioned personnel, plus 150 outsourced personnel. The distribution of personnel per category / post is shown in **Table 13.1.10** below.

Table 13.1.10 Distribution of Posts under Mirzapur Jal Kal

SL	Category / Post	Sanctioned		Non-Sanctioned	Total Staff	Pay Band
		Filled	Vacant	Number		
1	Waterworks Asst. Engineer	1	0	0	**1**	9300-34800
2	Junior Engineer	1	2	0	**1**	5200-20200
3	Supervisor	1	0	0	**1**	5200-20200
4	Clerk/Typist	3	0	0	**3**	5200-20200
5	Fitter	4	0	0	**4**	4440-7440
6	Beldar	21	0	0	**21**	4440-7440
7	Pump Operator	41	2	0	**41**	4440-7440
8	Foreman	1	0	1	**2**	4440-7440
9	Gardener	5	0	1	**6**	4440-7440
10	Chowkidar	2	0	0	**2**	4440-7440
11	Peon	6	0	0	**6**	4440-7440
12	Outsourced Personnel	0	0	0	**150**	
				Total	**238**	

As on 30 October 2015

There are 19,000 domestic / piped water connections, which is equivalent to a service coverage of 51% of the service area. In times of piped water disruptions, there are tanker services – 12 nos. of 5,000-litre water tankers for Rs.5000 per full tank and 10 nos. of 3,000 litres at Rs.3000 per full tank.

Water tax for Mirzapur is 10% of house tax plus a water charge of Rs600 per annun for domestic customers. Commercial customers are charged as follows:

- Tea shop / sweet shop Rs.100/ month
- Restaurants Rss150/ month
- Hotel/ Nursing Home Rs.200/ month
- Ice cream factory/ Wedding Hall / Carpet Factory Rs.300/ month

In terms of customer redressal, complaints are attended to within 24 hours. These are received by the clerk responsible and logged in the complaint register. Complaints are either given in writing, or are called in through phone. On the average, 250 complaints are received every month, the most common of which are "dirty" water or turbid water, non-functioning or breakdowns of mini-tube wells, leakages and motorized tube wells that are out of order.

There are two sewage treatment plants in Mirzapur – 4MLD and 14MLD sewage treatment plants. However, these plants are being operated and maintained by UPJN. According to the Mirzapur Executive Officer, around 1,889 households are connected to the sewerage system, and there are plans to charge a sewer tax in the future.

5) Ghazipur Nagar Palika Parishad (NPP)

Ghazipur came into existence in 1868, and in 1973 was upgraded into a Category II city. Presently, Ghazipur is an Urban Agglomeration coming under category of Class I UAs/Towns in the State of Uttar Pradesh. Although Ghazipur City has population of 110,587; its urban / metropolitan population is 121,020. (Census India 2011). The city, which has 28 wards, is governed by Nagar Palika Parishad. Ghazipur City is situated in Ghazipur Urban Region and is the headquarters of Ghazipur District.

The organisational / administrative set-up of Ghazipur NPP is presented in **Figure 13.1.7** Organizational / Administrative Structure of Ghazipur NPP.

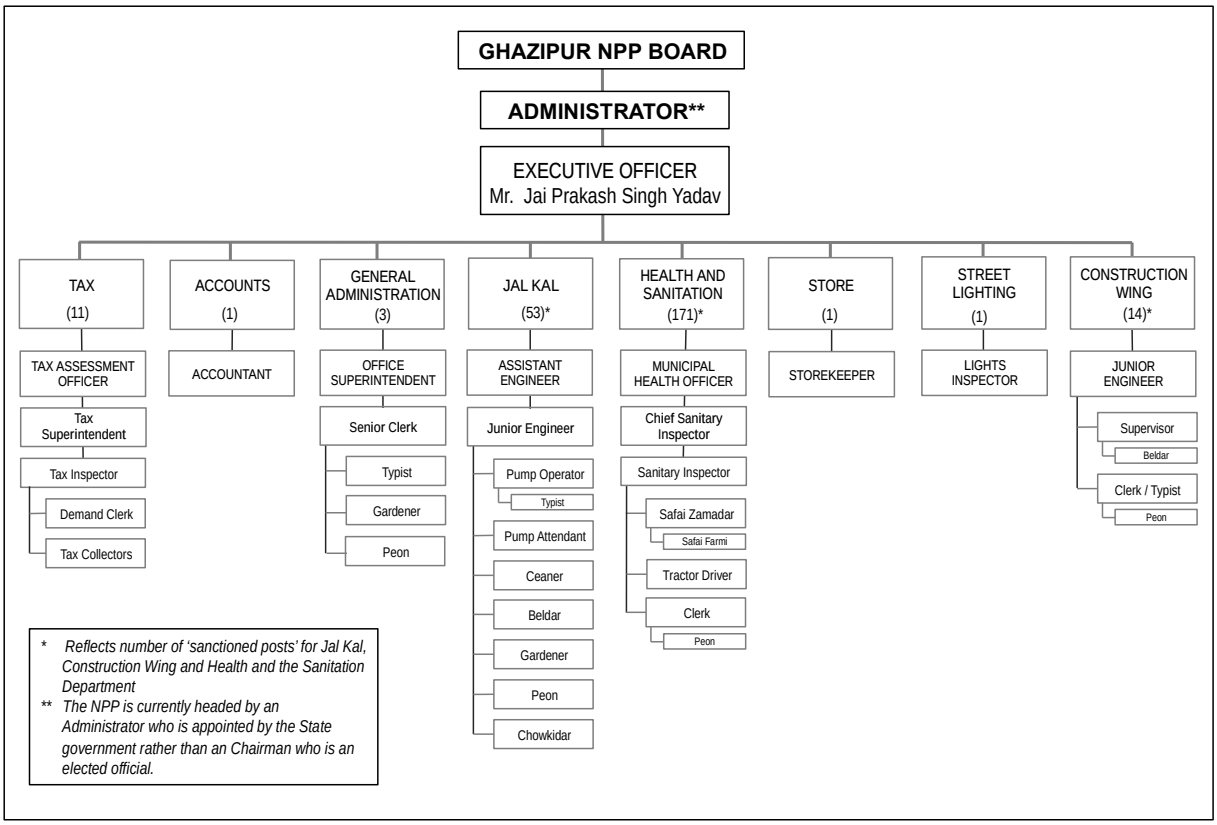


Figure 13.1.7 Organizational / Administrative Structure of Ghazipur NPP

The distribution of personnel in Ghazipur NPP is shown in **Table 13.1.11**.

Table 13.1.11 Distribution of Personnel according to Wing, Ghazipur NPP

S.L	Name of Wing / Unit / Division	No. of Personnel*
1	Tax	10
2	Accounts	2
3	General Administration	5
4	Jal Kal	53
5	Health and Sanitation	171
6	Store	1
7	Street Lighting	1
8	Construction (only eight out of 14 posts filled up)	14
	Total	**257**

* As per 'sanctioned posts' As on October 30, 2015

Ghazipur Ja Kal is divided into four water supply zones. Its existing facilities are: 36 nos. of tubewells with a production capacity of 1MLD per tubewell that each has a average depth of 150 meters; overhead reservoirs with a total storage capacity of 10.59 million litres; and 94.55 kms. of distribution pipelines. Treatment of groundwater is done through chlorination before being

pumped into the overhead storage reservoirs. Water is then distributed by gravity to the service area. There is no sewerage system in Ghazipur.

Water revenue is charged as 10% of the property tax, plus a water charge of Rs.600 per annum to the 10,312 customers with piped water connections, which are all under "domestic" customer category. In times of water disruptions, there are two water tankers with a capacity of 3,000 litres (Rs.300 per tank) that supply water to the customers, as well as for construction purposes, and when requested, for social functions.

Customer complaints are received by the Jal Kal clerk and are recorded in a complaint register. These come either in written format, through phone call, or through personal visit by the complainant. On the average, 60 complaints are lodged and the most common complaints range from leakage, hand pump breakdown and the breakdown of the public stand posts.

There is a total of 43 staff in the Jal Kal, which is headed by a Junior Engineer. However, this post remains vacant. Instead, the JE of the Construction Wing is the concurrent head of the Jal Kal.11 The distribution of posts for Ghazipur Jal Kal is shown in **Table 13.1.12**.

Table 13.1.12 Distribution of Posts under Jal Kal Ghazipur)

SL	Category / Post	Sanctioned		Non-Sanctioned	Total Staff	Pay Band
		Filled	Vacant	Number		
1	Junior Engineer*	0	1	0	**0**	5200-20200
2	Clerk/Typist	1	0	0	**1**	5200-20200
3	Fitter	0	2	1	**1**	4440-7440
4	Beldar	9	0	0	**9**	4440-7440
5	Pump Operator	3	1	0	**3**	4440-7440
6	Pump Attendant	15	5	0	**15**	4440-7440
7	Cleaner	3	0	0	**3**	4440-7440
8	Gardener	1	1	0	**1**	4440-7440
9	Chowkidar	10	1	0	**9**	4440-7440
10	Peon	1	0	0	**1**	4440-7440
				Total	**43**	

As on 30 October 2015

***** The post of Junior Engineer (JE) under Jal Kal Ghazipur is vacant, but the JE assigned under the Construction Wing is the concurrent head of Jal Kal.

[11] Interview with Mr. Vivekananda Singh, Junior Engineer, Construction Wing, Ghazipur. 24 November 2015.

13.2 Project Implementation System

The federal Constitution of India treats water supply and sanitation as a State matter. As such, States are vested with the constitutional right on planning, implementation, operation and maintenance and cost recovery of water supply and sanitation projects.

The role of the Central Government in water supply and sanitation is in the crafting of policy, the formulation of guidelines, and provision of implementation support for specific laws. It also acts as an intermediary in mobilizing external assistance in the sector and links assistance via State plans. To some extent, it sometimes provides direct grant assistance to water supply and sanitation programs in urban areas.

On the local level, the responsibility for the provision of water supply, sewerage services, and sanitation is entrusted by legislation to the urban local bodies like the municipal corporation, the municipal board, and the municipal council.

The successful implementation of the Ganga Rejuvenation Project entails setting up an effective project implementation system, with clearly defined responsibilities and provision for accountability that would take into consideration the following realities:

- The mutual agreements between both the lender, the Government of Japan (GOJ) through the Japan International Cooperation Agency (JICA), and the borrower, the Government of India (GOI) which will utilize the funds for the ULBs under consideration in the Project;
- The most recent policy decision of the Government that sewage treatment is to be mandatory and that all STPs along the river Ganga shall be taken up through the hybrid annuity-PPP mode. In addition, the institutionalization of the Special Purpose Vehicle (SPV) shall be also taken up for project execution through Transaction Advisors.

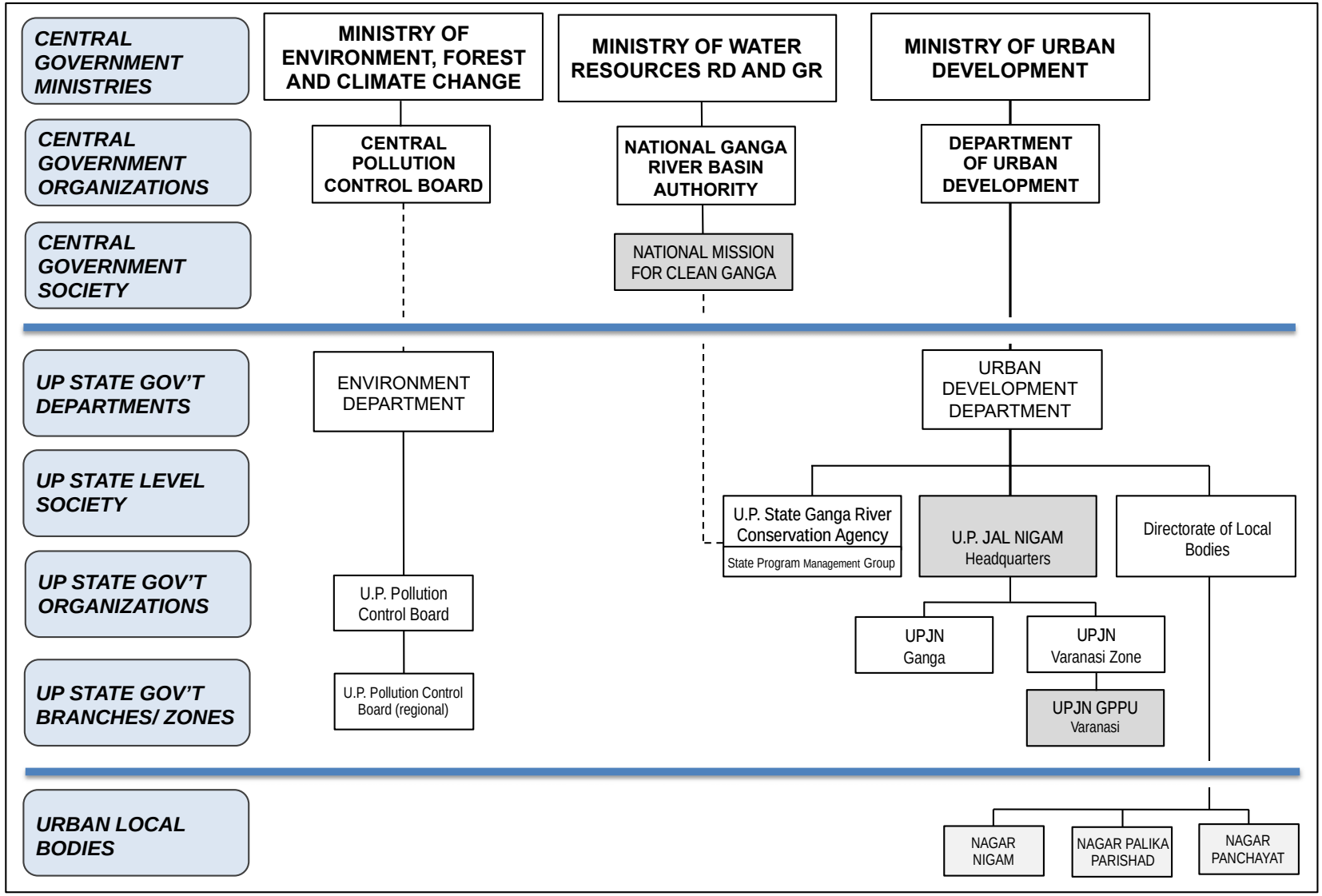
13.2.1 Current Institutional Framework for Water Supply and Sanitation

The objective of undertaking measures to prevent pollution in the river Ganga is not only to improve the water quality in India's holiest river, the Ganges, or the hygienic condition in the river basin; but also to improve the sanitation and living conditions of people who reside in the Project area. Among the approaches to address current sanitation situation is the construction of sanitation facilities to treat sewage before this is discharged into the Ganges. This means augmenting sewage collection systems and sewage treatment facilities leading to improved sewerage services, as well as implementing measures for efficient management both in the technical, institutional and financial aspects, including operation and maintenance of sewerage facilities.

There are central government, state and local government actors / stakeholders which make up the current institutional framework in the water supply and sanitation sector. These are:

- *For central government ministries* – the Ministry of Water Resources, River Development and Ganga Rejuvenation, under which the National Ganga River Basin Authority, and its implementation / operational arm, the National Mission for Clean Ganga are allocated; The Ministry of Environment, Forests and Climate Change, and the Ministry of Urban Development. These central government agencies formulate policies, plan and monitor program and project execution, and coordinate activities with other central ministries, state-level governments, nodal authorities and urban local bodies.
- *For state-level departments / organizations* – the State Ganga River Conservation Agency / State-Level Program Management Group (SGRCA-SPMG), UP Environment Department and the UP Urban Development Department (UDD), under which are the UP Jal Nigam (UPJN) and its subordinate office, UPJN Ganga Pollution Prevention Unit (GPPU).
- *For urban local body level* – the Varanasi Nagar Nigam, Ramnagar NPP, Chunar NPP, Mirzapur NPP, and Ghazipur NPP. These ULBs fall under purview of the Directorate of Local Bodies, UDD.

The current institutional framework is presented in **Figure 13.2.1.**



JICA Survey Team, 18 November 2015

Figure 13.2.1 Current Institutional Framework for Water Supply and Sanitation

13.2.2 Proposed Project Implementation System

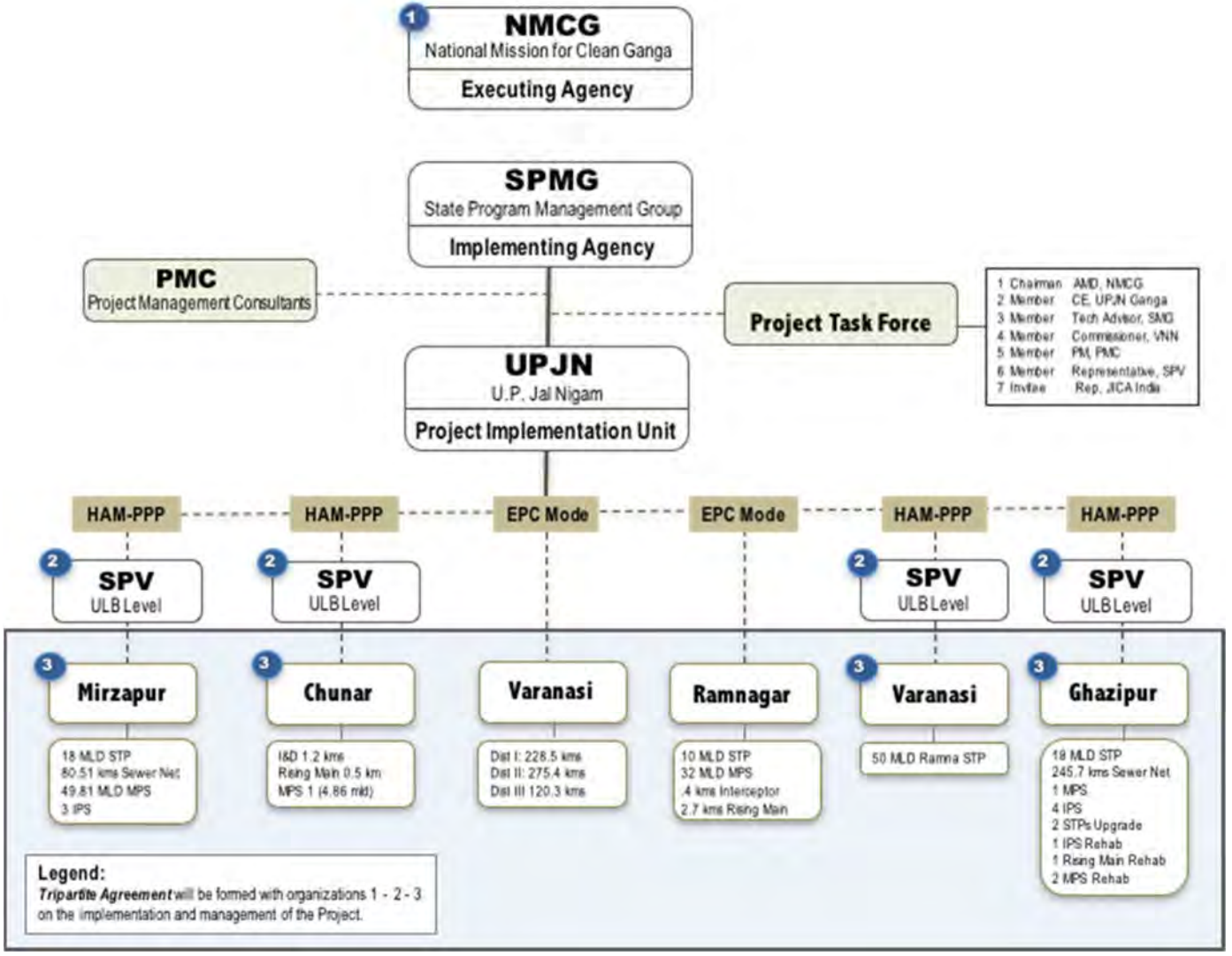
The proposed project implementation system necessitates the establishment of formal institutional linkages among the key stakeholder-institutions through a streamlined project organisation system. The system should provide avenues for coordination and policy guidance, on one hand, as well as guidelines in managing the activities of project implementation, on the other, with a sharing of roles and responsibilities to mitigate managerial, technical, financial, environmental and social problems that may arise in the course of the Project's implementation.

The implementation system also describes each major stakeholder's roles and responsibilities to help smoothen project implementation and ensure successful project completion. The project implementation system also includes the Special Purpose Vehicle (SPV) and the centrality of SPV's role in Ganga rejuvenation by scaling up future sustainability of completed projects.

The project implementation system / framework is proposed by JICA Survey Team, March 2017.

Figure 13.2.2**: Proposed Project Implementation System**. It shows the following sets of major stakeholders:

- *The regular agencies of government* directly involved in project implementation – the GoI through the MoWR RD&GR as the responsible Ministry, NMCG as the executing agency (E/A), SPMG as the implementing agency (I/A), and UPJN as the project implementation unit (PIU);
- *Specialized government corporations* or SPV(s) to be established at the ULB levels, which focus on planning, structuring, procuring concessionaires, monitoring implementation of sewerage system / sewage treatment projects and developing the market for treated wastewater through appropriate policy advocacy under the overall guidance of NMCG;
- *Ad hoc organizations* – Steering Committee and the Project Task Force – to support and to coordinate project implementation tasks; and
- *The Urban Local Bodies* where the Project(s) is / are to be implemented.



JICA Survey Team, March 2017.

Figure 13.2.2 Proposed Project Implementation System / Framework

1) Executing Agency (E/A)

The Executing Agency for the Ganga Rejuvenation Project is the National Mission for Clean Ganga, also the Central government's programme implementer of Namami Gange. The E/A shall:

- Spearhead setting up of the Special Purpose Vehicle, together with the SPMG, to steer Namami Gange towards the achievement of its general and specific programme objectives by taking up measures to ensure that each individual projects perform efficiently and effectively, and are viable and sustainable investments;
- Since the E/A implements projects through its State counterpart – the State Program Management Group, it shall ensure that the SPMG is given the required resources and is adequately capacitated to discharge its tasks;
- Representing the Central Government/ GoI, the E/A representative shall sit as a member of the Board of Directors of the SPV(s) to be organized;
- Appraise both the technical feasibility and commercial viability of individual projects through its Transaction Advisors, then offer these to the PPP market;
- Monitor projects' implementation considering that the 40 percent (maximum) exposure of GoI is in the form of loans from development partners like JICA;
- Comply with general stipulations in the Loan Agreement between GoI and development partner such as JICA in terms of expenditure / disbursements procedures, and overall work accomplishments; and
- Participate in project review missions and assess project implementation against targets and indicators.

2) Implementing Agency (I/A)

The Implementing Agency for the Ganga Rejuvenation Project shall be the State Program Management Group, being the State counterpart and operational wing of NMCG in the state of Uttar Pradesh. Its main role shall be the programme-level monitoring and coordinating for the Project. As such, it shall perform the following:

- Together with the NMCG, undertake formation of the ULB level Special Purpose Vehicle(s) that will take up individual projects on sewerage networks/ systems and sewage treatment;
- Assist the U.P. State government to mobilize financial resources from national or international institutions for said project(s);
- Representing the NMCG, the appointed I/A representative shall sit as a member of the Board of Directors of the SPV(s) to be organized in the State of U.P.;
- Appraise the technical feasibility and financial viability of projects to be undertaken

by the SPV through either feasibility reports and/or detailed projects reports;

- Be involved in formulating the "Tripartite Agreement" among the NMCG and/or SPMG, the ULB-level SPV, and the concerned/ participating ULB;
- Select and employ, negotiate with, award and sign the contract with the winning Project Consultant (to be named "Project Management Consultant") based on the *Guidelines for the Selection and Procurement of Consultants for JICA ODA Loans*.
- Plan and execute capacity building / training activities for participating ULBs in anticipation of the latter's role as enumerated in the MoA / Tripartite Agreement;
- Coordinate with SPV and/or execute its own programmes to generate public awareness, participation and support utilizing various forms of information, education and communications (IEC) media on the abatement of water pollution and on measures to enhance environmental cleanliness in rover Ganga;
- Considering that performance standards are linked with the payment of annuities, ensure that the treatment of sewage is in accordance with appropriate/ latest standards prescribed by GoI, U.P. State government, the Central Pollution Control Board, and the U.P Pollution Control Board;
- Prepare monitoring and reporting template for the Project(s), or utilize/ expand its current monitoring system to record implementation progress and results, which include the meeting of technical, financial and environmental targets;
- Report on implementation challenges and provide solutions; and
- Document lessons learned from project completion reports for possible replication in other NMCG projects in the area.

Monitoring: SPMG utilizes a 13-column project monitoring sheet[12] that provides information on all the projects that fall under the aegis of NGRBA/ NMCG programme in the state of U.P. For this Project, the same monitoring system can be utilized. The following are the information contained in the monitoring sheet:

- SL number
- State / Town
- Name of Project, including:
  - Reference of sanction

[12] Sourced from SPMG, 4 December 2015.

  - Project code
- Programme (under what Ministry / Office)
- Approved Cost
  - Total
  - Capital
  - 5-Year Main
- Major Component
  - Item
  - Quantity (mld for STP, kms for sewer net; number for SPS and MPS, numbers for dhobi ghats, urinals / toilets, water fountains, watch towers, change rooms, etc.)
- Physical Progress
  - In percentage for each major component / item
- Over-all Progress (in %)
  - Release of Fund for every major project component
  - Total for Share of Central / State
- Expenditure
  - Total for Central / State
- Present Status
  - A – Not started
  - B – On-going
  - C – Completed
- Remarks / Bottlenecks
  - The remarks portion identifies non-problematic status of the project(s) such as "work in progress" or "mobilization advance given survey work in progress";
  - The bottlenecks portion identifies the specific problems such as "court stay" or "district court" or "land dispute".

3) Project Implementation Unit (PIU)

The UPJN is the State parastatal organization with the mandate to formulate, execute, promote, finance, set standards and fix tariffs for water supply and sewerage services, sewage treatment and disposal of all schemes in the State including river pollution abatement projects. It also has the function to "render all necessary services in regard to water supply and sewerage to the State Government and local bodies, on request to private institutions or individuals".

In this connection, therefore, UPJN can and shall be appointed jointly by the SPV and SPMG as the implementing unit for the Project. This is borne out of the following circumstances:

- The SPV is still to be established and needs to develop the experience on the implementation of sewerage and sewage treatment projects;
- SPMG's powers and functions do not include project execution (plan, design and construct). Additionally, it also lacks the requisite experience on, and human resources for, project implementation; and
- UPJN possesses implementation capacity, having depth and breadth of experience in implementing projects similar to the scale and cost as the proposed Project(s).

UPJN has adequate institutional capacity in project implementation, project execution, project coordination, project monitoring, supervision, and project management. Specifically, it shall be UPJN-GPPU that shall be tasked to provide the day-to-day supervision over the project at the field level, or the tasks that relate to the application of project management concepts, tools and techniques. It shall address scope definition, scheduling, cost estimating, procurement management, financial management, human resource management, environmental and social considerations, public awareness and communications, capacity development and training, and risk management.

A more detailed discussion on the PIU is presented in **Section 13.3:** "PIU Structure, Personnel Composition, Roles and Responsibilities".

4) Special Purpose Vehicle (SPV)

According to the explanation by GoI, the Special Purpose Vehicle (SPV) for Hybrid Annuity-based Mode of Public Private Partnership (HAM-PPP) will be set up and institutionalized for project execution of sewage treatment infrastructure under Namami Gange. The SPV shall be established under the *Indian Companies Act 2013* to provide the required governance framework and enable functional autonomy. The Government has decided that all STP development and operation along the river Ganga will be taken up under HAM-PPP.

With this decision, Government can take up more projects with reduced financial liability in the initial years. There is also the opportunity of developing of the market for treated water that will lead to a reduced demand on riverine fresh-water and will result in enhanced flows in river Ganga. On the part of the private participant, risks over the project(s) are lowered as the stakes are spread over the entire period of the concession. To be equally benefited are the ULBs, which would be ensured of continued facility operations over a long term. Additionally, the ULBs would gradually build capacity by setting the ground for the recovery of user charges using the "polluter pays" principle. By linking performance standards with the annuities to be paid the private partner, the desired objective of treated water of appropriate standard will be achieved.

To start with, the SPV would enter into a Memorandum of Understanding (MoU) with the State Government and the ULB where the project is to be located. It is important to delineate the roles and responsibilities considering that provision of sewage services to the people / communities are a joint responsibility of the State and the ULB, with the latter in charge of the operation and maintenance of sewage networks and treatment facilities. The MoU will clarify the intent of the SPV in providing the needed reforms and regulatory measures which other previous projects on river Ganga were not able to address.

Thereafter, the SPV will enter into a Tripartite Agreement (T/A) with the concerned ULB and the Concessionaire that was awarded the particular project that would list the roles and responsibilities of each party in order that sewage treatment services can be provided as envisioned by Namami Gange and that project and programme objectives are realized.

More detailed discussion of the SPV is presented in **Section 13.4:** "SPV Organization Roles and Responsibilities".

5) Project Task Force (PTF)

While the Project Steering Committee was set up during the project formation stage, this will no longer be required during the project implementation stage. Instead a Project Task Force (PTF) will be organized to provide overall direction for the Project's implementation; facilitating coordination among concerned Government, State and ULB stakeholders, government corporations and state parastatal organizations; and seeking support from the concerned communities where the projects are implemented.

The project implementation phase can bring about problematic issues that would require immediate solutions to accomplish short-term tasks and realize specific objectives for the Project and the working group best suited for results-centred and problem-solving orientation is the task force.

A task force is typically comprised of a small group of people who are selected for their expertise in their recognized areas of knowledge, their history in the area of practice, and their interest in the Project. In this sense, the task force members bring different skills and ideas, become project advocates within the implementation system, foresee potential hurdles to implementation, and build solutions into their recommendations. Essentially, a task force, in itself, does not have on-going functions, as their purpose is to provide solid and collective recommendations within a given time frame. Thus, the Project as a whole will greatly benefit from the advantages of a task force and the rigorous analytical multi-disciplinary approach and comprehensive knowledge of the sanitation sector and the areas where the sub-components are to be implemented. The role of the PTF will be the following:

- Study, formulate and recommend solutions on issues referred to it because of legal, policy, technical and operational concerns or differences;
- Identify appropriate agencies to whom to refer and/or follow up solutions caused by project implementation bottlenecks, problems and issues;

- Facilitate timely release of construction and other licenses/ permits needed for the Project;
- Monitor and/or coordinate environmental and social requirements during project implementation,
- Monitor and/or coordinate public participation and enlightenment requirements related to project implementation;
- Should the project require it, monitor land acquisition procedures on their compliance to law;
- Hold regular quarterly meetings and call for special meetings, if required;

To provide technical and/or administrative support services to the Project Task Force, a 'secretariat' composed of staff from the SPMG shall be made available. The implementation arrangements summary for Ganga Rejuvenation project is shown in **Table 13.2.1**.

Table 13.2.1 Implementation Arrangements Summary

SL		Aspects	Arrangements
1	Estimated Implementation Period		
	1.1	Project Formation	To be determined during Loan Agreement stage
	1.2	Project Implementation	To be determined during Loan Agreement stage
2	Estimated Completion Date		To be determined
3	Estimated Loan Closing Date		To be determined
4	Management		
	4.1	Executing Agency (E/A)	National Mission for Clean Ganga thru the Mission Director
	4.2	Implementing Agency (I/A)	State Programme Management Group (SPMG) located in the State Ganga River Conservation Agency (SGRCA)
	4.3	Project Implementation Unit (PIU)	UPJN-GPPU with appointment from E/A, I/A and SPV
	4.4	Project Task Force (PTF)	Assistant Mission Director, NMCG – Chairman Chief Engineer, UPJN Varanasi – Member Advisor, Technical, SPMG – Member Municipal Commissioner, VNN – Member Project Manager, Project Management Consultants – Member Representative, JICA India – Invitee SPMG Staff – PSC Secretariat
	4.5	Special Purpose Vehicle (SPV)	To be established for each ULB-based project sewerage facility as a limited corporation under the *Corporation Act, 2013*
			SPV for Mirzapur
			SPV for Ghazipur
			SPV for Chunar
			SPV for Varanasi (for 50 MLD Ramna STP)

5	Procurement		
	5.1	PPP Concessionaire and/or O&M Contractor	National Competitive Bidding for ULBs under SPV Mode
	5,2	EPC Contractor and/or O&M Contractor	National Competitive Bidding for ULBs under EPC Mode
6	Procurement for Consulting Services		• By SPMG • International Competitive Bidding • Project Management Consultants (PMC) for project implementation support and capacity building (quality and cost-based)
7	Advance Contracting		NMCG/SPMG may require advance contracting of Project Management Consultants before actual implementation stage.
8	Disbursement		Loan disbursement will be in accordance with JICA's transfer and disbursement procedures and detailed arrangements between GoI and JICA

13.3 The Project Implementation Unit (PIU) Structure, Personnel Composition, Roles and Responsibilities

The establishment of the Project Implementation Unit (PIU) should take into consideration several factors – such as past experience from organizing PIUs for development projects in India for the water supply and sanitation sector together with executing and implementing agencies, and with SPVs. Also to be taken into consideration are the requirements of JICA as a development partner. Most, if not all, loan projects from the Government of Japan (GOJ) to the Government of India (GOI) that pass through JICA generally necessitate the establishment of PIUs. Considering the scope, the number of sub-project components and their locations for the Ganga Rejuvenation Project, the PIU is required.

As explained in the previous section, SPMG shall appoint UPJN to be the PIU. The main justifications are that UPJN possesses implementation capacity, having depth and breadth of experience in implementing projects similar to the scale and cost as the proposed project(s). It also has the mandate to render "all necessary services in regard to water supply and sewerage to the State Government and local bodies, on request to private institutions or individuals." The SPMG's powers and functions, on the other hand, do not include project execution (plan, design and construct). Additionally, it also lacks the requisite experience on, and human resources for, project implementation.

Given this situation, SPMG, as the Implementing Agency, will not only appoint UPJN as the PIU, but will also engage the project management consultants (PMC) to work alongside PIU in ensuring that the project(s) are implemented on schedule, within scope and on budget. The PIU and PMC shall provide regular implementation reports to SPMG for either information or action, if required.

In this connection, therefore, UPJN shall organize the Project Implementation Unit (PIU) in the UPJN Varanasi Zone office, set up as an independent office under the Office of the General Manager, UPJN

Ganga Pollution Prevention Unit (UPJN-GPPU). The UPJN-GPPU implements centrally and state funded pollution prevention projects for the River Ganga. It has adequate experience in implementing internationally-funded or overseas development assistance projects, such as but not limited to wastewater treatment projects, sewage collection and disposal projects, as well as pollution control-related projects in the areas of capacity development, health and hygiene, public awareness and IEC.

13.3.1 Organization Structure of PIU

The PIU for the Ganga Rejuvenation Project needs an effective structure for project implementation and control with clearly defined responsibilities and provision for accountability. It shall:

1) Serve as the technical arm in managing, supervising and controlling day-to-day project activities, which includes the work of the HAM-PPP Contractor-Concessionaire and the EPC Contractor in activities related to project planning and management, project construction supervision, disbursements, environmental management and monitoring, and preparation of reports;
2) Work alongside the Project Management Consultants (PMC) who will be engaged by the SPMG for the Project;
3) Institute a measurement system to assess results of work and schedule of progress, budget, compliance with technical specifications, and resource requirements in order to predict results of deviations, then implement actions(s) to correct deviations while continuing to review procedures; and
4) Monitor and evaluate the performance of each specific project.

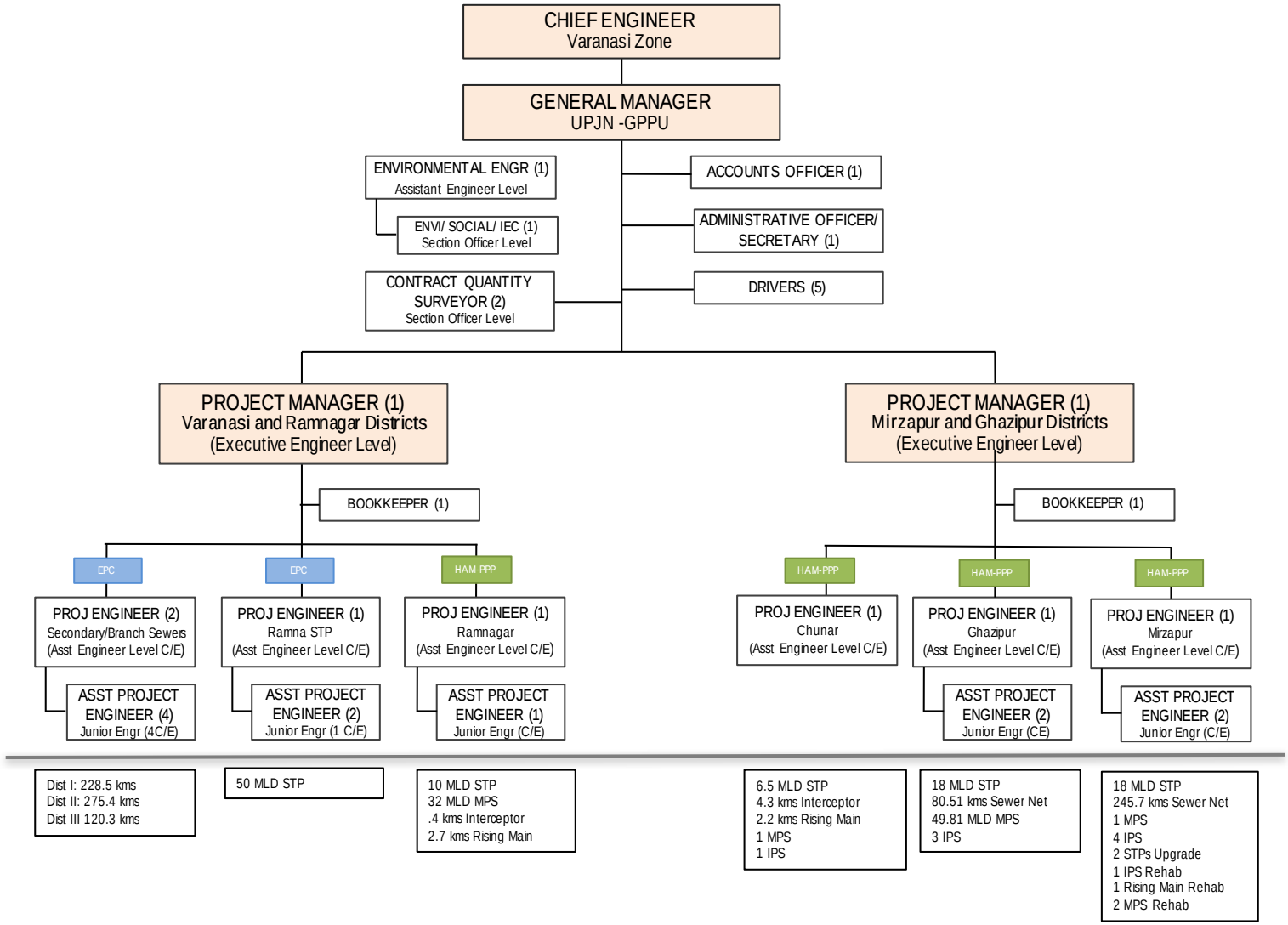
The proposed organization structure and staffing of PIU considers the application of organisational principles to ensure efficient and effective accomplishment of the Project objectives as delegated to it by the NMCG / SPMG and the particular SPV, together with organisational factors and practices existing in UPJN-GPPU, as follows:

1) The *organizational principles* that integrates work flows such as:
    - Vertical differentiation, or the levels of authority decision-making, responsibility, accountability and communication;
    - Horizontal differentiation, or the degree of separation and distribution of functions;
    - Spatial differentiation, or the geographic locations and equitable load distribution of the sub-projects;
2) The *reporting relationships* that provide:

- The order in the chain of command;
- The clarity in the span of control; and
- The logic in the pattern of inter-relationships.

3) The *line and staff positions* that provide management authority and responsibility in the division of work and achievement of Project objectives.
    - The number of staff required for the PIU shall be exclusively assigned for the Project, using the normal ratio for PE to assistant PE which is 1:2;
    - The proposed PIU posts have an equivalent post/ rank as contained in UPJN service rules regulations; and
    - The proposed PIU staffing shall be in addition to the existing staff complement in UPJN-GPPU.
4) The *coordinating activities* that ensure the process of linking support activities within and outside of the PIU for goal accomplishment.

Figure 13.3.1 shows for the organization structure of the PIU, the clustering of projects depending on the type of financing, that is EPC mode or HAM-PPP mode. The clustering also addresses the geographic areas on a per ULB basis.



JICA Survey Team, March 2017.

Figure 13.3.1 Organization Structure of PIU for Ganga Rejuvenation Project

13.3.2 Staff Requirement and Qualifications

Implementation should be managed by experienced project implementation staff with strong central control and supported by the active participation of staff in the project-specific areas. In this sense, the PIU should have dedicated staff to implement/ manage the project and its sub-components while allowing flexible use of staff from its own functional organization.

The General Manager, GPPU will serve as the *de facto* Project Director for the Ganga Rejuvenation Project. He will be supported by two full-time Project Managers (PM) – one to manage and supervise the EPC works in the Varanasi District, including Ramnagar; and another who will manage and supervise the HAM-PPP works in in the Varanasi District for Ramna STP, and the STPs in the Chunar, Mirzapur and Ghazipur Districts.

In addition, an environmental engineer, supported by an environmental / social specialist will be required to establish and monitor the environmental and social conditions during the implementation of the Project. The Project Accountant and the two Bookkeepers will be responsible for project finance and accounting. The Administrative Officer cum Secretary will be responsible for secretarial and administrative-related functions. See **Table 13.3.1** for the personnel requirement of the PIU. The number of personnel in **Table 13.3.1** shows the total of internally-deployed and externally-recruited staff for the project.

Table 13.3.1 Positions and Number of Personnel Required for PIU

SL	PIU Position	Equivalent Level /Position in UPJN	Number
1	Project Director	General Manager (Actual)	1
2	Project Manager	Executive Engineer	2
3	Project Engineer	Assistant Engineer	7
4	Assistant Project Engineer	Junior Engineer	11
5	Environmental Engineer	Assistant Engineer	1
6	Environmental/ Social/ IEC Specialist	Section Officer	1
7	Contract/ Quantity Surveyor	Section Officer	2
8	Accounts Officer	Accounts Officer	1
9	Administrative Officer/ Secretary	Administrative Officer	1
10	Bookkeeper	Bookkeeper	2
11	Driver	Driver	5
		Total	**34**

Note: The General Manager in **Figure 13.3.1** is supposed to be the Project Director

The engagement of the PIU staff will be governed by the Service Regulations of UPJN. The educational and experience qualifications of the proposed staff are as shown in **Table 13.3.2.**

Table 13.3.2 Proposed Educational and Experience Qualification of PIU Staff

Post	Proposed Qualifications	
Project Manager Executive Engr Level	Education	• A Bachelor's degree in Civil / Environmental Engineering; • Master's Degree in Civil / Structural Engineering; • Project Management Professional (PMP) Certification an added advantage.
	Experience	• At least 15 years' experience as project manager in sewerage and/or water supply planning, design and/or implementation projects; • At least 10 years' experience as senior project engineer or project manager of sewerage and/or water supply construction projects; • At least five years' experience as project manager of sewerage and/or water supply construction projects similar in scale to this Project.
Project Engineer Assistant Engr Level	Education	• A Bachelor's degree in Civil/ Environmental Engineering; • Master's Degree in Civil / Structural Engineering an advantage; • Project Management Professional (PMP) Certification also added advantage.
	Experience	• At least 10 years' experience as project engineer in water supply and/or sewerage projects; • At least five years' experience as project engineer or assistant project manager in sewerage and/or water supply construction projects; • At least two years' experience as project engineer or assistant project manager of sewerage and/or water supply construction projects similar in scale to this Project.
Assistant Project Engineer Junior Engr Level	Education	• Diploma in Civil/ Environmental Engineering from any reputable engineering university/ college; • A Bachelor's degree in Civil Engineering preferred.
	Experience	• At least eight years' experience as assistant project engineer / junior engineer in sewerage and/or water supply projects; • At least four years' experience as junior engineer in a water supply and/or sewerage construction project.
Environmental Engineer Asst Engr Level	Education	• A Bachelor's degree in Environmental Engineering.
	Experience	• At least, 10 years' experience as environmental specialist in sewerage and/or water supply projects; • At least five years' experience as environmental specialist in water supply and/or sewerage construction project.
Environmental / Social Specialist Section Officer Level	Education	• Diploma Course in Civil/ Environmental Engineering from a reputable government polytechnic institute.
	Experience	• At least five years' experience as project supervisor in water supply and/or sewerage project.
Contract / Quantity Surveyor Section Officer Level	Education	• Diploma in Civil/ Environmental Engineering from a reputable government polytechnic institute.
	Experience	• At least five years' experience as materials estimator/ contract/quantity surveyor for water supply and/or sewerage construction projects.
Accounts Officer	Education	• A Bachelor's degree in Business Accountancy from a

		reputable government university. • A Master's degree in Commerce with specialization in Accountancy.
	Experience	• At least five years' experience in accounts, financial planning and budgeting with exposure to financial computer software in a project office.
Administrative Officer / Secretary	Education	• A Bachelor's degree in Business Administration/ Commerce from a reputable government university.
	Experience	• At least five years' experience in administrative work in a reputable organization.
Bookkeeper	Education	• A Bachelor's degree in Business Commerce with accountancy specialization from a reputable government university.
	Experience	• At least five years' experience in accounts keeping in a reputable organization.
Driver	Education	• Passed 10th class/ standard.
	Experience	• At least five years' driving experience with a valid Driving License for type of vehicle to be driven.

13.3.3 Responsibilities of PIU Staff in Project Implementation

Duties and responsibilities have been specified for the posts proposed in the PIU that not only determine how critical each position or job is, but also show how the job or tasks relate to the others in the PIU.

1) Chief Engineer, UPJN Varanasi Zone

The Chief Engineer, UPJN Varanasi Zone shall exercise strategic-level management and leadership over PIU by ensuring that the objectives, targets and outcomes of the Project are achieved efficiently and effectively and according to plan. As such, the CE has general management and supervision over the PIU, and shall:

a) Approve technical/ engineering-related Project matters such as technical studies and detailed designs and over-all construction management requirements;

b) Undertake higher-level project coordination by bringing to the attention of UPJN Managing Director, SPV, SPMG, the Steering Committee, or the Project Task Force important implementation issues (legal, financial, and policy) that need immediate resolution;

c) Approve and/or endorse official documents and communications emanating from the PIU/ UPJN-GPPU addressed to inter-governmental and external offices;

d) Approve and/or endorse claims or requests for payments from the Contractor-Concessionaire of each ULB Level SPV through identified channels.

2) The General Manager (GM), UPJN-GPPU Varanasi

The General Manager, UPJN-GPPU shall be the *de facto* Project Director (PD) of PIU. He shall exercise administrative and operational control over the PIU and project implementation activities. As such, the GM/PD ensures that the Project is implemented in accordance with the schedules, plans and procedures agreed upon by GoI and JICA, and delegated authority from SPV and SPMG, and shall:

a) Initiate the hiring process or the engagement of technical, administrative/ finance personnel (PIU staff) required for the Project according to UPJN service rules;

b) Provide progress and/or performance evaluation reports to the Chief Engineer, Varanasi Zone, the UPJN Managing Director, SPMG, SPV, JICA, as well as to the concerned State and Central government authorities, when required;

c) Review and/or endorse for payment claims from the Contractor-Concessionaire of each ULB-Level SPV through identified / proper channels;

3) The Project Manager (PM)

The Project Manager 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, consistent and proven project management methods and practices from relevant past experience. This position also requires collaborative efforts among project stakeholders, such as GoI, JICA, NMCG, SPMG, SPV other state and local authorities, project beneficiaries, and other interested parties.

There shall be two project managers for the PIU – one for the Varanasi Zone, including Ramnagar, and another for the Ghazipur and Mirzapur Districts. Both PMs are expected to perform the following tasks/ responsibilities:

a) Provide management direction and leadership guidance to the personnel of the PIU by:

- Defining and delineating the roles, functions, responsibility and accountability of each PIU team member and securing their respective commitments;
- Defining the outputs, timelines and quality expectations in the performance and submission of work by each team member;
- Developing work systems, policies, rules and regulations for the proper functioning of the project office/ PIU; and
- Determining the resource and logistical requirements and constraints to complete the objectives of the Project.

b) Develop systems, standards, procedures and guidelines to effectively manage, monitor and evaluate the implementation of the Project components, which include:

- Monitoring scope, cost, quality, schedules, change, procurement and contract;
- Monitoring the progress of the Consultant and Contractors in terms of scope, time and budget;
- Monitoring preparation of regular Project Reports – financial, progress and procurement reports, among others; and
- Using appropriate software to create database and monitoring system that will enable quick and accurate online downloading of information on the progress of the Project.

c) Ensure the timeliness and quality of outputs of the Consultants and the work quality of the Contractors by:

- Reviewing and confirming the scope of work of the Consultant(s) and Contractor(s) for the approval of the General Manager/ Project Director (GM/PD), then of the Chief Engineer;
- Reviewing the Contractor-Concessionaires'' reports and recommending appropriate action(s), where required;
- Reviewing post-field reports from the PE/APE, identifying actual and potential issues and proposing recommendations; and
- Reviewing and/or approving invoices, certification of work completion and acceptance of the Contractor-Concessionaire(s) and Supplier(s).

d) Manage financial based on the Loan Agreement between by GOJ/ JICA and GOI such as preparation and submission of regular financial statements and financial reports in accordance with JICA requirements/ formats and with prescribed GoI standards;

e) Oversee the conduct of the following:

- Technical studies, detailed designs, and construction management,
- Monitoring plan for the natural and social environment; and
- Pre-operation and/or operation phases before turnover and acceptance of the newly constructed facilities;

f) Manage project office work and workflows, technical, financial and administrative coordination;

g) Provide regular progress and performance evaluation reports to the GM/PD and the Chief Engineer, Varanasi Zone.

4) Project Engineer (PE) and Assistant Project Engineer (APE)

There are nine Project Engineers and 11 Assistant Project Engineers responsible for specific components of the Project. The PEs will report directly to the PM, while the APEs will report directly to their particular PEs.

Working as a team, the PEs and the APEs will be responsible for supervising the assigned technical projects, construction packages and implementation-related activities of the PIU, developing various systems and procedures for the smooth implementation of the Project, installing and/or developing and utilizing project management processes for the PIU. The specific tasks of the PEs are to:

a) Assist the PM on his responsibility in the management and supervision of the Project, by:

- Developing and undertaking planning activities, such as but not limited to, the work (technical) and financial plans; and
- Undertaking the implementation of the approved work plan.

b) Directly oversee and supervise the implementation of field-level activities of the different components of the assigned project/ package, particularly in civil works construction through:

- Monitoring project activities and accomplishments, using in part, the monitoring system designed for ODA projects;
- Monitoring the performance of the Contractor-Concessionaires; and
- Reporting any deviations and problems, and recommending solutions.

c) Certify the completion of work and payments of the Contractor-Concessionaires and Suppliers by validating the progress of project implementation of each activity in the work plan.

d) Perform project finance and administration functions with the delegation of administrative and financial functions from the level of the PD/GM and PM to the PE/APE, such as:

- Developing and managing the Project's records system, project office documents and communications system, as well as physical facilities and supplies;
- Coordinating and processing procurement of goods and services for the PIU;
- Processing of vouchers and documents for the disbursements of project funds such as request for payments from suppliers and contractors based on the field-level disbursement procedures, and reviewing their compliance with GoI and JICA procedures; and
- Preparing report of disbursements and periodic accounting reports of the Project.

5) The Environmental Engineer and Environmental / Social Specialist

There are one Environmental Engineer and one Environmental/ Social Specialist for the Project. The Environmental Engineer will report directly to the GM/PD, while the Environmental/ Social Specialist will report to the Environmental Engineer.

Working as a team, the functions and responsibilities of the Environmental Engineer and Environmental / Social Specialist are the following:

a) Provide the activities needed for the environmental and social aspects in the Tender

Documents to UPJN and each SPV, which include the baseline monitoring, the management plan and the monitoring plan;

b) Supervise the contractor in the implementation of environmental mitigating measures during construction, and the operator during the operation of the Project;

c) Conduct of regular environmental management plan monitoring and submit monitoring reports, such as:

- Preparation and submission of quarterly monitoring report to the UP Pollution Control Board;
- Monitoring of social concerns particularly the impact of the project and if the mitigating measures have been implemented; and,
- Monitoring the lifestyle of the local residents on whether or not their lives have improved with the implementation of the Project.

d) Perform sustained information, education and communication (IEC) campaigns among stakeholders on their roles, and on the importance of the Project in order to attain the health and hygiene objectives of the Project.

6) The Contract / Quantity Surveyor (CQS)

There will be two Contract/ Quantity Surveyor for the Project, and both shall report directly to the GM/PD. The functions and responsibilities of the CQS are:

a) Prepare produce initial cost plans for use in the drafting procurement/ tender document(s) for the project;

b) Draw up the bill of quantities and their cost breakdown;

c) Review contract and sub-contract tenders;

d) Manage cost planning and control in terms of schedule and budget for the Project;

e) Generate valuations for work done, cost estimating, lifecycle costing, and if required, dispute resolution.

7) The Accounts Officer and Bookkeeper

There will be one Accounts Officer and two Bookkeepers for the Project. The Account Officer shall be under the direction of the GM/PD, while the Bookkeepers will be assigned to and support each Project Manager.

Working as a team, the Accounts Officer and Bookkeepers shall be responsible for ensuring appropriate financial/ accounts management for the Project. As such, they shall:

a) Perform project finance functions, such as planning, budgeting, accounting, financial reporting, internal control, auditing supplies management and disbursements relating to the Project.

- Process disbursements/ payment requests of Contractor-Concessionaires and Suppliers in compliance with GoI and JICA guidelines/ agreements and procedures;

b) Ensure timely preparation of financial reports based on GoI and JICA guidelines for submission to appropriate agencies, such as:

- Financial (audited) statements,
- Financial reports, particularly those involving JICA funds, and
- Procurement reports.

c) Create project accounting, recording, storage, production and disposal system in order to facilitate proper financial accounting and reporting and effective project management; and

d) Maintain and safeguard financial records by having adequate back-up procedures and protection from unauthorized access.

8) The Administrative Officer/ Secretary

The Administrative Officer/ Secretary shall work under the direction of the GM/PD and will be responsible for the following:

a) Office administration tasks or the set of day-to-day activities related to project records management, personnel/ human resources records management, and maintaining business premises and other facilities and equipment, and basic office logistics; and

b) Secretarial duties such as office coordination, planning and scheduling of meetings, preparing and maintaining office records, documentation of meetings, reports and correspondence.

9) Driver

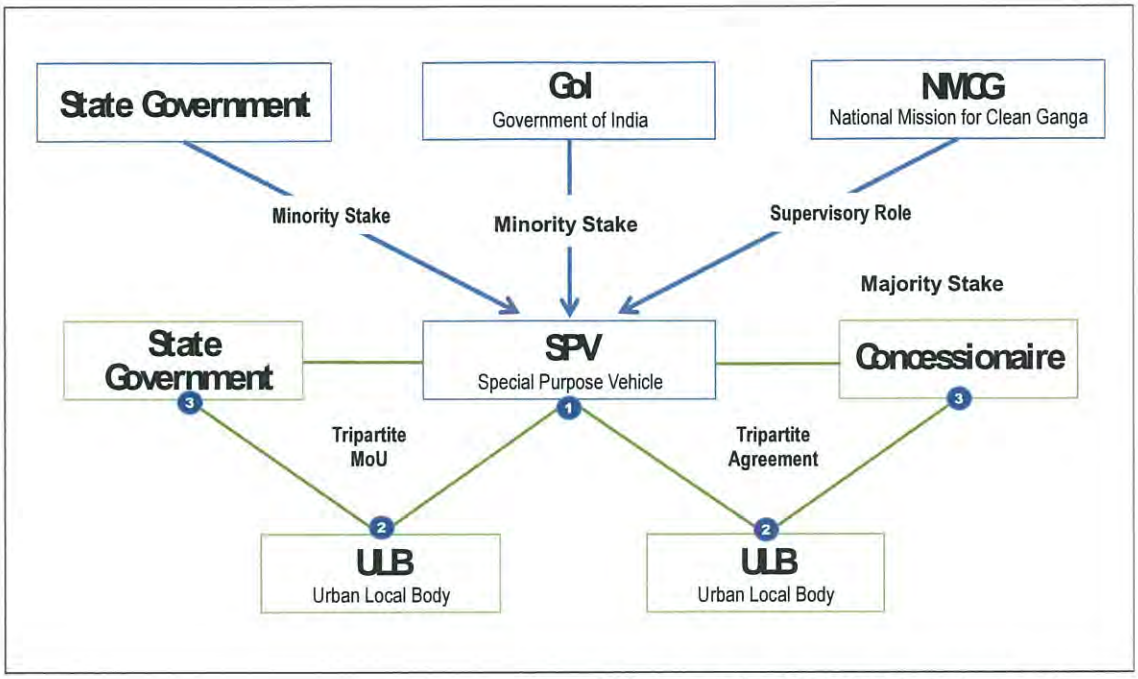
The Driver/s shall be under the GM/PD. Their main task is to ensure the safe transport of passengers and goods within and around the Project sites. The drivers will also perform daily checks and regular maintenance works on the vehicles assigned to them.

13.4 SPV Proposed Organization, Roles and Responsibilities

The Special Purpose Vehicle (SPV) for Hybrid Annuity-based Mode of Public Private Partnership (HAM-PPP) will be set up and institutionalized for project execution of sewage treatment infrastructure under Namami Gange for each ULB covered under this Project – Varanasi, including Ramnagar, Mirzapur, Ghazipur and Chunar. The Institutional Arrangement, recently released by NMCG for all projects under the Namami Gange, is shown in **Table 13.4.1.**

The arrangement shows the shareholding for the SPV, where the majority shares will come from GoI, and minority chares will come from the State Government concerned. In addition, there will be two sets of agreements that will be entered by the SPV – one will be a Memorandum of Understanding (MoU) among the State Government and ULB concerned, plus the SPV; and the other will be the

Tripartite Agreement among the ULB concerned, the Concessionaire and the SPV. The details of the agreements will center on the roles and responsibilities regarding financial structuring, financing (including tariff and revenue streams), technical (design, technologies, environmental safeguards, land arrangements, etc), procurement, project implementation arrangements, among others.



Source "Hybrid-Annuity-based PPP Model for the Creation of Sewage Infrastructure", Presentation by NMCG, February 2016

Figure 13.4.1 Institutional Arrangements for SPV

13.4.1 Proposed Structuring of the SPV

The proposed structuring of the SPV covers the following aspects / areas – purpose, structure, sponsor/ promoter, raising of funds, capitalization and shareholding, Board of Directors and CEO and implementation process as shown in **Table 12.4.1.**

Table 13.4.1 Proposed Structuring of the SPV

Area	Details
Purpose of SPV	• Plan the financial structuring of the Project(s) through the following: Hybrid Annuity Model (HAM)-PPP, O&M and engineering-procurement-construction (EPC) contracts, finance-operate-build-transfer (FBOT) contracts, joint ventures, subsidiaries, turnkey contracts suitably dovetailed with revenue streams; • Design and manage the bid process system or overall procurement planning, management, monitoring and quality assurance under the project, including contract management; • Perform the detailed procurement management functions such as preparing, issuing tenders, opening and evaluation of tenders, and placing the contracts; • Plan the implementation structure of the Project(s); • Enter into contracts, partnerships and service delivery arrangements as may be required;

	• Release funds; • Monitor and evaluate sewerage / wastewater project(s); • Determine and collect user charges as authorized by the ULB.
Structure of the SPV	The SPV to be established as a Limited Company under the *Indian Companies Act, 2013*
Sponsor / Promoter	National Mission for Clean Ganga (National Level SPV) and / or the State Programme Management Group
Raising and utilization of funds by the SPV	GOI grant: not more than 40%; PPP Proponent: 60% Share may also have equity from State of ULB. The SPV may access funds from other sources such as debt, loans from ODA, user charges, taxes, surcharges, etc.
Capitalization and Shareholding	TBD (To be determined) • To be commensurate with the size of the project, commercial financing required and the financing modalities; • GoI grants may be permitted / utilized as ULBs share of equity capital in SPV; • Should enable building up of the equity base of the SPV by allowing ULBs to contribute their share of the equity capital; • Paid up capital may be enhanced in the subsequent years as per project requirements, with the provision mentioned above ensuring that ULB is enabled to match its shareholding in the SPV with that of the State.
Board of Directors and CEO	TBD (To be determined) • Shall include additional, functional directors, additional director. Number of board of directors proposed shall be not more than nine. • Chief Secretaries of States through which the Ganga passes; • State representative (Department of Urban Development, U.P.); • The Municipal Commissioner of ULB where project will be implemented; • Will comply with the provision of the Companies Act 2013 with respect to induction of Independent Directors; • The SPV shareholders will voluntarily comply with the provision of the Companies Act 2013 with respect to induction of independent directors.
Implementation Process	• The SPV appoints a "Project Implementation Unit" or Execution Unit" managing and implementing area-based projects supported by Project Management Consultants depending on conditionalities between GoI and a Development Partner (like JICA). • The SPV appoints the Project Management Consultants (PMC) for assistance in design, project implementation and management; • In procurement of goods and services, transparent and fair procedures as prescribed under the GoI, the State / ULB financial rules as well as a Development Partner's rules based on loan conditionalities shall be followed.

13.4.2 Roles and Responsibilities of SPV according to Project-related Activities

In addition, the SPV will undertake activities in seven areas of project identification and development; implementation arrangement and pre-procurement; procurement; approval and contract awarding; contract management; project implementation and project operation, as shown below:

1) Project Identification and Development
    - Identify the specific project(s) to be undertaken;
    - Conduct technical and financial appraisal of the identified/ eligible project(s);
    - Prepare conceptual project structure;

- Prepare preliminary and final financing plan;
- Perform risk analysis;
- Prepare business model for commercial viability;
- Involvement in drafting of the Tripartite Agreement with ULB and the Concessionaire and/or Contractor and the MoUs with the State Government and ULB.

2) Implementation Arrangement and Pre-Procurement

- Assess existing legal and regulatory regime and current public policy;
- Assess GoI public procurement, State procurement, as well as JICA procurement processes and requirements;
- Prepare "Procurement Manual";
- Prepare bid documents, bid evaluation criteria, draft concession agreement, draft contract documents for the private proponent depending on the financial model selected, whether EPC, HAM-PPP, as well as O&M packages;
- Set up committees – technical, financial, approval;
- Formulate implementation arrangement strategy/ies for PIU;
- Together with SPMG, appoint the Project Implementation Unit (UPJN-GPPU);
- Get government approval.

3) Procurement

- Undertake pre-qualification of PPP bidders – HAM-PPP-O&M, FBOT-O&M, EPC-O&M or any other PPP financial structure / combination as deemed fit by the SPV;
- Prepare RFP for the bidders;
- Finalize service and output specifications for the bidders;
- Finalize tender, bid evaluation and selection for the bidders;
- Get government approval.

4) Approval and Contract Awarding

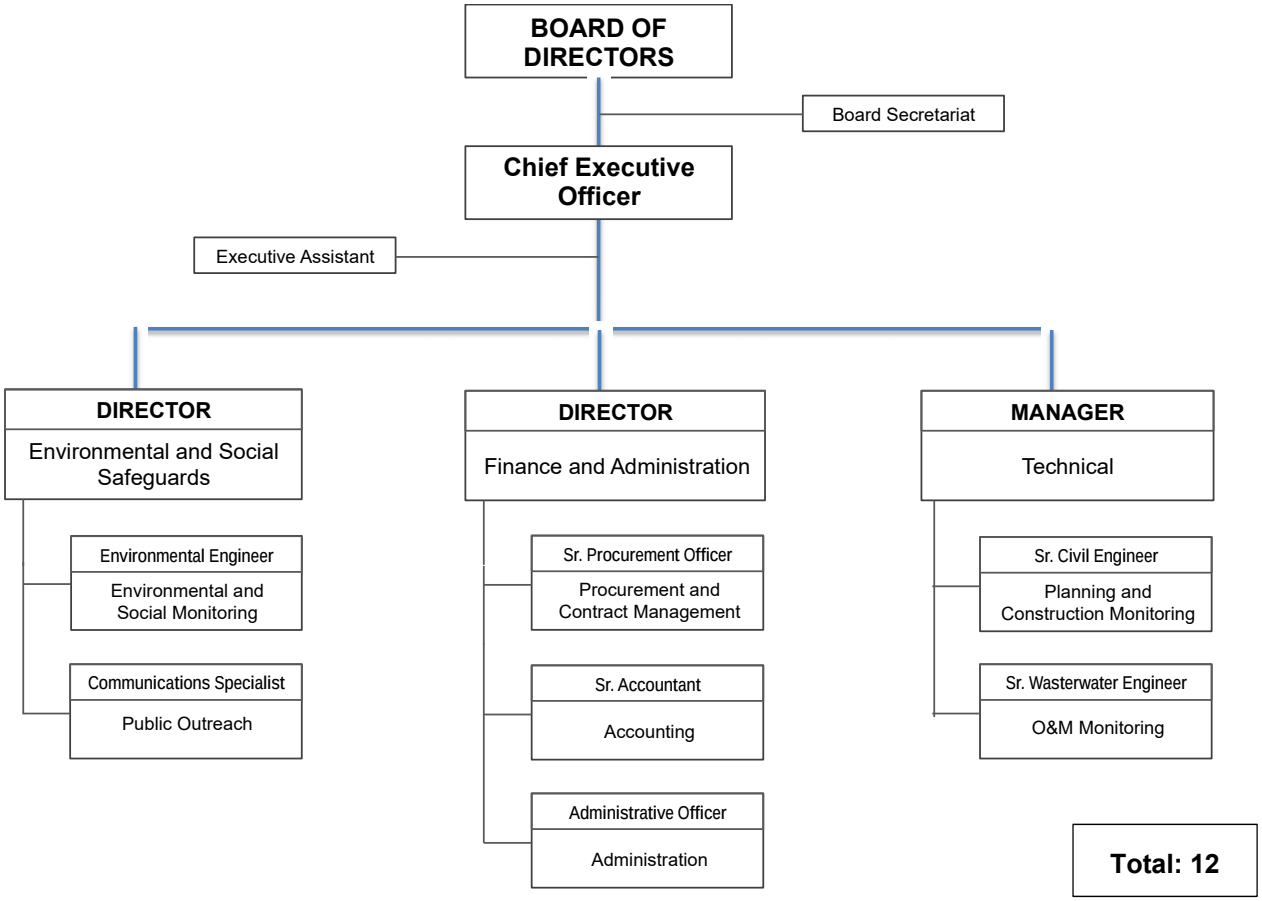
- Undertake FBOT and O&M contract awarding to the PPP Concessionaire, and/or EPC and O&M contract awarding to the Contractor, as the case may be;
- Undertake financial closing and contract signing for all awarded contracts;
- Get government approval.

5) Contract Management

- Undertake service delivery management;
- Monitor contract compliance;
- Undertake relationship management;
- Undertake renegotiation (when needed);
- Get government approval for renegotiation terms.

6) Project Implementation
    - Delegate project implementation and project management tasks to the Project Implementation Unit (PIU) through MoA among SPMG, the ULB-Level SPV and the UPJN-GPPU;
    - Undertake over-all monitoring of project implementation.
7) Project Operation
    - Monitor the quality of sewerage services to be provided by the Concessionaire (O&M of STP and other sewerage facilities) based on the Concession Agreement, the Tripartite Agreement, the MoU and other binding contracts and agreements;
    - Monitor the compliance of the Concessionaire with regulatory authorities' standards and regulations from the Central and State governments up to the ULB level;
    - Link performance standards of the STP and other measureable performance indicators agreed upon with the payment of annuities;
    - Develop market for treated water in the immediate vicinity / community of the ULB where STP is located;
    - Undertake environmental, social, IEC and community participation activities as spelled out in the MoU, the Concession Agreement, the Tripartite Agreement, and other binding agreements/ contracts;
    - Conceptualize/ plan and undertake capacity building activities for ULBs, if these are included in the MoU, the Concession Agreement, the Tripartite Agreement, and other binding agreements/ contracts.

The indicative organization structure of the ULB-Level SPV is proposed in Figure 13.4.2.



JICA Survey Team, March 2016.

Figure 13.4.2 Typical Organization Structure of ULB-Level SPV for Sewerage Infrastructure

13.5 Project Management Consultants

The Project Management Consultants (PMC) shall be engaged by the SPMG for the primary purpose of undertaking the detailed design of the specific projects(s), as well as ensuring proper, efficient and effective implementation of the projects identified in the project formation stage.

- The PMC will provide project implementation support to the SPMG, being the Implementing Agency, on technical and financial aspects of project implementation, as well as on project implementation issues to ensure the effective coordination and implementation of the Ganga Rejuvenation Project. As such, it shall assist in installing procedures, operationalizing procedures and establishing monitoring and reporting systems.
- The PMC will also provide project implementation support to the SPVs, with the expressed backing of SPMG, on the area of procurement management, that is, defining work packages, preparing contracts, and undertaking procurement for the PPP Contractor-Concessionaire and/or the O&M Contractor.

- The PMC will also work closely with, and provide implementation support to, the PIU, having been appointed by SPMG and SPV to manage, execute and implement the Project. It will complement PIU's method of project management – that is, establishing criteria for construction supervision, coordination and management and project performance monitoring. The PMC will also assist in sustainable capacity development of UPJN, VNN and the other ULBs included under the Project, particularly on capacity building and training, public enlightenment, information, education and communication (IEC) awareness for sanitation, and campaigns for household (sewer) connections to ensure that the project and programme objectives are achieved.

13.5.1 Proposed Tasks of PMC

1) For the SPVs
   - Assist the SPVs in finalizing the bidding documents for each of the Contract Packages of the Project;
   - Assist the SPVs in identifying and preparing its particular projects and/or subprojects by
     - Appraising subprojects,
     - Preparing subproject appraisal reports, and
     - Formulating bid packages.
   - Assist the SPVs with all aspects of procurement including tender document review, bid evaluation and selection of Concessionaires and/or Contractors;

2) For the PIU
   - Support PIU in finalizing the detailed design for the facilities to be constructed under the Ganga Rejuvenation Project;
   - Support PIU in technical matters such as reviewing and approving surveys, studies, subproject preliminary and final designs, construction drawings and estimates, approving contractor's works, review of variations, extra items and claims;
   - Assist PIU in project management and implementation, as well as construction supervision, such as:
     - Preparing annual work plans, staffing schedules, necessary budgets including equipment budgets, and detailed implementation schedule;

- Providing guidance and support to PIUs for construction supervision including quality, cost and time controls
- Providing assistance to PIU in supervising, coordinating and monitoring the work of the contractors and sub-contractors;
- Verifying work measurement and certification of the contractor's interim bill and/or verification of final bill of payment; and
- Reviewing "as built" drawings and completion certificates submitted by Concessionaire / Contractor.

- Assist PIU in setting up procedures, systems, standards, criteria and reporting systems for project management, implementation and monitoring of the project progress, such as:
  - Preparing an overall program performance monitoring system for the Project and assisting the PIUs in operationalizing it so that the physical progress of each project component is measured and delivered on time;
  - Inspecting and monitoring the progress of construction work of each contract package not only during construction but also during defect liability period;
  - Inspecting third party inspections, as required by the Client.
  - Monitoring the implementation of environmental and standards, safeguards;
  - Preparing, together with and/or on behalf of PIU, the project progress reports describing the physical and financial progress of the project, while underscoring obstacles to the quality and progress of the works, including the remedial actions taken. The progress report shall be submitted to GoI and JICA, and will also include the progress on implementation of the Loan Agreement;
  - Preparing and/or amending the existing procedures and guidelines for site supervision and quality control;
  - Setting the quality control procedures so that the quality of works conforms to the specifications and drawings; and
  - Finalizing quality control and assurance system including approval of source of material and certification.
- Assist PIU in implementation of social outreach and awareness on public health and sanitation, including IEC campaigns and community-based Ghat management programs;

- Provide advice to PIU for contractual issues including examining the Concessionaire / Contractor's claims for variations, extensions or additional compensations, etc and prepare recommendations for the approval;
- Assist the PIU and /or SPV in other tasks as assigned to it by the IA and EA.

13.6 Streamlining the Decision-Making Process

Decision making for procurement should both be strengthened and streamlined with the procuring agencies – SPMG for consulting services, and SPVs for the HAM-PPP Contractor-Concessionaire, focusing not only on downstream activities such as tender conditions, bid documents, eligibility criteria, bid evaluation, contract awarding etc.; but also on upstream activities like determination of technology, conceptual design, specification, "vendor" base identification, as well as post-tendering procedures such as contract management, payment, and monitoring after the award of a contract. This can be done through the following measures:

- Keeping itself well informed on the range of goods, services and works available before designing the tenders in order for the procurement process to achieve best value for money;
- Designing the tender process in a way that it maximizes/ enhances the potential participation of credible competing bidders;
- Defining requirements clearly and comprehensively, making it easier for potential suppliers to understand them, then prepare standardized/ consistent information across the submitted bids;
- Formulating the specifications and the terms of reference (TOR) focusing more on functional performance, meaning, on what is to be achieved rather than how it is to be done, thus encouraging innovative solutions;
- Carefully choosing its criteria for evaluating and awarding the tender since selection criteria affect the effectiveness and transparency of competition in the tender process as well as help avoid post-award challenges while rewarding innovation along with promoting competitive pricing; and
- Clearly spelling out the evaluation criteria in the tender documents by which evaluation should be carried out. Public opening should be mandatory, and the result of the tendering process should be put out in the public domain.

13.6.1 GoI Procurement Process

At present there is no legislation in India governing public procurement by the Indian government's ministries, departments and offices. However, the *Public Procurement Bill*, approved in 2012, is now undergoing further refinement before it can be formally legalized and adopted. The Bill is part of the

Indian government's continuing reforms in public financial management by creating a single overarching legislation to govern the procurement process. The jurisdiction of the Bill covers any Ministry or Department and any public sector undertaking of the Union government, or any company in which the government has a stake of more than 50 per cent. The Bill does thus not cover the procurement processes of the States and the local governments; however, the Bill will have a strong impact and influence over the State and local governments' own procurement processes.

The public procurement process is governed by the *General Financial Rules of 2005*,[13] particularly Chapter 5 (Works) and Chapter 6 (Procurement of Goods and Services) issued by the Government of India, Ministry of Finance. The issuance of the GFR 2005 is supplemented by acts, codes and manuals, such as: Manual on Policies and Procedure for Procurement of Works (2006), Manual on Policies and Procedure for Purchase of Goods (2006), Manual on Policies and Procedure of Employment of Consultants (2006), Standard Request for Proposals – Selection of Consultants, and Bidding Documents for Works.

In 2006, the GoI approved the National E-Governance Plan (NeGP), which was to lay the foundation and provide the impetus for long term growth of e-governance in India by setting up institutional mechanisms, core infrastructure and policies, and implement these in the Central, State and integrated service levels to create a citizen-centric and business-centric environment for governance. eProcurement is aimed at making government procurement simplified, transparent and result-oriented.

The eProcurement Mission Mode Project Portal consolidates all the tenders floated at various State Governments and Union Territories across the country, thereby enabling the establishment of a one stop-shop for all services related to government procurement. This procurement reform enhances the efficiency of procurement, reduces the cycle time and cost of procurement, and promotes transparency in Government procurement.

13.6.2 Procurement in NGRBA / SPMG

In 2011, NGRBA issued the *Procurement Manual* (revised 2013) which provides essential information, including step-by-step procedures on the procurement of goods, works and services for IBRD and IDA projects. The Manual was prepared for procurement officers at NMCG, SPMG and the project execution agencies to achieve the uniform system of procurement in all the States under the NGRBA

[13] The *General Financial Rules of 2005* is issued by the Government of India, Ministry of Finance, Department of Expenditure. It is a compendium of general provisions to be followed by all offices of Government of India while dealing with matters of a financial nature. The States base their own financial rules/ handbooks on the GFR, 2005.

program. The Manual is organized in two parts – Part 1 specifies the processes, methods and various value thresholds that shall be maintained; while Part II includes formats and documentation required in carrying out procurement activities under World Bank-assisted projects.

The procurement process follows these steps: (i) identification of need, (ii) developing specifications, (iii) estimating costs, (iv) securing approvals and funding, (v) determine procurement strategy, (vi) deciding tendering procedure, (vii) preparing request for tender, (viii) allowing time for submission of EOIs, (ix) issue tender documents, (x) receipt and opening of bids, (xi) clarifying receipts, if required, (xii) evaluation and awarding of contract, and (xiii) publishing, contract management and closure.

The revised Procurement Manual (2013) can be utilized/ applied for the procurement of consulting services to support the implementation of the JICA-assisted projects under the Ganga Rejuvenation Project. However, the forms/ formats, as well as the procedures/ process should be that utilized and required for projects undertaken under JICA assistance.

13.6.3 Procurement in Uttar Pradesh: Case of UPJN

The Government of Uttar Pradesh has issued the *Financial Handbook (Revised Edition, 1984)* that governs all financial transactions of the State government, including procurement of goods, services and works. The Financial Handbook is presently undergoing revisions.[14] The State departments and offices have their own procurement process, guided by the Financial Handbook.

The State of Uttar Pradesh has also implemented the e-procurement system under "Tenders Uttar Pradesh". This enables the tenderers to download the tender schedule free of cost and then submit the bids online through the Uttar Pradesh Government Tenders Information System.[15] Latest tenders are provided with the following information: tender title, reference number, closing date and bid opening date; while the latest corrigendums are also given similar information such as the corrigendum title, reference number, closing date and bid opening date.

The tenders information system services the entire U.P. government, thus a prospective tenderer can find tenders by location (area) or by organization by simply clicking on the drop down menu, "organization chain", to select the particular department or organizational unit of interest. The tenderer can also narrow down his choices based on "tender type", which has seven choices – auction, EOI,

[14] http://budget.up.nic.in/finhand1.htm, Retrieved 27 January 2016.

[15] https://etender.up.nic.in/nicgep/app, Retrieved 27 January 2016.

limited, open, limited open, single or test; or go to tender category", which has three choices – goods services or works. It a tenderer goes "product category" there are numerous categories to choose from, such as consultancy, civil works, pipe laying, repair and maintenance works and services, among many others.

In every case, the tender information system gives important information for each tender – the e-published date, the bid submission closing date, the tender opening date, and the title/ reference number/ tender ID.

One of the examples for procurement process is that of UPJN. Being a state corporation, UPJN has its own procurement process governed by its own Financial Handbook. Tenders are listed in its own website with the following tender information – district, category, tender number, tender date, last date of sale, opening date and tender file.[16]

1) Approval of Tenders

The approval in the procurement of goods, services and works is based mainly on the value of the tender, which passes through different levels of approval. There are several tender committees that tackle the procurement process, including technical and financial evaluation. These committees' levels are the Unit level, Circle level, Zonal level, and two Headquarter levels – one whose accepting authority is the Managing Director (MD) and the other whose accepting authority is the Chairman.

The approval system generally specifies the following: (i) The value of the tender; (ii) Officers involved; (iii) The composition of the Tender Committee; and (iv) The accepting authority. **Table 13.6.1** provides the range of the value of the tender, the officers / tender committee involved that deliberate on the tender, and the approval or accepting authority once a decision has been made.

Table 13.6.1 Approval of Tenders according to Value of Tender in UPJN

S.L.	Value of Tender	Officer(s) Involved	Level	Composition of Tender Committee	Accepting Authority
1.	Up to Rs.40,00,000.00	Executive Engineer (EE)/ Project Manager (PM)	Unit Level		EE / PM
2.	Rs 40,00,000.00 to 100,00,000.00	Superintending Engineer (SE)/ General Manager (GM)	Circle Level	SE and PM	SE / GM
3.	Rs 100,00,000.00	Chief Engineer, Zone	Zonal Level	CE and SE / GM/	CE Zone

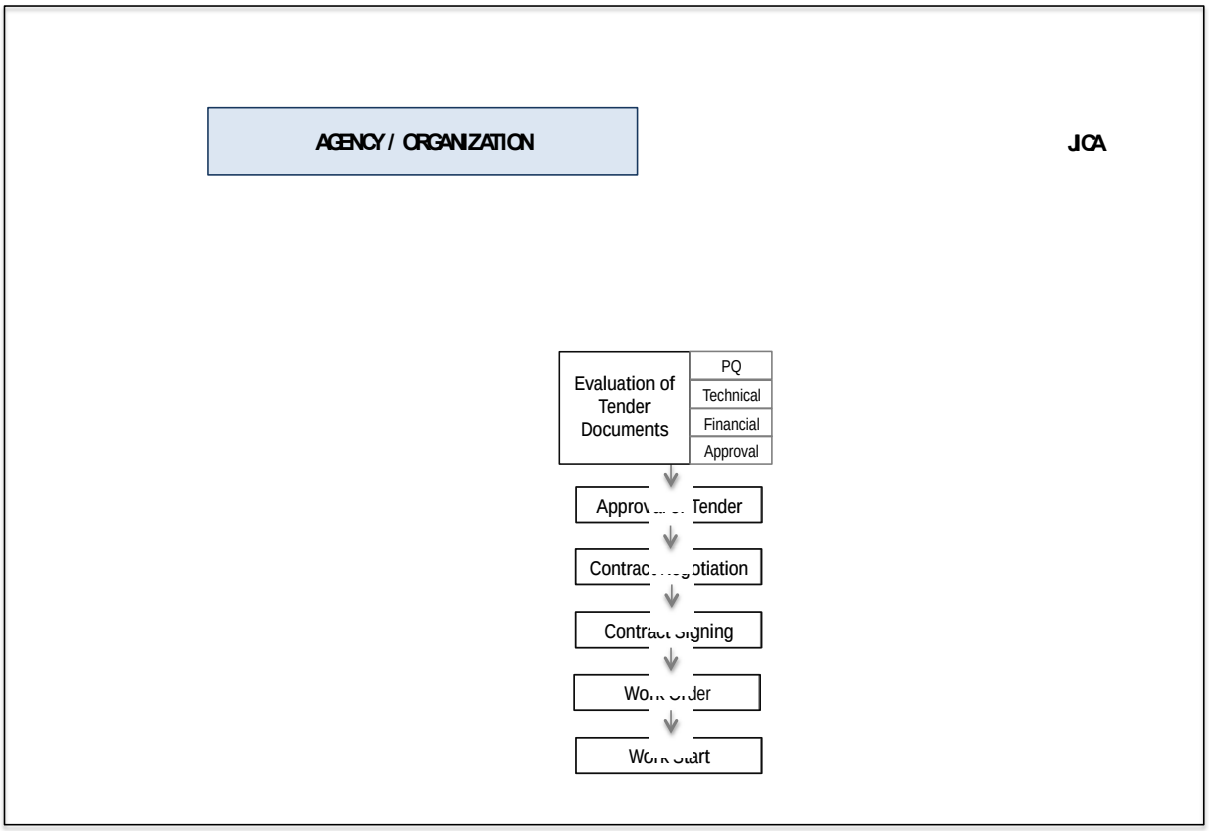
[16] http://www.upjn.org/ShowAllTender.aspx

	to 500,00,000.00	(CE)		PM/ EE	
4.	Rs 500,00,000.00 to 2500,00,000.00	Managing Director (MD)	HQ Level	MD/ CE Hq / CE Zone, SE/ GM and PM	MD
5.	Above Rs 2500,00,000.00	Chairman	HQ Level	Chairman, MD, CE Hq, CE Zone, SE / GM, and PM	Chairman

Source: Office of the Chief Engineer, UPJN Varanasi Zone, 18 December 2015.

2) Procurement Tasks

The procurement system for goods, services and works are generally the same in the Government of India, the States and the ULBs. What varies are the processing time and the limit(s) and level(s) of the approval authority. **Figure 13.6.1** presents the typical Project procurement tasks' flow, and this is also followed by UPJN.



Source: JICA Study Team, January 2016.

Figure 13.6.1 Typical Procurement Process in India

3) Streamlining the Processing Time

The procurement process and the decision-makers are set out in rules and orders. These are consistent with the Financial Handbook and in the manner that the departments in the State of Uttar Pradesh conduct procurement. Thus, according to UPJN, streamlining the decision-making process should be

geared to properly managing the process effectively, and where feasible, in shortening the time it takes to accomplish each step or task in the procurement process.

Table 13.6.2 presents the project procurement tasks and the normal processing time per task for UPJN-GPPU that shows that, barring any problems, it would already take anywhere from 12.15 to 15.85 months to complete the project procurement process. It also indicates the target for streamlining the decision-making time involved in the procurement process for this Project without sacrificing quality in the preparation of tender documents, and thoroughness in the evaluation of bid documents.

Table 13.6.2 Streamlining Procurement Tasks Processing Time

SL	Task			By	UPJN-GPPU						Contractor		JICA	
					Preparation (Days)		Publication (Days)		Processing (Days)		Processing (Days)		Processing (Days)	
					Normal	Target	Normal	Target	Normal	Target	Normal	Target	Normal	Target
1.	Preparation of Bid Documents	1.1	Request for Proposal (RFP)	UPJN-GPPU	30		30-45		-		-		-	
		1.2	Prequalification (PQ) Documents		30		90-120				-		-	
		1.3	Tender Documents											
2.	Preparation of Contractor's Proposal			Eligible Contractors	-		-				30-45		-	
3.	Evaluation of Tender Documents	3.1	PQ Evaluation	UPJN-GPPU	-		-		15-20		-		-	
		3.2	Technical Evaluation	UPJN-GPPU	-		-		20-30		-		-	
		3.3	Approval of Technical Evaluation	UPJN-GPPU	-		-		15-20		-		-	
		3.4	Cost / Financial Evaluation	UPJN-GPPU	-		-		10-15		-		-	
4.	Approval of Tender			UPJN HQ Tender Committee	-		-		10-15		-		-	
5.	JICA Concurrence			JICA India	-		-		-		-		21	
6.	Contract Negotiation /Bank Guarantee Submission			UPJN-GPPU	-		-		10-15		-		-	
7.	Contract Signing			UPJN-GPPU	-		-		07-10		-		-	
8.	Work Order			UPJN-GPPU	-		-		07		-		-	
9.	Work Start / Mobilization			UPJN-GPPU	-		-		30		-		-	
	Total (More or Less)				60 days or 2 months		120-165 days or 4-6 months		30 to 45 days or 1 to 1.5 months		131-169 days or 4.4 to 5.6 months		21 days or .75 months	

13.6.4 Considerations on Procurement Process of SPV

The Planning Commission, through its Secretariat for PPP & Infrastructure, has issued the third revision of the "Model Request for Qualification (RFQ) Document" in 2014. This incorporates the results of experiences in implementing the first set of guidelines, as well as includes best practices after the said document was issued in 2007. It is the expected that Ministries and autonomous bodies of the Central Government will follow these Guidelines, and that the State Government are to adopt the same to enhance the possibilities of fair, transparent and competitive selection of bidders for delivery of successful PPP projects in infrastructure.[17]

The guidelines are also expected to be followed by the SPV. The guide's framework is not only broad and generic, which makes it easy to adopt; but is also flexible enough to make it project-specific. The guidelines are aimed at allowing for objective and expeditious decisions. Furthermore, it ensures the efficient, competitive and economic delivery of services and the selection of bidders for those undertaking infrastructure projects within the PPP umbrella in a selection process that is fair and transparent. The features of the guidelines are as follows:

- Bidding process is typically in two stages – first being the RFQ or EOI stage, and the second is the RFP stage;
- The RFQ stage should aim at shortlisting and prequalifying applicants who will be asked to submit financial bids in the RFQ stage; therefore, only credible bidders should be prequalified;
- Guidelines should be transparent to eliminate collusion or cartelization, and avoid or eliminate conflict of interest;
- The number of bidders to be shortlisted / pre-qualified should be set at around six to seven, and to be qualified set to the international practice of around three to four bidders;
- Balance in serving the objective of prequalifying a reasonable number of bidders at the RFQ stage should be kept in mind when identifying eligibility criteria;
- The guidelines provide sufficient flexibility to add project-specific conditions by the project authorities;
- The evaluation criteria for shortlisting bidders are divided into two:

[17] Planning Commission. "PPP Request for Qualification: Model RFQ Document", 2014.

- Technical capacity where experience will be a major measureable indicator such as project and construction experience in the specified sector; and
- Financial capacity where minimum net worth (25% estimated capital cost of the projects for which bids are to be invited) is the major measureable indicator of sufficient financial strength; and

- In terms of the "stake of consortium members", it is suggested that each member should hold at least 26 percent of the equity of the project SV, and should also hold equity to at least 5 percent of the total project cost for a period of two years after the commissioning of the project.

CHAPTER 14 Pilot Project

<Objective of the Study>

Pilot project for direct Ganga purification method was studied.

<Result of the study>

From the stand point of maintenance and operation, EBB and Iron and Charcoal method were proposed for the Pilot Project. EBB unit was taken as possible process with less maintenance work and less operation cost in the CPHEEO than Iron and Charcoal. Pilot Project by employing EBB is proposed to be conducted in the upstream of Varuna river in consideration of status of flow and O&M of the facility, since it is difficult to select Ganga River as project site for Pilot Project in terms of flow, water depth and O&M for the facility.

<Issues>

River direct purification is under jurisdiction of Irrigation Department. Although DPR was produced by Survey Team and submitted to UPJN, no action has been taken by India side so far..

14.1 Current Status of the Rivers and Necessity of Water Quality Improvement

Feasibility of pilot projects for direct purification of river water was examined in the study with investigating the river flow rate, water quality, and velocity. Study on the references and making hearing investigation to the relevant authorities and contractors were made, and the draft DPR was submitted to UPJN and NMCG in September 2016 according to an agreement in the July mission in 2016, however no comments were provided to JICA survey team.

First of all, treatment of the entire flow for all the season is impossible in terms of flowrate. Second, water level variation between dry season and rainy season is about 12meters which will make all the efforts to maintain the facility nothing in rainy season. And during the rainy season, Ghats are submerged under water with any facility on the bottom of the river or along the river side to be submerged in the deep water and no maintenance work will be possible in the rainy season. After the rainy season, large volume of sediment will be found on the structures of the Ghats and floors. It will need a lot of labour works to remove/clean the grits and soils from the Ghats. Machines, if used, they will be found broken down. Further, in the rainy season the facility will be exposed to danger of wash-out by the strong flow and burial by the grits and silt.

Water Buffalos are another problem. Around hundreds of water buffalos are found along the Ganges just upstream of the Ghats. They usually stay and do water bathing along the river side of the Ganges. If the treatment facility is installed along the river, they will break the structures/devices back and

force from the river.

Thus, application of direct purification for the Ganges River is deemed not realistic because of the reason above. If the facilities for the direct purification are planned, Ganges must be avoided and tributaries will be the candidates. Refer to 13.3 for detailed discussion in terms of installation of the facility in the Ganges river.

Scope of the implementation of direct purification of the Ganges River will be decided through the pilot project by which the effect of the measure will be monitored, and it will be proposed through the discussion with UPJN and JICA.

14.2 Concept for the Direct Purification System

A proposal is to conduct the direct purification to a tributary like Varuna River to confirm the effect of the measure. After the confirmation of the effect the methods can be developed to the tributaries in the Ganges.

1) Process of direct purification of rivers

There are physical purification process, biological process, and combined process of physical and biological process. In the selection of the process, economics in terms of construction and operation & maintenance, process performance and necessity of the foot print for the process was examined.

From the construction cost, power requirement and maintenance work, Gravel Contact Oxidation Process and Special Bio Block are preferred.

Table 14.2.1 Outline of water purification process

Process	Advantage	Disadvantage
Gravel Contact Oxidation Process	*High removal efficiency of BOD & SS for low incoming load *Less energy requirement *Easy O&M	*Low removal efficiency of BOD & SS for high load *Large foot print *Clogging by grits
Plastic Contact Oxidation Process	*High removal efficiency of BOD & SS for low incoming load *Less energy requirement *Smaller foot print than Gravel Contact Oxidation	*Low removal efficiency of BOD & SS for high load *High material cost *Low removal for soluble matter

Aerated Gravel Contact Oxidation Process	*Applicable to high incoming load(20mg/l) and high soluble BOD *Organic matters and must smell removable	*Power required *Aesthetic issue by foaming
Aerated Plastic Contact Process	-Ditto-	*Power required *Aesthetic issue by foaming *High material cost
Plant Purification	*High removal efficiency of N & P *Less energy requirement	*Applicable depth shallow *Need harvesting
Special Bio Block	*High removal efficiency of BOD & SS for low incoming load *Less energy requirement *Easy O&M	*Procurement of Blocks

Gravel bed contact purification process is the most applied process for direct purification in Japan. Special Bio Block was examined in terms of water purification performance in India Delhi and result was published in the CPHEEO in India.

Field study of the Block was conducted in the water channel of 3.2km long with channel width 1.5m. The technology was developed by Japanese private company and patented in USA and Japan. Since the process does not need blowers, electric power and maintenance work as well, it is befitted to the condition in developing countries. Once the advantage of the method is recognised, it can be developed in the tributaries along the Ganges improving the status of water quality in the Ganges River. Table14.2 shows the comparative outline of the processes.

Table 14.2.2 Performance of river purification process

Process	Condition	Applicable Site		Parameter (%)				
		River	Separate Channel	BOD	SS	Coliform	T-N	T-P
Gravel Contact Oxidation Process	BOD:<20-30 mg/l	OK	OK	50-80	65-90	50-90		50-90
Plastic Contact Oxidation Process	BOD:<20-30 mg/l	OK	OK	50-80	65-90	50-90		50-90
Aerated Gravel Contact Oxidation Process	BOD:<20-30 mg/l	N/A	OK	75-90	75-95	50-95		
Aerated Plastic Contact Process	BOD:<20-30 mg/l	N/A	OK	75-90	75-95	50-95		
Plant Purification	BOD:<20-30 mg/l	N/A	OK	30-50	30-80	25-75	50-75	25-50

Eco Bio Block	BOD:<200mg /l	Depends	OK	50	75	54	50-80	50-80

Special features of the Special Block are shown as follows (Source: Pamphlet Manufacturer of the Block):

- Biological purification method using aerobic Natto bacteria and porous concrete block which contains Natto bacteria inside the block.
- Aerobic environment is needed for the level of survival for fishes
- Past record in the experiment in New Delhi: BOD removal=32.4%、TSS removal =62.5%
- No power needed

Special Block (Eco Bio Block)

Source: Manufacturer's Pamphlet

Figure 14.2.1 Special Block Field Experiment in New Delhi

From these examination, employing special block for the pilot project for the river purification will be the solution in terms of construction cost and operation & maintenance work.

2) Removal of Floating Solid Waste

Small tributaries are usually very crowded with the residents and wastes are dumped in the channels. Removal of such wastes is also needed in such situation at the same times. Installation of screenings and waste collection point is the common practices for the issue. Corporative work by resident people will be necessary before the installation of the equipment for the Pilot Project.

14.3 Location Condition and Appropriate System

14.3.1 Main Stream of Ganges

Most favourable location for the installation of the units of the pilot projects will be in the main stream of the Ganges, for example just in front of Ghats showing advantages of the treatment to the residents and tourists. It will enable to show the presence of the units in the water and will also be able to show the improvement of the water quality to the public in terms of improvement of turbidity/transparency of the water and living water creatures such as aquatic mammals and fishes to the public. It will be the best presentation of the Clean Ganga.

Current status of the Ganges in front of Varanasi is summarised as follows:

(1) Flowrate: 4,100m^3/sec, at annual average flow
(2) Velocity: 3.0m/sec
(3) Water Level: Dry season +62.000m, High High Water Level +74.000m
(4) Width of the Ganges: Approx 400m in dry season

However there are problems as follows:
(1) Big variation of flow rate and water level between dry and wet season,
(2) Tremendous flow of grits in the water and thick sediment on the river bottom,
(3) Difficulty of maintenance and operation of the units installed under water due to depth and variation of the water depth,
(4) Difficulties to supply power for the motor when electro-mechanical devices are used for the treatment,
(5) Frequent black outs by which generators are needed for the backups occur,
(6) Concentration of BOD_5 is not high enough for the electro-mechanical treatment and
(7) Presence of a lot of water buffalos

Variation of water depth just before the Ghats is usually 10 m between dry season and wet season. The devices installed in the river must stand both of the static and dynamic water pressure in rainy season. After the rainy season, mountain of grits is seen on the Stages of the Ghats. The grits are sent from upstream by the water flow and it must be cleaned before the ceremony at the Ghats. If the installation of the devices is conducted on the bottom of the river, the devices will be buried under the grits or washed away by the hydraulic forces in the rainy season. The big difference of water level between dry and rainy season will cause maintenance and operation problem if the devices are installed on the bottom of the river in case of malfunction. If the electro-mechanical machine is used for the treatment of the water, power is needed for the operation. In Varanasi City in which black outs frequently happens, engine generator with the fuel supply system will be indispensable to guarantee the treatment. The system itself will need a lot of maintenance work. Installation of the treatment system under the main stream has a lot of problems and it will have little advantage for the water quality improvement. Other problems are derived from the points. Even the tributaries or nallas are in the same condition. Issue of water depth and grits must be taken seriously.

14.3.2 Assi nalla

Assi nalla is a channel of drainage of the Varanasi district 2 and 3. Since sewerage construction is not completed yet, only raw sewage is flowing. Since dwellings along the nalla is very close to the channel and densely constructed. Access points for heavy machine of the construction work to the stream from the shore are very difficult to find out. DO in the water shows almost zero in Assi Nara which is very severe condition for the devices such as Special Blocks which is capable of partly treatment of

the sewage. After the construction work of the Varanasi district 2 and 3 under the GAP II project, the water of the flow will be improved in terms of all water quality parameters. It will be worthwhile to plan river purification in Assi nalla then.

14.3.3 Varuna River

Origin of Varuna river is in Janhai City with a length of 50km from the Ganges river. Water quality of the river is far better than Assi nalla. Many kinds of fish and aquatic creatures are found in the river. A lot of catfish and carps are caught in the river. Varuna river flows in the district 2 in which sewerage construction is underway.

According to the result of the water quality survey, the water quality in the Ganges becomes bad right after the confluence of the Varuna. For example pH decreases 8.35 to 7.9, DO drops from 6.8mg/l to 5.3mg/l, BOD rises from 2mg/l to 7.4mg/l, Coliform rises from 11,000 to 14,000 in December 2015. At the same period in Varuna, BOD was 8.4mg/l, DO 4.2mg/l and Coliform 33000. The fact shows that there is possibility to improve the water quality in the Varuna

Ground height of the point at the upstream is high enough around 70m which is not influenced by the water level in the Ganges. In addition, access points to the river from the shore can be found very easily along the Varuna.

14.4 Selection of Subject River

From the discussion in 13.3, Varuna River was selected and proposed for the Pilot Project.

14.5 Process Selection

1) General

General ground level varies from 71m to 80m. For example, Varanasi city is situated above 80 m height from the sea level. Geologically it is situated in the alluvial Gangetic plains and nature of soil is mixture of clay and fine sand.

2) Preferred Processes for the objective

Gravel Bed Treatment System is common in Japan however, as shown in the comparison table, from the stand point of maintenance and operation, Special Blocks method were proposed for the Pilot Project from the point of view of less maintenance work and less operation cost.

14.6 Plan of Pilot Project

14.6.1 Process Selection

Processes for the Pilot Project were selected as Special Block as discussed in the former section.

14.6.2 Installation Point and Maintenance Work

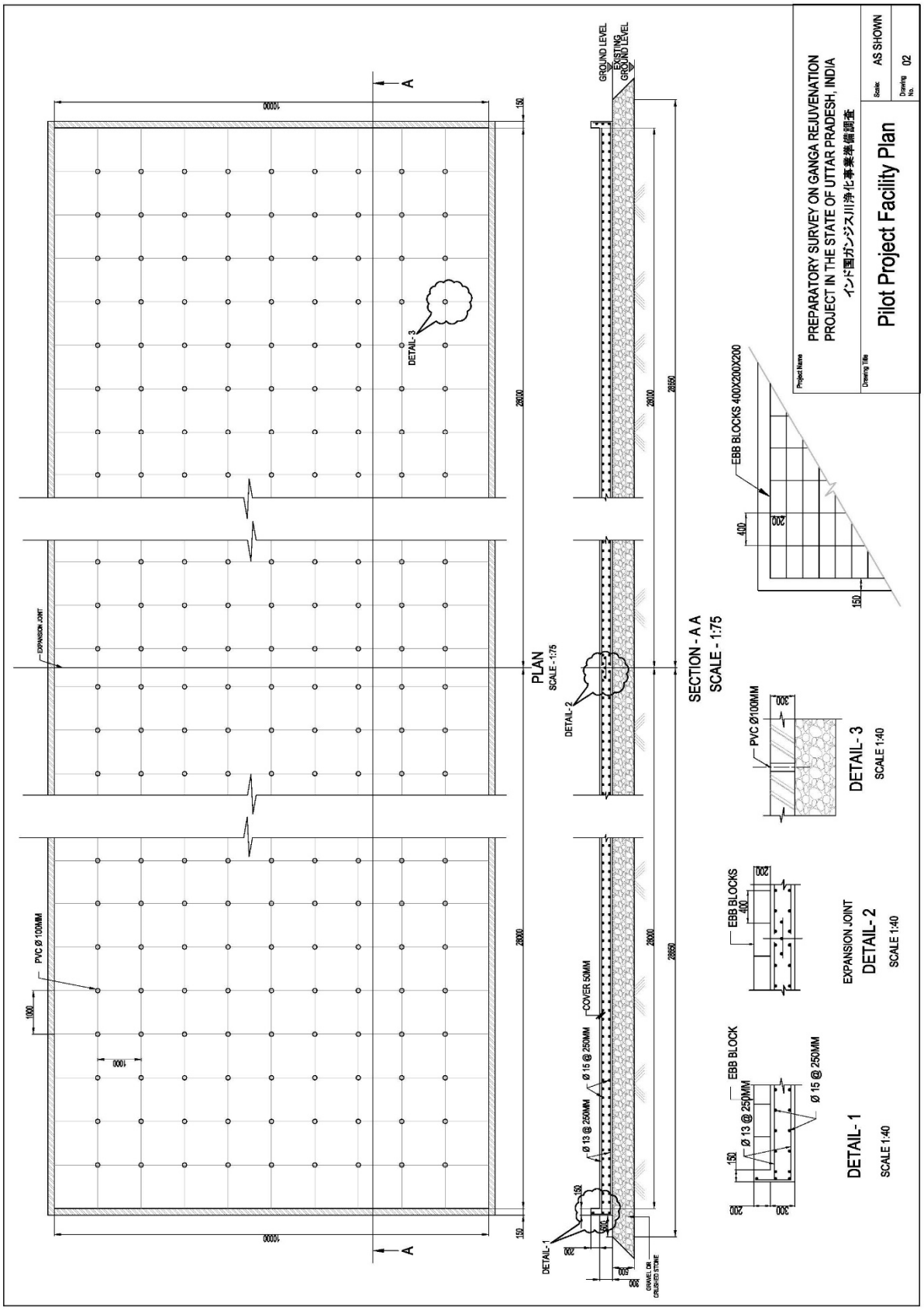
Installation of the units in the Ganges River is not appropriate in terms of construction and operation & Maintenance. Installation points are planned along the Varuna River with the elevation higher than altitude of 74 m from the discussion in the section 14.3. Installation point must be the outer course of the bend of flow to avoid covered by sand and grit as shown in the drawings. (Inner course of the bend will be easily buried by sand) Depth of installation shall be shallow enough considering the maintenance work in dry season. Maintenance work will be made manually using water jet or scoops after the wet season.

14.6.3 Quantity of the Special Block and Structure of the Unit

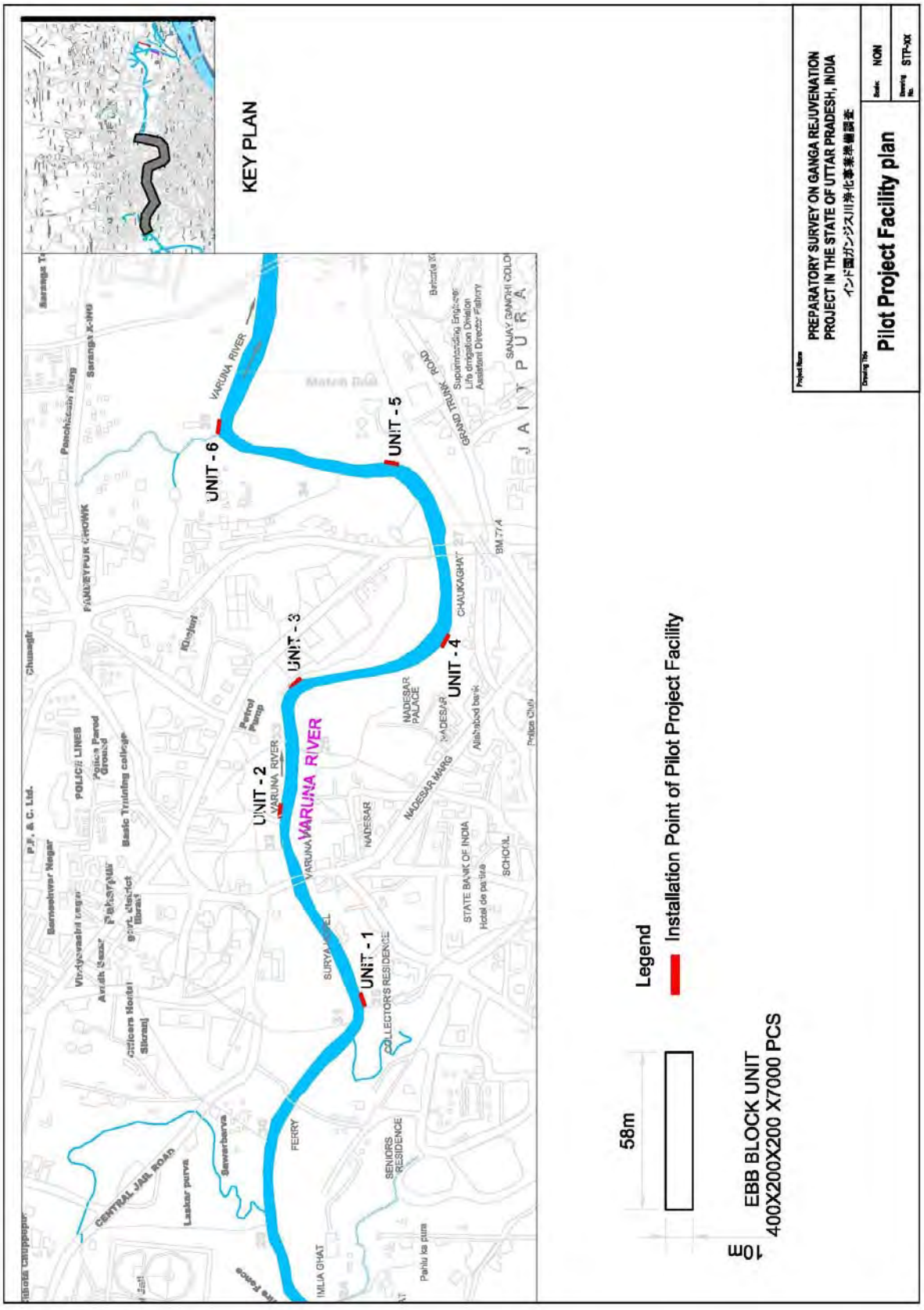
Unit Structure is a RC bed for the special blocks with following dimension:

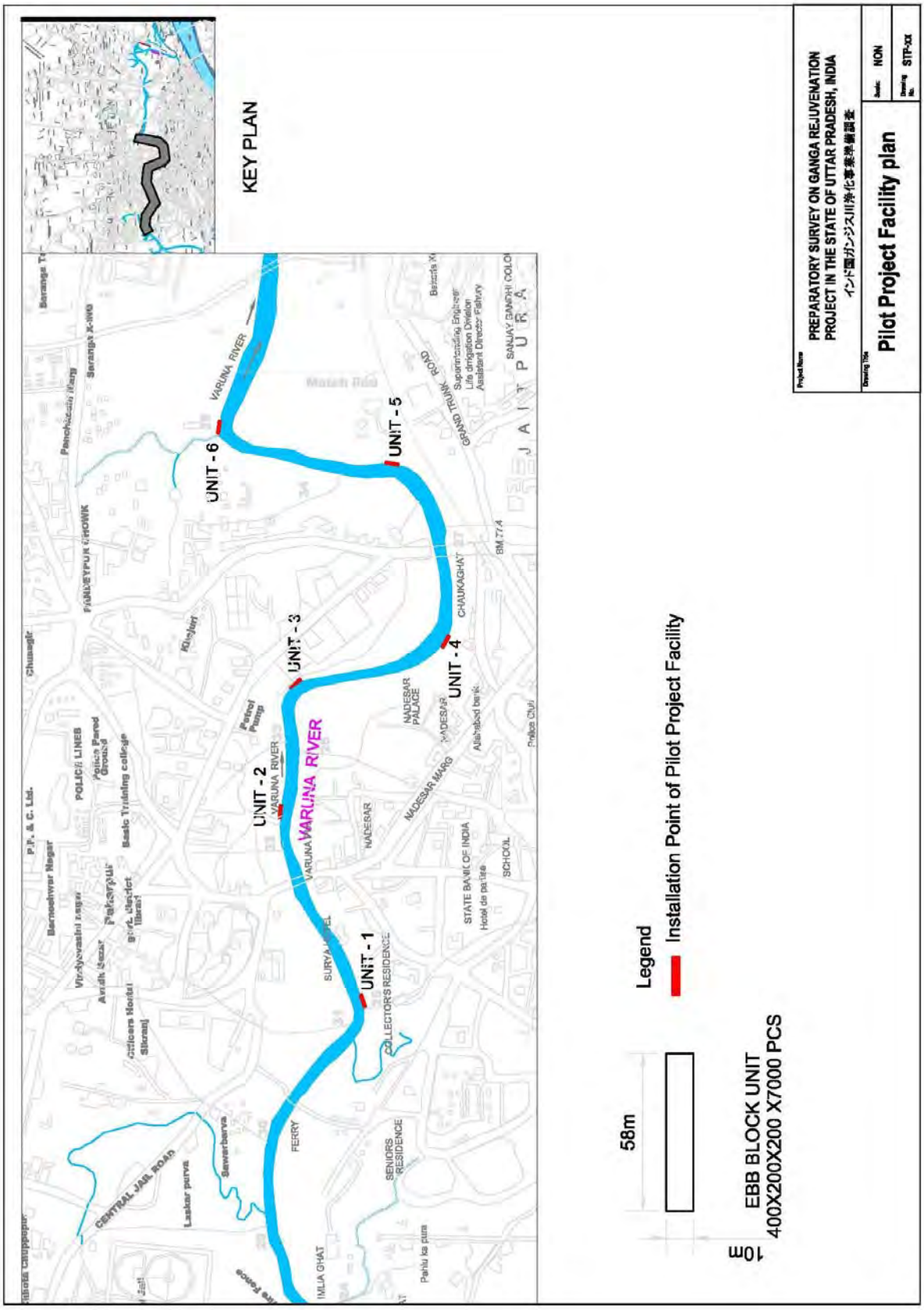
- 6units of W 10.0m x L 56.0m with 7000 pcs of special blocks

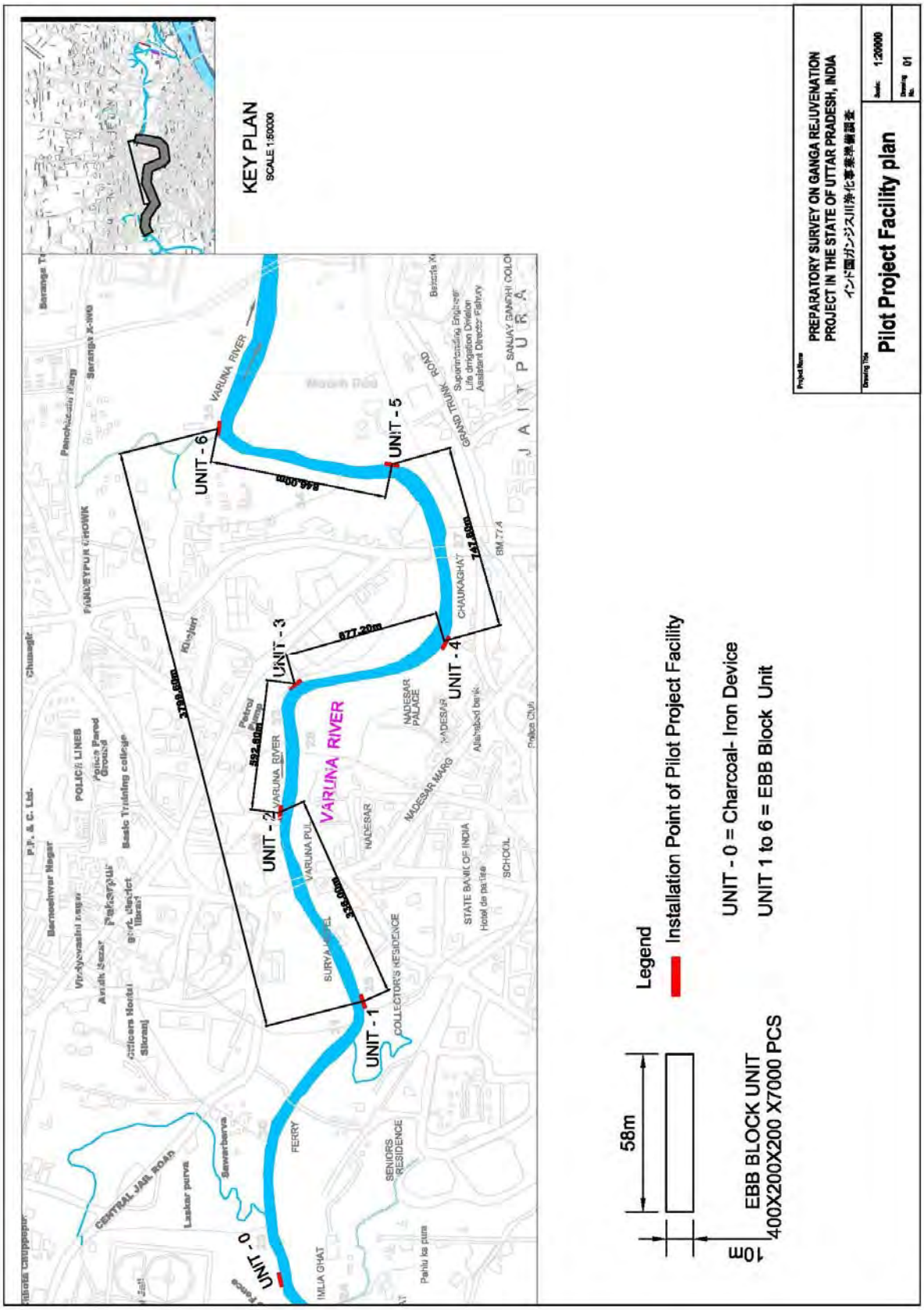
From the guideline of the manufacturer, detention time in the river was decided as about 5 to 6 hours for proper treatment. Assuming velocity in the river is 0.2 m/s and average depth is 1.0m, 4000m water course was selected with several bends of river as shown in the drawing. Approx 40,000 pcs of the blocks were planned in the 4000m considering the setting points at the bends of the river as mentioned in 14.6.2.


PREPARATORY SURVEY ON GANGA REJUVENATION
PROJECT IN THE STATE OF UTTAR PRADESH, INDIA
インド国ガンジス川浄化事業準備調査
Pilot Project Facility Plan
Scale: AS SHOWN
Drawing No. 02
PLAN
SCALE - 1:75
SECTION - A A
SCALE - 1:75
DETAIL- 1
SCALE 1:40
DETAIL- 2
SCALE 1:40
EXPANSION JOINT
DETAIL- 3
SCALE 1:40
EBB BLOCKS 400X200X200
PVC Ø100MM
EBB BLOCKS
EBB BLOCK
Ø 13 @ 250MM
Ø 15 @ 250MM
COVER 50MM
GROUND LEVEL
EXISTING GROUND LEVEL
EXPANSION JOINT
GRAVEL OR CRUSHED STONE

14.7 Location of Units Installed in the Varuna River




KEY PLAN
UNIT - 1
UNIT - 2
UNIT - 3
UNIT - 4
UNIT - 5
UNIT - 6
VARUNA RIVER
VARUNA
Legend
Installation Point of Pilot Project Facility
58m
10m
EBB BLOCK UNIT
400X200X200 X7000 PCS
PREPARATORY SURVEY ON GANGA REJUVENATION
PROJECT IN THE STATE OF UTTAR PRADESH, INDIA
Pilot Project Facility plan
NON
STP-XX


KEY PLAN
SCALE 1:50000
PREPARATORY SURVEY ON GANGA REJUVENATION
PROJECT IN THE STATE OF UTTAR PRADESH, INDIA
インド国ガンジス川浄化事業準備調査
Pilot Project Facility plan
1:20000
01
UNIT - 0
UNIT - 1
UNIT - 2
UNIT - 3
UNIT - 4
UNIT - 5
UNIT - 6
VARUNA RIVER
Legend
Installation Point of Pilot Project Facility
UNIT - 0 = Charcoal- Iron Device
UNIT 1 to 6 = EBB Block Unit
58m
10m
EBB BLOCK UNIT
400X200X200 X7000 PCS

14.8 Cost Estimate

The cost estimation for the In-situ Water Cleaning Facility was prepared and is summarized in the following tables. Latest labour and material rates were taken and also the Schedule of Rates for the year 2014-15 Sanction by GM, GPCU, U P Jal Nigam, Varanasi vide order no. 1407/11-02/45 dtd 02/05/ was referred for the cost estimation purpose. The Capital cost of the In-situ Water Cleaning Facility is estimated as Rs 13.05 Crores.

Table 14.8.1 Cost Estimate for In-situ Water Cleaning Facility

1	**In-situ Water Cleaning Facility**	**Cost Rs in Lacs**
1.1	Cost of Gravel Work 320m3/unitx6unitsx4300Rs	82.56
1.2	Cost of Rebar works 10.9t/unitx6unitsx71000Rs	46.43
1.3	Cost of Concrete works 174m3/unitx6unitsx3500Rs	36.54
1.4	Cost of Porus Concrete Blocks (140x50)pcsx6unitsx2500Rs	1,050.00
1.5	Cost of PVC pipe 55x9x0.3mx6unitsx1000Rs	8.91
1.6	Cost of EXP.J 10mx6unitsx1200Rs	0.72
	Sub Total for In-situ Water Cleaning Facility	**1,225.16**
3	**Provision for survey, investigation, preparation of DD and tender preparation and supervision charges etc.**	**80.00**
	TOTAL	**1,305.16**
4	**Total Annual O&M Cost for ten years for In-situ Water Cleaning Facility**	**23.00**
Grand Total including O&M cost for 10 yrs		**293.38**
	Say	**15.98 Cr**

Detailed cost break up for Civil, mechanical, electrical and instrumentation items is provided in Vol II of this Report. Annual operation and maintenance cost has been estimated as Rs. 0.23 crores including maintenance, chemical, manpower and power cost.

Table 14.8.2 Annual Operation and Maintenance Cost

S. No	Component	In-situ Water Cleaning Facility (Lacs)	Remarks
1	Manpower Cost	1.80	Labours 10x1month/yr 600Rsx10x30
2	Cost of Chemical & Sludge Disposal	-	-
3	Maintenance Cost	21.00	Refilling New Blocks of 2%- 1050Lacs x 0.02
4	Power Cost	0.2	Water Jet Machine for Grit Cleaning on the Facility 6.1Rs/kWH x 1x8x30
Annual O & M cost =		**23.00**	

Table 14.3 O&M Cost for 10 years

S.No.	Year wise O&M Cost	Cost in Rs. (Lacs)
1	Year 1	23.00
2	Year 2	24.22
3	Year 3	25.50
4	Year 4	26.85
5	Year 5	28.28
6	Year 6	29.78
7	Year 7	31.35
8	Year 8	33.02
9	Year 9	34.77
10	Year 10	36.61
Total O&M Cost for 10 Years		**293.38**

Estimated Escalation Rate: 5.3%

14.9 Environmental and Social Impact Assessment of works

During DPR stage, an Initial Environmental Examination (IEE) was conducted to determine impact on environment as a result of the implementation of the project. No significant adverse impact was found for either the environment or social aspects. Further, An Environmental Impact Assessment (EIA) is not required as per findings of an Initial Environmental Examination (IEE). This IEE done at the DPR stage is considered as the final environmental assessment of the project. Summary of the IEE prepared at the DPR stage is given in table below.

Table 14.9.1 Evaluation and Conclusion of IEE study during construction and operation phase.

Environmental Element	Construction Stage	Operation Stage
Social Environment		
a. Planned Residential Settlement	D	D
b. Involuntary resettlement	D	D
c. Substantial changes in the way of life	D	D
d. Population increase	D	D
e. Drastic change in population composition	D	D
f. Changes in bases of economic activities	D	D
g. Occupational changes and loss of job opportunities	D	D
h. Increase in income disparities	D	D
i. Adjustment & regulation of water or fishing rights	D	D
j. Increased use of agrochemicals	D	D
k. Outbreak of endemic diseases	D	D
l. Spreading of endemic diseases	D	D
m. Residual toxicity of agrochemicals	D	D
n. Increase in domestic and other human wastes	D	D
Natural Environment		
a. Change in vegetation	D	D
b. Negative impact on important or indigenous fauna and flora	D	D
c. Degradation of ecosystems with biological diversity	D	D
d. Proliferation of exotic and/or hazardous species	D	D
e. Change in surface water hydrology	D	D
f. Change in ground water hydrology	D	D
g. Water contamination and deterioration of water quality	D	D
h. Water eutrophication	D	D
i. Noise and vibration	D	D
j. Odour	D	D
k. Damage of landscape	D	D
l. Traffic	D	D

14.10 Implementation Programme

Execution of the project shall be done in 3 phase. In phase one DPR shall be approved in first three months. The second phase is of tendering which will consists of various activities including preparation and issue of PQ document and its evaluation, tender document preparation, approval by NRCD, issue of tender document to pre-qualified Bidders and evaluation of tender , and work award. The second phase is planned to be completed in 6.5 months. The third phase is the execution stage is construction. This phase is planned to be completed in 6 months. Total project duration is 15.5 months.

CHAPTER 15 VARANASI CONVENTION CENTRE

<Objectives of the Study>

As an initial stage of consideration, basic information was collected and the concept of Varanasi Convention Centre was studied based on DPRs submitted by India side..

<Result of the Study>

The proposed building aims to address the requirement for a convention centre that will facilitate for hosting conventions on a grand scale. Architectural plan, HAV facilities and exhibit plan were comparatively studied with the Sapporo Convention Centre in Japan for the DPR plan of VARANASI COMMONS which was submitted July 2016.

<Design Proposal>

The survey team proposed Design Concept based on the motif of culture, history, heritage, industry, tourism and regional characteristics and the plan was made to fit to the natural condition and surrounding environment. Ornate appearance may be avoided and in this context, façade of Mughal style is recommended to express the heritage and history of Varanasi. Further discussion to develop the concept was handed over to "Data Collection Survey on Varanasi Convention Centre in India" starting from September, 2016.

15.1 Introduction

15.1.1 General

The name Varanasi originates from the names of the two rivers from north and south Varuna, flowing in Varanasi and Assi, a small stream near Assi Ghat. The old city is located on the north shores of the Ganges, bounded by its two tributaries: Varuna and Assi. Varanasi also known as, Benares, Banaras, or Kashi, is a North Indian city on the banks of the Ganges in Uttar Pradesh, India, is one of the oldest inhabited city in the world. Varanasi lies along National Highway 2, which connects it to Kolkata, Kanpur, and Delhi. Varanasi is located at an elevation of 80.71m in the centre of the Ganges valley of North India, in the Eastern part of the state of Uttar Pradesh. By road, Varanasi is located 797 kilometres (495 mi) south-east of New Delhi, 320 kilometres (200 mi) south east of Lucknow, 121 kilometres (75 mi) east of Allahabad, and 63 kilometres (39 mi) south of Jaipur. VNN was planning to construct (scrap and build) Varanasi Convention Centre (VCC) adjacent to city hall, which was posed for the consideration under Japanese ODA assistance.

Based on communication between both governments, the project started to be considered as one of the components under proposed "Ganga Rejuvenation Project". The JICA mission was dispatched to understand the current status of consideration with JICA survey team. The points to be covered in DPR

was clearly submitted by the mission.

As a result of the discussion in the mission, DPR as of May 2016 was revised and submitted in July 2016. Study regarding VCC in this chapter deals with review of the updated DPR as of July 2016 by domestic and field survey during end of June 2016 to end of July 2016.

After the work has been completed under the the scope of the study, further discussion was handed over in September 2016 to "Data Collection Survey for Varanasi Convention Center in India" by JICA.

15.1.2 Objectives

The proposed building aims to address the requirement for a convention centre which will facilitate for hosting conventions on a grand scale. The survey aims to clarify the concept work of VCC and requirement/issues to be clarified to consider for Japanese ODA assistance based on the examination of DPR. Recommendations were made for the plan of VARANASI COMMONS which was submitted in July 2016.

15.2 Issues on DPR of the VARANASI COMMONS

Main issue for VARANASI COMMONS was confirmed and described/studied for the DPR as follows:

(1) Architectural Planning

1) Compliance to the law

Compliance to the legal system and construction standards of the country should be made and reflected to facility planning and design. Laws and regulations must be precisely described in the DPR.

In the DPR, there were 3 options and only the Option 1 was compliant with the standard for FAR and ground coverage in India. For this reason, only Option 1 can be adopted as the eligible plan. This method for the selection is not suitable for the comparative study to select best plan from the alternatives.

2) Basic concept/Zoning plan/Traffic line

Layout plan in the site lot must be decided based on the block plan which was made from the required area for each facility. Coordinative plan with the peripheral zone shall also be planned in terms of landscape, environment information, commercial facilities, neighbouring parks and other public facilities. Plan of traffic line between the centre and other landmarks should be

incorporated in the plan. Since the facility shall be a symbolization of Ganga Rejuvenation, exhibition of river ecosystem and river purification facility is to be displayed inside.

3) Plot plan.

Plot plan is the base for the design of architecture. Specific points to be covered in the Plot Plan is as follows:

- Required rooms to be planned in terms of purpose of use, operation and maintenance(O&M) and organization of O&M, shall be the appropriate sizes.
- The plan shall be conducted to clarify the flowing line of user, pedestrian, vehicles and operation and maintenance work.
- Each room shall be designed based on the usage condition and particular condition for the room.
- Clearance from the existing building.
- Simultaneous interpreter room

In the Plot Plan, Mayor's Office and Accommodation for guests are included, which may be out of scope according to communication between two governments.

4) Plan of flowing line

Study on the flowing line of facility user, operation and maintenance, equipment carrying in and out should be shown on the plan.

5) Layout Plan and Façade (Elevation)

The layout plan and structure shall be provided based on the motif of natural/neighbouring environment and design concept of culture, history, heritage, industry, tourism and characteristic of the region.

Façade (Elevation) shall not be planned employing folly design but using motif of tradition and history of Varanasi. Plural plans shall be provided in the DPR for the comparison/examination.

For the Layout Plan, Issues were identified as follows:

MAYOR'S OFFICE

Construction of MAYOR'S OFFICE is planned in the VCC plan. Since Mayor' office may be out of scope and shall be an independent structure from the VCC, building plan needs required revision.

Accommodation

9 rooms on 3rd floor is accommodation It is recommended that the utility of the rooms is changed appropriately or revise the plan.

6) Section plan

Required space of each room shall be secured just enough on the basis of the requirement from the function of the room. Necessary height of each room shall be studied and reflected to the DPR, for example traffic of large busses. These points are not described in the DPR.

7) Finish Plan

Finish inside and outside the facilities should be decided considering the smooth work environment by the maintenance based on the material durability, corrosion resistivity and economics. Comprehensive tables of finish should be provided in the DPR.

8) Structure Plan

The structure plan should be planned considering the balance of safety, constructability and economics in consideration of the environment of the site, ground condition, and function of a use and scale of each room.

In consideration of the building to be a lifeline facility which must secure a city function at the time of the disaster, it is necessary to design the structure safer than general buildings.

Plan of alternatives for the structure studied/classified should be provided in the DPR. Appropriateness of the adopted substruction/foundation of the Convention Centre should be presented by the result of geo-survey.

9) Disaster Prevention Plan

It is required to be a lifeline facility that facilitates safe just in case as well as usual safety securing for the users. Disaster prevention measures of that purpose shall include the daily preservation standard of facilities and standards for disasters and other damages. Standards established in the laws and regulations shall be strictly in compliance. Safety standards must be provided in the DPR

10) Universal design

Social capital maintenance in the near future will highlight the followings: "high quality that can support variety of needs of all people", "the material richness". The idea of universal design and its implementation will become the basic approach to the society maintenance future.

These facilities shall have 7 following universal design principles as viewpoints.

1) Facilities to be available to anyone equally (equitableness)

2) Facilities to be having high flexibility for the users (flexibility)

3) To be simple in use for anyone

4) Information necessary for anyone to be coming effectively, timely and easily comprehensive

5) To be a design safe for anyone (safety)

6) To be usable by little power easily without forcing anyone physical difficulties

7) To secure space and the size for easy use (space security)

.Study on the above must be shown on the DPR

(11) Trade Facilitation Centre and Craft Museum

Trade Facilitation Centre and Craft Museum have been constructed in Varanasi. Competitive nature of the on-going Trade Facilitation Centre and Craft Museum, Varanasi must be studied in terms of usage and manner of operation.

15.3 Discussion and Recommendations

15.3.1 Comparative Study of VCC with SCC

Since VCC will be planned as a component of Ganga Rejuvenation Project, sustainability in the future is indispensable. As a basis of examination and confirmation, planning of SAPPORO CONVENTION CENTRE (SCC) was taken in this comparative study.

The SCC is located in Sapporo City in Japan with a population of 1,910,000. Management is entrusted private with annual utilization rate of more than 70 %. The centre has a lot of facilities such as large halls to small meeting rooms with plural function. (Population in VNN is 1,435,113 in 2011)

(1) Study of Facility

Scale/size, appurtenant facilities, layout, flow line of VCC in the DPR were studied in comparison with the SCC in terms of functions employed.

Comparison table of 6 functions were developed in Table 15.4.1 for ①Auditorium, ②Seminar Hall, ③ Gallery/Exhibition/Display Area, ④ Reception, ⑤ Office, ⑥Vocational Training Centre.

Table 0.1 Comparison of VCC and SCC

	Varanasi Convention Centre (DPR) as of July 2016	SAPPORO Convention Centre	Remarks
① Auditorium	・Auditorium (1200 m^2—for 1000 capacity) Furniture: Fixed chair Utilization: Theatre	・Conference Hall (692 ㎡—700 capacity) Furniture: Movable chair Utilization: Theatre and others Appurtenant equipment: 6 languages simultaneous translation booth, 80 gallery seats, multi screens ・Main Hall for bigger conference (2607 ㎡—2500 capacity) Furniture: Movable chair Utilization: Theatre and others Appurtenant equipment: simultaneous translation booth, multi-screens, briefing room, lifting stage	Appurtenant equipment for international conference are necessary for VCC. Movable chairs are recommended in the Auditorium.
② Seminar Hall	・Seminar Hall 4 rooms (170 m^2 x 2) & (220 m^2 x 2)	・Hall (240 m^2, 193 capacity) ・Meeting Room-A (283 m^2) ・ Meeting Room-B (328 m^2) to be separated in 2 to 4 rooms ・ Meeting Room-C (83 - 86 m^2) x 2 rooms to be separated in 2 rooms ・ Meeting Room-D (172 m^2) x 2 rooms to be separated in 2 rooms ・ Meeting Room-E (50 m^2) ・ Meeting Room-F (21 - 40 m^2)	Splittable rooms shall be planned in VCC with storage for the furniture
③ Gallery/Exhibition/ Display Area	・Gallery/Exhibition/Display Area (625 m^2 x 1 room) (760 m^2 x 1 room) Utilization form: permanent gallery for the culture and science of India ・Multipurpose Hall (Open Space 625 m^2) ・Hall (Open Space 800 m^2) Total 2,810 m^2	・Main Hall (2,067 m^2) ・Conference Hall (692 m^2) ・Mid-sized Hall (533 m^2) Utilization form: Multiple uses Appurtenance: Movable table, chairs, store room Total 3,292 m^2	Since Exhibits of Sewerage technology and ecosystem in the river as well as river purification technologies will be made in the facility, utilization form of the facility shall be reconsidered if the total area of exhibits is fixed. Store rooms shall be constructed for the storage of furniture, exhibits, and etc. Carry-in entrances are necessary for equipment and exhibits for Multipurpose Hall.
④ Reception	・Hall (800 m^2)	・Main Hall (2,067 m^2) Utilization form: 800 capacity for party	Hall and Multipurpose Hall are thought to be utilised as reception. Catering space linked with kitchen shall be set

	・ Multipurpose Hall (625 m^2)	・Conference Hall (692 m^2) Utilization form: 330 capacity for dinner ・Mid-sized Hall (533 m^2) Utilization form: 210 capacity for party	along with store room for table and chairs.
⑤ Office	・Office Space (200 m^2)	・Office Space (300 m^2) Service space for citizens with Office Space, Information Space and Nursing Space	Since Office Space in the VCC is planned underground, utilization for citizen's use is considered to be difficult. It is desirable to set such function in the entrance lobby on Ground Floor for the common office work, information and services for the citizen.
⑥ Vocational Training Centre	・Training Hall (800 m^2) ・Seminar Room (300 m^2 x 2 rooms) Total 1,400 m^2	・Business supporting rooms (50 m^2 x 8 rooms, 60 m^2 × 3 rooms) ・Industrial Information room（170 m^2) ・Small Seminar rooms（100 m^2 × 2 rooms) ・OA Seminar room（90 m^2) ・Seminar room（180 m^2) ・Rest room（30 m^2 × 2 rooms) ・Green room (40 m^2), Storage (40 m^2 × 2 rooms) ・Multi-purpose room（220 m^2) Total 1,620 m^2	Although size and capacity seem appropriate, splittable rooms for other uses are recommendable.

(2) Flow Line

Comparison of flow lines of VCC and SCC was conducted as follows:

① User Flowline

VCC plans the rooms as splittable spaces while SCC plans the rooms as consecutive ones.

② Service Flow line

VCC: Cluster Type (Dispersed rooms connected by corridor and hall)

SCC: Linear Type（Rooms distributed along the flow line）

③ Main Entrance

There are two entrances in basement and ground floor in VCC plan. Main entrance of the VCC is uncertain. From the layout of COMON/SPILL OUT SPACE, basement is considered as the main however, ground floor is the main from 3D view.

④ Common space

Although independence of each space is prioritised in the plan of VCC, high mobility in the plan which enables various utilization is required as seen in the SCC plan.

Having high mobility in the plan is recommended on this convention centre in terms of flowline of the users and safety for the users at the disaster.

(3) Layout Plan

MAYOR'S OFFICE and Accommodation should be isolated from the subject structure.Cost Estimates

In the cost estimates, validity of the rate is required. In the DPR of VCC, other than Item A (Cost of Building) grounds of rates for TOTAL (B～F) must be clarified and submitted as evidences. The rates are considered to come from "CENTRAL PWD PLINTH AREA RATES (1.10.2012)" for Total A. TOTAL (B～F) and loaded centage must be studied for clarity.

Validity of the cost estimates of VCC was conducted in the manner using the example of SCC shown below:

① Reference:

SPON'S ASIA - PACIFIC CONSTRUCTION COSTS HANDBOOK 4TH EDITION 2010

② Trial computation:

Rates from "Hotel 5 stars, City Centre" in the table by Spon 2008, From Table 15.4.2

- Japan (JPY400,000/m^2)
- India (JPY96,226/m^2)

Then, Japan:India≒4.2:1.0

Actual cost of SCC is as follows

SCC JPY565,000/m^2

Conversion to the VCC is made as follows:

VCC JPY134,523/m^2

Conversion rate: 1.75Rs/JPY

- JPY134,523/1.75=76,870Rs/m^2 ----- (A)

VCC DPR Rate

DPR Cost/Gross Floor Area=21142,88,531Rs/27,782.6 m^2 76,100Rs/m^2-----(B)

Thus, VCC DPR rate is considered to be close to actual SCC rate.

Table 0.2 Comparison of Building Unit Cost by SPON (4th Quarter, 2008)

(Unit: JPY)

Type of Building		Japan	India
	Rate	Yen 1.00	Rs. 1.99
Factories for owner occupation	m^2	160,000	26,713
Secondary/middle schools	m^2	220,000	13,903
Private sector apartment building	m^2	210,000	33,366
Prestige/headquarters office, high rise, air-conditioned	m^2	350,000	47,071
Hotel, 5 star, city centre	m^2	400,000	96,226

(4) Implementation Program

Example of SCC in Japan is described as follow:

D/D: 12 months, Tender assistance:3 months, Construction: 26 months, Commissioning: 6 months,

Total 47 months from the start of DD

(5) Construction

1) Securing the space for the work and flowline

2) Environmental management plan

3) Temporary work plan

4) Hazard and Safety

15.3.2 Exhibit of River Purification Facility

Exhibit of River Purification Facility will be an indispensable facility for the VCC. SCC was taken as a sample for the facility, since it has the same function inside.

(1) Significance of River Purification and sewerage

VCC shall have the function of provision of correct knowledge to citizen in this project. It will be established to show river purification process and sewerage close to people who visit the VCC. In this context, plan of exhibit facility of river purification process/sewerage is proposed as exhibits.

(2) Planning of exhibits

Science Museum for Sewerage in Sapporo City is suggested for a sample of the facility.

Outline of the facility is shown below:

1) Objectives

   The facility was opened to propagate mechanism of sewerage and its roll to conservation of the environment through sewerage in Sapporo in May 1997.

2) Facility

   Structure: RC , 1200m2

   Cost: 1,100,000USD

3) Management

   Managed by public with no charge to users

4) Exhibits

   Global environmental issues

   Roll of Sewerage to the issues

   Outline of Sapporo sewerage

5) Number of Visitors

   Over 700,000 by 2014

   43,989 in 2015

15.3.3 Design Proposal

Design Concept based on the motif of culture, history, heritage, industry, tourism and regional characteristic shall be established to fit to the natural condition and surrounding environment. Ornate appearance will be avoided and in this context, façade of Mughal style is recommended to express the heritage and history of Varanasi as shown in the photos below:

<Hyumayun>

<Lahore>

<Vaishnava>

<Taj Mahal 1>

<Taj Mahal 2>

<Agra Mirza Ghiyas Beg>

15.3.4 Building Services

Building Service is an important function of the VCC in terms of amenity, safety and cost. It is recommended to include the following items in the DPR in terms of building service:

(1) Power Control Method

Decrease of power consumption and O&M cost for long, middle and short term shall be planned based on the standard for power administration

(2) Selection of Equipment and System

Optimum selection shall be made for decision of main equipment and HVAC according to the specification, function, O&M, CAPEX, OPEX and LCC.

(3) Layout of MEP room

Decision of rational plumbing route and effective O&M flowline shall be planned

(4) Green Building Measures and Certification

94 points of GRIHA 5 Stars shown in the DPR shall be achieved

15.3.5 Structural Consideration

In the DPR, description regarding the structure is not found. Structural consideration is necessary as follows:

(1) Structure shall be designed as SMRF structure and condition of Zone 4 shall be applied in the structure computation in terms of safety and sustainability.

(2) Geotechnical report must be referred for the foundation design

(3) Items of "SUPERSTRUCTURE, COMPUTER PROGRAMS, 2 MATERIAL PARAMETERS, 3STABILITY LIMIT STATE, 4SERVICEABILITY LIMIT STATE, 5 TYPES OF FOUNDATIONS＆SBC, 6 DESIGN CODES, STANDARDS AND REFERENCE DOCUMENTS" shall be followed in the DPR

15.4 Proposal for VARANASI COMMONS

(1) Basis of the proposal

Based on the discussion and recommendation, proposal for OPTION 1 of VARANASI COMMONS in terms of Zoning, Site Plan and Floor plans was made for development of the plan.

Points for planning are summarised as follows:

1) Since mayor's office is out of scope for ODA project, intended end use for the rooms should be examined and changed to another one.

2) Competitive nature of the on-going Trade Facilitation Centre and Craft Museum, Varanasi must be studied in terms of usage and manner of operation.

3) Coordinative plan with the surrounding City hall, public parks, athletic fields and

residential with the centre and additional construction plan of roads and parks should be planned for harmonious area establishment.

4) Since description of design condition and specification is lacking in the DPR, additional information should be incorporated to make the DPR comprehensive.

(2) Development of plan of OPTION 1

Since plan of OPTION 2 and 3 in the DPR is not legally justified, only OPTION 1 was covered in the study. Improvement of the OPTION 1 is developed in this section.

Proposal for improvement of the plan

Consideration for maintenance and operation is needed in terms of indoor condition including plan of building services. Explicitness and simplicity is needed from the viewpoint of the guests as follows:

- Cleary setting of main entrance of the facility together with the doorways for each facility
- Site lot is deemed to be the same location with the OPTION 1
- Built-in function of service for citizen shall be equipped in administration office with easy access
- Arrangement is needed for the plan of building and structure for the underground parking area and superstructure
- Consideration of the revenue to secure the sustainability of the centre

Layout plan

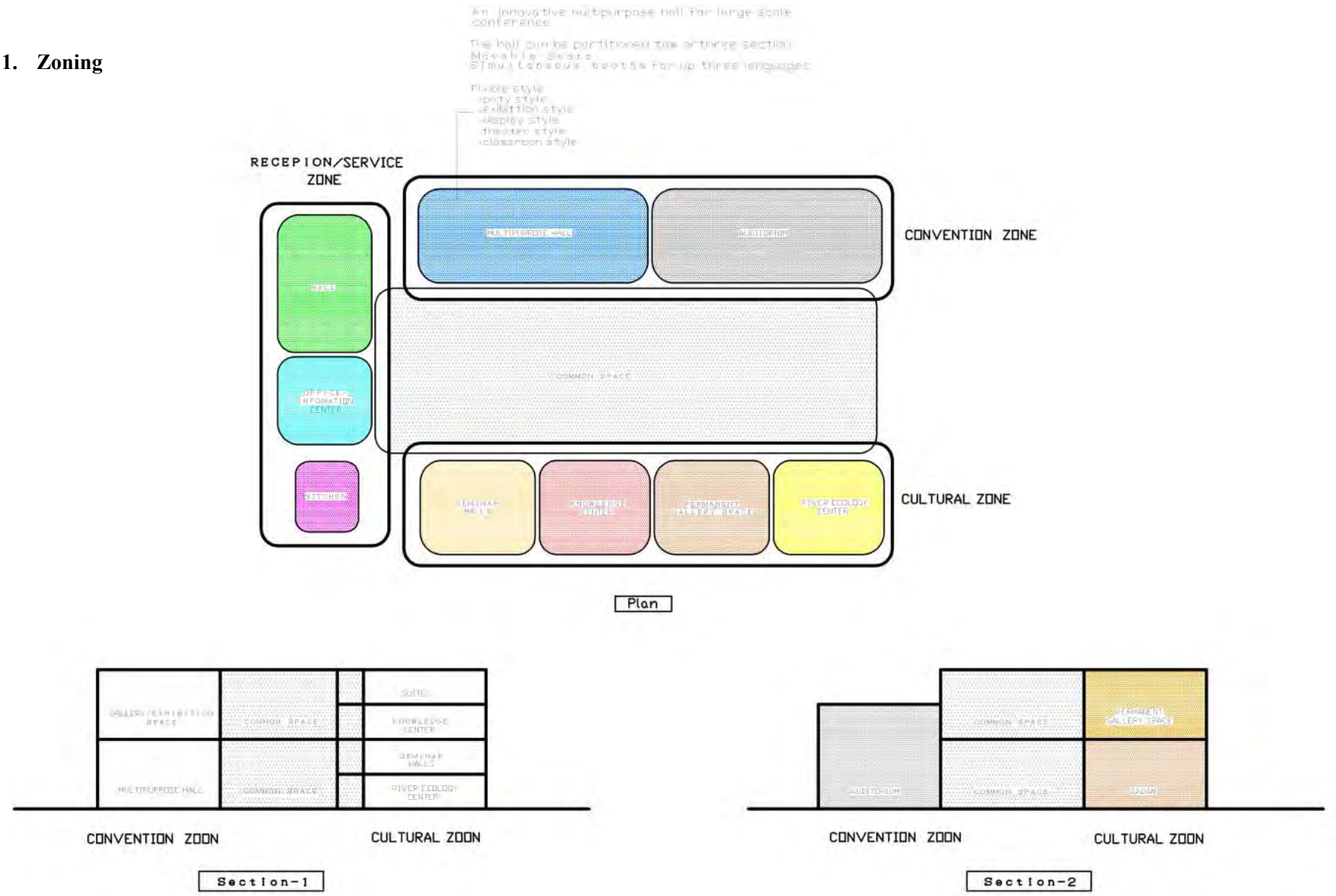
The main point of the concept of the layout plan of OPTION 1 is deemed to be whether all-inclusive public space becomes interactive space. Specific planning such as common space or reception hall is needed in order to realize the interactive space along with the landscaping plan. Although the function seems introduced in the inner court in the Option 1, interactivity with other spaces is not felt from the manner of approach from south side. As a proposal for the plan, Images are shown in the figures (1.Zoning, 2.Site Plan, 3.Floor Plans) In the plan, both culture zone and convention zone were set as a symbol of interactive space.

(1) The lot for the centre is expanded in comparison of the precedent DPR. Confirmation of boundary of the lot is necessary.

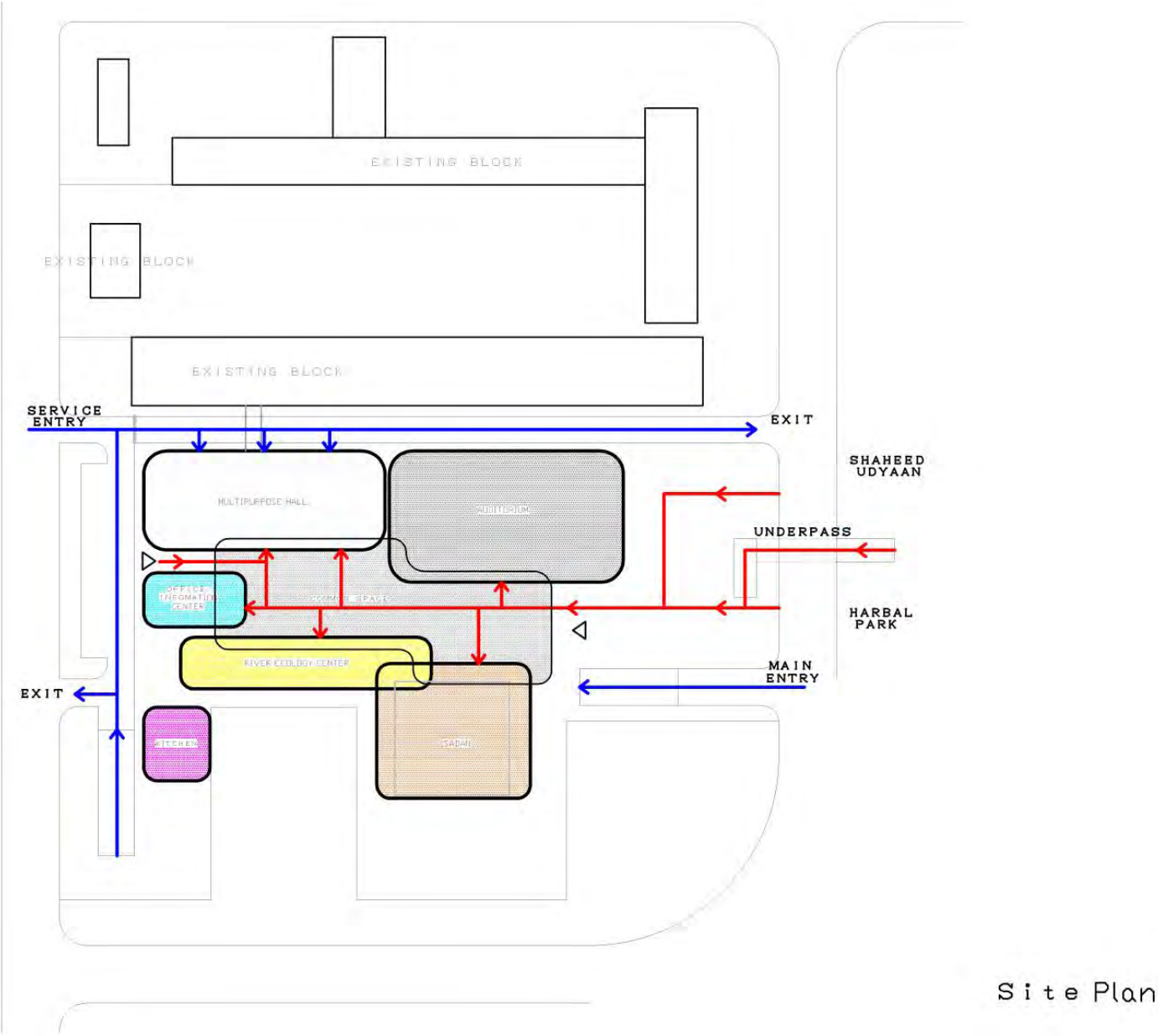
(2) Cooperative planning with the SADAN is needed.

(3) Security is another point for the planning of doorways of facilities with various utilization forms. Dispersed doorways method needs studies on securing spaces and flow line analysis of users, vehicles, buses and other service vehicles for superstructure as well as basements.

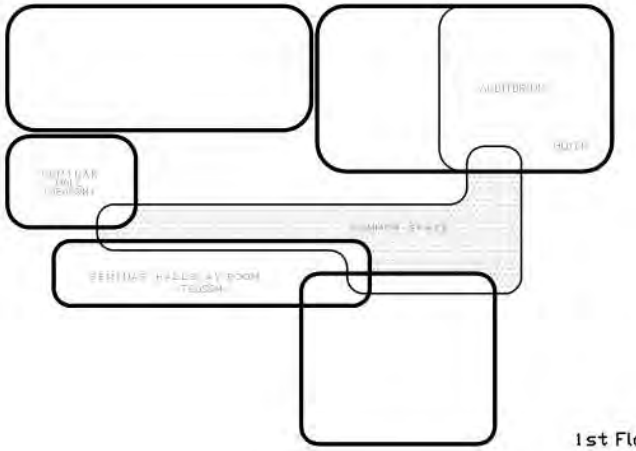
1. Zoning


An innovative multipurpose hall for large scale conference
The hall can be partitioned raw or three section
Movable Seats
Simultaneous booths for up three languages
Flexible style
party style
exhibition style
display style
theater style
classroom style
RECEPTION/SERVICE ZONE
HALL
OFFICE
INFOMATION CENTER
KITCHEN
MULTIPURPOSE HALL
AUDITORIUM
CONVENTION ZONE
COMMON SPACE
SEMINAR HALLS
KNOWLEDGE CENTER
PERMANENT GALLERY SPACE
RIVER ECOLOGY CENTER
CULTURAL ZONE
Plan
GALLERY/EXHIBITION SPACE
COMMON SPACE
MULTIPURPOSE HALL
COMMON SPACE
SUITE
KNOWLEDGE CENTER
SEMINAR HALLS
RIVER ECOLOGY CENTER
CONVENTION ZOON
CULTURAL ZOON
Section-1
AUDITORIUM
COMMON SPACE
PERMANENT GALLERY SPACE
CAFE
CONVENTION ZOON
CULTURAL ZOON
Section-2
ZONING

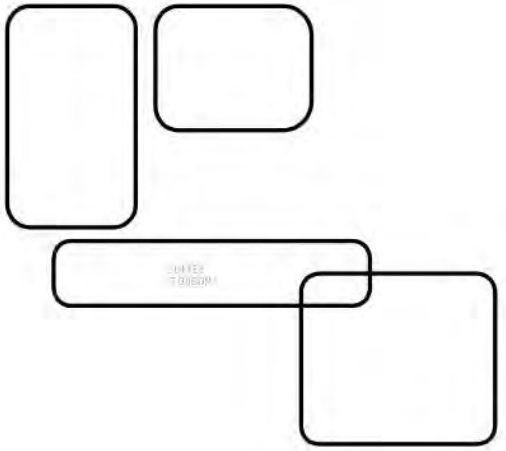
2. Site Plan


EXISTING BLOCK
EXISTING BLOCK
EXISTING BLOCK
SERVICE ENTRY
EXIT
SHAHEED UDYAAN
MULTIPURPOSE HALL
AUDITORIUM
UNDERPASS
OFFICE INFORMATION CENTER
COMMON SPACE
HARBAL PARK
RIVER ECOLOGY CENTER
MAIN ENTRY
EXIT
KITCHEN
SADAN
Site Plan

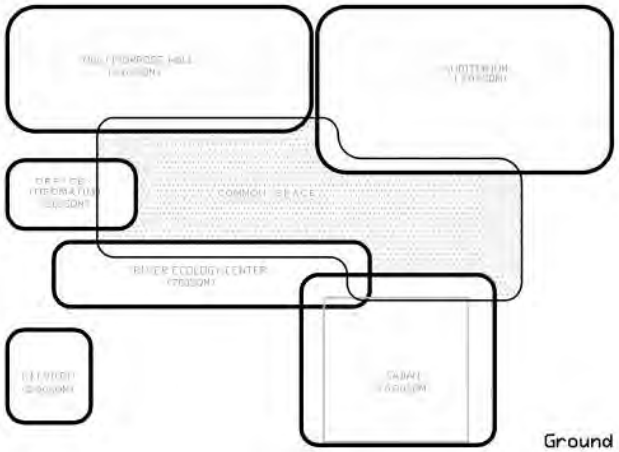
3. Floor Plans



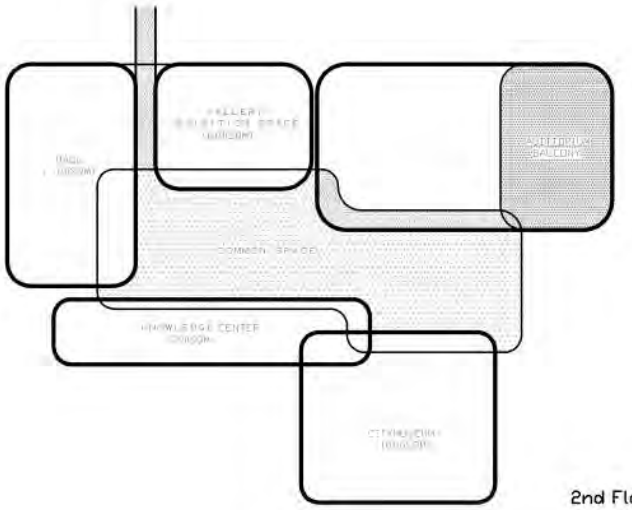
1st Floor Plan



3rd Floor Plan



Ground Foor Plan



2nd Floor Plan

FLOOR PLANS

CHAPTER 16 ACTION PLAN

<Objective of the Study>

Action plan was formulated in terms of institutional improvement

<Result of the Study>

Following nine subjects are required to be discussed as Action Plans:

1) *Self-reliant Management of Sewerage Works*
2) *Preparation of Annual Business Plan up to Project Completion*
3) *Development of Asset Ledger*
4) *Improvement of Information Management System*
5) *Streamlining of Sewage Tariff and Improvement of a Collection System*
6) *Mandatory House Connection to a Sewerage Network*
7) *Preparation of Financial Statements*
8) *Improvement of Customer Service*
9) *Improvement of Human Resource Development and Management*

In the sewage works, a sewerage system consisting of sewage collection, treatment and disposal is managed by one utility including billing and collection and its operation and maintenance cost will be covered by tariff revenue at least will be the basis of self-reliant management. However, in both cases of EPC and HAM-PPP in UP, the present sewerage management system by two organizations will be maintained in the future. Following issues supposing the management by single organization will be excluded from Action Plans.

1) *Self-reliant Management of Sewerage Works*
2) *Preparation of Annual Business Plan up to Project Completion*
3) *Streamlining of Sewage Tariff and Improvement of Collection System*
4) *Preparation of Financial Statements*

*Refer to the discussions in **Chapter 12** to cover abovementioned issues as required.*

In the State of Uttar Pradesh, the UPJN is responsible for planning and construction of sewerage facilities, but for their operation and maintenance, the UPJN is responsible for sewage pumping stations and sewage treatment plants, while the Jal Kal Varanasi (JVK) is responsible for sewer networks in addition to the billing and collection of sewage tariff.

The O&M cost of UPJN is covered by centage charges from the state government but not the sewage tariff, while the JVK is responsible for billing and collection of the sewage tariff which is spent for personnel and other O&M expenses for JVK itself and not allocated to the UPJN. Like this, in the

situation that a sewerage system composed of sewage collection, treatment and disposal is not managed by one utility but separately managed by two organizations and the sewage tariff collected by the JVK has not been allocated to the UPJN, there is no concept for a self-accounting system as the whole of a sewerage system.

The Central Government of India has decided to apply the Hybrid Annuity Model under PPP (HAM-PPP) to the construction, operation and maintenance of sewage pumping stations and sewage treatment plants through the establishment of the Special Purpose Vehicle (SPV) to be invested by the central, state, local governments and concessionaire under the Ganga Action Plan Phase-II. Under the HAM-PPP, the Central Government will pay the annuity regardless the sewage tariff collection to a concessionaire based on the bidding amount. Therefore, under the HAM-PPP, the SPV will be only substituted for UPIN and there will be no change in the formation that a sewerage system will be separately maintained by two organizations in the future.

Accordingly, the following issues supposed to be managed by single organization are not suitable to the situation that a sewerage system will be managed separately by two organizations. Hence, they are excluded from further discussions

5) Self-reliant Management of Sewerage Works
6) Preparation of Annual Business Plan up to Project Completion
7) Streamlining of Sewage Tariff and Improvement of Collection System
8) Preparation of Financial Statements

16.1 Development of Sewerage Asset Ledger

The mapping system for sewerage is basically composed of (i) automated mapping (AM) system, (ii) geographical information system (GIS), and (iii) facility management system (FM), out of which a geographical information system (GIS) is to process and analyse the information on the geographical information, while a facility management system is to construct the database integrating the geographical location and its relevant information and to search and process the geographical information and attribute information.

Figure 16.1.1 shows the conceptual image of a mapping system for sewerage.

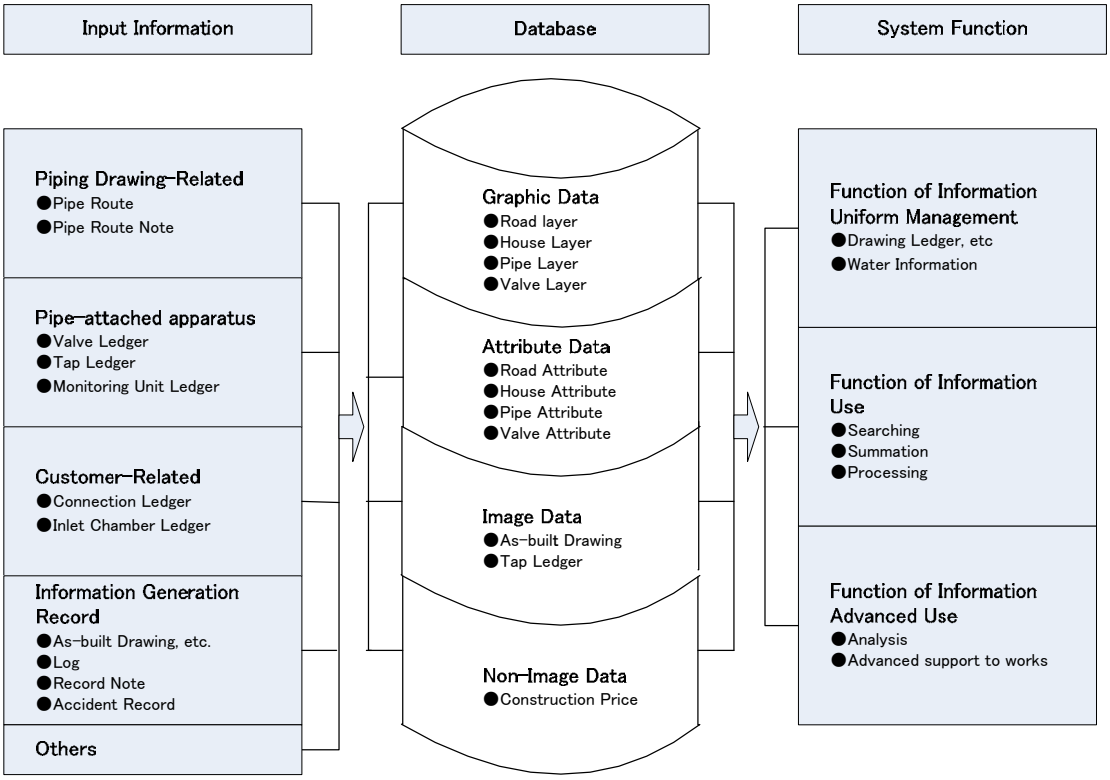


Figure 16.1.1 Conceptual Image of a Mapping System for Sewerage

The construction of a mapping system for sewerage makes the following possible:

1. Uniform management of the information

The uniform management of information means that information sources on the particular pipe will be concentrated in only one location. Therefore, when the particular information is inputted, the relevant drawing ledger, etc. will be simultaneously corrected or added and there will be no risk that another section / unit will get the different information.

2. Rapid information use through searching, etc.

Up to now, it takes a lot of manpower to search, retrieve, summarize and process information.

However, with the use of computer-based programs, these activities can be done more accurately and with more speed.

3. A variety of analysis linked to supporting the work

Through the development of database contents and the application of a variety of analytical methodologies, such as a hydraulic analysis, earthquake damage projection and so on, the linkage and integration between routine works and planning works can be easily achieved.

4. Linkage with other systems

The database of a mapping system for sewerage can be linked with another system enabling the exchange of the data between different mapping systems.

A mapping system requires a database (data arrangement and inputting) which is composed of the graphic information such as pipes, roads, houses, letters, etc. and attribute information such as piping material, diameter, etc.

Table 16.1.1 Action Plan and Monitoring Sheet for Provision of Sewerage Asset Ledgers

Sr. No.	Action	Contents/Outputs Expected Hints to Be Included	Target Date (DD/MM/YY)	Budget (INR)	Responsible Official	Monitoring		
						Date (DD/MM/YY)	Status	Remarks
1	Conceptual design of asset ledgers for water supply facilities using GIS	**Subjects:** •Scope of system •Graphic data •Attribute data •Image data •etc.	31/09/2018	—	Zone I: E.E.		•Not started •On-going •Completed (DD/MM/YY)	
2	Selection of basic map & software for preparation of asset ledgers	**Subjects:** •How to use the information •Type of analysis •Type of output	30/11/2018	—				
3	Review of input data for GIS database		31/01/2019	—				
4	Data collection of existing water supply facilities		31/03/2019	—				
5	Provision of IT devices for GIS database preparation		31/03/2019	—				
6	Training of GIS database operators		30/06/2019	—				
7	Construction of GIS database		31/12/2025	—				
8	Operation of asset ledgers for water supply facilities		01/01/2026	—				

16.2 Improvement of Information Management System

16.2.1 Project Rationale under the JICA-assisted Preparatory Survey on Ganga Rejuvenation

India and Japan has come together to enhance the living environment in Varanasi city and other neighbouring four cities along Ganga river through improved sanitation system under the Ganga rejuvenation project.

Looking at the challenges faced due to rapid growth of the all these five municipal departments along the Ganga River, there is urgent need to have a comprehensive, integrated, "**GIS database**" and "**GIS based MIS System**" at each municipal premises. Such a system will help administration to adhere to the reforms agenda set under the preparatory survey on Ganga rejuvenation project. This reform agenda is given below:-

- ***Promote people centric administration:*** *Common citizens should get the benefits of the system of accurate billing.*
- ***Move from process accountability to productivity accountability and from transactional to transformative governance****:*
- ***Reduce delays and ensure promptness in delivery of services:*** *Computerization integrated with "GIS model" would ensure timely delivery of accurate service.*
- ***e-Administration:*** *Improve administrative processes by cutting cost, managing performance, making strategic connections within the local bodies and creating empowerment*
- ***Citizen Centric Organization****: JICA will be interested to augment the citizen centricity by integrating the GIS technology & new IT initiative at different service delivery channels.*

We proposed to leverage strength of information technology for creation of authentic baseline data and support utilities in IT enablement of their business processes at each municipal office. The creation of IT infrastructure will enable utilities to integrate other business processes such as GIS, MIS, Sewerage/Water Simulations, and SCADA Systems together.

16.2.2 Project Approach

Although the Varanasi urban area "GIS Master database" & "GIS enabled MIS system" has been conceptualized under the Institutional Development plan (IDP) of the JICA assisted Ganga Action Plan, and the same has been approved by the JICA, UP-Jal Nigam, VMC, UP-UDD-Lucknow, and other stake holders of the project. So there won't be any other requirement for further investment on IT & ITES side for the Varanasi Municipal Corporation. Notice inviting tender for the provision of consulting services under the Institutional Development plan (IDP), Varanasi has been floated on 5th May 2015. The method of selection was single stage, three envelopes, quality based system tender against the loan agreement number:-ID-P164. The process for the selection of the consultant through

the tender document has been completed.

16.2.3 Proposed system architecture for Varanasi Urban Area & its integration with E-Nagar Sewa portal at SDC, Lucknow under IDP Program:-

The "GIS database" and "GIS enabled Decision Support System" of Varanasi Urban area developed under IDP-GAP-II project will be integrated with the **E-Nagar Sewa portal** on the pilot basis.

Overall system architecture has been designed in close discussion with Director UP-UDD, Lucknow Government of Uttar Pradesh, and other stakeholders of the project. The proposed system of Varanasi Urban Area has been approved by JICA & other stake holders for further processing.

The State Data Centre, (SDC), Lucknow will host & manage the GIS database, and GIS enabled MIS for Varanasi urban area. The replica of the same will be implemented by UP-UDD, Lucknow in another 634 urban bodies around the state of Uttar Pradesh, on the basis of priority and the availability of funds.

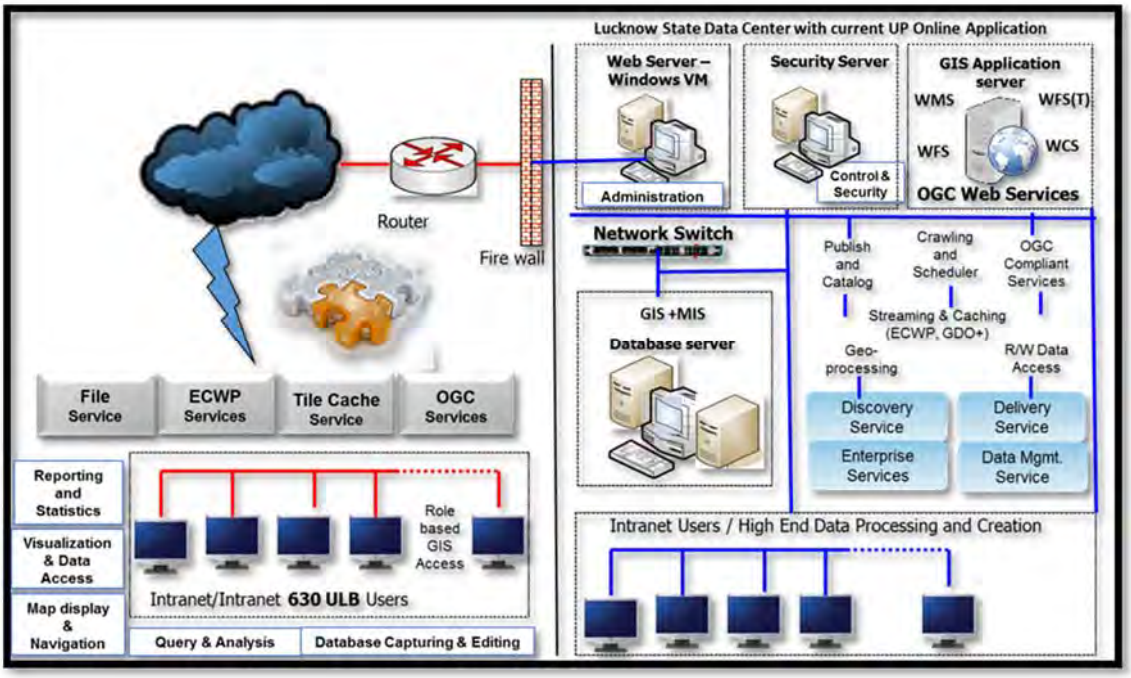


Figure 16.2.1 System Architecture for the Integration of Varanasi Urban Area "GIS Database" and "GIS based MIS" with the E-Nagar Sewa Portal under the "National Mission Mode Project on Municipalities"

16.2.4 Proposal from the Survey Team

We propose the scope of work to be implemented under the new Project Management Consultancy (PMC) schedule. Since the development of detailed GIS/MIS of VMC has been conceptualized under the IDP-GAP-II, we propose to implement comprehensive "GIS database" & "GIS based MIS system" at other four municipal departments in replica with Varanasi Urban area under IDP program.

Tasks to be undertaken by PMC during the implementation stage for four municipal departments are:-

- *Detail study of the four Municipal departments and preparation of AS-IS document.*
- *Preparation of Functionality Scope for the "**To-Be processes"** in consultation with the department of each municipal department.*
- *Objective analysis of the existing Information Technology solution at these municipal departments.*
- *Development of **"GIS based household database"** for the four municipal departments.*
- *Development of **"GIS based Water/Sewerage Asset Database"** that includes the existing and the future network for all municipal departments.*
- *Design, development & implementation of GIS based "Decision Support System" with Asset data, Consumer Database & Call Centre Management Module (Server/Desktop/Mobile Application).*
- *Design and develop the Integration plan of **"GIS based MIS Model"** with existing application of each Municipal department.*
- *Develop & implement the Capacity Building program for managing & updating the GIS Database &"GIS based Decision Support System" to selected officers from these municipal departments.*
- *Procurement of associated software, database, hardware equipment's that includes the Servers, Storages, firewall etc. for hosting, maintaining, developing & updating with GIS database & Web-GIS based MIS application*
- *Development of **"E-Knowledge Centre"** at each municipal departments*
- *Integration of each municipal department with the E-Nagar Sewa portal at State data center, Lucknow.*
- *Support to maintain the **"E-Knowledge Centre"** at each municipal department for minimum three years after the complete "Go Live "process.*

16.2.5 Proposed Project Components at Four Municipal Departments

E-Knowledge Data Centre will be responsible for providing all the technical and managerial information needed for strategic planning as well as daily operation decision making. The department will be comprised of four main sections.

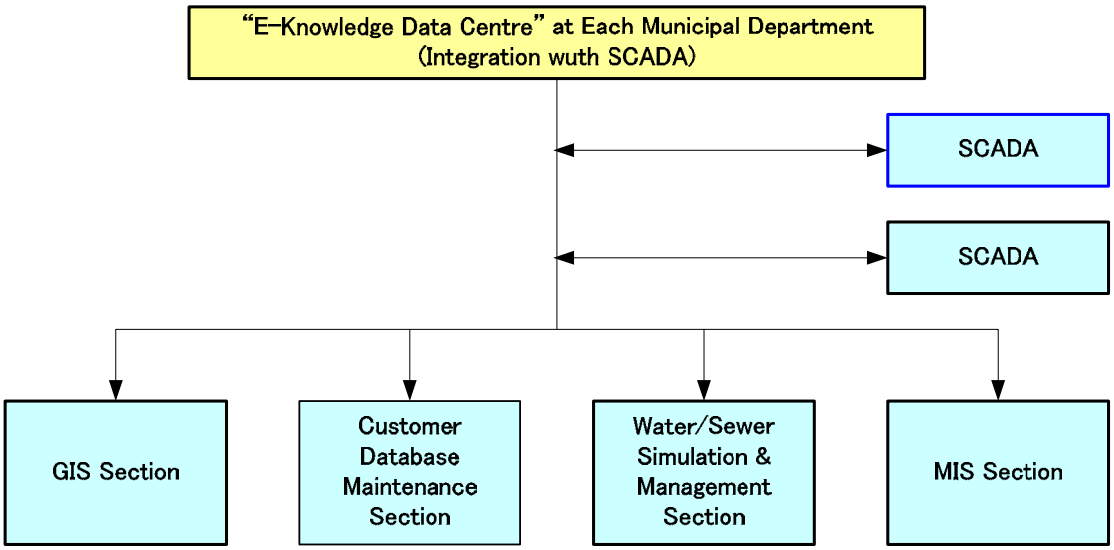


Figure 16.2.2 E-Knowledge Data Centre

(1) GIS Section

GIS Section will be responsible for keeping the most updated base map of the entire municipal area with various layers. It will also include the information of all utilities that includes the sewerage/water network facilities as well as household connections for entire municipal area limits. Comprehensive marketing cum service connection survey under the project management consultancy should be undertaken during the project implementation stage to register all the possible water/sewerage connections on the GIS platform. The GIS database should be made available for all the staff through internet/intranet within the organization for strategic needs such as marketing, maintenance and investment planning.

(2) Customer Database Maintenance Section

Customer Database Maintenance Section will be responsible for the development and maintenance of customer database including metering and billing information. During the design and implementation period, the division needs to start and, build an accurate database of all customers with in the each municipal department. It is estimated that the four municipal departments will generate approximately **1,00,000 customers**. New service connections to the household connection work should follow a sequence of marketing – connection application – actual service connection – metering and billing.

(3) Sewer/Water Model Building & Management Section

GIS and hydraulic modelling are complementary technologies. By integrating them with each other, each municipal department can reap substantial time and cost savings. A well-designed integration of

the two systems provides ready access to mission-critical data. As a result, risk-of-failure analysis, repair and replacement, capacity assessment, capital improvement planning, and numerous other utility applications run more efficiently and more effectively. *GIS and Hydraulic Modelling* identifies the challenges that must be navigated and offers best practices for achieving an integration that will be sustainable over the long term. We propose a platform that provides hydraulic modellers at each municipal department, the necessary tools to efficiently perform all aspects of system assessment. These include some of the following features:

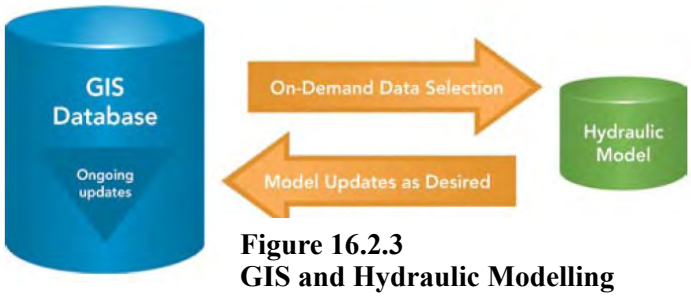


Figure 16.2.3
GIS and Hydraulic Modelling

1. *Model real-life and theoretical simulations to predict the impacts of rainfall on existing sanitary sewer systems*
2. *Offer variables for nearly any possible element in a sanitary collection system*
3. *Identify risk and magnitude of dry and wet weather sewer overflows*
4. *Optimize capital spending to eliminate combined and sanitary sewer overflows*
5. *Analyse performance and benefits of system controls*

We also propose to integrate all the four municipal departments "SCADA Division" with E-Knowledge Centre on real time basis. At least it should able to monitor the

1. *On-off status of pumps and valves of main facilities.*
2. *Flow volumes at major nodes including the WTP, STP, major gate valve nodes within the distribution networks, and*
3. *Sewer/Water quality at the STP/WTP outflows on real-time basis. The information should be made available not only for the Operation and Control Division but also for Regulatory Authority on a real-time basis as well to ensure the governance of the operation at all times.*

1. Management Information System Section

MIS Section will be responsible for preparing and analysing daily operation status, water consumption, billing records, work progress, etc. One of the main tasks for MIS Division would be productivity enhancement to compute the attainment of performance targets for each department, division and individuals to be linked with performance incentives.

2. Training & Capacity Building Section

Training is crucial in order to maintain the skill levels of the staff. Continuous training and capacity-building exercises will ensure that new staffs within all municipal departments are equipped with the

skills and knowledge required for managing operations, and which will, in turn, ensures long-lasting success of the program. With the incorporation of GIS Model & GIS based MIS systems at each municipal department, it will be imperative for the majority of the staff to acquire GIS/MIS skills. The program can be set up to teach the basics of computer programming operation as well as to teach specific operations of the deployed MIS/GIS System. A certification program may be designed to incorporate incentives for learning. Professional and technicians can be trained on how to properly plan, monitor, and manage the work at hand.

16.2.6 Proposed Scope of Services

The proposed scopes of services are:

1) Develop the "GIS Database" for four municipal department areas, i.e.,
    - *Mirzapur municipal council*
    - *Ramnagar municipal council*
    - *Chunar municipal council*
    - *Ghazipur municipal council*
2) Development of enterprise GIS based MIS systems and setup of "E-Knowledge Centre" at all four municipal departments.
3) Integration of "GIS Master database" and "GIS enabled MIS" at all four municipal departments through the State data centre, Lucknow, same in replica with Varanasi urban area designed under IDP-GAP-II Project.
4) Support for next three years in terms of supplying man power and required infrastructure at four municipal departments.

(1) Develop the "GIS-based Database" for Four Municipal Departments:-

For the development of "GIS Master Database" for each municipal area, it is proposed to establish the project office for twelve months at each town, near to the municipal department. This process will result in the development of accurate "GIS database" of each municipal area at the higher scale.

Stage I: Procurement of Latest High Resolution Satellite Imagery from NRSA, Hyderabad

In this project, the role of **"Fresh High Resolution Satellite Imagery"** is to provide feature in a very short amount of time, covering a vast area. The high resolution imagery, geo-positioned with DGPS equipment, provides an excellent source of base information upon which to develop an accurate Map. Latest 30 CM resolution; 4 bands natural Color composite Imagery is available for each

Figure 16.2.4 High Resolution Satellite Image

municipal department's area.

1) **Stage II: Geo Positioning, Edge Matching, Tiling, & Image Drape from High Resolution Satellite Imagery**

Geo-referencing of the High Resolution satellite imagery is necessary to ensure the positioning, scaling and orientation. After the pre-processing the satellite imagery needs to be geo-referenced using ground control points (GCP's) acquired from the Dual frequency DGPS survey for accurate referencing and ortho-rectification process.

Figure 16.2.5 Geo-referencing of High Resolution Satellite Image.

2) **Stage III: Update/ develop the detailed Base Map of each Municipal departments:**

The existing database collected from the various stake holders will be updated during this stage, these includes: - administrative boundaries, Base layers & land base data. The vector database developed will undergo a strict quality check under the supervision of expert before acceptance.

3) Stage IV-A: Development of Municipal Corporation Water/Sewerage Asset Register:-

The Project Management Consultants will assist each municipal department in carrying out GIS based survey of Water/sewerage facilities including, rising mains, transmission mains, raw mains, trunk sewers, main sewers, distribution networks, pumps stations, and sewage treatment plant, water treatment plants of the whole city to prepare a comprehensive GIS based asset data. The objective will be to locate & collect the maximum information related to asset on-site. Validation at certain places will be required to develop the accurate asset data. The attributes collected during the surveys will include but are not limited to the following:-

- *Location of asset (x,y)/Design Information like size, capacity, diameter, material etc.*
- *Operational details like sewage quantity, influent, effluent, chemical use, power consumption etc.*
- *assets, which are under control;*
- *the condition and existing performance of these assets*
- *the approximate residual life of these assets/the approximate value of these assets*

- *the asset repair, rehabilitation or replacement costs*
- *the date on which the asset was acquired or brought into use*
- *the original cost, or the re-valued amount determined in compliance*
- *the re-valued value of such fixed assets*
- *the accumulated depreciation to date/the carrying value of the asset*
- *the current insurance arrangements*

Stage IV-B: Development of Consumer database level information from High resolution Satellite Imagery & extensive field surveys.

Demarcation of individual plot level information using the High resolution Satellite Imagery& field surveys will be developed on High resolution Satellite Imagery. Validation of digitized plots will take place on-site. Here comes into play the idea of introducing a latest handheld GPS with android/windows/ios platform. The positional accuracy of these GPS will be very high. The application within the GPS will be pre-loaded with **consumer database form**. Each household demarcated on GIS platform will be interviewed onsite. The consumer database at each house will be filled online & the data once saved will be automatically updated at Web-GIS Server. This will be the **"new & unique thing"** adopted for the development of consumer database.

(2) Development of Enterprise GIS/MIS Systems for All Four Municipal Departments

The functionality of proposed MIS has to involve users with different roles and different access levels. We propose to apply model-based approach for designing & development of MIS. It provides many benefits to the various operation and maintenance activities. The benefits of using an integrated data model will be further leveraged by accessing the integrated data model through a **GIS interface**. It will enhance the ability to explore, navigate, access, and query asset data. Assisted by the GIS functionality, this integration can potentially improve the efficiencies, cost effectiveness, and coordination of maintenance plans and work processes. Suggestive functional modules under GIS based MIS for each municipal department are given below.

- *Multi-level security and user access control framework Module*
- *Property Database Management System*
- *Water/Sewerage based asset register Module*
- *Customer service and complaints Module*
- *Inventory Management System*
- *On line data updating Module*
- *Reporting and Analysis Module*
- *Documentation and Manuals Module*

(3) Integration of Four Municipal Departments "GIS Data" and "GIS Enabled MIS System" with the SDC, Lucknow, in Replica with Varanasi Urban Area Designed under IDP-GAP-II.

The selected PMC need to explore all the possible options to link each municipal department - GIS Model and application with E-Nagar Sewa portal for ULB websites in best possible & efficient manner & it should be ensure that the Web-GIS Decision Support System would route through E-Nagar Sewa portal in the efficient manner. As the major procurements and investment at SDC, Lucknow will be completed through the Infrastructure Enhancement component program under the GAP-II.

We suggest for other four municipal departments integration with SDC, Lucknow, the PMC should use the same integration process in replica with Varanasi urban area. Also the existing IT infrastructure, man-power resources, Web/Mobile-GIS Model, software's, and hardware's etc., at SDC, Lucknow funded and provided through the IDP (GAP-II) should be used for the integration purposes between four municipal departments with SDC, Lucknow. Some of the major advantages of integration between the GIS database & GIS enabled application of each municipal with E-Nagar Sewa Portal are:-

- *A customized Web-GIS-based decision support system with each municipal department spatial database will incorporate selected business requirements of existing E-NAGAR SEWA PORTAL Solution based MIS that including property Tax, Asset Management, PWD, water supply, Drainage, slums, Encroachment, etc.*
- *The customized application will be integrated with the authenticated server for MIS at SDC, Lucknow. Through this authentication server, only registered users could able to access & update the GIS Master database & GIS based decision support application at S-GIS Level.*
- *With this SDC, Lucknow will be able to manage, monitor & control the overall GIS database flow for entire UP State through customized application.*
- *The GIS users at each municipal department will be using standard desktop, web & mobile user applications to perform their routine work to develop the required analysis & update the spatial database of each municipal department at regular intervals.*
- *There will be certain cross check for updating the spatial database at each municipal corporations/councils/towns department & only then final updating will take place at SDC, Lucknow (S-GIS level).*

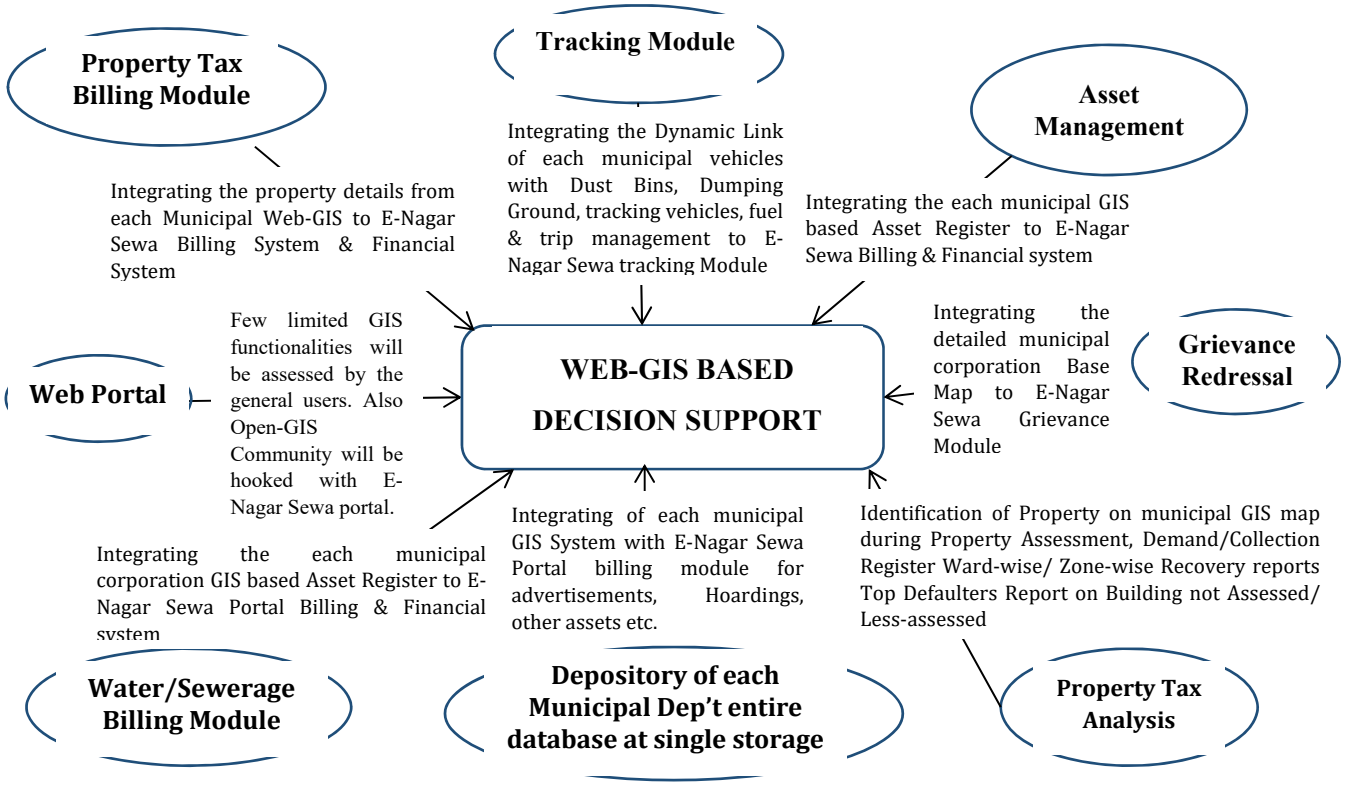


Figure 16.2.6 Suggested Integration Architecture for the Deployment of "GIS Model at State Level" for Four Municipal Departments

(4) Support for Next Three Years in Terms of Resources and IT-Infrastructure at Each "E-knowledge Centre" for Four Municipal Departments:-

The support in terms of resources and IT infrastructure will suffice by the project budget, so that the **"E-Knowledge Centre"** in all the four municipal councils/town Department areas could sustain for the longer duration. Also minimum three year resource based support program after the completion of the work is suggested to provide through the JICA funding. Detailing of each resource required is provided in the below mentioned table.

Table 16.2.1 IT-Infrastructure required at Each "E-Knowledge Centre"

Urban Local Bodies	Resources Required at Each Municipal Department	IT-Infrastructure required at Each "E-Knowledge Centre"
Mirzapur Municipal Council (Nagar Palika Parishad)	1-GIS/MIS Executive 1-Network Modeler (Water/Sewerage) 1-Hardware & Networking 1-GIS Surveyor 1-Helper	5 Hi configuration desktop system 1 Basic & Advance GIS Software license 2 Network Modelling Software 1 CAD Software, Laptop, Server A3/A4 Laser Printer, A0 Plotter/ Scanner Network enabled Centre with Hi end Internet facility, Generator/UPS etc.,

16.2.8 Implementation Approach

Since GIS & MIS require different kind of expertise, we propose domestic positions and support staff for the implementation of GIS & MIS systems at four different municipal departments.

(1) For GIS

To keep the data uniform, safe, accurate & useful, GIS database need to be fully developed under the Project Management Consultancy umbrella. Project Management Consultancy needs to develop the "GIS Master database" of 4 municipal departments during the design phase and need validate the same during the implementation stage. In this way the accuracy of the data will be double checked before delivered to the each municipal department.

(2) For MIS

Focus should be given on the use of **"COTS Modules"** to deliver functionality. Bespoke development for certain modules shall be allowed. Project Management Consultancy will be responsible for the final delivery of the entire GIS based MIS System with specific modules. We propose to publish open tenders by Project Management Consultancy for

- *Procurement of COTS Modules.*
- *Development of **"E-Knowledge Data Centre"** at each municipal department's premises. The tender will include the supply, installation, testing & support of servers, hardware & other equipment's to be set-up at **"E-Knowledge Data Centre"***

COTS Modules for the MIS development provide some of the following strengths:

- *Applications are provided at a reduced cost.*
- *The application is more reliable when compared to custom built software because its reliability is proven through the use by other organizations.*
- *"COTS" is more maintainable because the systems documentation is provided with the application.*
- *The application is higher quality because competition improves the product quality.*
- *COTS are of higher complexity because specialists within the industry have developed the software.*

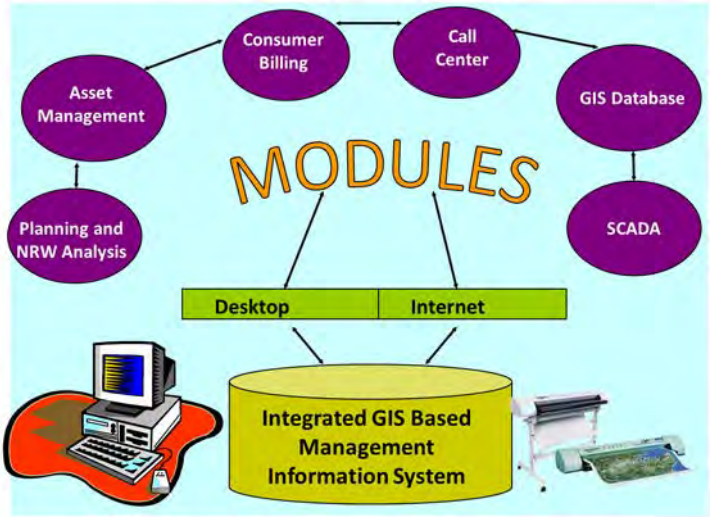
Specific Functionalities of GIS & MIS System Implementation are:-

- ***Geographical Information System** will be one of the core requirements of the system and will form the back bone of the decision making and planning process.*

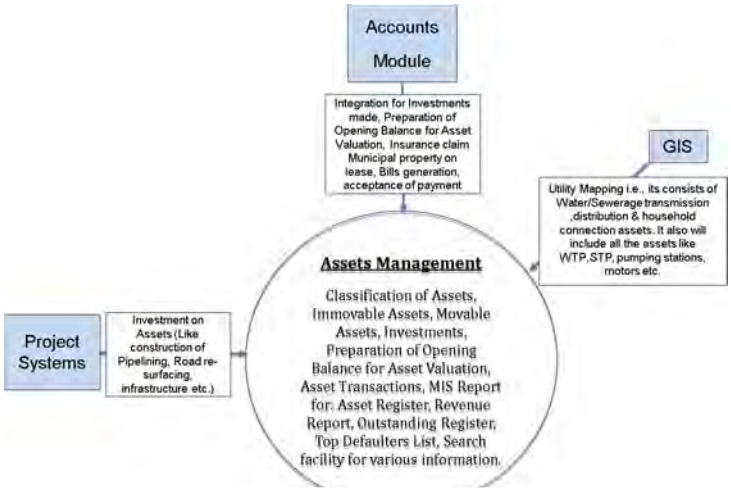
- ***Asset Management System****:-The spatial view of an asset will add new dimensions to supervisors' abilities, maintenance and work crews' efficiency, management curiosity, and a host of other intangible benefits. To wit, the ability to visually display the asset data that affects an individual employee's planned or completed work activities, along with reference features such as roads, buildings, sidewalks, and so on, can make all the difference between an efficient organization and a misdirected one.*
- ***Sewer/Water Model Building & Management Section*** *would base on integrated IT solution by use of GIS indexing, asset mapping &along with SCADA Application.*
- ***Call Centre****: - Single window customer care centres would be available at front end to interact with consumers, which will run through linking of back end business processes. The GIS system will be real time integrated with the Call Centre Application. All the data available in the call centre could be viewed through the GIS application. All incoming calls made through landlines have to be tracked to area it is coming from and displayed on the map. The calls as they are made should blink on the location in real time.*
- ***Billing &Metering****: - The system will provide realistic information on the billing and metering, based on GIS database and automates the revenue mobilization processes.*

On utilization of the services, all the "four municipal departments may benefit under following parameters:

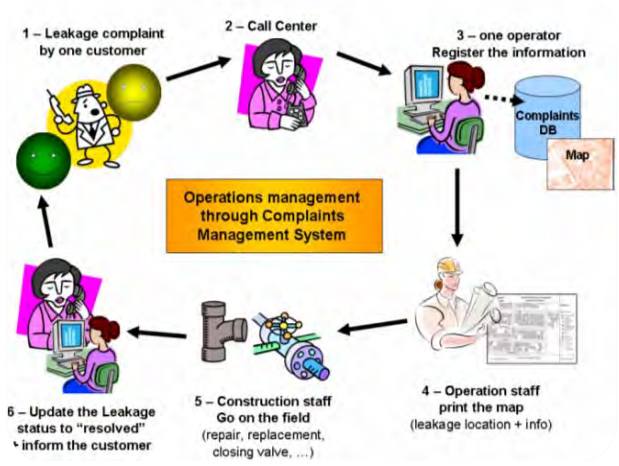
- ***Fool proof security****– locked server cabinets, with IP-based CCTV surveillance and hand key biometric access to all areas.*
- *24x7 monitoring of the IT infrastructure.*
  Fully Integration with SDC, Lucknow



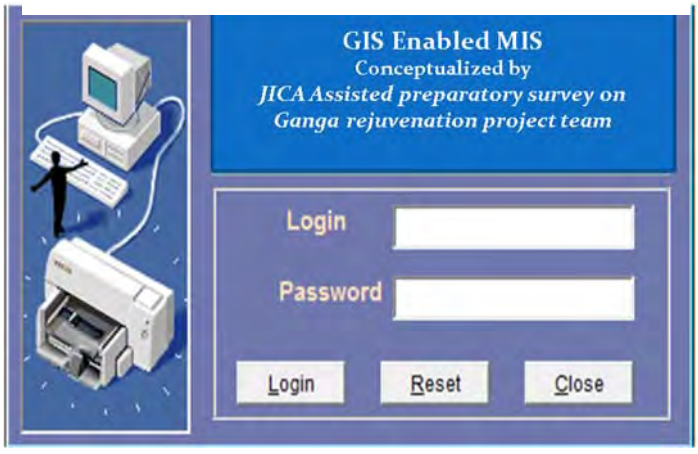
"Suggested Structure of GIS Model at each municipal department" with various modules



Suggested Structure for Asset Management module



Suggested Structure for Grievance Redressal Management



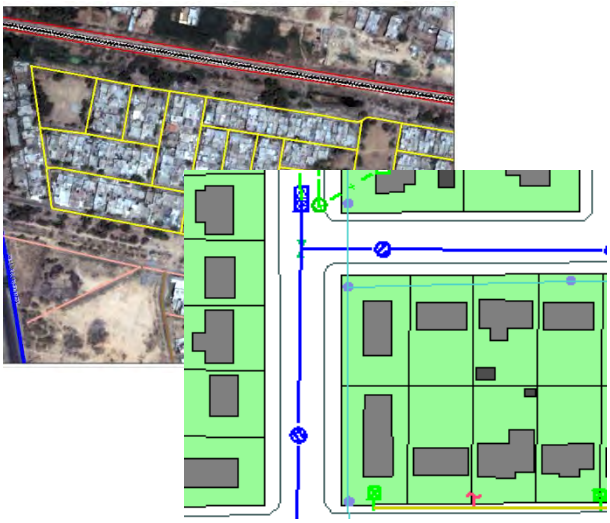


Figure 16.2.7 Utilization of "E-Knowledge Data Centre" at Each Municipal Department

16.3 Mandatory House Connection to a Sewerage Network

The Uttar Pradesh Water Supply and Sewerage Act, 1975 defines the house connection or sewer connection as follows:

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"**74. Right of owner or occupier to obtain sewer connection.** – The owner or occupier of any premises shall be entitled to empty sewage of the premises into a sewer of a Jal Sanstan provided that, before doing so, he, -

(a) Obtains written permission of the Jal Sanstan and pays connection fee in accordance with the bye-laws: and
(b) Compiles with such other conditions as may be provided by bye-laws."

"**75. Power to require owner to have sewer connection.** – Where any premises are, in the opinion of a Jal Sanstan, without sufficient means of effectual disposal of sewage and the sewer of the Jal Sanstan is situated at a distance of fifty metres from any part of the premises, the Jal Sanstan may, by written notice, require the owner of the said premises to have sewer connection as provided by bye-laws."

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Therefore, the house connection with a public sewerage system has been already mandatory for the people when the sewer of the Jal Sanstan is situated at a distance of fifty metres from any part of the premises.

According to the Service Lebel Benchmark (SLB) of the MoUD defines the coverage by sewage network services as follows:

The coverage by sewage network services

$$= \frac{\text{(Total number of properties with direct connection to the sewage network)}}{\text{(Total number of properties in the service area)}} \times 100$$

Table 16.3.1 No. of House Connections Proposed in the DPR

	Service Level Benchmark*1		DPR	
	Status (%)	Target (%)	Transfer of Exist.	New Pipe
	2010-11	2011-12		
Varanasi	67.3	72.3		
District I			38,288	9,804
District II			79,836	34,216
District III			100	5,987
Ramnagar	75.0	79.0	-	-
Mirzapur	53.0	56.0		5,726
Chunar	85.0	89.0		-
Ghazipur	98.0	100.0		3,900

The sewer connections from an inspection chamber to a manhole are proposed. These inspection chamber will be constructed along the roadside, as close to the house property lines as possible. The diameter of a pipe from an inspection chamber shall be the minimum of 150 mm. The part of the sewer connection inside the property and the sewer connection to the roadside inspection chamber will have to be constructed by the property owner. Even though the inspection chamber is installed along the roadside, it will be worthless if there is no connection from an inspection chamber to a house. Therefore, the house connection work to collect the domestic wastewater from respective houses is essential in the sewerage development project

Some DPRs for Varanasi, Ramnagar, and Ghazipur describe “Public Participation and Awareness: Communication and Public Outreach” in their projects

In the public participation and awareness, the focus will be to create awareness about ensuring the sewer connection to the households for cooperating in laying the sewer lines at household levels as well as improved solid waste, reduced open defecation, reduced introduction of pollutants into the River Ganga, sanitation management and environmental aspects of the River Ganga, including specific watch dog activities.

The actual implementation of the awareness & publicity campaign and conducting motivational training should be entrusted to a suitably chosen agency(s) and/or NGO(s). For this purpose the Corporation may invite agencies/NGOs by publishing “Expression of Interest (EOI)” advertisement clearly defining the scope of work. The agencies/NGOs who respond to the EOI may be requested to make presentations before a committee to prove their competence for carrying out the work. Only shortlisted parties may be invited to bid for the tender. The tender bids may be in two parts the “Technical Bid” and the “Financial Bid”. The technical bids (which also give the proposed

methodology and detailed scheme and work plan with time targets) may again be evaluated by a suitable committee and the financial bid of only those parties may be opened whose technical bids have been found to be satisfactory. The budgetary estimates given can act as a guideline for the implementing agency while choosing the agency which will execute the work.

16.4 Improvement of Customer Service: A Commitment to Level of Service

16.4.1 Introduction

Promoting customer service standards in the provision of water supply and sewerage services is a responsibility of the urban local bodies through their respective Jal Kals. Such customer service standards should not only be consistent with government and industry levels, but should also focus on customer expectations. Thus, performance targets and indicators provide a means to measure service, as well as to encourage continuous improvement. The key responsibility is being committed to provide continuous and reliable water supply and sewerage service to the Jal Kal customers who also happen to be residents of the Nagar Nigam / Nagar Palika Parishad.

The achievement of a specified level of performance for water supply and sewerage can be broadly categorized into the: (i) Day-to-day or 24/7 water supply; (ii) Adequate and reliable water supply system; (iii) Safe and high-quality water supply; (iv) Effective transportation and treatment of sewage; and (v) Sustainable and continuous water supply and sewerage services in the long-term.

1) Service Level Benchmarks of the Ministry of Urban Development

The quality of service provided by the water supply and sewerage utilities to its customers can be best assessed when compared to the performance indicators embodied in the Service Level Benchmarks (SLB) issued by the Ministry of Urban Development (MoUD) in 2008. The SLB identified basic minimum service level performance parameters for four basic urban services, including water supply and sewerage. The national government, through the Ministry, operationalized said framework by disseminating the service level performance parameters, defining a common minimum framework for monitoring and reporting on these indicator; and setting out guidelines in a phased manner while encouraging urban local bodies / utilities to integrate the benchmarking process and its outputs into their decision processes.

After a pilot initiative in the 2009 involving 28 pilot cities across 14 states, the SLB has moved Indian water utilities away from just being “production and supply” organisations to one that provides an essential and critical social and civic service to its various types of customers. As such, water utilities are now expected to perform their mandates based on a specified level of performance with respect to providing their constituents or customers, with safe, adequate, continuous and reliable of water supply and sewerage services. The benchmarks for water supply and sewerage are shown in **Table 16.4.1**[1]

[1] http://moud.gov.in/sites/upload_files/moud/files/pdf/Indicators&Benchmarks.pdf

Table 16.4.1 Service Level Benchmarks for Water Supply and Sewerage

No.	Indicator for Water Supply Service	Bench mark	No.	Indicators for Sewage Management	Bench mark
1	Coverage of water supply connections	100%	1	Coverage of toilets	100%
2	Per capita availability of supply of water at consumer end	135 lpcd	2	Coverage of sewage network services	100%
3	Extent of metering of water connections	100%	3	Collection efficiency of the sewage network	100%
4	Extent of non-revenue water (NRW)	15%	4	Adequacy of sewage treatment capacity	100%
5	Continuity of water supply	24 hrs	5	Quality of sewage treatment	100%
6	Quality of water supplied and adequacy of treatment/ disinfection	100%	6	Extent of reuse and recycling of sewage	20%
7	Efficiency in redressal of customer complaints	80%	7	Efficiency in redressal of customer complaints	80%
8	Cost recovery in water supply services	100%	8	Extent of cost recovery in sewage management	100%
9	Efficiency in collection of water supply-related charges	90%	9	Efficiency in collection of sewage charges	90%

Sourced from: http://moud.gov.in/sites/upload_files/moud/files/pdf/Handbook.pdf

2) Atal Mission for Rejuvenation and Urban Transformation (AMRUT)

In addition to the SLBs, the Atal Mission for Rejuvenation and Urban Transformation (AMRUT) was launched in June 2015 with the focus of the urban renewal projects is to establish infrastructure that could ensure adequate robust sewerage networks and water supply for urban transformation. The state of Uttar Pradesh has prepared the State Annual Action Plan (SAAP) (2015-16) that seeks to invest Rs3,287 Cr for improving water supply in 60 mission cities and sewerage project in 24 cities under AMRUT Action Plan. Out of the 60 mission cities are Varanasi, Mirzapur and Ghazipur, which are included in this Project. The SLB issued by the MoUD have been adopted by both Uttar Pradesh in its SAAP as basis for its water supply and sewerage improvement targets for funding under AMRUT.

To be taken up under AMRUT's water supply improvement projects are: (i) Water supply systems including augmentation of existing water supply, water treatment plants and universal metering; (ii) Rehabilitation of old water supply systems, including treatment plants; (iii) Rejuvenation of water bodies specifically for drinking water supply and recharging of ground water, and (iv) Special water supply arrangement for difficult areas, hill and coastal cities, including those having water quality problems (e.g. arsenic, fluoride).

Likewise, sewerage improvements under AMRUT are: (i) Decentralised, networked underground sewerage systems, including the augmentation of existing sewerage systems and sewage treatment

plants; (ii) Rehabilitation of old sewerage system and treatment plants; and (iii) Recycling of water for beneficial purposes and reuse of wastewater.[2] It should be noted that while there other cities under this project not included under AMRUT, they are still guided by the SLB for water supply and sewerage.

Table 16.4.2 shows the existing levels of service of the three cities based on selected water supply and sewerage indicators included in the SAAP/ AMRUT.

Table 16.4.2 Indicators of Service in Water Supply and Sewerage in UP State Annual Action Plan, 2015

	Water Supply Indicator	Bench mark	Varanasi	Mirzapur	Ghazipur	Sewerage Indicator	Bench mark	Varanasi	Mirzapur	Ghazipur
			Existing	Existing	Existing			Existing	Existing	Existing
2	Coverage (%)	100	59.85	59	55	Sewerage network coverage (%)	100	68	39.46	0
3	Liters per capita per day (LPCD)	135	206	105	300	Efficiency in collection (%)	100	40	No data	Not applicable
4	Non-revenue water (NRW) (%)	20	59	45	49	Efficiency in treatment (%)	100	38	No data	Not applicable

Source: Compiled from various tables, State Annual Action Plan (Uttar Pradesh), 2015, pp 17-32.

16.4.2 Institutional Development Programme (IDP) under JICA-assisted GAP II

The commitment of the Jal Kal (Nagar Nigam/ Nagar Palika Parishad) to the water supply and sewerage service levels is institutionalized in their respective annual plans and targets. These plans also become a basis for additional funding either from current State and/or the Central Government programs, or even from loans from development partners. One such project is the JICA-assisted Ganga Action Plan Project (Varanasi) under NGRB, with a component called the Institutional Development Programme (IDP), now ready to take off in June 2016.[3]

The Institutional Development Programme (IDP) was envisioned to support and strengthen JKV to operate and maintain water supply and sewerage infrastructure projects turned over to it, as in the case of the sewerage facilities being implemented under the JICA-assisted GAP II project, among others. The IDP is comprised of nine action plan clusters, and will take approximately two years, or from 2016-2018, to implement / complete. Obviously, the IDP will also will greatly benefit/ support the

[2] State Annual Action Plan (SAAP) submitted in 2015 by the Department of Urban Development, Government of Uttar Pradesh, Directorate of Urban Local Bodies, Government of Uttar Pradesh, and the Regional Centre For Urban and Environmental Studies, Lucknow to the Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Ministry of Urban Development.

[3] According to Mr. Gupta, Deputy Project Manager for Sewerage, Project Management Office for JICA-assisted GAP II, the IDP Consultant has already been procured/ chosen and that signing of the contract between the parties will be in the next three months, depending on negotiations.

projects to be undertaken under the Ganga Rejuvenation Project for Varanasi, and to a lesser extent for UPJN-GPPU.[4] Its successful implementation will have a positive impact on improving the over-all performance levels of JKV in providing water supply and sewerage services to its constituents.

1) IDP Components

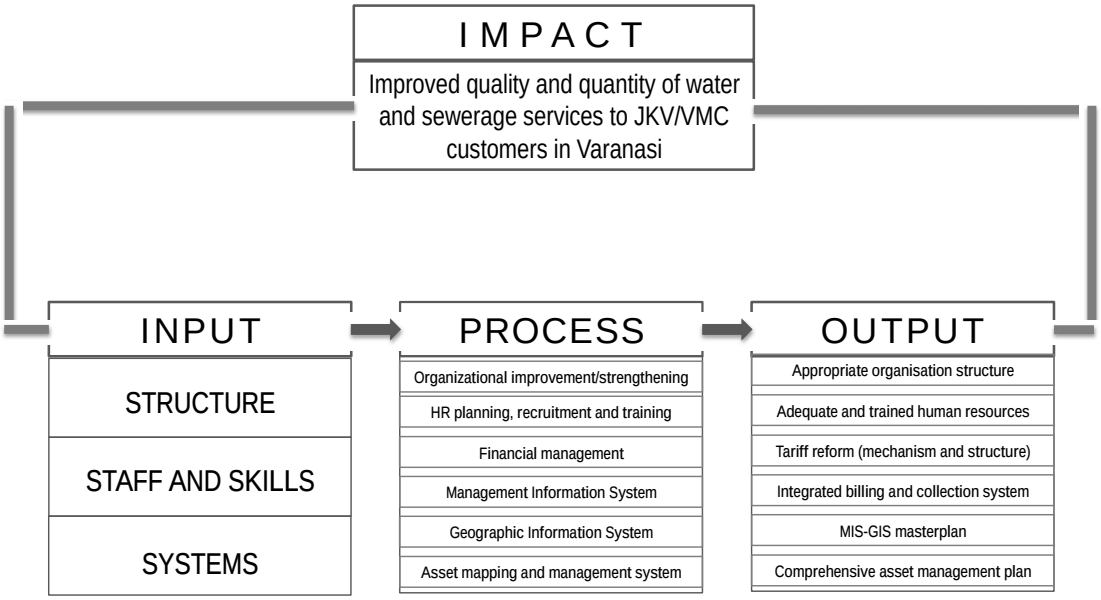
The IDP consists of the two components – consulting services and the provision of soft and hard infrastructure enhancement and equipment.

Under consulting services are the following areas or clusters: (i) Organization structure improvement and strengthening; (ii) Training /capacity development through conduct of training needs assessment, the development of a training plan, and implementation of overseas training and regular organization-wide; (iii) Tariff structure development through formulation of tariff mechanism and development of rationalized tariff structure; (iv) Asset Management Planning through GIS-enabled asset management planning and user connection mapping, the development of operation and maintenance manuals for key water supply and sewerage assets of JKV, and STPs and related assets operated by UPJN-GPPU; (v) Design and development of State level GIS-based Management Information System and the required architecture to support the consumer and utility database of all the Urban Local Bodies of Uttar Pradesh, including the VMC/ JKV; and (vi) Technology transfer and guidance to the Institutional Development Cell (IDC) under UPUDD and co-located in both UPUDD and JKV/VMC.

Under the provision infrastructure enhancement and equipment are the following: (i) Procurement of services for MIS and State Level GIS development, procurement of commercially available software, and procurement of hardware; (ii) Procurement of basic sewerage equipment; (iii) Upgrading of laboratory equipment; (iv) Provision of enhanced training infrastructure, upgrading of training facilities and equipment; and (v) Development of infrastructure at main burning ghats for 24/7 online birth and death registration facility.

The IDP framework (**Figure 17.4.1)** provides the interventions (the inputs) broadly categorized under structure, staff and skills, and systems; what is to be performed by the IDP consultants (the processes), and what are to be achieved (the outputs) and the expected results of the IDP (the impact) not only to JKV/ VMC but also to residents of Varanasi.

[4] Institutional Development Programme (IDP) Action Plan. JICA-assisted Ganga Action Plan Project (Varanasi) under NGRBA, by the Project Management Consultants, December 2013.



Source: Institutional Development Programme (IDP) Action Plan. JICA-assisted Ganga Action Plan Project, December 2013.

Figure 16.4.1 Framework for Institutional Development Program (IDP)

2) IDP Impact on Customer Service in JKV

The implementation of the IDP will have a big impact on customer (commercial) services and practices by improving the management of a wide range of customer service-related issues – on the organization development side, on capacity development and training, billing and collection efficiency with use of GIS-based MIS modules, redressal efficiency with the integration of the present grievance redressal management system to the GIS map, tariff development and structure, and others, as shown below:

- Under *organisational structure improvement*, establishing important units in JKV, such as:
  - Commercial / customer services unit that will manage customer requests for connecting, reconnecting to, and disconnecting from water supply and sewerage services; billing and collection, metering and payment of services; complaints handling and redressal;
  - Public information, education and communication (IEC) unit to tackle public health and sanitation aspects, water conservation and education, and the like;
  - Human resources management unit to address training and development and performance management; and
  - Further strengthening of the operation and maintenance unit(s).
- Under *GIS based on-line MIS System*, development of billing, asset management, call

redressal and water quality modules for VMC and JKV with the integration of the present grievance redressal management system to the GIS map to better monitor the location (spatial) of the grievance-prone areas thereby increasing redressal efficiency;

- In *management information system (MIS) modules for billing and collection*, working on the:
  - Implementation of mobile device-based MIS/ GIS billing and collection apps and its integration with the VMC/ JKV website, including the facility for online billing and payment management system, citizen service centre, payment at bank counter or other public/private agencies;
  - Development of integrated consumer database plan using door-to-door household's survey on GIS platform for VMC and JKV; and
  - Integration of VMC and JKV data with the State level billing and collection modules for property tax.
- In *tariff mechanism and tariff structure*, establishing and developing:
  - The actual and required expenditure requirements to fully cover for O&M of the water supply and sewerage systems in order to achieve the service level benchmarks set at 100% of water supply and sewerage costs; and
  - The appropriate tariff structure for implementation in a phased manner taking into consideration 100% metering plan of water service connections, using consultative processes, ensuring tariffs are affordable, while balancing long-term economic efficiently and financial sustainability.

3) IDP Impact on Customer Service in the Other Cities in this Project

While the IDP will primarily benefit JKV's ability and capacity to deliver better water supply and sewerage services, all other urban local bodies of the state of Uttar Pradesh will also benefit from it because one of the IDP's tasks is the development of the "State level GIS-based Management Information System", which also includes the required architecture. This will complement and support the consumer and utility database of all the ULBs in the State of U.P. In addition, the other customer service initiatives to be taken up in the IDP can also serve as a model for the other project ULBs to emulate and replicate.

16.4.3 Customer Services in Jal Kal of Project Cities

1) Jal Kal Varanasi

Comparing with the SLB of 100 percent for "service coverage", JKV presently covers only 67 percent

of its service area, as on December 2015. But in "sewerage network service coverage", JKV has a lot of catching up to do, having a mark of only 30 percent out of the SLB of 100 percent. This situation leaves the residents to cope with their own devices – like having household sewage flow into open drains, or constructing their own septic tanks, among others. Add to this the rotating water service of 10 hours per day, which is way below the 24/7 SLB on "continuity of service".

The billing and collection system is computerized, and payment of water supply tax and sewerage tax is accepted via bank, or at JKV offices. Collection of water and sewerage tariff or fees outside of the annual rental value (property tax) is also done through the accredited banks. SLB for "collection efficiency" is pegged at 90 percent, with JKV only able to muster collection efficiency of 72 percent for water supply and 76 percent for sewerage, as on 2014-15.

An average of 290-300 complaints per month are lodged with JKV through the following methods – web-based (online), by phone or through personal visit to the office. Only four percent of the complaints are not redressed within 24 hours, giving a redressal efficiency score of 96 percent, higher than the SLB on "complaint redressal" which is at 80 percent.

There is a redressal management system in place in JKV. A 24-hour control room receives all types of complaints from the public, and these are registered or entered into the system. These are fielded to the proper units for proper action, and the offices with access to the system can view the complaints by zone. The actions taken on the complaints are then logged into the system to confirm its redressal, which in turn will provide the redressal statistics at the end of the day, which is compiled on a monthly basis. Most of the complaints centre on water service – the supply hours, disruptions, leakage and water quality. The few complaints on the sewerage system were on damaged lines due to the on-going construction of new trunk lines and chocking from household sewage due to inclusion of solid waste.

The implementation of the IDP is very crucial for improving customer services, as it will complement management of the infrastructure being constructed, and those soon to be constructed. The IDP will ensure that JKV's billing and collection modules are integrated into the soon-to-be developed GIS map, thus making it easier for JKV to pinpoint and take appropriate action on the households not connected to the system, or those illegally connected, or households connected but not paying their water or sewerage bills on time. The GIS map will also help in ascertaining the actual number of water and sewerage connections, thus increasing service income for the Jal Kal. In addition, the GIS map's integration with the current grievance redressal management system will enable on-the-spot location of grievance-prone areas for even better redressal time and proper action improving on this particular indicator of good customer service – that is the efficiency in the redressal of customer complaints.

The revised JKV structure will include the organization of a dedicated customer service/ public information unit in each zonal office. The unit shall have a major role as JKV moves towards metering all service connections, as well as in getting more households to be connected with the sewerage system. It will have marketing and customer relations functions, and will process requests for new connections, disconnection, reconnections. Equally important is accepting/ processing customer complaints for redressal. This unit will also be in charge of public information, education and communication campaigns and bring important messages of JKV across to its customers. The number of personnel required for this commercial / customer service unit (and for the entire JKV, for that matter) will also be reviewed, analysed and recommended by the IDP consultants to ensure efficiency and effectiveness in the performance of the functions of the unit.

See **Annex 16.4.1** for the survey form on the commercial (customer service) practices of Varanasi.

2) Jal Kal Mirzapur

Mirzapur has a water supply service coverage of 51 percent and a sewerage network coverage of 57 percent. Water supply is available only for 6.5 hours per day. These numbers are way below the service level benchmarks of 100 percent for water supply and sewerage network coverage, and 24 hours per day for continuity of water supply service. There are 8,375 service connections and collection efficiency for water supply is 75 percent, 15 percent below the benchmark of 90 percent. There are 1,889 households with sewerage connections, but sewer fees are not charged/ collected as of the present time.

Mirzapur Jal Kal has an average redressal efficiency rate of 98 percent, besting the benchmark of 80 percent. There is an average of 250 complaints per month, received by telephone/ mobile, in writing, or by personal visit to the office. The complaints are official recorded in a logbook, including the action taken and the date and time it was taken. The most common complaints are about turbid or "dirty" water, leakages, and mini or motorized tube well breakdowns.

See **Annex 16.4.2** for the survey form on the commercial (customer service) practices of Mirzapur.

3) Jal Kal Ramnagar

There is no sewerage system in Ramnagar. However, the water supply system coverage is 92 percent, and water supply availability is at 12 hours per day. Billing is computerized for the almost 7,000 customers who pay through the banks, visits at the office, and through bill collectors. The water supply collection efficiency is at 131 percent (SLB is 90 percent).

In terms of complaint redressal, records are kept which also includes action taken on complaints. Complaints increase from 3-5 a month during the dry season, to 15-20 complaints a month during the

monsoon season. These are received by phone, or from the personal visits at the office. Complaints are usually on "dirty" water supplied and on pipe leaks. Redressal efficiency stands at an average of 93 percent per month.

See **Annex 16.4.3** for the survey form on the commercial (customer service) practices of Ramnagar.

4) Chunar

Chunar does not have a sewerage system. The water supply system coverage is at 95.4 percent, but water supply availability is only 11 hours per day. There are 8,375 water service connections and collection efficiency for water supply averages 92 percent.

Complaints are recorded, and around 50 reach the Jal Kal by telephone, and either verbally of in writing when customers visit the office. The main complaints are turbidity in supply, or dirty water during the monsoon season, leakage and contamination and stand post breakdown. Average redressal efficiency is at 100 percent.

See **Annex 16.4.4** for the survey form on the commercial (customer service) practices of Chunar.

5) Ghazipur

Ghazipur is without a sewerage system. Water supply coverage is quite low at 55.53 percent. On the redressal of complaints, there is an official record of complaints, which also includes the action taken on the complaints. There is an average of 60 complaints per month, reported through telephone/ mobile, relayed via personal visit to the office, or hand-written and also dropped at the Jal Kal office. Common complaints are hand pump / stand post breakdown and leakages.

See **Annex 16.4.5** for the survey form on the commercial (customer service) practices of Ghazipur.

16.4.4 PROPOSED ACTION PLAN FOR CUSTOMER SERVICE

As explained in the previous section, each of the ULBs in this Project has its own customer service practices, with the service level benchmarks guiding their performance in providing both water supply and sewerage. However, there is a need to strengthen customer service practices – on procedures for recording both customers' complaints and the responses of the service provider; analyzing cases and finding resolutions; and the monitoring of implementation of or disposal of the complaints.

There is much that can be done on the matter of commercial practices improvement; however, the *Action Plan for Customer Service* will focus on achieving customer service objectives by: (i) Putting in place a "Customer Service System" with the formulation of a citizen's charter; and (ii) Developing a more thorough "Complaint Redressal System".

1) The Formulation of Citizen's Charter

The first among the major activities in the action plan is the formulation of the "Jal Kal Citizen's Charter", defined as "the expression of an understanding between citizens and the provider of a public service with respect to the quantity and quality of services the former receive in exchange for their taxes."[1] It is essentially about the rights of the public, in this case, the water supply service and the sewerage service consumers; and the obligations of the public servants, in this case the Jal Kals of Varanasi, Ramnagar, Mirzapur, Chunar and Ghazipur.

The Citizen's Charter will define the service standards of the water supply and sewerage service provider, or the Jal Kal. As a written voluntary declaration by the service provider, it will discuss choice, accessibility, and non-discrimination. It will ensure transparency and accountability standards in accordance with the expectations of its citizens. Obviously, it is a useful way of defining for the customers the nature of service provision and explicit standards of service delivery, which is actually the duty of each public official in spending the public money that are collected through taxes, rent or water and sewerage tariff / fees. It is also an effective tool to help deliver good governance. Other water supply and sewerage service providers in India, as well as in Uttar Pradesh, have utilized the Citizen's Charter. It contributes tremendously in the improvement of service delivery, provides the public with greater responsiveness from the public officials, and results in greater public satisfaction with services.

a) Components of Citizen Charter for Jal Kal

The Citizen's Charter should be able to provide benefits to all Jal Kal stakeholders/ parties. To do so, the following components are suggested for inclusion: (i) Vision and mission statements; (ii) Details of business transacted by the Jal Kal, in general; (iii) Related legislation; (iv) Information about the Jal Kal; (v) List of services provided to each client / consumer group; (vi) Quality standards; (vii) Citizens' duties; (vii) Rights and compensation of the citizens; (viii) Details of grievance redressal mechanisms and how to access it; (ix) Citizen friendly measures; and (x) Expectations from the clients.

The central focus of a good citizen's charter is the requirements of the customer. It is imperative that the citizen charter be written in a language, and expressed in a manner, that can be easily understood by the customers, with the assurance that effective remedies to problems can be easily accessed. This process entails providing a feedback mechanism that includes close monitoring of the actions taken. Citizens expect service providers to provide reliable, responsive and consistent service performance and should attend to customer needs with empathy, courtesy and care.[2] Therefore, the citizen's charter shall see to it that the standards of service are published as a show of openness and transparency. It should be participative in the sense that the customers be given opportunities to openly consult on choices they have to make. It should also provide redress to the customers when

things go wrong.

b) Steps in Formulating a Citizen's Charter

Each Jal Kal is encouraged to start formulating its own Jal Kal Citizen's Charter. The proposed steps, which come with a timetable for completing the process, are detailed in **Table 16.4.3.**

Table 16.4.3 Steps in the Formulation of the Jal Kal Citizen's Charter

SL	Actions	Timetable / Remarks
1	Organize the "Citizen's Charter Task Force" within the Nagar Nigam/ Nagar Palika Parishad of about seven persons Objective: To draw up/ formulate the "Jal Kal Citizen Charter" in consultation with identified stakeholders within six months	One week with formal Notification on task force membership
2	Conduct stakeholder consultations with major customer groups, cross section of the community: • Domestic, business, institutional consumers • Government stakeholders with Jal Kal staff • Cross sectional representation from small and medium sized business, civic/ religious, educational/ professional groups	• Three consultations (to be completed in two months) • Each consultation meeting should be documented • Secretariat will come from the Task Force.
3	Prepare the draft of the "Jal Kal Citizen's Charter" • Circulate for comments/ suggestions • Modify to include suggestions	Not more than two months
4	Jal Kal Citizen's Charter to be reviewed/ modified by Task Force	One to two weeks
5	Seek approval from ULB Head	One week to get formal approval
6	Submit a copy of the approved Jal Kal Citizen's Charter to the Department of Administrative Reforms and Public Grievances	One week
7	Formally issue and release the Jal Kal Citizen's Charter and put it up on Jal Kal Website and disseminate widely	One week
8	Send copies to people's representatives and all stakeholders who were consulted	One week to circulate the copies
9	Appoint a Nodal Officer within Jal Kal to ensure effective implementation and monitoring of the Jal Kal Citizen's Charter	One week to make the appointment

JICA Survey Team, 2017.

2) Development of Complaint Redressal System

The development of a complaint redressal system is the second major activity in the action plan. Redressal is really an inherent part of the Citizen's Charter, and is considered one of the yardsticks of providing good customer service. However, in a bid to upgrade the present manner by which complaints are handled, it is necessary for the Jal Kals to establish both a complaint procedure and the performance standards for the system.

Traditionally grievance redressal procedures involve the procedure of the complainant giving details of the location of the problem, such as the address, or name of the road, block or area, which, more

often than not, led to delays from the Jal Kal to figure out the exact location of problem and then act on the complaint. Also, the complaints could not be properly recorded and tracked in real time. For the Jal Kals, complaint communication methods can be further improved. This can be done by coming up with either an emergency number, or a three-digit toll free number, which can be assigned for lodging urgent complaints either through telephone of mobile phone. Or, an SMS number can also be provided, which can be utilized for complaint purposes. In the event the customer base of the Jal Kal reaches 10,000 for both water supply and sewerage connections, a call centre can be put up to receive calls and provide action taken, or progress of action taken on the complaints.

To be able to provide timely redressal, the complaint shall be officially registered and a "complaint number" assigned. The complainant will be informed of the number, either by telephone or email, depending on the manner by which the complaint was received. The complaint will be immediately referred to the proper unit for action; and the action taken to address the complaint shall be relayed back to the complainant and be noted in the complaint register. If the complaint is received through post, or in writing, the above system may also be adopted.

The customer care office / staff may inform the facts such as who is attending the complaints, their contact number and stage of action taken to the complainant, a day after receipt of complaint. The unit-in-charge of acting on the issue should report final stage of action taken within two days to the customer care office / staff. The customer care office / staff may inform the final action taken to the complainant immediately after receipt of details received from the concerned unit-in-charge. The head of the Jal Kal (executive or junior engineer as the case may be) may review the status of complaints received every week.

However, redressal systems can adopt computerized systems to handle the regular operations and even customer grievance redressal systems. While this system requires investments in using information technology, such as Web-based GIS-based Water / Sewerage Complaint Redressal System concepts, adapting to such available technology can vastly improve redressal time with the people being able to communicate faster, reduce the distance and time barrier between the customer and the Jal Kal, and transact in a more transparent, user-friendly and flexible manner. This would also improve redressal efficiency rates.

Having a GIS-based redressal system pre-supposes that the Jal Kal has the layouts/ maps, etc of its water supply and sewerage assets and facilities, particularly the networks which are below ground. In addition, it also requires a GIS-based customer database to be able to trace the complaint using network diagram. In the event that the Jal Kal cannot invest in such as system as of this time, then the traditional method can be enhanced with better and more responsive complaint handling and redressal procedures. It should be noted that customer complaints are a source of information reflecting the

customer's perspective and a primary measure of dissatisfaction or satisfaction with Jal Kal's services. An effective and efficient response is a demonstration of the organization's performance.

In enhancing the system for complaint redressal sans the GIS-based Water supply and Sewerage Redressal System, the Jal Kals needs to review the present way of complaint redressal by asking themselves questions regarding the procedure to be incorporated in the Citizen Charter (adapted from *Citizen's Charters: A Handbook*. DARPG, Government of India), which are detailed below:

- Is there an established procedure for dealing with complaints? If so, does the complaints procedure contain the following features?
- That consumers can complain informally to any member of staff with whom they have contact, who then tries to resolve the problem on the spot?
- That consumers can make a formal complaint?
- That there is a complaints officer identified (name and contact details) and how to make contact is explained?
- Does it guarantee that a full investigation of a complaint will be carried out and a full reply provided?
- Does it guarantee that a full investigation of a complaint will be carried out and a full reply provided?
- Does it specify target times within which they will acknowledge the complaint, provide a full response, or give an interim reply, explaining by when a full response will be provided?
- Does it set out a procedure by which, if consumers are dissatisfied with the initial response, they can take the matter further?
- To what extent is the complaints procedure, or any stage in that procedure, 'independent'?
- If there are separate procedures for dealing with different types of complaints?
- Does it insist or imply that all formal complaints must be in writing? Or does it allow complaints to be made in person or over the telephone?
- Does it invite consumers to make constructive comments and suggestions in addition to complaints and does it suggest how to do so?
- Does it say that if consumers are dissatisfied with the organization's complaints procedure, there are external and fully independent avenues for taking the complaint further (Lok Adalat, Ombudsman, and Regulatory Commission)?

- Does it tell consumers how to get independent advice on, or assistance with their complaint?

According to the Department of Administrative Reforms and Public Grievances (DARPG), grievance redress mechanisms are part and parcel of the machinery of any administration. "No administration can claim to be accountable, responsive and user-friendly unless it has established an efficient and effective grievance redress mechanism. In fact, the grievance redress mechanism of an organization is the gauge to measure its efficiency and effectiveness as it provides important feedback on the working of the administration."[3] It identifies DARPG as the nodal agency central with respect to policy initiatives on public grievances redress mechanism and citizen centric initiatives, but calls for central, state and local governments and government organisations to set up their grievance redress mechanisms for the public, based on guidelines that have been issued.

Currently at Jal Kal, complaints are received (logged) and are attended to, however, the present approach can be vastly improved and brought to the level required by DARPG. Grievance redressal must, therefore, be systematized within all the Jal Kals under this Project.

a) Areas to Be Addressed for Grievance Redressal System

- *Developing norms and standard operating procedures* in accepting, acknowledging, processing and investigating complaints.
- *Designating a location and staff* to receive complaints, including the identity (names and designations) of the assigned staff, their office locations and contact numbers/ details.
- *Developing a system for record-keeping*, using information technology to create a database that not only contains vital customer information, but also provides easy access to historical data to track similar complaints. Information required are:
- Name of customer and details of customer account
- Exact nature of complaint
- Manner complaint was filed, date and time, name of staff who received the complaint
- Analysis of complaint
- Name of unit and staff to whom complaint was forwarded for resolution,
- Action taken and timelines, including regular feedback to customer
- Disposal of grievance
- *Developing target time for feedback response*, including monitoring of complaint solution.
- *Making periodic analysis of complaints*, how these were solved or not solved, with the aim at

improving services and/or streamlining grievance mechanism / processes further.

- *Achieving measure of efficiency* in redressal of customer complaints of not lower than the service level benchmark of 80%.

b) Characteristics of Proposed Grievance Redressal System

The characteristics that the proposed complaint redressal mechanism should possess and address are the following: (i) Ease of accessibility; (ii) Speed in response time; (iii) Exhaustive investigative methods; (iv) Safeguarding confidentiality; (v) Upward and downward communication; (vi) Meticulous complaint recording and analysis; and (vii) Timely disposition and disposal of complaints / cases. See **Table 16.4.4.**

Table 16.4.4 Important Characteristics for the Proposed Grievance Redressal System for Jal Kal

SL	Characteristics	Description
1	Accessibility	• Make it easy for customers to access ways to lodge a complaint • Accessibility modes should be well disseminated • Access modes should be simple, easy to understand and use by customers • Use "customer care" or "customer service" desks / officers instead of "complaint" desk / officer
	Face-to-Face • Customer Service Desk • Customer Service Officer	
	Remote • Telephone / Call Centre • Online	
	Mail • Regular Mail • Email	
2	Response Time	• The speed in acknowledging complaint
		• Time limits established for acting on a complaint
		• Informing the complainant of the proposed action
		• Feedback time at keeping people informed of progress of action
3	Investigative Methods	• Fairness • Comprehensiveness • Impartiality • Time bound
4	Confidentiality	Complaint protocol must ensure the confidentiality of both the staff investigating and the complainant
5	Communication (Upward and Downward)	Provide information to top management regarding major grievances so that services can be improved
		Issue booklets/ pamphlets about the schemes/services available to the public indicating the procedure and manner in which these can be availed and the right authority to be contacted for service as well as for grievance redress
		Publish yearly the numbers and types/categories of complaints, the speed of response to the complaints received, and the action taken as a result of complaints to improve services.

6	Complaint Recording and Analysis	• Record the number of complaints and the type / categories of complaints • Analysis of the frequency of the occurrence of each type of complaint / area to identify grievance prone areas where modification of policies and procedures may be undertaken to make delivery of services more expeditious • Analysis of the response time and the reasons behind the problems encountered
7	Disposition and Disposal of Complaints / Cases	• Aim not only for quantity, but also for quality • Satisfaction of complainant should be achieved • Complainant should feel that grievance was addressed • Redressal options could be in the form of an apology, explanation, assurance that the same thing will not happen again, backed up by action to correct the wrong, monitoring the action and/or providing financial compensation.

JICA Survey Team, Ganga Rejuvenation Project, June 2016.

3. Review and Reformulation of Customer Service Policies in Billing and Collection

The action plan for billing and collection policies is directed more to the Jal Kals of Ramnagar, Mirazpur, Chunar, Ghazipur and Saidpur. Efficient and effective billing and collection directly contributes to the financial health of each Jal Kal. This is the function of its "Commercial Services" unit, and how well it is performed is measured by its collection efficiency ratio.

While billing and collection will be improved through the implementation of the IDP for Jal Kal Varanasi, the other Jal Kals under this project should improve its billing and collection systems to ensure the its own organisational viability and sustainability, as this has an immediate impact on enhancing the revenue streams / revenue base. The reverse is also true – that poor billing and collection practices prevent the Jal Kals from recovering sufficient costs to properly operate and maintain facilities and, therefore, provide adequate service to the customer.

According to a study by the World Bank, successful billing and collection practices "depend on many internal factors and this is where proper institutional arrangements have to be established"[4] and suitable policies framed in areas as the extent of metered service provision, water tariff structures including service to the poor, billing cycles, delivery of bills, facilities for customer payments, use of technology, and customer databases. Needless to say, efficient billing and collection practices become the incentives for the Jal Kal to charge and collect water and sewerage bills while also fulfilling a commercial / customer service orientation to its clients.

Measures for improving billing and collection are in: (i) Accurate, complete listing / recordkeeping of customers served, (ii) Clear billing procedures, (iii) Regularly updated customer databases, (iv) Using improved technology in billing activities; and (v) Encouraging and incentivizing staff to undertake billing and collection functions more diligently. The latter is related to Jal Kal having an institutional

arrangements' approach to water supply and sewerage service delivery as a commercial endeavor, aiming for independent financial management that includes setting its own revenue targets.

Improvements in billing and collection practices result in lower costs per unit of billing and collection and make such practices worth the resources that are allocated and spent. Ineffective and poorly managed billing and collection practices impact on staffing costs and staff efficiency levels. **Table 16.4.5** proposes action steps to review and reformulate billing and collection policies as the basis for the billing and collection system.

Table 16.4.5 Monitoring Sheet of Action Plan for Implementation for Customer Service for Jal Kal Varanasi

SL Nr	Action	Content / Outputs Expected	Target Date (DD/MM/YY)	Budget	Responsible Official	Monitoring Date (DD/MM/YY)	Status	Remarks
6.	Formulate *Jal Kal Varansi Citizen's Charter*	• Published *JKV Citizen's Charter* • Improved customer service delivery	01/12/2017	• 5 consultations @ 10,000 per consultation for total of INR 50,000.00 • Publication cost @ lump-sum 50,000	General Manager	Monthly after start date	Not started	-
7.	Establish enhanced *Complaint Redressal System*	• *JKV Complaint Redressal System* in place and functioning • Achieve service level benchmark for complaint redressal	To be determined by IDP schedule in terms of GIS-based database	Included/ sanctioned in IDP project	Executive Engineer	Monthly after start date	Current system in place; IDP for enhanced system	-
8.	Institutionalize customer service functions in JKV through the on-going Institutional Development Programme (IDP)	Structure: Commercial Service Section officially established and organized as per IDP	To be determined by IDP schedule	Included/ sanctioned in IDP project	General Manager	Monthly after start date	Existing organ-ization in place; Enhanced / new structure still to be implemented	-
	Review staffing plan for	Staff: Human resources for Commercial	To be determined by IDP	Included/ sanctioned in IDP project		Monthly after start date	Existing staffing in place;	-

	proposed "Commercial Service Unit" in each zone	Service Section recruited and in place as per IDP plan	schedule				Improved staffing to be implemented	
	Review training plan for customer service staff	Skills: Reformulated training plan for customer service staff as per IDP	To be determined by IDP schedule	Included/ sanctioned in IDP project		Monthly before and after training	Still to start	-
	Review and (re)formulate customer service policies, especially for sewerage services	• Jal Kal *Billing and Collection Policy* • Service Connection Rules and Regulations (including metering) for water supply • Service Connection Rules and Regulations for sewerage	• One year before metering program to market for new water supply connections • One year before completion and operation of sewerage system/ facilities	Included/ sanctioned in IDP project		Six months before review and monthly after implementation	Still to start	-

Table 16.4.6 Monitoring Sheet of Action Plan for Implementation for Customer Service for Ramnagar, Mirzapur, Chunar and Ghazipur

SL Nr	Action	Content / Outputs Expected	Target Date (DD/MM/YY)	Budget	Responsible Official	Monitoring Date (DD/MM/YY)	Status	Remarks
9.	Formulate *Jal Kal Citizen's Charter* For Ramnagar, Mirzapur, Chunar, Ghazipur and Saidpur	• Published *Jal Kal Citizen's Charter* • Better customer service delivery	01/12/2017	• 5 consultations @ 10,000 per consultation for total of INR 50,000.00 • Publication cost @ lump-sum 50,000	Executive Engineer or Junior Engineer in charge of Jal Kal	Monthly after start date	Not started	-
10.	Establish comprehensive *Complaint Redressal System*	• *Jal Kal Complaint Redressal System* in place and functioning • Achiev	01/08/2019	• For enhancement: • Cost of main-taining emer-gency number or SMS mobile		Monthly after start date	Not started	-

		e service level benchmark for complaint redressal		number • Cost of addi-tional customer service staff				
11.	Review and (re)formulate customer service policies, especially for sewerage services	• Written Jal Kal *Billing and Collection Policy* • Service Connection Rules and Regulations for sewerage • Service Connection Rules and Regulations for water supply	Mid-2019 or one year to market for new sewerage service connections	• Nil	Executive Engineer / Junior Engineer / Head of Jal Kal	Six months before review and monthly after implementation	Not started	

[1] India's Citizen's Charters: A Decade of Experience, Public Affairs Center, Bangalore, 2007, p. 16.
[2] *Citizen's Charters: A Handbook*. Ministry of Personnel, Public Grievances and Pensions, Department of Administrative Reforms and Public Grievances, Government of India.
[3] http://darpg.nic.in/darpgwebsite_cms/Document/file/PGR_Guideline.pdf
[4] Water and Sanitation Program (South Asia), Field Note on "Performance Improvement Planning: Developing Effective Billing and Collection Practices", April 2008.

16.5 Improvement of Human Resources Development (HRD) and Management (HRM)

16.5.1 Current Status of HRD and HRM of UP State, Varanasi City and UPJN

(1) Survey Results

Summarized survey results of HR development and HR management status in Urban Development Department (UDD) and State Ganga River Conservation Authority (SGRCA) in Uttar Pradesh State Government Lucknow, Uttar Pradesh Jal Nigam (UPJN) HQ in Lucknow, Varanasi Nagar Nigam (VNN) and Varanasi Jal Kal (VJK), and UPJN Varanasi are listed in **Table 16.5.1**.

Table 16.5.1 Survey Results for HR Management and Development of Involved Organizations

Categories	Q #	Description	Name of the related organizations			
			State Level		Urban Level	
			1)	2)	3)	4)
		For Q1~Q5, Q7~Q9, and Q11~Q13: (Yes, No, NA=Not Available, DN=Did not asked)	UDD, UPSGRCA	UPJN HQ Lucknow	VNN, VJK	UPJN Varanasi
		For Q6: (Annual, Bi-annual, Quarterly Q, NA=Not Available at the site, DN=Did not asked)				
		For Q10: Yes or No in following choice (L=Labour, W=Worker, O=Operator, S=Supervisor, and M=Manager position)				
		For Q10a: 1. OJT (On the job training) 2. In house skill/technical training 3. In house classroom lecture/seminar 4. Outside skill/technical training 5. Outside classroom lecture/seminar				
Office function	1	Do you have well defined function of the office?	Yes	Yes	Yes	Yes
Job description	2	Do you have well defined job description for each post?	Yes	Yes	No (Simple one Yes)	Yes
Performance Management of Personnel	3	Do you have an annual performance appraisal system for employees?	Yes	Yes	No (not for all level)	Yes
	4	Do you have a set format for performance	Yes	Yes	Yes	Yes

		evaluation?				
	5	Is the same format used for all groups of employees?	No	No	No	No
	6	Frequency of performance evaluation	Annual	Annual	Annual	Annual
Training and Development	7	Does training and development programs take inputs form performance evaluation reports?	No	No	Yes	No
	8	Are training and development programs based on Training Need Assessment?	No	No	No	No
	9	Is there a mechanism to measure the effectiveness of the training received by employees?	No	No	No	No
	10	Is there a training program for labour, worker, operator, and manager? (L=Labour, W=Worker, O=Operator, S=Supervisor, and M=Manager position)	No: L, W, & O Yes:M	No: L, W, &O Yes:M	No: L, W, &O Yes:M	No: L, W, &O Yes:M
	10 a	If so, what kind of training do they receive? 1. OJT (On the job training) 2. In house skill/technical training 3. In house classroom lecture/seminar 4. Outside skill/technical training 5. Outside classroom lecture/seminar (L=Labour, W=Worker, O=Operator, S=Supervisor, and M=Manager position)	DN	M:3, 5	S:2, 3 M:3, 5	L:1 W:1 O:No S:3 M:5
	11	Do you have “On the Job Training (OJT)”?	Yes	Yes	No	Yes
	12	Do you have “Training of Trainers (TOT)”?	DN	No	No	No
	13	Do you utilize “Internal Trainers”?	DN	Yes	No	Yes
	14	Do you utilize “Outsourced Trainers”?	Yes	Yes	Yes	Yes
Training Facilities	15	Is there a training facility exist in your organization?	DN	Yes (classroom)	No	No (in STP)
	16	Do you use outside training Facility?	DN	Yes	No	Yes

From contents of **Table 16.5.1,** following information can be identified.

1) Office Function and Job Description (Question 1 and 2)

There are written defined function of offices for state level, city and UPJK, and UPJN HQ and district office (STP) existing. Also there are written well defined job description in state level, and UPJN HQ and district office (STP) existing. For Varanasi city and UPJK, there are simple written defined job description existing. Since both office function and job description existing, and the organizational management system established, one assume that the operation of those organization can be conducted without any hindrance or difficulties.

2) HR Management (Question 3 ~ 6)

In terms of HR management, basic management tools such as organizational chart with management structure, office functions description, and job descriptions already exists at state level, city, UPJK, and UPJN. The details of those institutional set up are explained in Chapter 13 Institutional Set-up for Project Implementation. In order to motivate officers and workers, annual performance appraisal system may be an effective tool to use. This system is already applied at state level, at city and UPJK, and at UPJN and there are written performance evaluation format existing. In the case of UPJK, the evaluation format exists for managers only, and for workers evaluation, ordinary A4 size papers are utilized in the case of performing well or not well, etc. For UPJN, both for managers and workers the formats are prepared. The samples of those formats for UPJK and UPJN are listed below.

3) HR Development and Training Facilities (Question 7 ~ 16)

From question 7 to question 14, HR training and HR development activities were questioned. From the hearing activities conducted, there are training programs available to most of officers and managers at state level, city and UPJK, and UPJN. However, there are no training opportunities existed for site officers and supervisors where the actual O&M activities are implemented. Thus there are some HR training demands exist for those site officers and supervisors.

16.5.2 Required Capability Standards for Efficient Sewerage System Management

For the effective sewerage operation, it is essential to monitor individual indicators and requires continuous improvement activities utilizing the PDCA cycle. Performance indicators (PIs) can be considered as a management tool to evaluate the degree of the undertaking's efficiency and effectiveness. Efficiency is the extent to which the resources of an undertaking are utilized to provide services, e.g., maximizing services delivery with the minimum use of available resources. Effectiveness is the extent to which declared or imposed objectives, such as levels of services, are achieved. Performance Indicators (Pls) can also be used for quantitative comparative assessment of performance. This quantitative comparison can be conducted comparing the actual performance which the past undertaking records and

the project targets by an entity concerned and other similar entities.

The International Water Association (IWA) developed PIs for water supply services and wastewater services and published "Performance Indicator for Water Supply Services" in 2000 and "Performance Indicator for Wastewater Services" in 2003. The International Organization for Standardization (ISO) developed international standards regarding activities related to drinking water and wastewater services and published "Guidelines for the Assessment and for the Improvement of the Service to Users: ISO 24510", "Guidelines for Management of Wastewater Utilities and for the Assessment of Wastewater Services: ISO 24511", and "Guidelines for the Management of Drinking Water Utilities and for the Assessment of Drinking Water Services: ISO 24512" in 2007. ISO 24500s are guidelines for evaluation of entire wastewater services, and their aim is to enhance the efficiency of undertakings and services. PIs used for evaluation are key factors.

Performance of an undertaking can be evaluated from various aspects and wastewater services are composed of numerous complicated activities. Therefore, a number of PIs have been developed and make available. Wastewater services in different countries have different histories, and they have different roles. Therefore, selection of proper PIs for each undertaking is the most desirable.

In Japanese national guidelines namely, "Guideline for Improving O&M for Wastewater Systems", published in 2007 from Japan Sewage Works Association, Performance Indicators (PIs) are composed of Context Information (CI) for business entities, systems and districts, PIs for operation, users, services, management and environment and with References. **Tables 16.5.2** and **16.5.3** shown below is definition of PIs and CI in the Japanese national guidelines.

Table 16.5.2 Context Information (CI) and Performance Indicators (PIs) from Japanese National Guidelines "Guideline for Improving O&M for Wastewater Systems" (2007)

Context Information (CI)	
Content information means background information of a district about legal framework, geological conditions, population, and capacity of facilities, conditions for operation and maintenance, and environment. CI is composed of 25 items and categorized as follow.	
1)	Characteristics of an undertaking: 9 items (example of items: name of undertaking, application of local public entity law, name of project, scale of project, and number of employees, etc)
2)	Characteristics of a project: 12 items (example of items: population in administrative district, served population, population density, and service ratio, etc)
3)	Characteristics of a district: 4 items (example of items: annual rainfall, average temperature, future population (base year 2000 as 100%), and classification of receiving water body, etc)

Performance Indicators (PIs)
Performance indicator means indicator to evaluate quantitative results and levels of operation and maintenance service. PIs are composed of total 56 items. The breakdown of 56 items is 1) Operation (Sewers): 7 items, 2) Operation (Wastewater Treatment): 12 items, 3) User Services: 17 items, 4) Management: 13 items, and 5) Environment: 7 items. The contents are listed in Table X.9.3

Source: Guideline for improving O&M of wastewater system, 2007, Japan Sewage Works Association

Table 16.5.3 Details of Performance Indicators (PIs) (56 Performance Indicators (PIs))

No	Category	Performance Indicator (PI)	Calculation Formula	Improvement
(1) Operation (Sewers) (7 Items)				
1	Op10	Ratio of age of facility (sewer)	= Total length of sewers exceeding life time / Total length of sewers maintained x 100	↓ (lower the better)
2	Op20	Ratio of inspected sewers	= Total length of inspected sewers / Total length of sewers maintained x 100	↑ (higher the better)
3	Op30	Ratio of repaired sewers	= Total length of repaired sewers / Total length of sewers maintained x 100	↑ (higher the better)
4	Op40	Ratio of inspected house connections	= Number of inspected house connection / Total number of house connection x 100	↑ (higher the better)
5	Op50	Number of repaired house connections (per 100,000)	= Number of repaired house connection / Total number of house connection x 100,000	↑ (higher the better)
6	Op60	Number of collapse per 1 km of sewer	= Number of collapse / Total length of sewers maintained	↓ (lower the better)
7	Op70	Maintenance cost per 1 m of sewer	= Maintenance cost for sewers / Total length of sewers	↓ (lower the better)
(2) Operation (Wastewater Treatment) (12 Items)				
8	Ot10	Ratio of age of main equipment	= Total age of main equipment / Total average life time of main equipment x 100	↓ (lower the better)
9	Ot20	Ratio of marginal wastewater treatment capacity	= (1 – Daily maximum DWF / Design capacity for DWF) x 100	↑ (higher the better)
10	Ot30	Ratio of emergency power source security	= Number of STPs with emergency power source / Total number of STPs x 100	↑ (higher the better)
11	Ot40	Ratio of earthquake resistant facilities	= Number of earthquake – resistant buildings / Number of buildings to be earthquake – resistant x 100	↑ (higher the better)
12	Ot50	Compliance with discharge	= Number of tests compiled with standard	↑ (higher the

		standard (BOD)	(BOD) / Total number of tests (BOD) x 100	better)
13	Ot60	Compliance with standard (COD)	= Number of tests complied with standard (COD) / Total number of tests (COD) x 100	↑ (higher the better)
14	Ot70	Compliance with standard (SS)	= Number of tests complied with standard (SS) / Total number of tests (SS) x 100	↑ (higher the better)
15	Ot80	Compliance with standard (T-N)	= Number of test complied with standard (T-N) / Total number of tests (T-N) x 100	↑ (higher the better)
16	Ot90	Compliance with standard (T-P)	= Number of test complied with standard (T-P) / Total number of tests (T-P) x 100	↑ (higher the better)
17	Ot100	Compliance with standard of odor	= Number of test complied with standard odor / Total number of tests of odor x 100	↑ (higher the better)
18	Ot110	Unit power consumption (wastewater treatment)	= Power consumed (wastewater treatment) / Total wastewater treated	↓ (lower the better)
19	Ot120	Unit disinfection chemical usage	= Annual consumption of chemical / Total wastewater treated	↓ (lower the better)
(3) User Service (17 Items)				
20	U10	Provision of storm water drainage	= Area with storm water drainage / Total planning area x 100	↑ (higher the better)
21	U20	Compliance with legal water quality standard for water body (BOD)	= Number of samples complied with legal standard (BOD) / Total number of legal tests (BOD) x 100	↑ (higher the better)
22	U30	Compliance with legal water quality standard for water body (COD)	= Number of samples complied with legal standard (COD) / Total number of legal tests (COD) x 100	↑ (higher the better)
23	U40	Compliance with legal water quality standard for water body (SS)	= Number of samples complied with legal standard (SS) / Total number of legal tests (SS) x 100	↑ (higher the better)
24	U50	Compliance with legal water quality standard for water body (T-N)	= Number of samples complied with legal standard (T-N) / Total number of legal tests (T-N) x 100	↑ (higher the better)
25	U60	Compliance with legal water quality standard for water body (T-P)	= Number of samples complied with legal standard (T-P) / Total number of legal tests (T-P) x 100	↑ (higher the better)
26	U70	Compliance with legal water quality standard for water body (E-coli)	= Number of samples complied with legal standard (E-coli) / Total number of legal tests (E-coli) x 100	↑ (higher the better)
27	U80	Sewer Blockages (per	= Number of sewer blockages / Served	↓ (lower the better)

		100,000 persons)	population x 100,000	
28	U90	Third party accidents (per 100,000 persons)	= Number of third parties accidents / Served population x 100,000	↓ (lower the better)
29	U100	Complaints (per 100,000 persons)	= Number of complaints / Served population x 100,000	↓ (lower the better)
30	U110	Response to complaints	= Number of complaints responded within one week / Total number of complaints x 100	↑ (higher the better)
31	U120	Service charge (residential)	= According to local government	-
32	U130	Unit operating cost per person (O & M)	= Operating cost (O & M) / Served population	↓ (lower the better)
33	U140	Unit capital cost (capital)	= Capital cost (wastewater) / Served population	↓ (lower the better)
34	U150	Unit cost (O & M + capital)	= Cost (wastewater) / Served population	↓ (lower the better)
35	U160	Unit revenue per staff	= Revenue / Number of staff	↑ (higher the better)
36	U170	Unit revenue water per staff	= Annual volume of revenue water / Number of staff	↑ (higher the better)
(4) Management (13 Items)				
37	M10	Unit revenue water per person per day	= (Annual revenue water / number of days) / Served population	↑ (higher the better)
38	M20	Accounted –for water	= Annual accounted-for water / Total treated wastewater x 100	↑ (higher the better)
39	M30	Current balance	= Gross earning / Total cost x 100	↑ (higher the better)
40	M40	Transfer ratio (profitable earning)	= Transfer / Profitable earning x 100	↓ (lower the better)
41	M50	Transfer ratio (capital earning)	= Transfer / Capital earning x 100	↓ (lower the better)
42	M60	Unit revenue	= Total revenue / Total accounted-for water	↑ (higher the better)
43	M70	Unit wastewater treatment cost	= Wastewater treatment cost / Total accounted-for water	↓ (lower the better)
44	M80	Unit wastewater treatment cost (O&M)	= Wastewater treatment cost (O&M) / Total accounted-for water	↓ (lower the better)
45	M90	Unit wastewater treatment cost (capital)	= Wastewater treatment cost (capital) / Total accounted-for water	↓ (lower the better)

46	M100	Cost covering ratio	= Service charge revenue / Wastewater treatment cost x 100	↑ (higher the better)
47	M110	Cost covering ratio (O&M)	= Service charge revenue / Wastewater treatment cost (O&M) x 100	↑ (higher the better)
48	M120	Cost covering ratio (capital cost)	= Service charge revenue / Wastewater treatment cost (capital cost) x 100	↑ (higher the better)
49	M130	Working accident (per 1 million m^3 treated wastewater)	= Number of accidents which caused 4 days of absence or more / Total wastewater treated x 1,000,000	↓ (lower the better)
(5) Environment (7 Items)				
50	E10	Pollutant reduction ratio in dry weather (BOD)	= (1 – Effluent BOD / Inflow BOD) x 100	↑ (higher the better)
51	E20	Wastewater reuse	= Wastewater reused / Total wastewater treated by advanced treatment x 100	↑ (higher the better)
52	E30	Sludge recycle ratio	= Sludge recycled / Total sludge generated x 100	↑ (higher the better)
53	E40	GHG emission per person	= GHG emission by sewerage service in terms of CO2 / Served population	↓ (lower the better)
54	E50	Compliance with standard for discharge to sewerage	= Number of compliance with standard / Total number of samples x 100	↑ (higher the better)
55	E60	Service ratio of advanced treatment for environmental standard	= Population served by advanced treatment / Served population x 100	↑ (higher the better)
56	E70	Improvement of combined system	= Area for which combined system was improved (ha) / Total area of combined system (ha) x 100	↑ (higher the better)

Source: Guideline for improving O&M of wastewater system, 2007, Japan Sewage Works Association

Table 16.5.4 Indicators from India's Service Level Benchmarking

2.2 Sewage Management (Sewerage and Sanitation				
No	Proposed Indicator	Calculation Formula	Benchmark	Improvement
2.2.1	Coverage of Toilets	= 1/(1+Total number of properties without individual or community toilets within walking distance / Total number of properties with access to individual or community toilets)*100	100%	↑ (higher the better)
2.2.2	Coverage of Sewage Network Services	= (Total number of properties with direct connection to the sewage network / Total number of properties in the service area)*100	100%	↑ (higher the better)
2.2.3	Collection Efficiency of the Sewage Network	= [Wastewater collected / ((Total water supplied + Estimated water use from other sources)*0.8)]*100	100%	↑ (higher the better)
2.2.4	Adequacy of Sewage Treatment Capacity	= [Treatment plant capacity / ((Total water consumed + Total number of properties with direct connection to the sewage network) * 0.8)] *100	100%	↑ (higher the better)
2.2.5	Quality of Sewage Treatment Capacity	= (Number of samples that pass the specified secondary treatment standards / Total number of wastewater samples tested in a month) * 100	100%	↑ (higher the better)
2.2.6	Extent of reuse and recycling of sewage (wastewater)	= (Wastewater recycled or reused after appropriate treatment / Wastewater received at STPs) * 100	20%	↑ (higher the better)
2.2.7	Efficiency in redressal of customer complaints	= (Total number of complaints redressed within the month / Total number of sewage – related complaints received per month)*100	80%	↑ (higher the better)
2.2.8	Extent of cost recovery in sewage management	= (Total annual operating revenues / total annual operating expenses) *100	100%	↑ (higher the better)
2.2.9	Efficiency in collection of sewage charge	= (Current revenues collected in the given year / Total operating revenues billed during the given year) * 100	90%	↑ (higher the better)

Source: JICA team summarized data from table of "Benchmarks at a Glance" in P. 8 and formulas from P. 40 ~ P.57, from Handbook of Service Level Benchmarking, 2008, Ministry of Urban Development, Government of India

16.5.3 Current Technical Skills and Abilities of Staffs in Supervising Agency (VNN), and implementing agency VJK and UPJN)

1) VNN and VJK O&M Staff Technical Level and Training

Sewer system supervising organization the Nagar Nigam and lower branch O&M implementing body the UPJK are conducting day to day O&M activities without any difficulty. The typical JKV organogram including the site O&M team is listed in **Figure 165.1**.

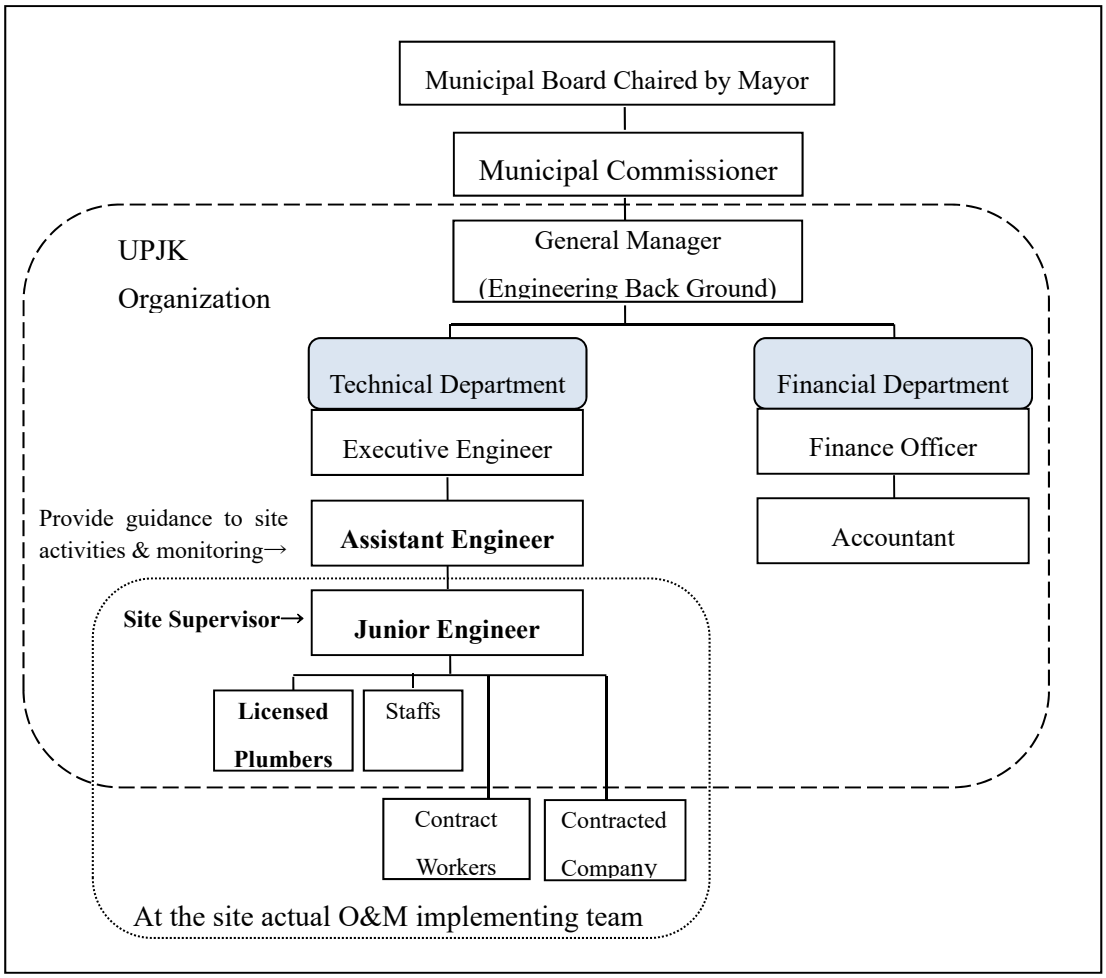


Figure 16.5.1 Typical JKV Organogram Icluding the Site O&M Team

According to UPJK managers, for daily sewer system maintenance activities that include cleaning, inspection, correspondence for sewer line clogging and minor repairs, they said there are necessary technical officers and technicians. In terms of technical aspects including needed skill and capability, shortages and need to be tackled by increasing number of site staffs and supervising officers in the future were confirmed during the interviews. The shortage is partly due to the aging sewer system that needs periodical inspection, cleaning and maintenance activities. To overcome this situation, many maintenance activities are outsourced or non-skilled

part-time workers were employed by recruiting through public announcement.

Some examples of sewer system difficulties in the case of Varanasi City are that there are sewers that are more than 100 years old and hydrogen sulphide acid gas problem due to the increase in population and human wastes, synthetic detergents and chemical products erode sewer main pipeline and concrete surfaces, that require major repair work. In the case of large-scale sewer system repair work, Nagar Nigam usually entrusts the work to UPJN for the re-construction or large maintenance/repair project.

For UPJK's managers, there are training opportunities about once a year, at outside training institutes to enhance their capacity. However, these opportunities are provided on seniority basis. Thus the actual site O&M implementing supervisors (Junior Engineer), with their busy daily work and schedule, usually cannot receive the needed training. Also city-employed staffs called "Licenced Plumber" are the expert on sewer O&M activities who support Junior Engineer (site supervisor) from technical aspect at the site operation. Licenced Plumber receives training at technical school for about 2 to 3 years, mainly in the field of the sewer O&M and then pass the exam and are certified. Licenced Plumbers are not managers and thus they too are not entitled to receive periodical training.

With all those conditions in mind, the training program for actual at the site O&M implementing supervisors such as Junior Engineer, Licensed Plumber and Assistant Engineer are needed. Also, the training program can be implemented in-house or outsourced to UPJN.

2) UPJN O&M Staff s'Technical Level and Training

Daily O&M activities are conducted at both STP and SPS with supervision of district level UPJN offices. UPJN also receive entrusted construction projects such as re-construction of sewer main pipeline or sewer system large maintenance/repair work from state government.

a) O&M staff at STP and SPS (Sewer Pumping Station) at UPJN

From hearing conducted to UPJN managers, there are training demands and needs for O&M site operators as a periodical refresher training for once a year or twice a year. Also newly assigned operator and manager may need new-comer training for smooth take over of position and for O&M implementation.

b) Sewere System Construction and Maintenance / Repair Staffs at UPJN

At India, for the sewer main pipeline construction and renewal work, the major method is by digging from top side by excavator or by manually to bury sewer piles and for those

traditional construction, the technique is already available at India and thus there are no problem in terms of technical aspect.

On the other hand, at the hearing conducted to UPJN managers, there are some demands for new technologies such as Pipe Jacking Technology which is under the proposed scheme in Varanasi and Mirzapur. The technology is used in Japan and in the western countries very often. The request of the training was more like introductory course on how the technology can be utilized and construction sequences, etc.

16.5.4 Training Plan and Capacity Development for O&M

For sewer O&M operator and supervisors, and for newly assigned manager, the needed training programs can be categorized into 4 types. The details of those training courses are lited below.

It should be noted that the contents of overseas and local training mentioned in this report show the ideas of the consultants.

(1) O&M Personnel Training of Newly Assigned Supervisors, Operators and Managers for Sewer Network

Training Purpose:	The purpose of this training course is to make aware of the importance of O&M of Sewer System, overall sewer system and function of each section, i.e. sewarage pipeline, SPS, and STP, and to make smoth implementation of various tasks at assigned destination (position) for newly assigned supervisors, operators, and managers.
Training Target:	For Nagar Nigam, UPJK, UPJN, and SPE(V). For Newly Assigned Supervisors, Operators, and for Managers who will involve in Sewerage facility O&M.
Training Pediod:	About 5 days (Within 5 days of training period, the main lecture is morning session only and for afternoon session the site visit and O&M activities observation will be conducted.)
Training Offering Time/Frequency	At Start-up phase, and once a year or once in two years
Training Instructor:	Can be in-house instructor or can be outsourced to UPJN, etc
Training Schedule:	5 days full day program. (See **Table 16.5.5**)

Table 16.5.5 Training Program for Newly Assigned Sewer O&M Operator, Supervisor and Manager

	Monday	Tuesday	Wednesday	Thursday	Friday
AM	**9:00 Registration** **9:10 Orientation** Purpose of the Training **9:15 Lecture 1** What is Sewer, what is the benefit of sewer system? (Basic system) **10:45 Tea Break** **11:00 Lecture 2** The policy of Indian Government and preservation of nature of Ganga River	**9:00 Registration,** **9:10 Icebreaking,** Information Shearing **9:15 Lecture 4** Function of sewerage main pipe line **10:45 Tea Break** **11:00 Lecture 5** Maintenance of main pipe line.	**9:00 Registration,** **9:10 Icebreaking,** Information Shearing **9:15 Lecture 6** Function of sewage pumping station (SPS) Introduction of Simultaneous plural distanced monitoring and control system for **10:45 Tea Break** **11:00 Lecture 7** Operation and maintenance of SPS.	**9:00 Registration,** **9:10 Icebreaking,** Information Shearing **9:15 Lecture 8** Function of Sewage Treatment Plant (STP) **10:45 Tea Break** **11:00 Lecture 9** Operation and maintenance of STP	**9:00 Registration,** **9:10 Icebreaking,** Information Shearing **9:15 Lecture 10** Daily, weekly, monthly, quarterly and annual O&M activities planning for sewerage pipe line, SPS, STP and project planning **10:45 Tea Break** **11:00 Case Study and Group Exercise** (Assignment given for annual schedule planning of pipe line, SPS and/or STP)
Lunch	**12:30 Lunch**	**12:30 Lunch**	**12:30 Lunch**	**12:30 Lunch**	**12:30 Lunch**
PM	**13:30 Lecture 2** What is the purpose of maintenance? Traditional Maintenance Methodology. **15:00 Tea Break** **15:30 Lecture 3** Preventive maintenance Periodical maintenance Schedule control **17:30 Class ending**	**13:30 Moving by Car** **14:30 Field Survey 1** Sewage Main Pipeline Site or Pipeline Construction site Visit Visit to the sewage unconnected river / creek (example: Varanasi) **17:30 Class ending**	**13:30 Moving by Car** **14:30 Field Survey 2** Sewage Pumping Station Visit and observation of O&M activities (example: Varanasi) **17:30 Class ending**	**13:30 Moving by Car** **14:30 Field Survey 3** Sewage Treatment Plant Visit and observation of O&M activities (example: UPJN Varanasi) **17:30 Class ending**	**13:30 Group Exercise continue** Group work Each group write & display planed results **15:15 Tea Break** **15:30 Presentation** Presentation by each group. Q & A Session **Certificate Giving** **Picture Taking** **17:45 Class ending**

(2) O&M Personnel Training of Newcomers for Sewer Network

Training Purpose: The purpose of this refresher training is to enhance O&M supervisor and operator's ability, knowledge and skills, and also to deepen the understanding of inportance of Sewer system maintenance.

Training Target: For UPJK Junior Engineer, Licenced Plumber and Assistant Engineer, and SPV's O&M staffs

Training Pediod: For 3 days~ 5 days (In the case of 3 days training, the course will be

held in both morning and aftenoon session. In case of 5 days of training,only mornign session will be conducted, and after lunch is for their daily work. The reason of short period is due to O&M supervisors' day to day busy O&M work and activities. Therefore if the time are allowed, full 5 days shall be utilzed including actual sewere cleaning machine practice / OJT can be implemented in afternoon session.)

Training Offering Time/Frequency: Once a year or Twice a year

Training Schedule: 3 days full day program, or 5 days mornig session program. The contents of those course are listed in **Table 16.5.6.**

Table 16.5.6 Training Program for Sewerage O&M Supervisor for 3 days Concentration

	Monday	Tuesday	Wednesday
AM	**8:45 Registration** **9:00 Orientation** Purpose of the Training **9:15 Lecture 1 Sewer Function** 10:45~ 11:00 Tea Break **11:00 Lecture 2 Policy**	**8:45 Registration** 9:00 Icebreaking and Information Shearing **9:15 Lecture 5 Sewerage Cleaning techniques ②** 10:45~ 11:00 Tea Break **11:00 Lecture 6 Sewerage Cleaning techniques ③**	**8:45 Registration** 9:00 Icebreaking and Information Shearing **9:15 Lecture 7 New Equipment for Sewerage O&M** 10:45~ 11:00 Tea Break **11:00 Lecture 8 Sewerage Damage Investigation and Repairing Techniques and New Technology**
Lunch	12:30 ~ 13:30 Lunch	12:30 ~ 13:30 Lunch	12:30 ~ 13:30 Lunch
PM	**13:30 Lecture 3 Purpose of O&M, Patrol and Pipe Inspection** 15:00 ~ 15:30Tea Break **15:30 Lecture 4 Sewerage Cleaning Techniques ①** 17:30 Class ending	13:30 Moving by Car **14:00 Field Survey 1** 17:30 Class ending	**13:30 Lecture 9 New Technology, Future Technology and Way Forward** 15:00 ~ 15:30Tea Break **15:30 Group Exercise and Discussion** 17:30 Class ending

Table 16.5.7 Course content for Training Program for Sewerage O&M Supervisor

No.	Name of the Course	Course Content
Orientation	Orientation	Appreciation to daiy hardwork. Purpose of the refresher and new staff training. Importance of sewerage and O&M activities for the society.
Lecture 1	Sewer Function	Sewerage system and each facility's function. Function of Sewage Main Pipe Line
Lecture 2	Policy	The policy of Indian Government and preservation of nature of Ganga River
Lecture 3	Purpose of O&M, patrol and pipe inspection	What is the purpose of maintenance? Patrol of sewerage system from road side and inside pipe inspection using worker entering visual checking and TV camera checking (for

		main pipes and for lateral pipes)
Lecture 4	Sewerage cleaning techniques ①	Inside pipe cleaning techniques ①: Large diameter pipe: traditional method by human power
Lecture 5	Sewerage cleaning techniques ②	Inside pipe cleaning technology ②: Small diameter pipe: water – jetting sewer cleaner
Lecture 6	Sewerage cleaning techniques ③	Inside pipe cleaning techniques ③: Inverted siphon pipe: submerged stretcher and horizontal small bucket operation.
Field Survey 1	Field Survey 1	Sewage Main pipeline maintenance site visit using new machines and new methods (example: in Varanasi)
Lecture 7	New Equipment for Sewerage O&M	Maintenance of Main Pipe Line using New Technology and Equipment (i.e. horizontal bucket machine, high pressure sewage washing machine, and vacuum car, etc.)
Lecture 8	Sewerage Damage Investigation and Repairing Techniques and New Technology	Type of sewerage damages (type of clogging, damage by other construction, and erosion by sulfuric aside gas, etc.) and repairing techniques.
Lecture 9	New Technology, Future Technology and Way Forward (Using Japan's existing technologies as an example)	1 Pipe jacking technology, 2 Sewerage pipe relying technology for existing pipeline and automated robot coating (as a similar effect as new pipeline construction), 3 Sewerage main pipe inspection and damage information computer database (mapping), 4 Priority of improvement and repair work analysis using computer database (mapping), and 5. Way forward

(3) O&M Personnel Training for STP and SPS Operators and Engieer (for UPJN Regional Officers and SPV')

Training Purpose: The purpose of this refresher training course is to enhance O&M supervisor and operator ability, knowledge and skills, and also to deepen the understanding of inportance of SPS and STP maintenance.

Training Target: For UPJN's actual operators and engineers in STP and SPS, and O&M staffs in SPV.
(In the case of UPJN, 1. ASP / Biofiltration Operators, 2. Power Plant Opperators, 3. Aerated Lagoons Operator, and 4. UASB Treatment Plant Operator if UASB plant exist). For newly assined operators and managers, both are eligible to receive the training. In the case of SPE (SPV) officers, the eligible trainer will be equivalent to UPJN cases)

Training Pediod: For 3 days~ 5 days (In the case of 3 days training, the course will be held in both morning and aftenoon session. In case of 5 days of training,only mornign session will be conducted and after lunch is for daily work. The purpose of short training period such as 3 days or 5 days morning session is due to the busy O&M supervisors' day to day work schedule. If the time are allowed, then actual machine peration OJT activities at the site can be implemented in afternoon session and utilize 5 days folly.)

Training Offering Time/Frequency: Once a year or Twice a year

Training Schedule: 3 days full day program, or 5 days mornig session program. The contents of those course are listed in **Table 16.5.8**.

Table 16.5.8 Training Program for STP and SPS Operator for 3 days Concentration

	Monday	Tuesday	Wednesday
AM	**8:45 Registration** **9:00 Orientation** Purpose of the Training **9:15 Lecture 1 Sewer Function** 10:45~ 11:00 Tea Break **11:00 Lecture 2 Policy of Indian Government**	**8:45 Registration** 9:00 Icebreaking and Information Shearing **9:15 Lecture 5 Details of aeration and its types, and involved bacteria** 10:45~ 11:00 Tea Break **11:00 Lecture 6 Facility cleaning and 5S activities**	**8:45 Registration** 9:00 Icebreaking and Information Shearing **9:15 Lecture 7 Machine cleaning and maintenance** 10:45~ 11:00 Tea Break **11:00 Lecture 8 Machine and facility maintenance principle (periodical and preventive maintenance principle)**
Lunch	12:30 ~ 13:30 Lunch	12:30 ~ 13:30 Lunch	12:30 ~ 13:30 Lunch
PM	**13:30 Lecture 3 Purpose of O&M, Patrol of SPS and STP, and Inspection** 15:00 ~ 15:30Tea Break **15:30 Lecture 4 Mechanism of each system in STP** 17:30 Class ending	13:30 Moving by Car **14:00 Field Survey 1** Visit of model STP and SPS 17:30 Class ending	**13:30 Lecture 9 Safety measure and precaution. Safe environment and in case of emergency** 15:00 ~ 15:30Tea Break **15:30 Group Exercise and Discussion, and Case Study** 17:30 Class ending

Table 16.5.9 Course contents for STP and SPS Operator

No.	Name of the Course	Course Content
Orientation	Orientation	Appreciation to daiy hardwork. Purpose of the refresher and new staff training. Importance of STP and SPS, and O&M activities for the society.
Lecture 1	Sewer Function	Sewerage system and each facility's function. Function of Sewage Pipe Line, SPSs and STP.
Lecture 2	Policy of Indian Government	The policy of Indian Government and preservation of nature of Ganga River
Lecture 3	Purpose of O&M, patrol of SPS and STP and inspection	What is the purpose of maintenance? Prolonging equipment life and cost reduction for long run. Daily patrol of SPS and STP and inspection. What need to be inspected and maintained, etc.
Lecture 4	Mechanism of each system in STP	Pretreatment, primary treatment, secondary (advanced) treatment and aeration, and tertiary treatment. Details of each mechanism and functions.

Lecture 5	Details of aeration and its types (biological nutrient removals types), and involved bacteria	Biological nutrient removals and type of secondary (advanced) treatment process and differences in each design (Standard process, AO process, A2O process, Step A2O process and AOAO process). Process involved bacteria and fungi, for Nitrogen and phosphorus removal.
Lecture 6	Facility cleaning and 5S activities	Concept of 5S (sorting, set-in-order, shining/sweeping/cleaning, standardize, and sustain the good practice) and importance of clean facilities at STP and SPS.
Field Survey 1	Field Survey 1	Visit of model STP and SPS (example: in Varanasi)
Lecture 7	Machine cleaning and maintenance (Electrical device, hydraulic equipment, mechanical moving devices, electrical components, etc)	Methodology of how to clean and maintain each machine by types (i.e. Electric motor, gear, hydraulic piston and hydraulic equipment, mechanical moving devices, diesel engine, electrical components, PLC, computer, monitor and electrical instrumental panel, etc). Use of cleaning cloth, cleaning tool, air pressure and water pressure machine. Place where you cannot use air pressure and water pressure cleaning device: hydraulic piston and equipment) Use of cleaning chemical, oil change and lubricating. Type of oil lubricant and grease. Periodical filter change, etc.
Lecture 8	Machine and facility maintenance principle (Periodical Maintenance, and Preventive Maintenance Theory)	Periodical maintenance schedule planning and maintenance theory. Contents can be following; 1. Introduction, 2. What conditions are necessary so that operator does not cause anybreakdowns?, 3. What is Productive Maintenance (PM)?, 4. Classification of maintenance methods: a) Preventive Maintenance: a1) Time Based Maintenance, and a2) Condition Based Maintenance, b) Breakdown Maintenance: b1) Planned Breakdown Maintenance, b2) Emergency Maintenance, c) Corrective Maintenance,and d) Maintenance Prevention, 5. Total Productive Maintenance (TPM), 6. Reasons why everyone should participate in Productive Maintenance, 7. Six Major Losses (i.e. Loss due to failure, Loss due to arrangement and adjustment, Loss due to idling and a short shutdown, loss due to speed reduction, loss due to defect and correction, and loss due to starting up and yield), 8. Relations between Minor Defects and Major Defects (How do these losses occure? and Heinrich's Law), 9. From Forced Deterioration to Natural Deterioration, 10. For Zero Failure: a) Maintenance of basic condition, b) Observe the operating conditions, c) Recover deterioration, and d) Increase opration and maintenance skills.
Lecture 9	Safety measure and safety precausion. How to development of safe working environemt. What to do in case of emergency occured	Presentation on safety device (working uniform / clothes, helmet, grove, eye goggles, mask, safety shoes / boots and safety belt), reliable devices and facilities (ladder, stepladder, scaffold (plank), and handrail), separation of working area and walkway, signboard, danger zone, and enclosed space (CO2 and sulphuring aside gas) and caution for hazardous chemicals, etc. Where to call and what to do when emergency occurred (emergency contact list (telephone tree), facility damage, and human injury (first aid), etc.).
Lecture 10	Group Exercise and Discussion, and Case Study	Assignment given for annual schedule planning of STP and SPS maintenance.

(4) Consideration of Training in Japan and Sharing of Japanese Experience

As a part of the project, consideration of corroboration activities between Japanese side and India side needed to be considered. On August 30th, 2014, in the presence of Mr. Narendra Modi, the Prime Minister of India and Mr. Shinzo Abe, the Prime Minister of Japan, Varanasi City and Kyoto City signed a letter of intent for cooperation as partner cities and confirmed the intents of enhanced collaboration and promotion of interactions between the two cities in the area of cultures, arts, academics, conservation of historical heritages and modernization of city. Through interactions followed thereafter at workshop conducted on January 2015, both cities have shared the understanding on severe issues of waste management systems in Varanasi City, and hereby confirm the collaboration to the following extent.

With above bilateral cooperation ongoing, for India's governmental officers who develop water related environmental policy and/or decision making, and for engineers and managers who want to introduce new sewer related technology and river cleaning technology, to shear Japan's municipality level sewerage knowledge, the consideration of future workshop and Japan training at Kyoto City can be considered. The tentative visiting plan for sewer and river cleaning related organizations in Kyoto City and in Kansai Area is listed in **Table 15.5.10**.

It should be noted that the contents of overseas and local training mentioned in this report show the ideas of the consultants

Sample plan of Japan Training in Kyoto underb ODA Loan Scheme (Reference Plan) is descrobe below.

Training Purpose:	The purpose of Japan training is for India's governmental officers who develop river water and sewer related environmental policy and/or decision making, and for engineers and managers who want to introduce new sewerage related technology and river cleaning technology, to shear Japan's municipality sewerage know-how. With the consideration of information shearing workshop and survey activities, the Japan training at Kyoto City can be considered.
Component of Japan Training Plan	Effect that construction of a sewage system has on a city ・ Construction of a sewage tailored to city's conditions ・ Measures to enhance residents' awareness of the importance of maintaining the aquatic environment ・ Cutting-edge sewage treatment technology and examples of its application ・ Concept of sewage tariff levy and status of implementation ・ Sludge treatment ・ Reuse of reclaimed wastewater

Objectives

- Use of empty upper area at sewage treatment plant
- Sewer construction

a) To understand the history of sewage systems in cities and the effect of their installation
b) To learn about cutting-edge technology used with sewage treatment and environmental protection
c) To understand the importance of improving residents' awareness

Details of sample visiting sites**:** As listed in **Table 16.5.10**.

Table 16.5.10 Details of Japan Training in A City (Sample Plan: Using Yen Credit Scheme)

No	Subject	Type	Lecturer request	Content	Objective
1	Activity of A City: (Part 1)	Lecture and discussion (for information shearing)	City of A, Sewer Department Planning Division	Hearing of activities conducted by A City and their continuous water related activities namely "Live Together with Water (Symbiosis) Plan (City wide activities)" and history of improvements to aquatic environment in A	a)
2	Activity of A City: (Part 2) XX River Rejuvenation Pilot Activities	Visit to XX River and site observation	City of A, River Development Section / Sewer Department	Visit to XX river site and lecture on "XX River Rejuvenation Pilot Activities" with citizens participation type development for river water flow planning and cleaning activities involving citizens.	a), c)
3	YY Sewage Treatment Plant	Visit	City of A, Environmental Department	To observe the STP to see how energy is efficiently used in a sewage treatment plant (Solar and Waste Gas Generator)	b), c)
4	Recent Sewer and Environmental Clean Technology Development activities at Research Institutes (A University Graduate School of Engineering, Department of Environmental Engineering)	Visit	A University Graduate School of Engineering,	To learn about cutting-edge technology used with sewage treatment and environmental protection	b)
5	ZZ Sewage Treatment Plant	Visit	E City	To observe sewage treatment plant, applying the membrane treatment on the largest scale in Japan, and learn about the difference with standard treatment methods and plant condition during operations.	b)
6	C Museum	Visit	C Museum in D Prefecture	To hear the natural functions of Lake C which is one of the world's oldest lakes, and the source for the metropolitan district, as well as its history and people's lifestyle. Training participant will be given a tour of the museum, which raises	c)

				residents' awareness about environmental conservation at the lake.	

16.5.4 Conclusion

At the central government level, it has been recognized through the experience with past programmes that once projects are completed the ULBs pay little attention to the operation and maintenance of infrastructure assets created. Therefore, the NGRBA Guidelines as well as the AMRUT schemes require the tender to include O & M for five years. The NGRBA will share 70% of the O&M cost for the first five years, and the ULB is to then on pay the full amount of O&M through user fees. The Guidelines provide clear instructions and methodology for determining the O&M cost, and these methodologies will be followed once the construction costs are determined during the course of this Preparatory Survey.

The NGRBR/AMRUT recommended O&M arrangement is much different to the current arrangement where the Nagar Nigam performs the O&M of the sewerage assets through its own staff; the Jal Kal staffs perform the O&M of sewer lines whereas the UP Jal Nigam performs the O&M of the sewage pump stations and the treatment plants. This arrangement will need to change, and the Nagar Nigam will have a more of a supervisory role for the O&M of the assets. A policy decision in this regard is required at the Government level through discussions with UP Jal Nigam and Nagar Nigams (Municipal Bodies).

CHAPTER 17 Construction Cost Estimates and Implementation Plan

<Object of the Study>

Construction cost for the projects was estimated and implementation plan was established.

<Result of the Study>

For the construction cost, refer to the relevant tables. Design-Build method for STP is recommended from the current practices in the similar projects in India. While for the construction of 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. ICB would be applied for all packages in view of securing the quality assurance and time management for constructing the facilities. On the other hand, supporting components of the Project for Capacity Development for UPJN in application of GIS and MIS, and Strengthening in Public awareness/participation and institutional capacity, and facilitation of implementation of Environmental Management Plan, LCB is recommended instead of applying ICB.

17.1 Project cost of each DPR

17.1.1 Collected Project cost

UPJN provided 11 DPRs to JST for conducing the review of their contents in the first field survey whereas some DPRs were under preparation by UPJN.

Table 17.1.1 to **Table 17.1.15** show the cost and construction duration of each DPR. The project cost on each DPR contains not only the construction and other relative costs but also several taxes and O&M cost. **Table 17.1.16** summarises the planned construction commencement year and construction period of the projects mentioned in each DPR. Most of construction works are completed within 30 months, however there are no detailed implementation plan in each DPR.

Table 17.1.1 Rehabilitation and Upgradation of Existing STPs at Dinapur & Bhagwanpur

No.	Item	Cost (Rs. in Lacs)	Remarks
(1)	Basic cost of Work	6,703.39	
(2)	Centage Charges		
a.	Cost of Project Preparation @ 4%	268.14	
b.	Cost of Supervision of Project @ 4% as per NGRBA Guide-lines	268.14	
c.	Cost of Supervision of Project @ 4.5% borne by U.P. Govt. as admissible	301.65	
	Subtotal (2)	837.92	
3	Labour Cess @1% of Basic Cost (1)	67.03	
4	Cost of Work on which no Centage is admissible		
a.	Communication & Public Outreach	100.55	
b.	Cost of Land	0.0	
	Subtotal (4)	100.55	
5	Operation & Maintenance		
a.	Operation & Maintenance for first 5 years of commissioning of project	5,405.39	
6	Total	13,114.29	

Source: Form J Cost Abstract Dinapur.xlsx

Table 17.1.2 Ramna STP (Comprehensive)

No.	Item	Cost (Rs. in Lacs)	Remarks
(1)	Cost of Works		
a.	Required for construction of STP	5,878.58	
b.	Required for disposal of treated effluent	1,757.93	
c.	Required for site development and miscellaneous works	2,665.39	
	Subtotal (1)	10,301.90	
(2)	Centage Charges		
a.	Cost of Project Preparation @ 4%	412.08	
b.	Cost of Supervision of Project @ 4% as per NGRBA Guide-lines	412.08	
c.	Cost of Supervision of Project @ 4.5% borne by U.P. Govt. as admissible	412.08	
	Subtotal (2)	1,287.74	
(3)	Cost of Works which no Centage admissible		
a.	site office	5.00	
b.	power connection & allied works	673.72	
c.	communication & Public outreach	10.00	
d.	Environmental and management plan	15.00	
e.	Governance and Accountability Action Plan (GAAP)	10.00	
	Subtotal (3)	713.72	
(4)	Operation & Maintenance		
a.	Operation & Maintenance for first 5 years of Civil works	3,255.36	
(5)	Labour Cess @1% of Basic Cost	103.2	
(6)	Total	15,661.74	

Source: Financial statement.pdf (Ramnaer)

Table 17.1.3 Mirzapur (comprehensive)

No.	Item	Cost (Rs. in Lacs)	Remarks
(A)	Basic cost		
i	Sewer Networks and Appurtenance	21,455.25	
ii	Sewage Treatment Plants	3,683.48	
iii	Pumping Stations	2,078.80	
iv	Septic Tanks	32.03	
v	Communication & Public Outreach	40.00	
vi	Environmental and Management Plan (EMP)	77.82	
vii	Governance and Accountability Action Plan (GAAP)	10.00	
	Subtotal (A)	27,377.37	
(B)	Centage Charges		
i	Cost of Project Preparation @ 4%	1,095.09	
ii	Cost of Supervision of Project @ 4% as per NGRBA Guide-lines	1,095.09	
iii	Cost of Supervision of Project @ 4.5% borne by U.P. Govt. as admissible	1,231.98	
	Subtotal (B)	3,422.17	
(C)	Contingency		
i	@ 2 % of Basic Cost ie Sub Total A	547.55	
(D)	Labour Cess Charges		
i	Cess Charges @ 1% of Basic Cost ie Sub Total A	273.77	
	Subtotal (D)	273.77	
(E)	Cost of Work on which no Centage is admissible		
I	Cost of sewer cleaning equipment, Flushing Van	39.80	
Ii	Hiring of Godown and Site Office	18.48	
iii	Power Connection & Allied Works	227.22	
Iv	TPI Charges @0.1% of Basic Cost ie Sub Total (A)	27.38	
	Subtotal (E)	312.87	
(F)	Operation & Maintenance		
i	Operation & Maintenance for first 5 years of commissioning of project	2,958.28	
(G)	Total	34,892.01	

Source: 2._final_costing_4_10-15-ak.exl (Mirzapur)

Table 17.1.4 Mirzapur (I&D-part 1)

No.	Item	Cost (Rs. in Lacs)	Remarks
(A)	Basic cost		
i	Sewer Networks and Appurtenance	1,406.50	
ii	Nara Tapping structure	71.34	
iii	STPs	3,345.16	
iv	Pumping Stations	2,305.78	
v	Contingency @2% of Basic cost	145.18	
	Subtotal (A)	7,403.96	
(B)	Cost of work on which no centage is admissible		
v	Communication & Public Outreach	40.00	
vi	Environmental and Management Plan (EMP)	80.00	
vii	Governance and Accountability Action Plan (GAAP)	10.00	
viii	Power connection & allied works	260.81	
	Hiring of Godown and site office	18.48	
	Cost of sewer cleaning equipment, flushing van	26.30	
	TPI Charges @0.1% of Basic Cost ie Sub Total (A)	7.26	
	Subtotal (B)	442.85	
(C)	Operation & Maintenance		
i	Operation & Maintenance for first 10 years of commissioning of project	8,703.68	
(D)	Contingency charges		
	@ 12.5 % of Basic Cost	925.49	
(E)	Labour Cess Charges		
	TPI Charges @0.1% of Basic Cost ie Sub Total (A)	74.04	
(F)	Total	17,550.03	

Source: Volume I final.pdf (Mirzapur I&D)

Table 17.1.5 Mirzapur (I&D-part 2 A-1)

No.	Item	Cost (Rs. in Lacs)	Remarks
(A)	Basic cost		
i	Rehab & Process upgrading of 2 Existing STPs	1,517.58	
ii	Contingency	30.35	
	Subtotal (A)	1,547.93	
B	Cost of work on which no centage is admissible		
v	Communication & Public Outreach	40.00	
vi	Environmental and Management Plan (EMP)	20.00	
vii	Governance and Accountability Action Plan (GAAP)	10.00	
	TPI Charges @0.1% of Basic Cost ie Sub Total (A)	1.55	
	Subtotal (B)	71.55	
(C)	Operation & Maintenance		
i	Operation & Maintenance for first 10 years of commissioning of project	1,847.82	
(D)	Contingency charges		
	@ 12.5 % of Basic Cost	193.49	
(E)	Labour Cess Charges		
	TPI Charges @0.1% of Basic Cost ie Sub Total (A)	15.48	
(F)	Total	3,676.27	

Source: Volume I final.pdf (Mirzapur I&D)

Table 17.1.6 Mirzapur (I&D-part 2 A-2)

No.	Item	Cost (Rs. in Lacs)	Remarks
(A)	Basic cost		
i	Rehab & Process upgrading of 2 Existing STPs	691.82	
ii	Contingency	13.84	
	Subtotal (A)	705.65	
(B)	Cost of work on which no centage is admissible		
v	Communication & Public Outreach	40.00	
vi	Environmental and Management Plan (EMP)	20.00	
vii	Governance and Accountability Action Plan (GAAP)	10.00	
	TPI Charges @0.1% of Basic Cost ie Sub Total (A)	0.71	
	Subtotal (B)	70.71	
(C)	Operation & Maintenance		
i	Operation & Maintenance for first 10 years of commissioning of project	1,115.52	
(D)	Contingency charges		
	@ 12.5 % of Basic Cost	88.21	
(E)	Labour Cess Charges		
	TPI Charges @0.1% of Basic Cost ie Sub Total (A)	7.06	
(F)	Total	1,987.14	

Source: Volume I final.pdf (Mirzapur I&D)

Table 17.1.7 Chunar (Comprehensive)

No.	Item	Cost (Rs. in Lacs)	Remarks
(A)	Basic cost		
i	Sewer Networks and Appurtenance	8,163.01	
ii	Sewage Treatment Plant	638.70	
iii	Pumping Stations	1,132.54	
iv	Communication & Public Outreach	20.00	
v	Environmental and Management Plan (EMP)	26.00	
vi	Governance and Accountability Action Plan (GAAP)	10.00	
	Subtotal (A)	9,990.25	
(B)	Centage Charges		
i	Cost of Project Preparation @ 4%	399.61	
ii	Cost of Supervision of Project @ 4% as per NGRBA Guide-lines	399.61	
iii	Cost of Supervision of Project @ 4.5% borne by U.P. Govt. as admissible	449.56	
	Subtotal (B)	1,248.78	
(C)	Contingency		
	@ 2 % of Basic Cost	199.81	
(D)	Labour Cess Charges		
	Cess Charges @ 1% of Basic Cost ie Sub Total A	99.90	
(E)	Cost of Work on which no Centage is admissible		
i	Cost of sewer cleaning equipment, Flushing Van	44.75	
ii	Hiring of Godown and Site Office	13.30	
iii	Power Connection & Allied Works	41.06	
iv	TPI Charges @0.1% of Basic Cost	9.99	
	Subtotal (E)	109.09	
(F)	Operation & Maintenance		
i	Operation & Maintenance for first 5 years of commissioning of project	905.16	
(G)	Total	12,552.99	

Source: chnar_final_costing 04022015-FINAL.xlsx (Chunar comprehensive)

Table 17.1.8 Chunar (I&D)

No.	Item	Cost (Rs. in Lacs)	Remarks
(A)	Basic cost		
i	Interceptor Sewer & Appurtenance Works	967.46	
ii	Sewage Treatment Plant and Effluent Reuse	1,172.61	
iii	Pumping Stations	614.00	
iv	Septic Tank	16.14	
v	Contingency @ 2%	55.40	
	Subtotal (A)	2,825.61	
(B)	Cost of works on which no Centage is admissible		
i	Communication & Public Outreach	20.00	
ii	Environmental and Management Plan (EMP)	26.00	
iii	Governance and Accountability Action Plan (GAAP)	10.00	
iv	Hiring of Godown and Site Office	13.30	
V	Power Connection & Allied Works	25.11	
vi	TPI Charges @0.1% of Basic Cost	2.83	
	Subtotal (B)	91.23	
(C)	Operation & Maintenance		
i	Operation & Maintenance for first 10 years of commissioning of project	2,067.41	
(D)	Contingency charges		
	@ 12.5 % of Basic Cost	353.20	
(E)	Labour Cess Charges		
	Cess Charges @ 1% of Basic Cost ie Sub Total A	28.26	
(F)	Total	5,365.70	

Source: Vollume_I Main Report and Finacial Report.pdf (Chunar I&D)

Table 17.1.9 Ghazipur (Comprehensive DPR)

No.	Item	Cost (Rs. in Lacs)	Remarks
(1)	Basic cost		
i	Sewer and appurtenant works	9,307.95	
ii	Treated Effluent Disposal	225.00	
iii	Sewage Pumping Station	1,479.85	
iv	Sewage Treatment Plant	3,013.35	
v	Building Works	66.47	
vi	Construction of Boundary wall & site development	134.16	
vii	Sewer connection for BPL families	66.70	
viii	Power Sub-station	130.22	
ix	Hiring of Godown	2.40	
x	Power transmission lines & power connection	21.97	
	Subtotal (1)	15086.04	
(2)	Centage Charges		
i	Project preparation charges @4%	181.03	
ii	Project Supervision Charge @4%	181.03	
	Subtotal (2)	362.03	
(3)	Items on which no Centage is Admissible		
i	Hiring of Godown	19.20	
ii	GAAP	10.25	
iii	ESAMP	64.00	
iv	Public Participation & Community Mobilization	15.33	
v	Power Connection & Allied works	44.04	
vi	Operation & Maintenance for first 10 years of commissioning of project	2,803.27	
	Subtotal (3)	2,956.09	
(4)	Component of works to be borne by GOUP		
i	Special T&P and Vehicles	62.00	
ii	Cost of Land	0.00	
iii	Contingencies @2% on (1)	301.72	
iv	Labour Cess @1% on (1)	150.86	
v	Centage @ (12.5-8) on (1)	678.87	
	Subtotal (4)	1,193.45	
(5)	Total	20,442.46	

Source: GhaziPur DPR_Comprehensive_201504.pdf (Ghazipur comprehensive)

Table 17.1.10 Saidpur (Comprehensive DPR)-in preparation

No.	Item	Cost (Rs. in Lacs)	Remarks
A	Basic cost		
i	Sewer and appurtenant works	5,929.00	
ii	Sewage Pumping station	869.25	
iii	Channels & Screen	208.45	
iv	Rising Main	151.00	
v	Building workers Staff quarters	49.05	
vi	25MLD Capacity STP	3,631.13	
vii	Boundary walls site development	66.70	
viii	Dismantling & Reinstatement of road	2,050.00	
ix	Hiring of Godown	2.40	
x	Power transmission lines & power connection	21.97	
	Total	12,978.95	

This DPR is under preparation so that figures on **Table 17.1.10** is as of year 2007 Saidpur DPR.

Table 17.1.11 Varanasi District I (Comprehensive DPR)

No.	Item	Cost (Rs. in Lacs)	Remarks
(1)	Basic cost		
a.	Sewer Networks and Appurtenances	21,490.28	
(2)	Centage Charges		
a.	Cost of Project Preparation @ 4%	859.61	
b.	Cost of Supervision of Project @ 4% as per NGRBA Guide-lines	859.61	
	Subtotal (2)	1,719.22	
(3)	Cost of Work on which no Centage is admissible		
a.	Cost of sewer cleaning equipment, Flushing Van	10.50	
b.	Hiring of Godown and Site Office	10.20	
c.	Power Connection & Allied Works		
d.	Communication & Public Outreach	35.00	
e.	Environmental and Management Plan	60.00	
f.	GAAP	17.00	
g.	Institutional Arrangement	0.00	
	Subtotal (3)	132.70	
(4)	Operation & Maintenance		
a.	Operation & Maintenance for first 5 years of commissioning of project - Civil Works	761.04	
(5)	Other Charges		
a.	Labour cess @ 1 % of basic cost (1)	214.90	
b.	Cost of Supervision of Project @ 4.5% of Basic Cost (1) borne by U.P. Govt. as admissible	967.06	
	Subtotal (5)	1,181.97	
	Total	25,285.21	

Source: I.2_Financial_Statement_D1_BY.xlsx (Varanasi District I)

Table 17.1.12 Varanasi District II (Comprehensive DPR)

No.	Item	Cost (Rs. in Lacs)	Remarks
(1)	Basic cost		
a.	Basic cost of Work - Civil Works	32,722.80	
b.	Basic cost of Work - E & M Works	0.00	
(2)	Centage Charges		
a.	Cost of Project Preparation @ 4%	1,308.91	
b.	CostofSupervisionofProject@4%asperNGRBA Guidelines	1,308.91	
	Subtotal (2)	2,617.82	
(3)	Cost of Work on which no Centage is admissible		
a.	Cost of sewer cleaning equipments, Flushing Van	10.50	
b.	Hiring of Godown and Site Office	10.20	
c.	Power Connection & Allied Works	0.00	
d.	Communication & Public Outreach	35.00	
e.	Environmental and Management Plan	80.00	
f.	GAAP	17.00	
	Subtotal (3)	152.70	
(4)	Operation & Maintenance		
a.	Operation&Maintenanceforfirst5yearsofcommissioning of project	875.00	
(5)	Other Charges		
A	Labour cess @ 1 % of basic cost	327.23	
b.	Cost of Supervision of Project @4.5% of basic cost (1) borne by U.P. Govt. as admissible	1,472.53	
	Subtotal (5)	1,799.75	
(6)	Total	38,168.08	

Source: dist 2.pdf (Varanasi District II)

Table 17.1.13 Varanasi District III (Comprehensive DPR)

No.	Item	Cost (Rs. in Lacs)	Remarks
(1)	Basic cost		
a.	Basic cost of Civil Work (including Contigency @ 2%)	14,938.64	
b.	Basic cost of Electrical and Mechanical Work (including Contigency @ 2%)	107.34	
	Subtotal (1)	15,045.98	
(2)	Centage Charges		
a.	Cost of Project Preparation @ 4%	601.84	
b.	Cost of Supervision of Project @ 4% as per NGRBA Guidelines	601.84	
c.	Cost of Supervision of Project @ 4.5% borne by U.P. Govt. as admissible	677.07	
	Subtotal (2)	1,880.75	
(3)	Cost of Work on which no Centage is admissible		
a.	Cost of sewer cleaning equipments, Flushing Van	44.75	
b.	Hiring of Godown and Site Office	10.20	
c.	Power Connection & Allied Works	20.59	
d.	Communication & Public Outreach	20.00	
e.	Environmental and Management Plan	50.00	
f.	GAAP	17.00	
	Subtotal (3)	162.54	
(4)	Operation & Maintenance		
a.	Operation & Maintenance for first 5 years of commissioning of project - Civil Works	499.24	
(5)	Other Charges		
a.	Labour cess @ 1 % of basic cost	150.46	
b.	Contingency @ 2 % on (1+3)	304.17	
	Sub Total (5)	454.63	
	Grand Total (1+2+3+4+5)	18,043.14	

Source: I.1 Final Rev. Report Varanasi.docx (Varanasi District III)

Table 17.1.14 Ramnagar (Comprehensive DPR)

No.	Item	Cost (Rs. in Lacs)	Remarks
(1)	Basic cost		
i	Sewerage Network	8,860.92	
ii	Sewage Pumping Station	1,477.29	
iii	Sewage Treatment Plant	2,233.62	
iv	Cess Charges	251.43	
	Subtotal (1)	12,823.26	
(2)	Centage Charges		
i	Cost of Project Preparation @ 4% as per NGRBA Guidelines	512.93	
ii	Cost of Supervision of Project @ 4% as per NGRBA Guidelines	512.93	
	Subtotal (2)	1,025.86	
(3)	Items on which no Centage is Admissible		
i	Communication & Public Outreach	40.0	
ii	GAAP	15.0	
iii	ESAMP	40.0	
iv	Cost of Land	272.97	
v	Cost of sewer cleaning equipment	61.53	
vi	Cost of mobile flushing van	80.0	
vii	Power connection & Allied works	389.11	
viii	Railway X-ing	50.0	
	Subtotal (3)	948.61	
(4)	Operation & Maintenance		
i	Operation & Maintenance for first 5 years of commissioning of project	5,554.67	
(5)	Other charges		
i	Labour Cess @1% on (1)	128.23	
ii	Cost of supervision of Project 4.5% of Basic cost (1) borne by U.P. Govt. as admissible	577.05	
	Subtotal (5)	705.28	
(6)	Total	21,057.68	

Source:Vol1.pdf (Ram Nagar comprehensive)

Table 17.1.15 Ramnagar (I&D DPR)

No.	Item	Cost (Rs. in Lacs)	Remarks
(1)	Basic cost		
i	Sewage Treatment Plant	1,632.27	
ii	Sewage Pumping Station	1,202.91	
iii	Cess Charges	56.70	
	Subtotal (1)	2,891.88	
(2)	Items on which no Centage is Admissible		
i	Communication & Public Outreach	10.0	
ii	GAAP	10.0	
iii	Power connection & Allied works	381.27	
iv	ESAMP	10.0	
	Subtotal (2)	411.27	
(3)	Cost of Land		
i	STP Ram Nagar	256.91	
ii	MPS Mallahi, Ram Nagar	25.71	
	Subtotal(3)	282.62	
(4)	Operation & Maintenance for 10 years	5,537.19	
(5)	Centage charges @12.5% on basic cost	361.49	
(7)	Labour Cess @1% on (1)	28.92	
(8)	Total	9,513.37	

Source:Vol1.pdf (Ram Nagar comprehensive)

Table 17.1.16 the planned construction commencement year and construction duration on project mentioned on each DPR

City Name	Type of Report	Commencement year	Construction duration (month)
Dinapur & Bhagwanpur	Comprehensive	-	20.5
Ramna	Comprehensive	2015-2016	32.0
Mirzapur	comprehensive	2016-2017	36.0
Mirzapur	I&D-part 1	2016-2019	36.0
Mirzapur	I&D-part 2 A-1		
Mirzapur	I&D-part 2 A-2		
Chunar	Comprehensive	2016-2017	36.0
Chunar	I&D	2016-2017	36.0
Ghazipur	Comprehensive	2015/May	27.0
Varanasi District I	Comprehensive	-	30.0
Varanasi District II	Comprehensive	-	30.0
Varanasi District III	Comprehensive	-	30.0
Ram Nagar	Comprehensive	2016/Jan	30.0
Ram Nagar	I&D	2015/Dec	22.0

Note: The symbol (-) means DPR does not mention specific year.

17.1.2 Review of each DPR

1) General

Based on the review of DPRs conducted by JST during the first and second field surveys, following items are clarified.

- Construction cost on each DPR is estimated based on SOR and quotation and unit price on piping work is calculated from SOR.

- Cost estimation method for project cost is 'build-up approach' on each DPR, which is similar to that of being applied in Japan.

-However, lack of documents, miscalculation on MS-excel sheet are seen on each item in DPRs. Therefore, it is difficult to check/track where each figure comes from on each unit price.

- JST also requests to UPJN to wrap up the unit price on the table. (See **Table 17.1.17**)

-JST requests to recheck/revise the unit price for each item and acquire quotations that is utilized on cost estimation on DPR.

- There are some difficulties of acquiring a quotation of each item from the contractor/supplier.

The reasons for this are as follows:

1. The contractor/supplier knows that submitted quotation is only used for budgetary purposes,
2. The contractor/supplier considers that the price of each item is his intellectual asset so that he hesitates to submit his information to the third party, and
3. The contractor/supplier is afraid of being come out his information to his opponents.

- Detailed implementation schedule such as bar charts is not specified whereas most of construction period of each project are set at three years in each DPR. Construction period of sewer networks is not mentioned in its report as well.

Table 17.1.17 Price checking sheet (reference)

Material rate Unit: Rs

Code	Description of Item	Unit	Rate
M.1			

Note: this type of table is made by each item such as material, labour, electrical equipment and mechanical equipment. SOR is also wrapped up in the table.

2) STP Cost

Estimated STP construction cost in Mirzapur and Chunar DPRs is calculated by using the cost function referred to the book titled "Sewage Treatment in Class I Towns: Recommendation and Guidelines (*Report Code: 003_GBP_IIT_EQP_S&R_02_Ver 1_Dec 2010*)" published in 2010. The reference book indicates the construction cost per MLD of several wastewater treatment process such as SBR, Water Stabilization Pond, etc., which is commonly used for estimating STP cost with consideration of price escalation in India. However, there is a doubt whether cost estimation using the cost function per MLD is appropriate, although it is utilized for estimating STP cost in India.

In this regard, JST examines 1) STP cost estimated by tender awarded price on Current project implemented in UPJN and 2) STP cost per MLD by existing projects on detailed design stage and Tender awarded price on existing projects. If both STP cost per MLD are close figure, it is concluded that unit function by using STP cost per MLD is appropriate for estimating STP cost.

a) Project cost on Current project in UPJN

There is only one STP construction project, the capacity of wastewater flow is 140 MLD, tendered in Dinapur on 2014 and it is under construction in current whereas there are many construction work on sewer network and pumping stations in Varanasi and surrounding areas.

Table 17.1.18 shows STP cost estimated by detailed design stage and tender awarded price on Dinapur STP. The difference between two costs is 8 Crores and Tender awarded price is approximately 5%.

Table 17.1.18 STP cost estimated by detailed design stage and tender awarded price on Dinapur STP

Item	STP Cost per MLD (Crores)	Tender Awarded price (Crores)	Remarks
Dinapur STP	162	170	

Source: NJS EI Office

b) Project cost on existing project in India

i) MLD cost on Detailed Design stage

Table 17.1.19 shows STP cost per MLD by existing projects on detailed design stage. The number of existing projects on detailed design stage is 11 projects in India and wastewater flow on projects ranges from 7 MLD to 125 MLD. All projects were conducted in 2013.

STP cost per MLD by existing projects on detailed design stage is 135 lacs Rs.

Table 17.1.19 STP cost per MLD by existing projects on detailed design stage

Item	STP Cost per MLD (Lacs)	Number of project	Wastewater flow (MLD)
Detailed Design	135	11	7-125

Source: NJS EI Office

ii) MLD cost by Tender awarded price

Table 17.1.20 shows STP cost per MLD by Tender awarded price on existing projects. The number of Tender awarded cost on existing projects is 20 projects in India and wastewater flow amount on projects ranges from 20 MLD to 202 MLD. All projects were conducted between 2006 and 2013.

STP cost per MLD by Tender awarded price on existing projects is 149 lacs Rs.

Table 17.1.20 STP cost per MLD by Tender awarded price on existing projects

Item	STP Cost per MLD (Lacs)	Number of project	Wastewater flow (MLD)
Tender awarded	149	20	20-202

Source: NJS EI Office

c) Conclusion

The result of comparison on 1) STP cost by tender awarded price on Current project imple-

mented in UPJN and 2) STP cost per MLD by existing projects on detailed design stage and Tender awarded price on existing projects show that tender awarded price is 5 to 10% higher than estimated cost on detailed design stage. However, it is considered that 5 to 10% difference is in tolerance because the actual cost such as tender price is normally affected external factors such as price escalation on market and economical condition in India. In conclusion, cost function for estimating STP cost on DPR is applicable on this project.

17.2 Procurement plan

17.2.1 General Condition of Bidding

All biddings for public works in India should follow the India tender laws and Tender Transparency Act stipulated by the government of India. Each state of India has a general guideline for bidding for public works for its Local Bodies that is called the Procurement Guidelines. Currently, bidding is conducted based on notification of "The e-Procurement Solution of National Informatics Centre (NIC) of the Government of India" by each State. According to the interview survey to local engineers, 50% of tendering is conducted through e-procurement in UPJN for reducing the time and paper saving purposes. **Table 17.2.1** shows the e-Procurement trends in India, in which the number of tenders has been increasing year by year so that it is assumed that e-procurement is going to be the mainstream tendering method nationwide.

Table 17.2.1 e-Procurement trends in India

Financial Year	No. of Tenders	Value in Crores (INR)
2003 - 2004	1549	3623
2004 - 2005	4901	30822
2005 - 2006	9930	11892
2006 - 2007	21985	31487
2007 - 2008	33904	75119
2008 - 2009	44883	130061
2009 - 2010	26062	28208
2010 - 2011	47182	19675
2011 - 2012	49354	24436
2012 - 2013	67593	25191
2013 - 2014	93566	36845

Reference: http://www.eprocurement.gov.in/

E-Procurement system is introduced for processing of procuring the items/services by the Internet based on the IT Act 2000 in India to reduce 1) tendering cycle, 2) indirect cost and enhancing the

transparency of the tender processing.

For the registration of e-procurement, local and foreign contractors which registered as eligible company access to e-procurement website and input necessary information (company name, company profile, physical address, size of the company etc.) on-line. The enrolment is completed once the applicant finishes required information inputted on the website, and then UP Government issues DSC (Digital Signature Certificate) to the applicant within 24 hours.

Registered contractor/ supplier finishes the enrolment of e-procurement and acquires DSC, the contractor/ supplier is able to participate tenders through the U.P Government website. Necessary procedure of participating the tender such as instruction manual and required documents for tender procedure are documented on the website and the contractor/ supplier enables to download the documents easily.

Reference: https://etender.up.nic.in/nicgep/app

17.2.2 General Situation of Local Consultants (Detail Design, Construction Supervision)

The municipal clients in India appoint consultants in various phases of a project. It can be categorised as follows:

- Planning Phase: in this phase, consultants are appointed for preparation of Feasibility Study Reports, Master Plans, and Detailed Project Reports.
- Pre-tendering Phase: consultants are appointed for doing the preliminary or detailed design based on the type of contract works. This is generally accompanied by preparation of bid document, evaluation of bids and award of contract.
- Post-Tendering Phase: consultants are appointed for doing project management, construction supervision, quality control, assistance during testing and commissioning, O&M planning etc.

In many case the last two bullets scope are submitted and the client appoints the Project Management and Construction Supervision Consultants (PMSC). However, the opportunity can come in any combination.

In India there is abundance of local as well as international consultants. Based upon the type of the project, funding source and client requirement, consultants get involved in the project both Local as well as International.

There are various local consultancy firms in India in which some are sector specific and some are multi-sectorial. The size of local consultants varies from small, medium to big. In case of externally funded projects, international consultants make partnership arrangements with local consultants. In most cases, the local consultants are associated with local funded projects as they are having a cost

advantage and limited tax liability over international consultants. Presently the consultants are appointed using the QCBS (Quality and Cost Based Selection) procedure.

In many cases, international consultancy firms have opened their India subsidiaries to mitigate these constraints considering the immense market potential India provides. All the design and construction supervision are conducted as per the guidelines provided by the CPHEEO (Central Public Health and Environmental Engineering Organization). In some cases, the turnkey contractor also appoints local consultants for doing their detailed design and engineering.

17.2.3 General Situation of Local Contractor

There are a number of local contractors from a small- to large-scale in India and they correspond to a wide range of construction works such as road, bridges, water and wastewater infrastructures, buildings, factories etc. **Table 17.2.2** shows top 10 construction companies in water/wastewater sector in India. Most of the big construction companies have their own heavy machineries, leasing arrangement for the machineries and their own route for construction material procurement.

Table 17.2.2 Top 10 construction companies in water/wastewater sector in India

Name of the Contractor	Location of the head office
Vatech Wabag Ltd,	Chennai
L&T Water Ltd,	Chennai
UEM India Pvt Ltd,	New Delhi
Degremont Ltd,	New Delhi
Shriram EPC limited	Chennai
Gharpure Engineering	Pune
Enviro control	Surat
Ramky Enviro Ltd	Hyderabad
Hindustan Dorr Oliver Ltd.	Mumbai
GE power and water.	Bangalore

Source: NJS EI office

UPJN categorises local contractors as Class A to Class C, based on the ability of construction works and size of the company. **Table 17.2.3** shows the number of contractors listed by UPJN. A Class A contractor is able to conduct any work with no concern of project budget. There are 101 Class A contractors and 6 Class C contractors listed by UPJN. Even class A contractors are not suitable for big budget project such as construction of a wastewater treatment plant and/or a sewer network, therefore they participate as a sub-contractor that works under major contractors if they request to be involved in the project.

Table 17.2.3 Number of contractors listed by UPJN

Class Category	Number of Company	Project Budget Allowance*
A	101	No limit
B	*Unknown (No Data)*	120 lacs
C	8	-

**Note: the allowance varies. Table shows the project budget allowance of STP construction work*

Source: UPJN office

17.2.4 Construction Method

The Government of India stipulates the IS (Indian Standard) Codes for implementing various public works in the country and the codes defines the detailed technical specification of equipment/materials to be procured and construction method to be applied for the public works.

The bidding documents for all public works provide reference to the respective IS codes to be followed which stipulates the detailed construction methods to be adopted for that activity. The measurement for works is approved by the client or client's representative only after proper scrutiny that compliance to the codes is met with.

17.2.5 Material and Equipment Procurement

Table 17.2.4 shows the status of material and equipment in Varanasi. All civil and building work materials, mechanical and electrical equipment are able to be procured in Varanasi and its surrounding areas easily. For instance, as for pipe materials, any type of piping material such as PVC, RCC, DI and GI are easily procured therein. If there is a shortage of necessary materials in Varanasi and its surrounding areas, there is no issue for back-order the suppliers in other areas and procure them. However, occasionally the imported mechanical/electrical equipment is used from other countries on the project basis.

Table 17.2.4 Status of Material and Equipment Procurement in Varanasi

Work Type	Material/Equipment	Varanasi and surrounding areas	Other Area in India	Foreign Country
(1) Civil Work	Worker	O		
	Sand	O		
	Cement	O		
	Form	O		
	Reinforcement Bar	O		
	Pile in situ	O		
(2) Pipe Material	PVC Pipe	O	O	
	RCC Pipe	O	O	
	DI Pipe	O	O	
	GI Pipe	O	O	
(3) Mechanical・Electrical	Pump	O	O	O
	Gate	O	O	O
	Valve	O	O	O
	Control Panel	O	O	O
	Transformer	O	O	O
	Generator	O	O	O
(4) Construction Machinery	Excavator	O		
	Crane	O		
	Dump Truck	O		
(5) Building Material	Brick	O		
	Interior Material	O		

17.2.6 Material and Equipment Procurement

Table 17.2.5 shows the list of national highways to Varanasi. There are two types of transportation of material/ equipment to Varanasi, which is national highways and the other is a railway.

1) National Highway

Construction materials and equipment is basically transported by the national highways NH-56, NH-2 and NH-29. The condition of national highways is almost paved, which is utilized for commuting, community road and commercial activity. However, the traffic jam is caused chronically due to unpaved and narrow roads in some parts of national highways. In addition, there is a restriction on NH-56, in which the transportation by heavy trucks is banned from 8 a.m. to 10 p.m. because of avoiding the traffic congestion by heavy trucks. Therefore, heavy trucks passing through NH-56 drive at night. There is no such a regulation on NH-29, but the traffic congestion

occurs at night due to the movement of the heavy trucks.

Table 17.2.5 List of National Highway to Varanasi

National Highway	Route	Remarks
NH-56	Lucknow to Varanasi (via Jounpour)	No Entry for heavy truck from 8 a.m. to 10 p.m.
NH-2	Kolkata to Varanasi (via Delhi)	Small traffic congestion throughout the day
NH-29	Varanasi to Ghazipur (via Saidpur)	Traffic congestion during night time period

2) Railway

Indian Railway network covers all over the nation, which is utilized for commuting, traveling and transporting material because it cost cheaper than any other transportation method such as truck and airplane. However, the contractors/suppliers rarely use the railway for transporting construction material/equipment and they only use the railway for transporting a large amount of cement for construction. The reasons for this are that 1) the local market cannot absorb the large amount of supply by train shipment and 2) there is a lot of delay on railway transportation. Thus, the contractors/ suppliers prefer to adopt trucks for transporting material and equipment even it is costlier than using railway transportation.

17.3 Implementation Plan and Construction Cost Estimates

17.3.1 General

This chapter describes the implementation plan for construction/ rehabilitation of sewerage facilities such as STP, IPS and sewer network and consulting service in the project, which contributes for improving the sewerage system in Varanasi and its surrounding area. Considerable issues occur in India, countermeasures for prompt accomplishment of the project are taken into account from the tendering stage to the completion of the project. The present cost utilized for the project is calculated on the basis of preliminary design for sewerage facilities. The final cost will be further considered through the discussion between the Indian side and the JICA so as to cover the required items by the assistance of Japanese ODA loan.

17.3.2 Conditions and Assumptions for Preparation of Implementation Plan

Establishment of the implementation plan for the project needs to consider the lessons from past projects or similar projects conducted in India. Considerable conditions and assumptions are outlined as follows.

(1) Needs for the improvement in the project implementation based on the experiences on the similar

projects in India

1) Modification on the Scope of the Project

   a) For preventing the modification on the scope of the project, site conditions such as topographic and geotechnical conditions needs to be confirmed before commencing the construction works and it is desirable to clarify the conditions during D/D stage.

2) Delay of land acquisition and/or legal authorization on the site

   a) Land use agreement on the site should be concluded between UPJN and representative land owner prior to the Loan Agreement
   b) If planned facility site needs to be relocated from the original site, necessary measures should be taken in the early stage including the legislative countermeasures.

3) Delay in processing of acquiring the concurrence

   a) Selection of Consultants: NRCD should appoint a procurement specialist and the person in charge should arrange to accomplish the selection procedure in the shortest time. As the result, approval procedure for nominating the consultant simplifies in the GoI.

   b) Selection of Contractors: As Required conditions of eligible bidders of the project, the bidders should have the work experience and procurement experience on similar projects in India and/or other countries. Therefore, necessary documents should be submitted by the bidders, which declares the relevant work experience. The required documents should also include the completion certificate issued from the clients on the similar projects. The procurement specialist needs to take necessary training courses such as on-the-job training (OJT) arranged by the Consultant prior to bidding stage for selecting the contractor.
   c) For shortening the approval process in UPJN, a short cut way for acquiring the approval of the procurement should be considered as follows;

      - Establishment of approval committee for simplifying the approval process,
      - Preparation of concise documentation format by the type of approval, which is classified to technical, administrative and accounting parts, and
      - Conducting training courses for procurement specialists in UPJN before commencing the Consulting service.

4) Countermeasure for low respond to the biddings from the eligible contractors

   a) Eligible contractors for the Project should be listed up in UPJN and other states in India based on the scope of work on the project.

b) For acknowledgement of the bidding of the project, the bidding announcement should be informed by any type of media such as newspaper, radio or TV.

5) Setting up the PQ conditions on the Project

a) Eligibility of bidders: The prime contractor should be selected through International Competitive Bidding (ICB). However, local contractors by the prime contractor may be employed on civil/architectural work as sub-contractors.
b) Eligible bidders for STP construction should have the work experience on large-scale construction projects which cost is more than 3 billion yen to ensure the quality of the work. The bidders should experience on O&M of STPs.
c) Qualification of staff: The condition of qualification for Project Manager and other engineer in the bidders should comprehend and communicate in English. For presenting the capability of the Project Manager and other engineers, the bidders need to submit not only the PQ, bid documents but also 1) pictures of experienced project(s) done by the bidder, 2) completion certificate(s) from the client(s) and 3) the scope of work on the project in Asian countries.

(2) Other condition on the Project

a) Downpour occurs during rainy season in Project area and it may cause flood in the city area. Therefore, weather conditions in project sites shall be taken into account for setting the construction period/months, especially for the construction of sewer networks.
b) Bidding method for sewerage facilities such as sewer network, IPS and STP should be determined by complying with procurement manners conducted in India.

17.3.3 Scope of Work for the Project

Table 17.3.1 shows the scope of work for the Project.

Table 17.3.1 Project Components for Ganga Rejuvenation Project in Uttar Pradesh

Category	Component	Remarks
A. Sewer	1.Construction of Main/Sub-main and Branch sewers in Varanasi District-1	220km
	2.Construction of Main/Sub-main and Branch sewers in Varanasi District-2	276 Km
	3.Construction of Main/Sub-main and Branch sewers in Varanasi District-3	128 Km
	4. Construction of Rising Main and sewer diversion in Ramnagar	3km

	5. Construction of Main Sewers and interceptor in Chunar	4.3km and 16 locations
B. Sewage Treatment Plant (STP) and Pump Station (PS)	6. Construction of STP, IPS and MPS in Chunar	Treatment capacity: 6.5 MLD
	7. Construction of STP and SPS, and rehabilitation of STP in Mirzapur	Treatment capacity: 18 MLD (newly constructed) Treatment capacity: 14 and 6 MLD (rehabilitation)
	8. Construction of STP and SPS in Ramnagar	Treatment capacity: 10 MLD
	9. Construction of STP in Ramna	Treatment capacity: 50 MLD
	10. Rehabilitation of Dinapur STP	Treatment capacity: 80 MLD
	11. Rehabilitation of Bhagwanpur STP	Treatment capacity: 8 MLD
C. Environmental management	12. Environmental Monitoring Plan (EMoP)	
D. Consulting Services	(1) Detailed Design, Bidding and construction for Sewers (2) Design Built: Basic Design, Bidding and Construction Supervision for IPS and STPs, Strengthening in Public awareness/participation and institutional capacity, and facilitation of implementation of Environmental Management Plan (EMP)	(1) Sewers: Detailed design, assistance for Bidding and construction supervision (2) IPSs & STPs,: Basic Design, assistance for Bidding and Construction Supervision (3) Public Part., Institutional Capacity & Environment: Supervise Contractors

Note: Sewer Numbers in item "A is refereed to those in sewerage DPR

17.4 Detailed Study on Implementation Plan

17.4.1 Packaging for Project Component

Each DPR consists of following components: (1) sewers, (2) STPs/pump stations and (3) consulting

services, for instance, sewer network, IPS and STP in Chunar DPR and sewer network only in Varanasi District-1 DPR. It is easy to compile the work by DPR, not by the type of work.

The packaging of contracts mentioned in this report is proposed by the consultants. It will be further considered through the discussion between the Indian side and the JICA

Sewer

Sewerage service area in Varanasi is divided into three areas, namely District-1, District-2 and District-3. It is recommended that three districts in Varanasi should be combined in three (3) packages for sewer construction and each sewer construction work in Ramna and Chunar should be included in STP construction work.

A. Sewage Treatment Plant (STP) including a central SCADA system

Five packages in total are recommended for the construction of STPs and PS, and the rehabilitation of STPs based on the project locations.

B. Capacity Development for UPJN

C. Strengthening in public awareness/participation and institutional capacity, and facilitation of implementation of Environmental Management Plan (EMP), and Environmental Monitoring Plan (EMoP)

D. Consulting Services

Consulting firm will be employed for the two kinds of construction components of the Project; design-bid-construction for sewers; and design-built for IPSs and STPs. In addition, two components for supporting requirements (people's participation, institutional development and environmental management) are included covering TOR preparation for selection of the contractors, bidding assistance and supervision of the contractors.

Based on the contents of the work, project packages by component are divided as follows;

(1) Package 1: Construction of Main/Sub-main and Branch sewers in Varanasi District-1
(2) Package 2: Construction of Main/Sub-main and Branch sewers in Varanasi District-2
(3) Package 3: Construction of Main/Sub-main and Branch sewers in Varanasi District-3
(4) Package 4: Construction of STP, SPS, rising main and sewer diversion in Ramnagar
(5) Package 5: Construction of STP in Ramna
(6) Package 6: Construction of STP, IPS, MPS and Main Sewers and interceptor in Chunar
(7) Package 7: Construction of STP and SPS in Mirzapur
(8) Package 8: Rehabilitation of Dinapur STP and Bhagwanpur STP
(9) Package 9: River Purification

(10) Package 10: Construction of community toilet
(11) Package 11: Strengthening in public awareness/participation and institutional capacity and facilitation of implementation of Environmental Management Plan (EMP) and Environmental Monitoring Plan (EMoP)
(12) Package 12: Capacity development for UPJN (institutional development)
(13) Package 13: MIS
(14) Package 14: Consulting Services

17.4.2 Procurement Method for the Implementation of the Project

(1) Contract method for the construction of sewerage system

It is considerable that all packages in the project are implemented by applying the procedure that is utilized on typical loan project such as Japanese Yen loan. Therefore, re-measurement contract method shall adopt for the construction of sewers.

However, for the construction/rehabilitation work for STPs and IPSs, design-built method is recommended following current practices in the similar projects in India.

(2) Possibility of adopting Local Bidding

Local Competitive Bidding (LCB) does not require much time for concluding the contract comparing with International Competitive Bidding (ICB) in general so that it takes advantage for LCB rather than implementing the project by ICB. Thus, it is recommended that supporting components of the Project for Capacity Development for UPJN in application of GIS and MIS, and Strengthening in Public awareness/participation and institutional capacity, facilitation of implementation of Environmental Management Plan are conducted by LCB.

For constructing STP, ISP and sewer network, it is inappropriate to adopt LCB because the implementation of the project requires not only a wide range of knowledge and but also abundant working experience for sewerage system and it is considered that local contractors do not match with these conditions.

(3) Procurement Methods

Table 17.4.1 summarizes the procurement methods both for Consultants and Contractors.

Table 17.4.1 Procurement Method

Procurement	Scope of Work	Manner of Procurement with required process/ events
Consultants	One consultancy package: D/D, Assistance for Bidding and	ICB (Short list, QCBS)

Procurement	Scope of Work	Manner of Procurement with required process/ events
	C/S for sewer packages of work and Basic Design, Assistance for Bidding and C/S for IPSs & STPs	
Contractor	Construction of sewers: Design-Bid-Construction	ICB (PQ, Single stage with two envelope)
Contractor	Construction/rehabilitation of IPSs and STPs, and Central SCADA System: Design-Built	ICB (PQ, Single stage with two envelope)
Contractor	Capacity Development for UPJN and Strengthening in Public awareness/participation and institutional capacity, and facilitation of implementation of EMP and EMoP	ICB/LCB (PQ, Bid, Approval)

Table 17.4.2 shows eligible contractors for the implementation of sewerage projects in India through ICB. Large number of eligible contractors in India and/or other countries is eligible for executing the project. Noted contractors have work experience on ODA typed projects in India and they are financially secured companies earn more than 500 million INR as annual income. For sewer construction, they (Indian contractors) have experiences including the construction of more than 10 km sewers as well as financial soundness (more than 500 million INR annual income).

Table 17.4.2 Potential Contractors for the Implementation of the Project

Component Category	Potential Contractors
Sewer	1. L&T (Larse & Toubro), 2. Nagarjuna Construction Company, 3. SPML (Subhash Project and Marketing Ltd), 4. SMC Infrastructure, 5. Megha Engineering, 6. HCC (Hindustan Construction Company)
IPS 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)

17.4.3 Implementation Schedule by Major Component /Procurement Case

(1) Conditions of Implementation Schedule

Appraisal of the Project and Exchange of the Note between GoI and GOJ and Loan agreement are as-

sumed to be concluded by March 2017, as shown in **Table 17.4.3**.

Table 17.4.3 Loan Agreement Schedule

Detailed Fact Finding of the Project	January, 2017
Pledge of JICA Loan	February 2017
Exchange of Note between GOB and GOJ	March 2017
Signing of Loan Agreement	March 2017

Table 17.4.4 shows the required months for the implementation of the Project under the following site conditions and assumptions.

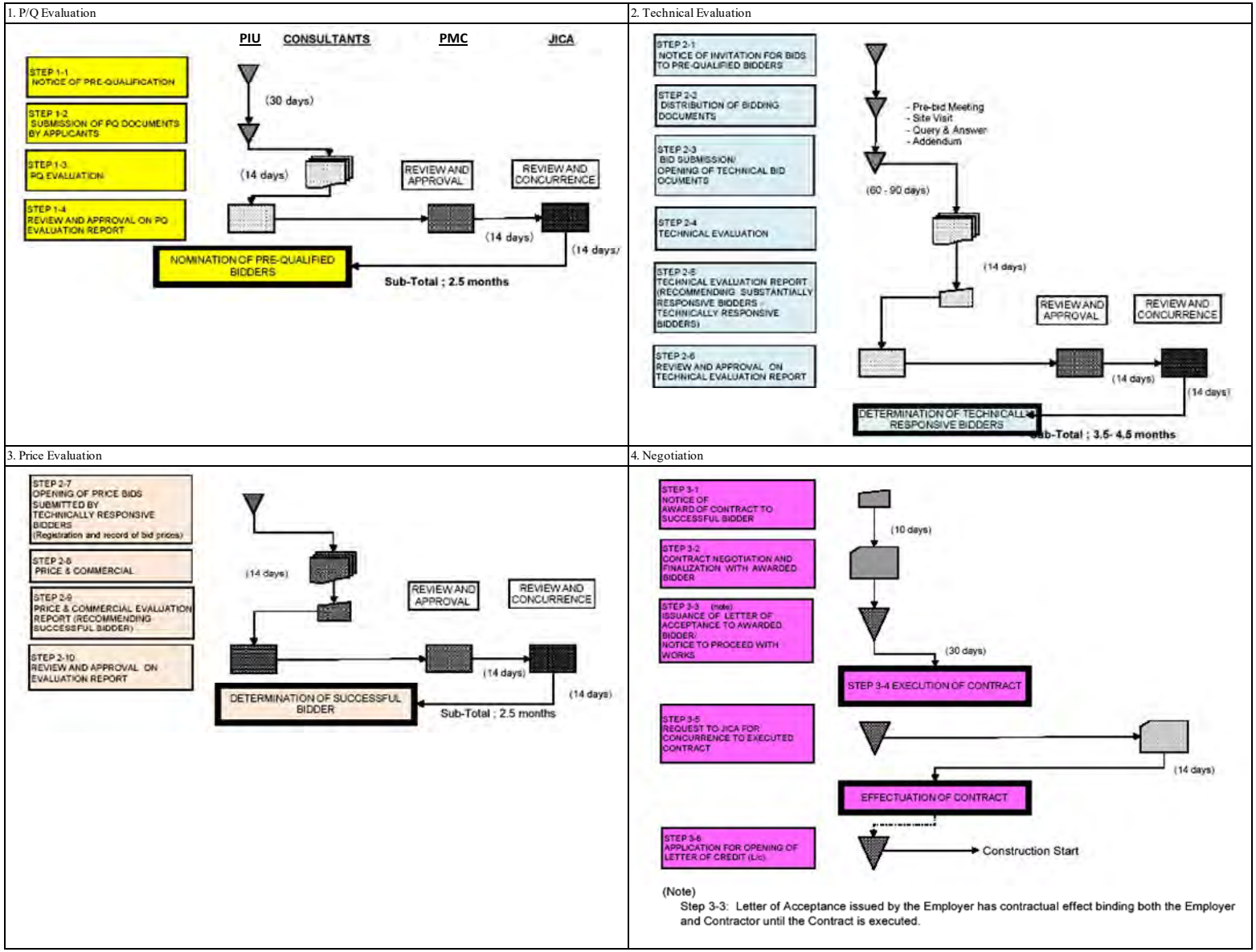
- Rainy season from July to September and a series of national holidays usually affect the civil works in Varanasi area. Therefore, non-working time during the construction works takes into consideration for setting the construction period.

Table 17.4.4 Package and Construction Periods

Item	Date	Remarks
Loan Agreement	March, 2017	
Selection of Consultant	12 months April, 2017 to March, 2018	
Detailed Design of STP, IPS and Sewers	12 months, April, 2018 to March, 2019	
Detailed Design of Community Toilet	10 months April, 2018 to December 2018	
Selection of Contractor		
Package 1, 2, 3, 4, 5 6, 7 & 8	April, 2019 to March, 2020	PQ: June, 2018 to August, 2018
Packages 9	October, 2019 to March, 2020	
Packages 10, 11, 12 & 13	December, 2019 to March, 2020	
Construction/ Implementation stage		
Package 1, 2, 3, 5, 6, 11 & 12	30 months April, 2020 to September, 2022	
Packages 4 & 8	24 months April, 2020 to March, 2022	
Package 7, 8, 10 & 13	36 months April, 2020 to March, 2023	
O&M stage for IPS & STP		
Completion of Project including defects liability period for Package 1, 2, 3, 5 & 6	September, 2023	
Completion of Project including defects liability period for Package 4	March, 2023	
Completion of Project including defects liability period for Package 7& 8	March, 2024	

- Construction period of the Project varies in each project. The duration is considered from 24 to at 36 months including rainy season.
- Shop inspection for procurement of materials/equipment is included in the construction period.

Figure 17.4.1 shows the Work-flow of bidding procedure to select contractors (Two-Envelope Bidding under JICA Procedure) and the required time by major work is summarized below.



➢ **Figure 17.4.1 Work-Flow of Bidding Procedure to Select Contractors**

- P/Q; 3 months
- Preparation of Bidding Document including JICA concurrence; 3 months
- Submission of Bid; 2 months
- Technical Evaluation/Price Evaluation including JICA concurrence; 5 months
- Negotiation to L/C; 2 months

Figures 17.4.2 - 17.4.5 show the implementation schedule for the Project. The construction periods for each package are set based on submitted DPRs. The duration of the construction period mentioned in the DPR is adequate compared with other Indian projects done under the ODA loan. Therefore, the construction period in each DPR is adopted as it is.

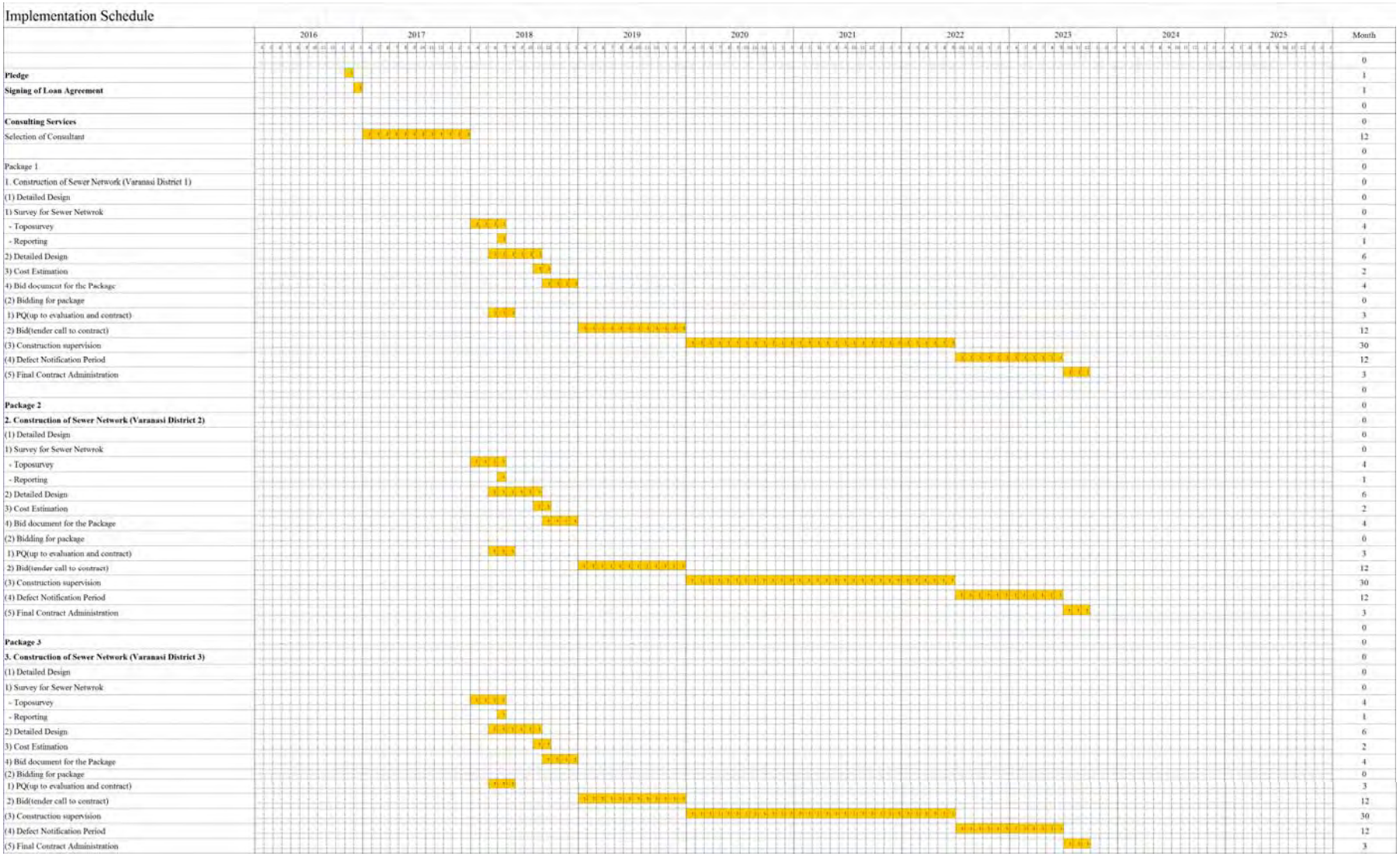


Figure 17.4.2 Implementation Schedule (1/4)

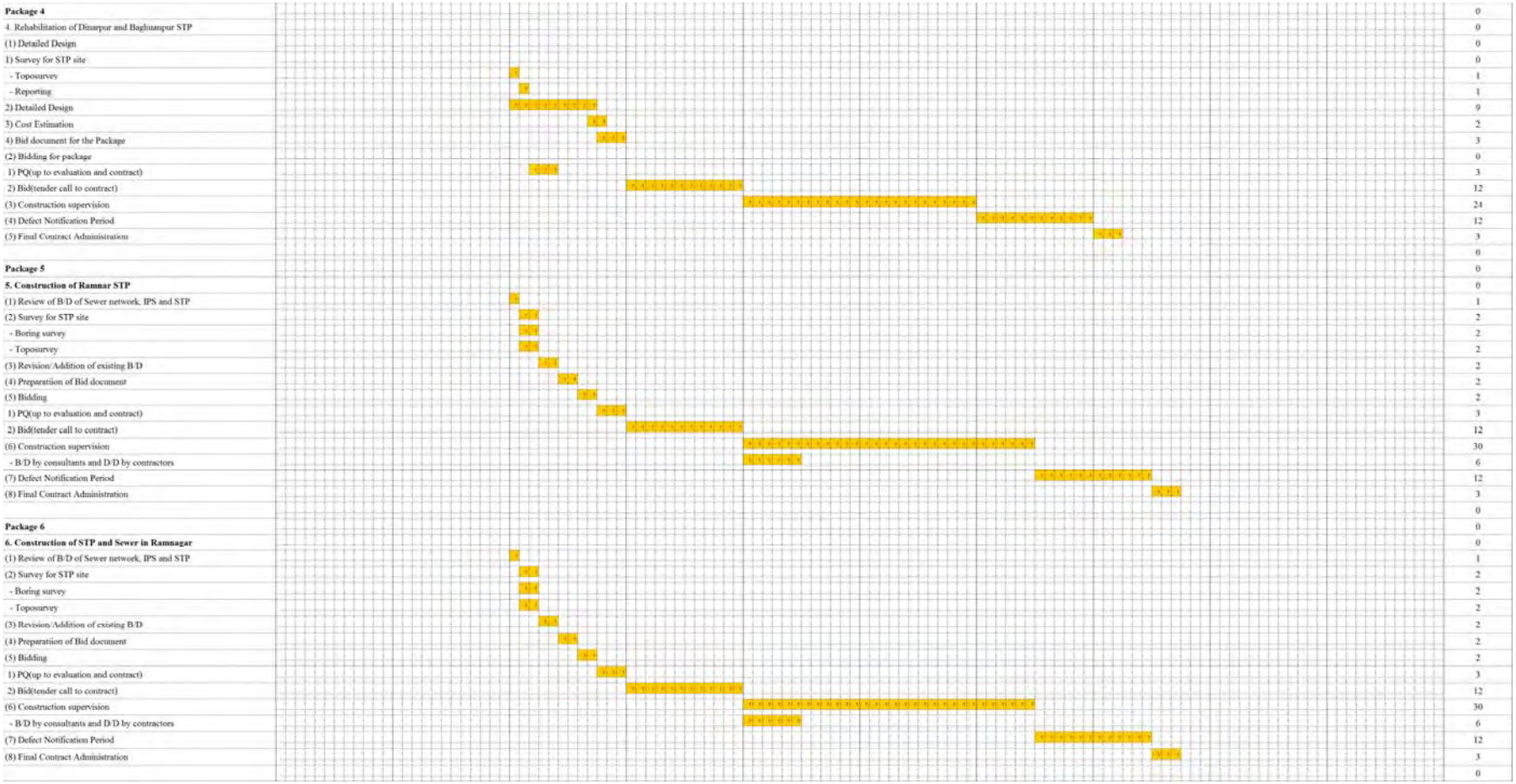


Figure 17.4.3 Implementation Schedule (2/4)

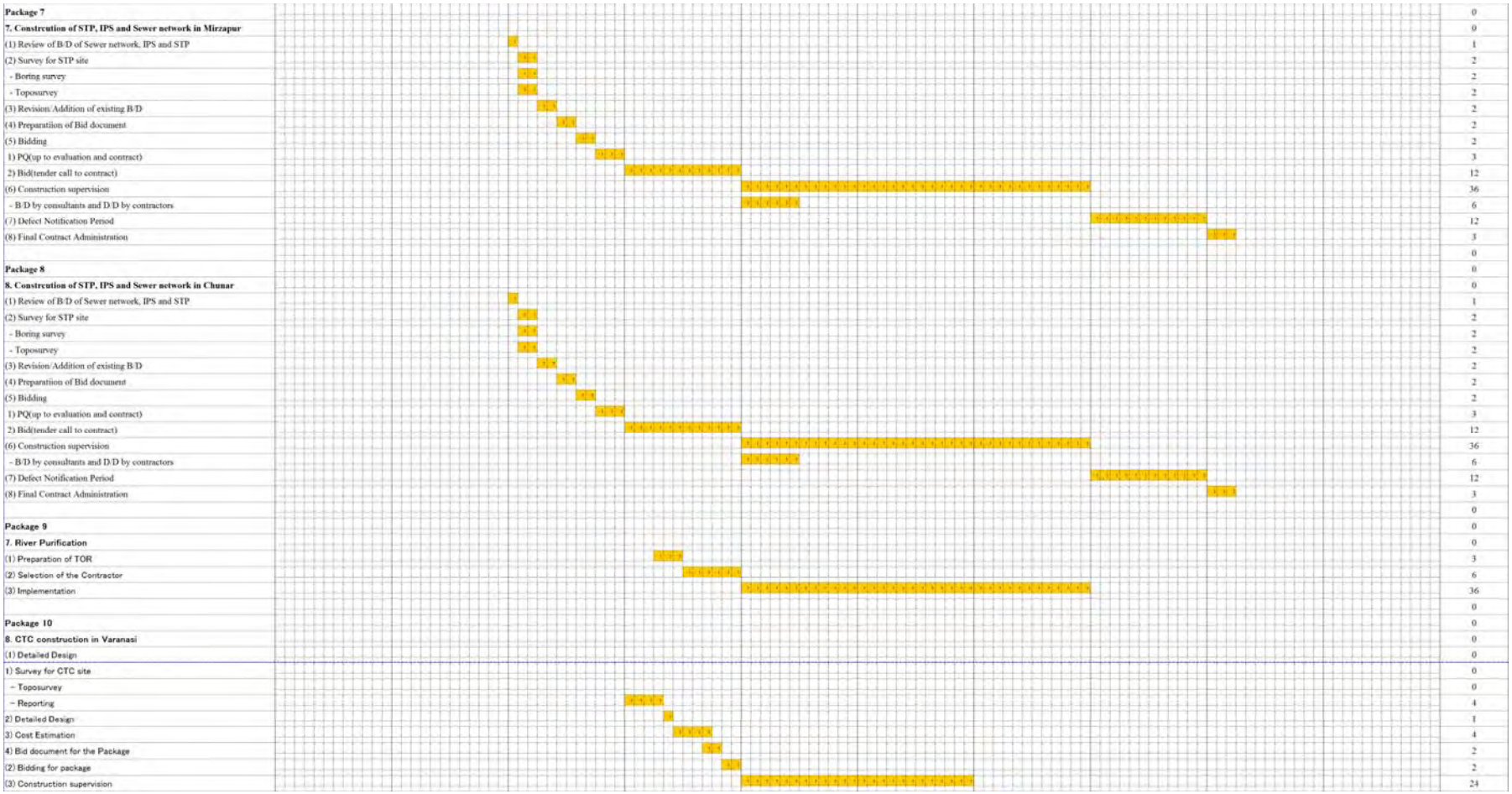
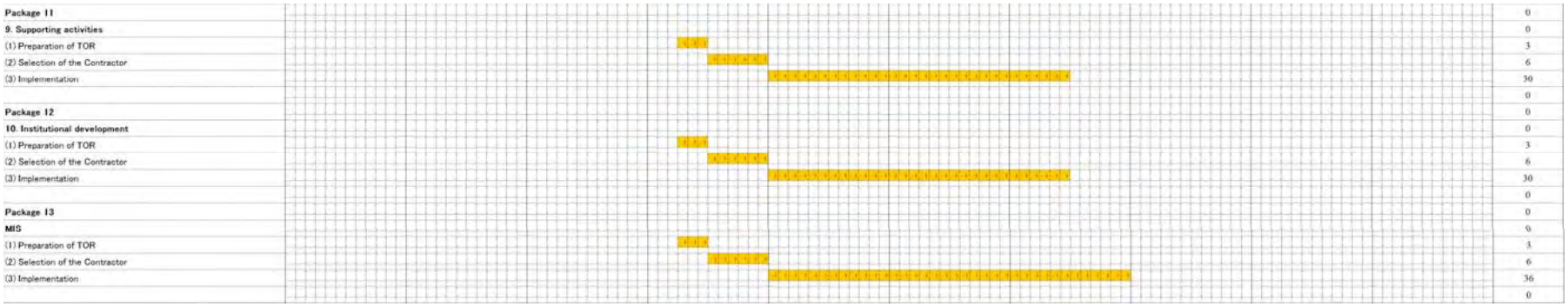


Figure 17.4.4 Implementation Schedule (3/4)



Figures 17.4.5 Implementation Schedule (4/4)

17.5 Consulting Services

17.5.1 Terms of Reference

NMCG will procure consulting services through ICB for the construction/installation of sewers, STPs and IPS, Construction of Community Toilet Facilities and Institutional Development. 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 sewerage facilities; one for design-bid-construction and the other design–built method.

For the former method, detailed design will be applied including preparation of tender documents for the six packages for the construction of sewers (sewer networks in Varanasi and construction and rehabilitation of three STPs). For the latter method, Community Toilet Facilities and river purification apply the latter method and it includes as well as bidding assistance and construction supervision.

17.5.2 Cost Estimates for Consulting Services

The consulting service contract includes preparation of detailed design/basic design, assistance for bidding and construction supervision, and procurement of equipment for "Ganga Rejuvenation Project in the state of Uttar Pradesh". However, appropriate number of construction supervision staff is not included to assist UPJN during implementation of the project, as the Consultants' primary responsibility would be to provide review, monitoring and guidance during project implementation. It is strongly recommended that UPJN would take measures to employ sufficient number of construction supervision staff for smooth, successful and timely implementation of each project component. A total of 184 man-months of foreign, 786 man-months of local engineers and 729 man-months of supporting staffs are considered. The service will also include on-the job training for UPJN staff from investigation/design, construction supervision and trial operation of facilities. The engineers assigned for the work will transfer technologies to UPJN staff who will assign as counterpart staff members during the implementation of the Project. UPJN staff will stay with Consultants staff in the field during the period of on-the-job training without additional expenditures.

Under the above condition, total cost for the consulting services is estimated at approximately 1,647 million yen (Foreign portion: 619 million yen, Local portion: 655 million INR equivalent to 1,028 million Yen). **Table 17.5.1** shows the detailed cost estimate for the consulting services.

Table 17.5.1 Estimated Cost for Consulting Services

			Unit	Qty.	Foreign Portion (JPY) Rate	Foreign Portion (JPY) Amount ('000)	Local Portion INR Rate	Local Portion INR Amount ('000)	Combined Total ('000) JPY
A	Remuneration								
	1	Professional (A)	M/M	302	2,676,156	808,199	1,565,003	472,631	1,616,398
	2	Professional (B)	M/M	892	541,565	483,076	316,704	282,500	966,151
	3	Supporting Staffs	M/M	741	0	0	100,000	74,100	126,711
		Subtotal of A				1,291,275		829,231	2,709,260
B	Direct Cost								
	1	International Airfare	trip	154	405,150	62,393	19,615	3,021	67,559
	2	Domestic Airfare	trip	297		0	19,615	5,826	9,962
	3	Domestic Travel	trip	124		0	6,650	825	1,410
	3	Accommodation Allowance	Month	302		0	117,000	35,334	60,421
			Month	892		0	100,000	89,200	152,532
			Month	741		0	50,000	37,050	63,356
	4	Vehicle Rental	Month	302		0	32,000	9,664	16,525
			Month	302		0	55,000	16,610	28,403
	5	Office Rental	M/M	75		0	165,000	12,375	21,161
	6	International Communications	M/M	75		0	55,000	4,125	7,054
	7	Domestic Communications	M/M	75		0	20,000	1,500	2,565
	8	Office Supply	M/M	75		0	25,000	1,875	3,206
	9	Office Furniture and Equipment	M/M	1		0	10,000,000	10,000	17,100
	10	Report Preparation	Month	36			3,000,000	108,000	184,680
	11	Survey, water quality and other works	Lump Sum	3			75,000	225	385
		Subtotal of B				62,393		335,629	636,319
		Total				1,353,668		1,164,860	3,345,579

17.6 Preliminary Cost Estimates

17.6.1 Conditions and Assumptions for Cost Estimates

Following conditions were assumed for the cost estimates of construction, and administration cost and tax.

(1) Conditions for cost estimates.

1) Base Year	December, 2016
2) Exchange Rate	1 INR = 1.71 Yen
	1 USD = 116.0 Yen = 67.9 INR
3) Price Escalation Rate per year	Foreign Currency: 1.6%, Local Currency: 3.7%
4) Physical Contingency	5.0%
5) Administration Cost	5.0% (of the eligible portion)
6) VAT for local currency	5.0% (of the expenditure in FC and LC portion of consulting services)
7) Import Tax	15% (of the expenditure in FC portion)
8) Interest during Construction	Assumption 0.30 % (Consulting service 0.01%) 40 years loan
9) Front End Fee	0.2% x loan amount

(2) Methodology of cost estimates

The following methodologies apply for cost estimation of sewer, IPS and STP, and current local practices and features is reflected to the cost estimation.

1) Civil and architectural items

The construction and rehabilitation cost for IPS and STP are calculated by using the SOR and the quantities mentioned on DPR because 'build-up approach' for cost estimation of the project is also common in Japan so that this method is also applied in this project. However, cost function method that is widely used in India is employed for estimating construction cost for Chunar, Mirzapur and Ghazipur STPs.

2) Mechanical and Electrical items

Whereas cost estimation for civil and architectural items are utilized by 'build-up approach', cost estimation for mechanical and electrical items are calculated by using the price of each equipment on similar project.

17.6.2 Construction Costs

Table 17.66.1 shows details of the construction cost. Total project cost is estimated at approximately 37,026 million JPY (216,520 Lakhs INR), out of which JICA finance portion is 32,080 million JPY (187,604 Lakhs INR).

Table 17.66.1 Total Project Cost

Item		Total		
		FC	LC	Total
A. ELIGIBLE PORTION				
Ⅰ)	Procurement / Construction	0	17,221	29,447
	Construction of Sewer Network (Varanasi District 1)	0	2,753	4,707
	Construction of Sewer Network (Varanasi District 2)	0	4,166	7,124
	Construction of Sewer Network (Varanasi District 3)	0	1,942	3,322
	Rehabilitation of Dinapur and Bhaguanpur STP	0	555	949
	Construction of Ramnar STP	0	961	1,643
	Constrcution of STP and Sewer network in Ramnagar	0	293	500
	Constrcution of STP, IPS and Sewer network in Mirzap	0	2,814	4,812
	Constrcution of STP, IPS and Sewer network in Chunai	0	331	565
	River purification	0	100	171
	CTC construction in Varanasi	0	135	231
	Supporting activities	0	29	50
	Institutional development	0	37	62
	MIS	0	150	256
	Power Connection & Allied Work-Ramnagar	0	0	0
	Power Connection & Allied Works-Ramnar	0	0	0
	Base cost for JICA financing	0	14,265	24,392
	Price escalation	0	2,136	3,652
	Physical contingency	0	820	1,402
Ⅱ)	Consulting services	1,091	864	2,569
	Base cost	990	730	2,239
	Price escalation	49	93	207
	Physical contingency	52	41	122
Total (Ⅰ+Ⅱ)		1,091	18,085	32,016
B. NON ELIGIBLE PORTION				
a	Procurement / Construction	0	133	227
	Construction of Sewer Network (Varanasi District 1)	0	0	0
	Construction of Sewer Network (Varanasi District 2)	0	0	0
	Construction of Sewer Network (Varanasi District 3)	0	0	0
	Rehabilitation of Dinapur and Bhaguanpur STP	0	0	0
	Construction of Ramnar STP	0	0	0
	Constrcution of STP and Sewer network in Ramnagar	0	0	0
	Constrcution of STP, IPS and Sewer network in Mirzap	0	0	0
	Constrcution of STP, IPS and Sewer network in Chunai	0	0	0
	River purification	0	0	0
	CTC construction in Varanasi	0	0	0
	Supporting activities	0	0	0
	Institutional development	0	0	0
	MIS	0	0	0
	Power Connection & Allied Work-Ramnagar	0	67	115
	Power Connection & Allied Works-Ramnar	0	38	65
	Base cost for JICA financing	0	106	180
	Price escalation	0	21	36
	Physical contingency	0	6	11
b	Land Acquisition	0	31	53
	Base cost	0	28	48
	Price escalation	0	1	2
	Physical contingency	0	1	3
c	Administration cost	0	944	1,615
d	VAT	0	1,822	3,115
e	Import Tax	0	0	0
Total (a+b+c+d+e)		0	2,930	5,010
TOTAL (A+B)		1,091	21,014	37,026
C. Interest during Construction		470	0	470
	Interest during Construction(Const.)	455	0	455
	Interest during Construction (Consul.)	15	0	15
D. Front End Fee		64	0	64
GRAND TOTAL (A+B+C+D)		1,625	21,014	37,559
E. JICA finance portion incl. IDC (A + D)		1,155	18,085	32,080

17.6.3 Comparison of construction cost on STP/ Sewer Network between DPR and Revised DPR

Table 17.6.2 shows comparison of construction cost on STP/ Sewer Network cost between DPR and revised DPR prepared by JICA study team.

Table 17.6.2 Comparison of Total Project Cost between DPR and Revised DPR using JICA Method

Unit: Lakhs Rs

Name of the project	(1) Original DPR	(2) Revised DPR	(3)=(2)/(1)
Varanasi Dist. I	21,490	27,488	1.28
Varanasi Dist. II	32,722	41,621	1.27
Varanasi Dist. III	14,938	19,383	1.30
Rebab. Of Dinapur and Bhagwanpur	6703	5548	1.21
Const. of Ramna STP	10,302	9,597	0.93
Const. of STP and Sewer network in Ramnagar	2,835	2,917	1.01
Const. of STP, IPS and Sewer network in Mirzapur	27,216	28,354	1.04
Const. of STP and IPS in Ghazipur	13,826	17,859	1.29
Const. of STP, IPS and Sewer Network in Chunar	2,750	3,283	1.19

Total construction cost on STP/IPS and Sewer Network increases after revision of the design and modification of wastewater treatment method. However, the difference is lower than 30 per cent and it is considerable that the price difference between two estimates are adequate in the view of normal cost estimation practice.

CHAPTER 18 Measures for Climate Change

<Fundamentals and applied Model>
This chapter first introduces the scenario, projection model, target year for projection, parameters for projection, and summary of climate change in Uttar Pradesh referring to "the State Action Plan on Climate Change" prepared by the Department of Environment, the State of Uttar Pradesh in 2014. Global Circulation Models (GCM) is applied.
<Measures and influence Proposed>
Description of the measures for climate change involves the project such as utilization of treated sewage for irrigational use and sewage sludge for power generation with an total Greenhouse Gas (GHG) reduction of 2,435.6 MWh per pear at three STPs namely Dinapur, Bhagwanpur and Ramna STPs in Varanasi as well as the measure for floods and droughts frequently occurs in Varanasi and its surrounding areas.

18.1 Projection of Future Climate

The Department of Environment under the State Government of Uttar Pradesh has studied on greenhouse gas (GHG) emission, sustainable agriculture, solar energy, energy efficiency, green (forest), water resources, strategic knowledge, sustainable urban habitat and prepared the Report for State Action Plan on Climate Change in 2014 (herein referred to as "State Action Plan". Since the sewerage sector is deeply concerned with water resources and sustainable urban habitat, the measures against climate change shall be studied focusing thereon.

The description in **18.1** is based on that in "State Action Plan on Climate Change" prepared by, the Department of Environment, Government of Uttar Pradesh in 2014

The State Action Plan was prepared under the following scenario,

18.1.1 Scenario[1]

Indian RCM PRECIS (Providing Regional Climates for Impact Studies) has been configured for a domain extending from about 1.5°N to 38°N and 56°E to 103°E. For the analysis the weather conditions of the present and future have been provided by the IITM Pune as the output of a regional climate model (RCM-PRECIS) at daily interval at a resolution of about 50 km. Simulated climate outputs from PRECIS regional climate model for present (1961-1990, BL) near term (2021-2050, MC) and long term (2071-2098, EC) for A1B IPCC SRES socio-economic scenario (characterized by a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and rapid introduction of new and more efficient technologies, with the development balanced across energy sources) has been used. Q14 QUMP (Quantifying Uncertainty in Model

[1] Department of Environment, Government of Uttar Pradesh, "State Action Plan on Climate Change", 2014

Predictions) ensemble has been used for the simulation.

18.1.2 Projection Model[1]

Climate models are mathematic models used to simulate the behaviour of climate system. The latter, known as Global Circulation Models (GCM), incorporate oceanic and atmospheric physics and dynamics and represent the general circulation of the planetary atmosphere or ocean. The GCMs are usually run at very course grid (about 3° X3°) resolution. These GCMs are strengthened with the incorporation of local factors and downscaled, in general with a grid resolution of about 0.5°X0.5° or less. The downscaling can be of dynamic or statistical type. These models are referred to as Regional Climate.

18.1.3 Target Year for Projection[1]

The projected climate change in 2030 (average of 2021-2050) and in 2080 (average of 2071-2098) over Uttar Pradesh using IPCC SRES A1B scenario have been studied.

18.1.4 Parameters for Projection[1]

The following parameters are projected:

- Climate Change scenario rainfall Statistics – Annual Average and inter annual variation
- Climate Change scenario rainfall Statistics – Seasonal and inter annual variation in rainfall
- Climate Change scenario Temperature Statistics – Average and inter annual variation
- Climate Change scenario Temperature Statistics – Seasonal average and inter annual variation
- Exposure related vulnerability
- Vulnerability due to climate sensitivity
- Adaptive Capacity
- Climate Vulnerability Index (Combined) for UP
- Green water and blue water availability
- Change in Average Minimum Temperature during Winter, Pre-monsoon, Monsoon & Post-monsoon seasons across U.P.
- Change in Average Maximum Temperature during Winter, Pre-monsoon, Monsoon & Post-monsoon seasons across U.P.

18.1.5 Summary of Climate Change in Uttar Pradesh[1]

Climate change poses uncertainties to the supply and management of water in the State. The following summarize the critical situation of water resources in the state and how climate change will act as an additional stressor:

- Many semi-arid and arid areas are particularly exposed to the impacts of climate change and are projected to suffer a decrease of water resources.
- Changes in climate variables like temperature increases can affect the hydrologic cycle by directly increasing evaporation of available surface water and vegetation transpiration.
- Changes in climate variables can influence precipitation amounts, timings and intensity rates, and indirectly impact the flux and storage of water in surface and sub-surface reservoirs i.e. lakes, soil moisture, and groundwater.
- Climate change can impact surface water resources directly through changes in the major long-term climate variables such as air temperature, precipitation, and evapo-transpiration.
- Annual rainfall predicted to increase by 15% to 20% in the 2050's as compared to the baseline and the increase is higher towards 2080's (25% to 35%). Inter annual variability is higher towards 2080's.
- Greater variability in rainfall could result in frequent and prolonged periods of high or low groundwater levels, and saline intrusion in aquifers.
- The direct effect of climate change on groundwater resources depends upon the change in the volume and distribution of groundwater recharge.
- The change in blue water availability show spatial variation from marginal reduction (5%) to 20 % increase across the state towards 2050's as compared to the baseline and there is almost 40 to 50% increase towards 2080's.
- The green water flow also shows increase but the magnitude is marginal under both MC and EC scenario and may increase to 25% for some of the area.
- The green water storage can potentially benefit the agriculture in months with little or no precipitation. This information is quite helpful in planning cropping season and helps to model scenarios of changing cropping seasons and patterns and arriving at appropriate adaptation measures.

18.2 Measures for Climate Change in the Proposed Project

The measures for climate change in the sewerage project is roughly classified into the following four categories:

(1) Emission through energy consumption of power, fuel, etc.
(2) Emission from treatment processes accompanied with the operation of treatment facilities
(3) Emission accompanied with the consumption of clean water, industrial water, chemicals and so on
(4) Reduction of emission amount through the utilization of sewerage resources

Out of the above, (1) to (3) should be reviewed in the stages of detailed design and operation and maintenance. The focus is herein placed on "(4) Reduction of emission amount through the utilization of sewerage resources which is considered as the measures through the contribution to the reduction in greenhouse effect gas as the whole of society by the utilizing energy and resources held in sewerage.

(1) Promotion of sewerage development and sewage treatment

Annual rainfall predicted to increase by 15% to 20% in the 2050's as compared to the baseline and the increase is higher towards 2080's (25% to 35%). Maximum temperature is predicted to increase by 2.1 ^{O}C during pre-monsoon followed by monsoon (1.8 ^{O}C) towards 2050's. Predicted increase in maximum temperature during post-monsoon (5.3^{O}C) followed by winter (4.5^{O}C) towards 2080's. These climate change is supposed to have a bad influence on the urban environment. In the survey area, Ghazipur, Ramnagar and Chunar have no sewerage network at present and the sewer networks cover only 30% of the area even in Varanasi. In such low coverage by sewerage network, it is afraid of a deterioration of living environment by climate change. The implementation of sewerage projects itself is one of important measures against climate change.

For this purpose, the primary and secondary sewers will be installed together with connection chambers to be provided near the road boundary to collect wastewater, currently discharged into open drains, through house connections for treatment at the sewage treatment plants and reduce the pollution loads to be discharged into the River Ganga. The people awareness campaign will be extended to promote the connection of individual houses to a sewer system in parallel with the construction works mentioned-above.

By the construction of sewerage facilities, the living environment in the urban area will be improved as well as the water environment which runs in the urban rea

(2) Utilisation of Treated Sewage

In the upstream of the River Ganga, about eighty percent (80%) of river water is abstracted for irrigational purpose which results in the significant reduction in the river flow and causes the deterioration of river water quality in the stretch of Kanauji-Kanpur-Allahabad-Varanasi over the primary water quality criteria for outdoor bathing in the holy Ganga. For this reason, the reuse of treated sewage for irrigation purpose has been executed aggressively at the existing sewage treatment plants so far. The central government has also encouraged the reuse of treated sewage for industrial purpose.

To respond the population increase in Uttar Pradesh, the agricultural sector is required to increase the crop product which leads to the water demand for irrigational use. The supply of treated sewage for irrigational purpose will contribute to the reduction in water demand for river water.

Table 18.2.1 Measure for Climate Change in the Proposed Projects

City/Town	STP	Capacity (MLD)	Treated Sewage	Sewage Sludge	Flood HFL (Varanasi): 73.90m (1978)	Project Contents
Varanasi	Dinapur	80	Irrigation S.: Irrigational Use Non-irrigation S.: Discharge to Ganga	Digestion-Drying Bed-Sold as Manure Power Generation by Digested Gas		Upgradation
	Bhagwanpur	9.6	Irrigational Use	Digestion-Drying Bed-Sold as Manure Power Generation by Digested Gas		Upgradation
	Ramna	50	Irrigation S.: Irrigational Use Non-irrigation S.: Discharge to Ganga	Power Generation by Digested Ga	As the proposed STP site will be submerged during high water level, it will be protected by surrounding the 4.5m high embankment	Construction
Ramnagar	Ramnagar	14	Irrigation S.: Irrigational Use Non-irrigation S.: Discharge to Ganga	Digestion-Centrifuge-Sold as Manure	HFL is 73.90 m in 1978 which is lower than the ground level of the proposed STP site and other areas in Ramnagar. Therfore, safe against flood.	Construction
Mirzapur	Mirzapur	14 (UASB) 18 (SBR)	Dischage to Irrigation Channel	Digestion-Centrifuge-Carrying		Augmentation
	Vindhyachal	4 (WSP) 6 (WSP)	Dischage to Irrigation Channel	Drying Bed-Sold as Manure		Augmentation
Chunar	Chunar	6.5 (WSP)	Discharge to Ganga（Irrigational Use to surrounding farmland, if required)）			Construction
Ghazipur	Ghazipur	18 (C-Tech)	Discharge to Ganga	Centrifuge-Sold as Manure		Construction

Source: Flood Forecast Monitoring Directorate, Central Water Commission, "Flood Forecasting and Warning Network Performance Appraisal Report 2012", October 2011

As shown in **Table 18.2.1**, all the sewage treatment plants except for that in Ghazipur in the survey area will address the reuse of treated sewage for irrigational purpose.

(3) Utilisation of Sewage Sludge

Sewage sludge generated in the process of sewage treatment is used for power generation by digestion gas and as manure for agricultural use in the address utilizing the sewage value as a resource. The power obtained is used for the operation of mechanical equipment as well as lighting and results in the reduction of external power consumption as the whole of a STP. The agricultural reuse of biomass-derived sewage sludge as manure will bring the emission reduction of greenhouse effect gas in other industries

As shown in **Table 18.2.1**, in the survey area, the power generation is proposed at three sewage treatment plants in Varanasi, or at Dinapur, Bhagwanpur and Ramna STPs. In addition, five STPs out of seven STPs have plan to sold sewage sludge as the manure for agricultural use

(4) Greenhouse Gas Reduction

As mentioned above, the power generation is planned at three STPs in Varanasi, namely Dinapur, Bhagwanpur and Ramna, The greenhouse gas reduction at theses STPS is calculated as shown in **Table 18.2.2** under the following assumptions.

- The power generation directly lead to carbon-dioxide (CO_2) gas reduction.

- The CO_2 gas emission factor from a power generation station is set at 0.82 based on the data of the Indian Government.
- There is a somewhat fear of operation in winter with no heating, the methane gas generation to be used for bio-gas power generation is discounted to 80% of the value obtained from the volume calculation.
- The sewage treatment processes assumed are based on that proposed in the Ramna STP DPR by UPJN and those recommended by the JICA survey team against those proposed in the revised DPR for Dinapur and Bhagwanpur STPSs by UPJN to meet the new effluent standards.
- The calculated values simply show the difference between with- and without power generation facilities/equipment,

Table 18.2.2 Greenhouse Gas Reduction

City STP	Varanasi Dinapur	Varanasi Bhagwanpur	Varanasi Ramna	Varanasi
Flash Mixer	-	-	-	
Flow Rate at Average in m^3/d Treatment Process	80,000 D-CND	8,000 CND	50,000 CND	
Power Consumption Availability: 80%	9,695.9 MWh/y	1,176.1 MWh/y	3,889.7 MWh/y	14,761.8
Power Generation	7,763.4 MWh/y	672.8 MWh/y	38,90.0 MWh/y	12,326.2
Chlorine Dosing Rate: 10 mg/l	800.0 kg-gas/day	114.3 kg/day	500.0 kg/day	
De-chlorine Sodium Thiosulfate	190.4 kg/day	19.0 kg/day	131.3 kg/day	
Polyelectrolyte Dosing Rate: 1.5kg/t	30.21 kg/day	2.99 kg/day	0.00 kg/day	
	112.07 m^3/day	11.09 m^3/day	101.00 m^3/day	
GHG Reduction Factor: 0.82				2,435.6 Total

(5) Flood

Due to excess rains on the foot hills of Himalayas and trans-boundary flows from the rivers originating from Nepal and other neighbouring states floods occur in certain parts. Floods are the most common annual occurrences in the state, due to overflowing of its main rivers like Ganga, Yamuna, Ramganga, Gomti, Sharda, Ghaghra Rapti and Gandak, affecting one or the other part of the state the most affected being Eastern Uttar Pradesh and the Tarai region.

It is important to protect the sewerage treatment plants from flooding and to maintain the sewage treatment function even during the flood, so that they will contribute to restore the living environment and hygiene condition in the damaged area after the flood will go out.

As shown in **Figure 18.2.1**, the surrounding area of the River Ganga is classified into the flood prone area. The historical highest flood level of the River Ganga in Varanasi is +73.90 m in 1978 and recently 72.16 m was recorded in August 18, 2013. The sewage treatment plants which may be attacked by the flood have taken the measures as shown in **Table 18.2.1**

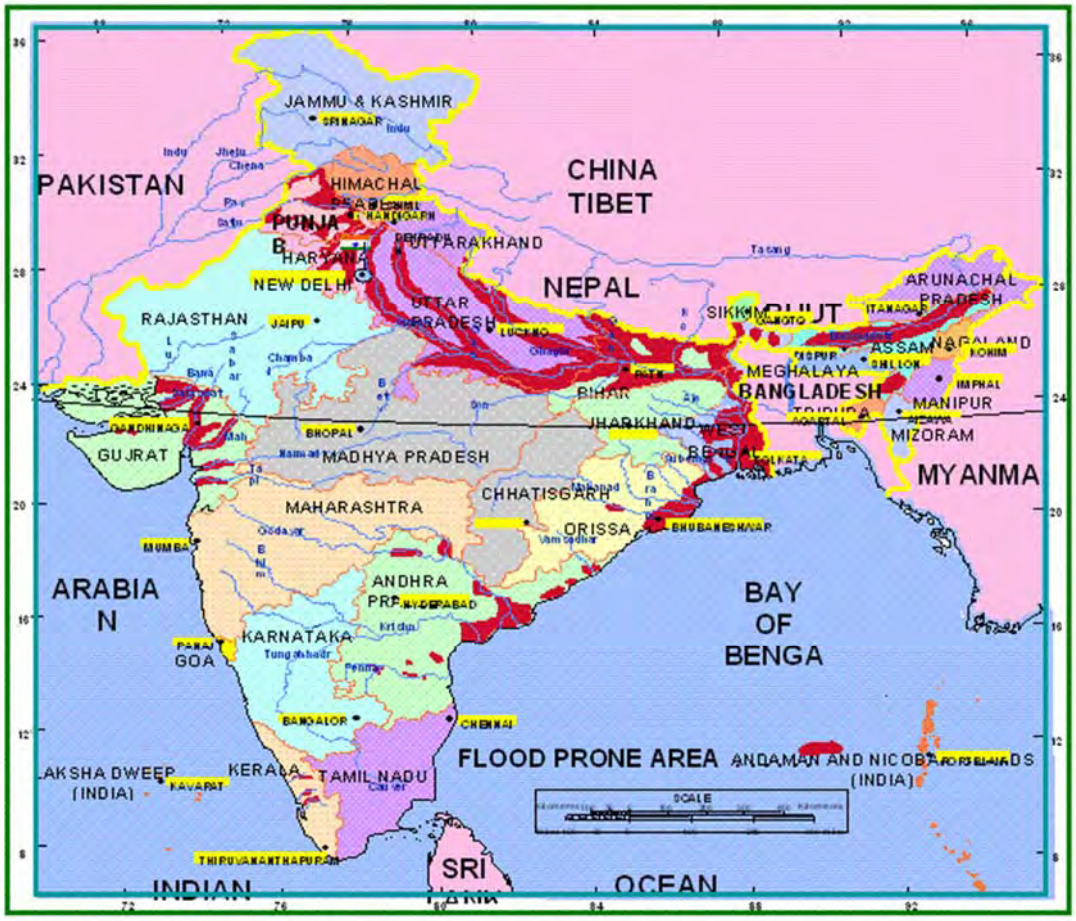


Figure 18.2.1 Flood Prone Area in India

(6) Drought

The recurrence of a major deficiency in annual rainfall follows a 6-8 year cycle in Eastern U.P. whereas in Western U.P., it is a 10 years cycle. Droughts are experienced due to deficient rainfall in the certain parts of the state. Bundelkhand and part of Mirzapur and Allahabad commissionaires are the most drought prone areas.

The survey area is classified into the frequently drought prone area as shown in **Figure 18.2.2**.

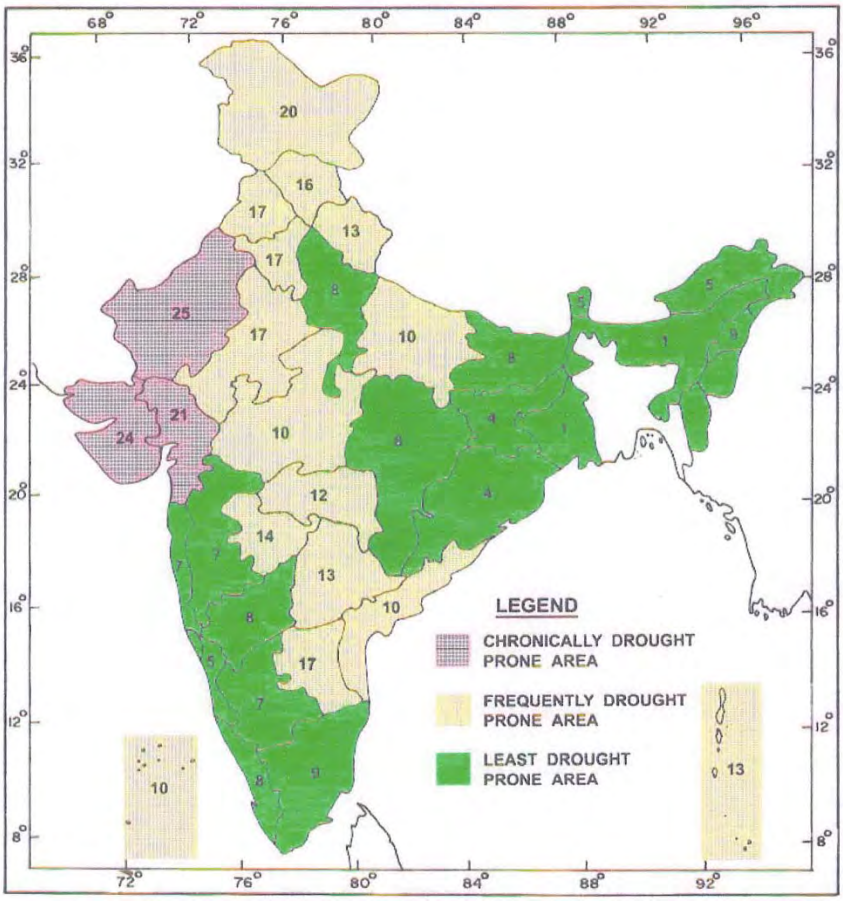


Figure 18.2.2 Drought Prone Area in India

During the drought period, sewage treatment can supply the treated sewage with good quality for irrigational use.

CHAPTER 19 Selection of Phase-II Project Sites

<Objective of the Study>
Project site of the Phase II for Ganga Rejuvenation Project was studied from 118 towns identified by NMCG.
<Methodology>
Compliance status of primary water quality criteria set for the Ganga in selecting the target area for the Phase-II Project was evaluated for the selection.
<Result of the Study>
Considering the impact on water qualityKanpur is recommended as the target area for the Phase-II Project together with Unnao (additional STP capacity requirement: 50.1 MLD) and Gangaghat (16.2 MLD). Unnao and Gangaghat are located on the opposite side of the River Ganga from Kanpur. Moradabad is secondly proposed as the target area.

PART-1: COLLECTION OF EXISTING INFORMATION

19.1 Introduction

19.1.1 Towns to Be Studied

NMCG identified 118 river front towns near the main stem of the River Ganga as the priority towns for Clean Ganga, which shall be set as the candidates for the selection of Phase-II Project sites. NMCG comments the present situation of "incomplete sewerage infrastructure"[1] as follows:

- 118 priority towns identified
- Only 21% of existing sewage is treated
- 30% of existing sewage treatment plants is non-functional
- Huge gap in sewage generation and available treatment capacity
- 100% sewerage infrastructure needs to be created in next 5 years – huge operational, financial and technological challenge

19.1.2 Information Required

The information to be collected is as follows:

(1) Natural conditions (climate, topography, geology, hydrology and hydrogeology)
(2) Socio-economic conditions (population, slum population, livestock, land use, industrial movement, conditions of public hygiene and status of ghats and crematoria)
(3) Irrigation, water supply and other water use
(4) Existing and under-planning sewerage facilities, discharge point

[1] NMCG, "Overview of India's Priorities and Needs – River Ganga Rejuvenation", February 5, 2016

(5) Status of industrial wastewater
(6) Status of solid waste plant
(7) Movement of other donors concerning water pollution control, measures for water pollution sources, environmental education and improvement in sanitary conditions, etc.
(8) Status of DPR preparation and structure of project implementation
(9) Flow and water quality of the River Ganga and its tributaries
(10) Status of water quality monitoring in the River Ganga and its tributaries
(11) Status on institutional structure concerning water quality control of the River Ganga

19.2 Natural Conditions of the River Ganga Basin

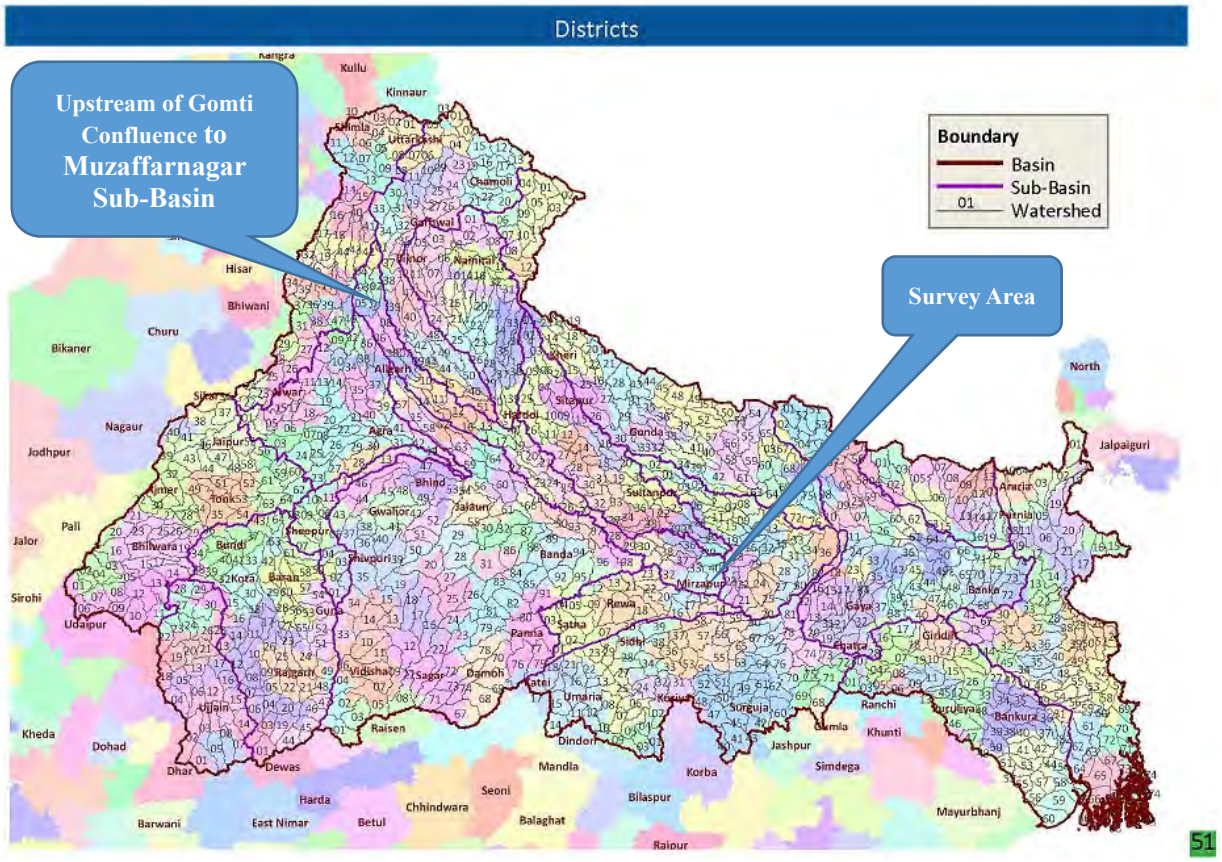
19.2.1 River Ganga Basin

The Ganga basin outspreads in India, Tibet (China), Nepal and Bangladesh over an area of 10,86,000 km^2. In India, it covers states of Uttar Pradesh, Madhya Pradesh, Rajasthan, Bihar, West Bengal, Uttarakhand, Jharkhand, Haryana, Chhattisgarh, Himachal Pradesh and Union Territory of Delhi draining an area of 8,61,452 km^2 which is nearly 26% of the total geographical area of the country. The basin lies between east longitudes 73°2' to 89°5'and north latitudes 21°6' to 31°21' having maximum length and width of approx. 1,543 km and 1024 km. The basin is bounded by the Himalayas on the north, by the Aravalli on the west, by the Vindhyas and Chhotanagpur plateau on the south and by the Brahmaputra Ridge on the east. The Ganga rises in the Gangotri glacier in the Himalayas at an elevation of about 7,010 m in the Uttarkashi district of Uttarakhand. At its source, the river is called as the Bhagirathi. It descends down the valley upto Devprayag where after joining another hill stream Alaknanda, it is called Ganga. The total length of river Ganga (measured along the Bhagirathi and the Hooghly) up to its outfall into Bay of Bengal is 2,525 km. The principal tributaries joining the river from right are the Yamuna and the Son. The Ramganga, the Ghaghra, the Gandak, the Kosi and the Mahananda join the river from left. The Chambal and the Betwa are the two other important sub-tributaries.

Table 19.2.1 Salient Features of Ganga Basin

Basin Extent: Longitude	73° 02' to 89° 05' E
: Latitude	21° 06' to 31° 21' N
Length of Ganga River (Km)	2,525
Catchment Area (km^2)	861,452
Average Water Resource Potential (MCM)	525,020
Utilizable Surface Water Resource (MCM)	250,000
Live Storage Capacity of Completed Projects (MCM)	42,060
Live Storage Capacity of Projects Under Construction (MCM)	18,600
Total Live Storage Capacity of Projects (MCM)	60,660
No. of Hydrological Observation Stations	318
No. of Flood Forecasting Stations	83

The survey area is located in the westernmost part of the upstream of Gomti confluence to Muzaffarnagar sub-basin.



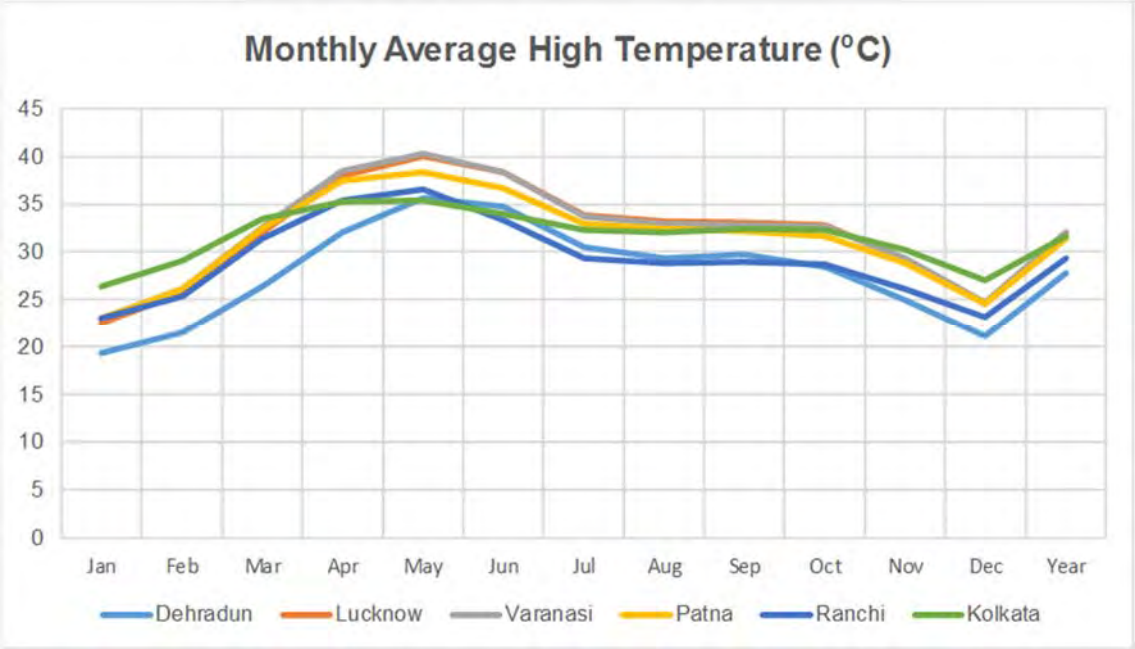
Source: Ministry of Water Resources, "Watershed Atlas of India (Version 2.0)", April 2014

Figure 19.2.1 Sub-basins of the River Ganga

19.2.2 Climate

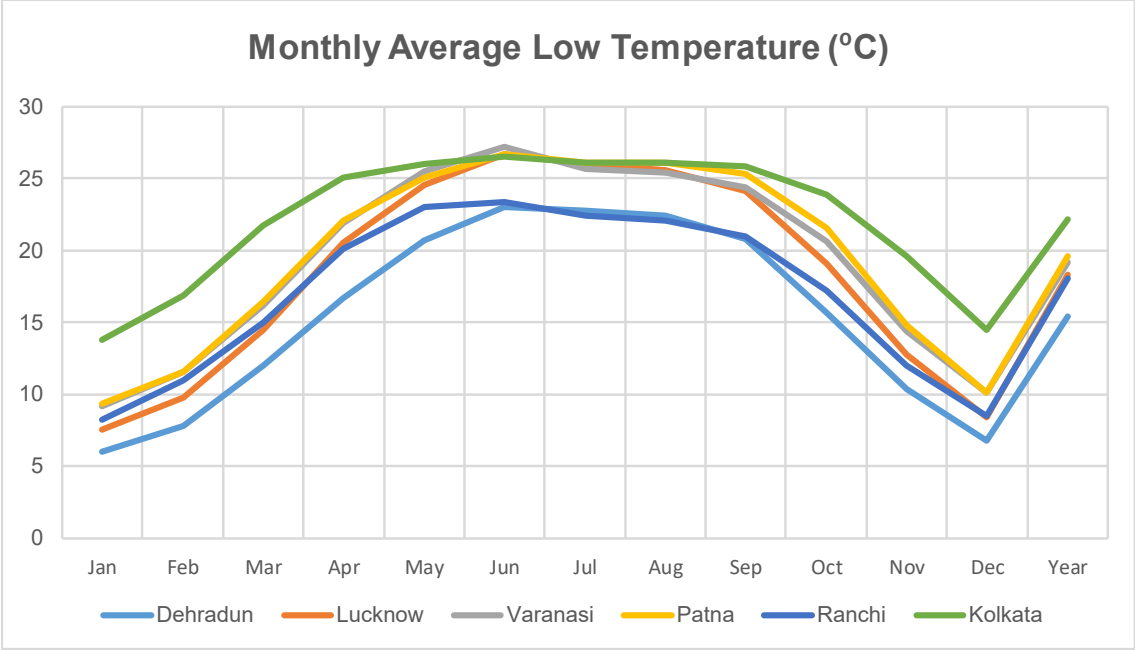
(1) Temperature

Figures 19.2.2 and **19.2.3** shows the monthly average high and low temperatures, respectively, at the four state capitals such as Uttarakhand, Uttar Pradesh, Bihar and West Bengal involved in the River Ganga Basin. As found from those figures, there is no significant change in the trend of monthly variation. The temperature is high in Kolkata with an elevation of 64 m and low in Dehradun with an elevation of 682 m in general,



Source: Prepared by JICA Survey Team based on Wikipedia town-wise data

Figure 19.2.2 Monthly Average High Temperature Variation at State Capitals Located in the River Ganga Basin

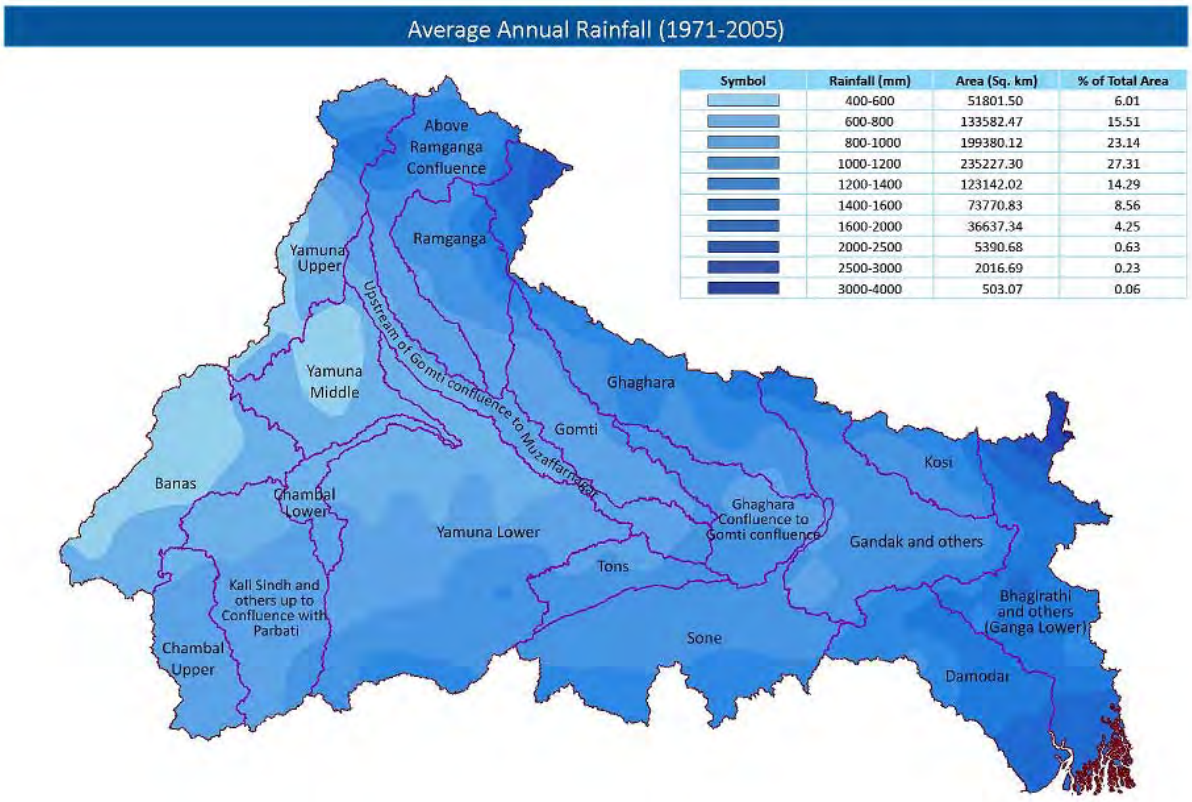


Source: Prepared by JICA Survey Team based on Wikipedia town-wise data

Figure 19.2.3 Monthly Average Low Temperature Variation at State Capitals Located in the River Ganga Basin

(2) Rainfall

The Ganges basin receives nearly 1,000 mm of precipitation annually. The greatest amount of rain – 84% of the annual total – falls during the monsoon season. Of the remainder, 7% falls during the premonsoon season, 5% in the post-monsoon season, and 4% in winter. There are some differences in precipitation between the upper and lower Ganga basins. Although there is not much difference between the annual amount of precipitation in the lower and upper parts of the basin, the number of rainy days varies considerably. In the upper basin, there are 179 rainy days, whereas in the lower basin there are 152 rainy days. The monsoon season accounts for 75% of the rain in the upper basin and 85% of the rain in the lower basin.[2]



Source: Ministry of Water Resources, "Watershed Atlas of India (Version 2.0)", April 2014

Figure 19.2.4 Average Annual Rainfall of the River Ganga Basin

As shown in **Figure 19.2.4**, the distribution of rainfall zone is bigger northwards and southwards from the main stem of the River Ganga and downstream-wards. The rainfall zone of 1,000-1,200 mm is largest sharing 27.31% of the total Ganga Basin followed by 800-1,000 mm zone of 23.14%

[2] ***http://www.grida.no/graphicslib/detail/ganges-basin-climate-indicators-rainfall-temperature_b9f6***

19.2.3 Topography

The Ganga sub-basin extends over an area of 1,086,000 km^2 and lies in India, Tibet, Nepal and Bangladesh. The drainage area lying in India is 861404 km^2 which is nearly 26.2% of the total geographical area of the country. The sub-basin is bounded on the north by the Himalayas, on the west by the Aravalis and the ridge separating it from Indus basin, on the south by the Vindhas and Chhotanagpur plateaus and on the east by the Brahmaputra ridge. The sub-basin lies in the States of Uttar Pradesh, Madhya Pradesh, Bihar, Rajasthan, West Bengal, Haryana, Himachal Pradesh and the Union Territory of Delhi. The State-wise distribution of the drainage area is given below:

Table 19.2.2 State-wise Distribution of Drainage Area

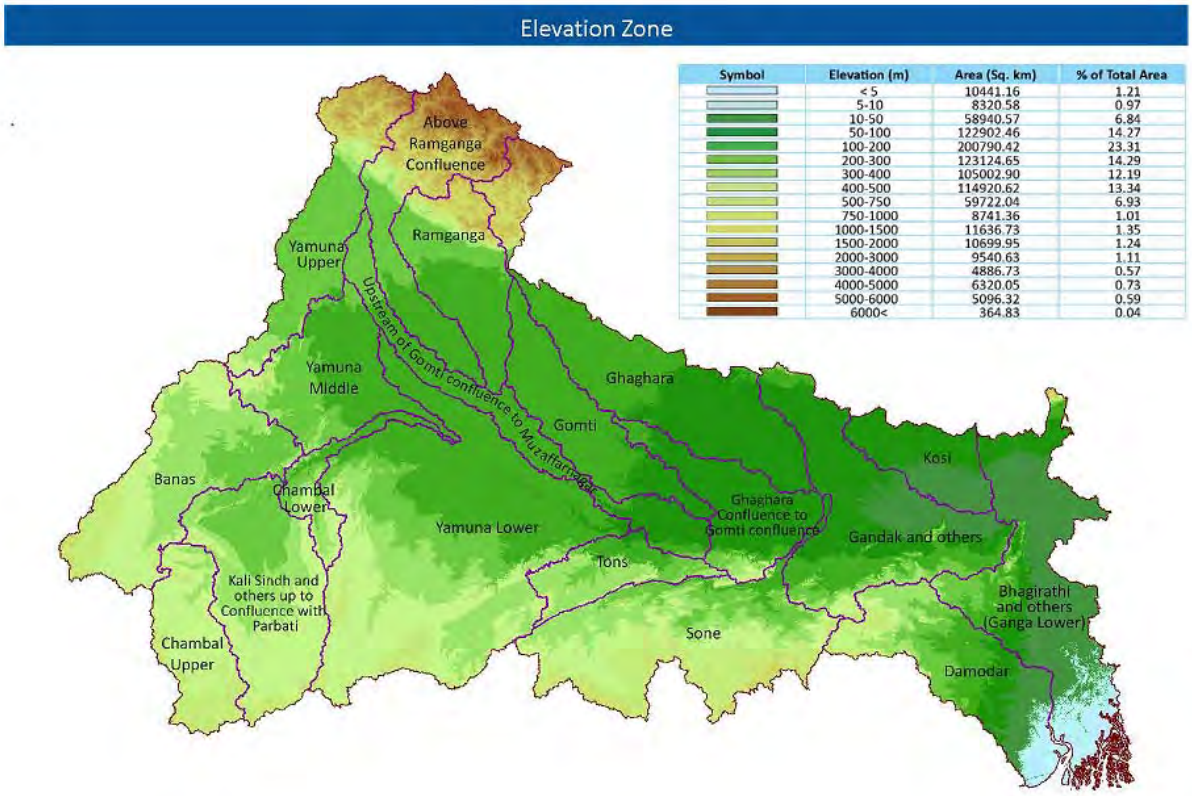
S. No.	State	Drainage Area (km^2)	S. No.	State	Drainage Area (km^2)
1	Uttar Pradesh	294,364	5	West Bengal	71,485
2	Madhya Pradesh	198,962	6	Haryana	34,341
3	Bihar	143,961	7	Himachal Pradesh	4,317
4	Rajasthan	112,490	8	U.T. of Delhi	1,484
				Total	861,404

The main physical sub-divisions are the Northern Mountains, the Gangetic Plains and the Central Highlands. Northern Mountains comprises the Himalayan ranges including their foot hills. The Gangetic plains, situated between the Himalayas and the Deccan plateau, constitute the most of the sub-basin ideally suited for intensive cultivation. The Central highlands lying to the south of the Great plains consists of mountains, hills and plateaus intersected by valleys ad river plains. They are largely covered by forests. Aravali uplands, Bundelkhand upland, Malwa plateau, Vindhyan ranges and Narmada valley lies in this region.

Predominant soil types found in the sub-basin are sandy, loamy, clay and their combination's such as sandy loam, salty clay loam and loamy sand soils. The culturable area of Ganga sub-basin is about 57.96 M. has which is 29.5% of the total culturable area of the country.[3]

The River Ganga Basin lies between the Himalaya Mountains with an elevation of higher than 7,000 m northwards and the Mahadeo and Ramgarh Hills with an elevation of 600-1,000 m southwards and has a slope eastwards from the west and them southwards. The elevation of Haridwar located at the entrance to Indo-Gangetic Plains from mountains is lowered to about 290 m. The 50-100 m high zone extends west of Indo-Gangetic Plains, while the 10-50 m high zone spreads eastwards. The elevation is below 10 m near the Bengal Bay.

[3] *http://india-wris.nrsc.gov.in/wrpinfo/index.php?title=Ganga*



Source: Ministry of Water Resources, "Watershed Atlas of India (Version 2.0)", April 2014

Figure 19.2.5 Topography of the River Ganga Basin

19.2.4 Geology[4]

The Ganga basin consists of a wide variety of soils. While soils of the high Himalayas in the north are subject to continuous erosion, the Gangetic plain provides a huge receptacle into which thousands of meters of thick layers of sediments have been deposited to form a wide valley plain. The Deccan plateau on the south has a mantle of residual soils of varying thickness arising out of weathering of ancient rocks of the peninsular shield. Some of the soils are highly susceptible to erosion. Mountain soils, submontane soils and alluvial soils, covering 58% of the basin area, have very high erodibility; red soils covering 12% of the basin area have high erodibility, red & yellow soils and mixed red and black soils covering an area of 8% have moderate erodibility, and deep black soils and medium black soils covering an area of 14% have low erodibility Shallow black soils and lateritic soils covering an area of 6% have very low erodibility.

[4] *https://nmcg.nic.in/soil.aspx*

Broadly, it can be said that soils in Haryana, Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal, through which the main stem of Ganga and all its tributaries flow, have very high erodibility.

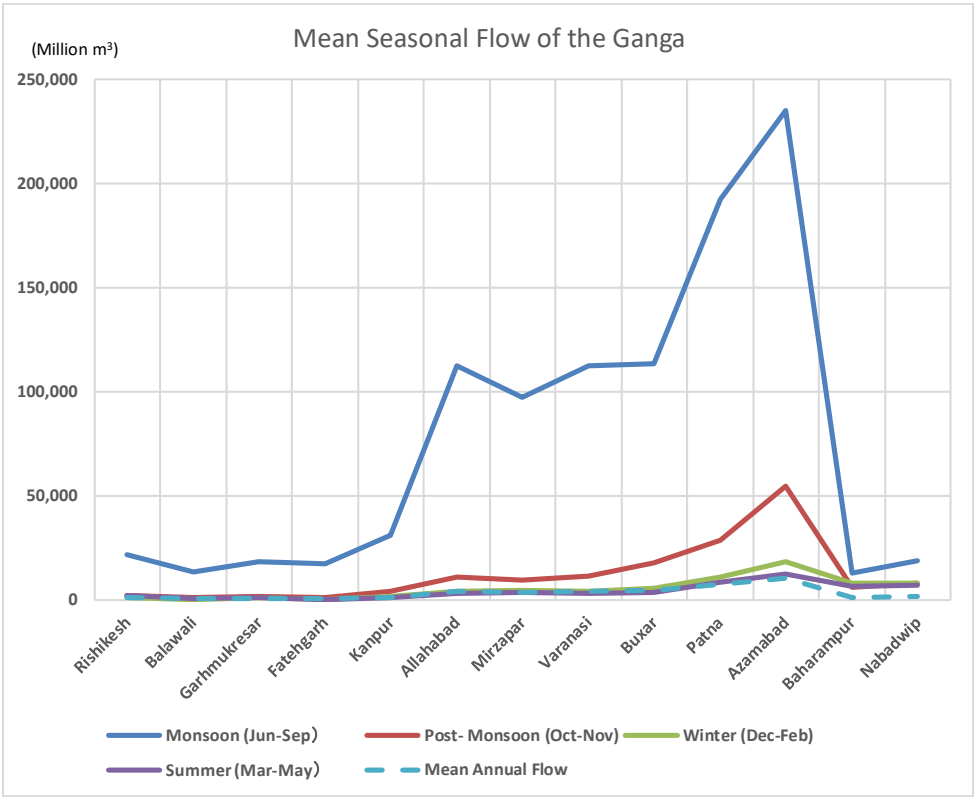
19.2.5 Hydrology[5]

Rainfall, subsurface flows and snow melt from glaciers are the main sources of water in river Ganga. Surface water resources of Ganga have been assessed at 525 billion cubic meter (BCM). Catchment area, annual yield of water and mean flow of tributaries of Ganga are given in **Table 19.2.3**. Out of its 17 main tributaries Yamuna, Sone, Ghagra and Kosi contribute over half of the annual water yield of the Ganga. These tributaries meet the Ganga at Allahabad and further downstream. The river has a problem of low flows between the Haridwar - Allahabad stretch in **Figure 19.2.6**. December to May are the months of lean flow in the Ganga. The lean flow during these months, at some important towns along the river Ganga, is shown in **Figure 19.2.6**.

Table 19.2.3 Mean Annual Flow Rate of Streams in Ganga Basin.

S. No.	Sub-Basin	Mean Annual Flow (BCM)	Percentage contribution
1.	Ramganga	17.789	3.39
2.	Yamuna (excluding Chambal)	57.241	19.90
3.	Chambal	32.554	6.20
4.	Tons-Kararmnasa	10.609	2.02
5.	Gomti-Ghaghra	113.511	21.62
6.	Sone-East of Sone	44.144	8.41
7.	Gandak-Burhi Gandak	58.967	11.23
8.	Kodi-Mahananda	81.848	15.59
	Total (Tributaries)	416.663	79.36
9.	Ganga Main Stem	84.980	16.19
10.	Evaporation * (attributable to Ground Water)	23.380	4.45
	Total Ganga (Upto Indian Border)	525.023	100.00

[5] Source: NRCD. “Status Paper on River Ganga – State of Environment and Water Quality”, August 2009



Enlargement

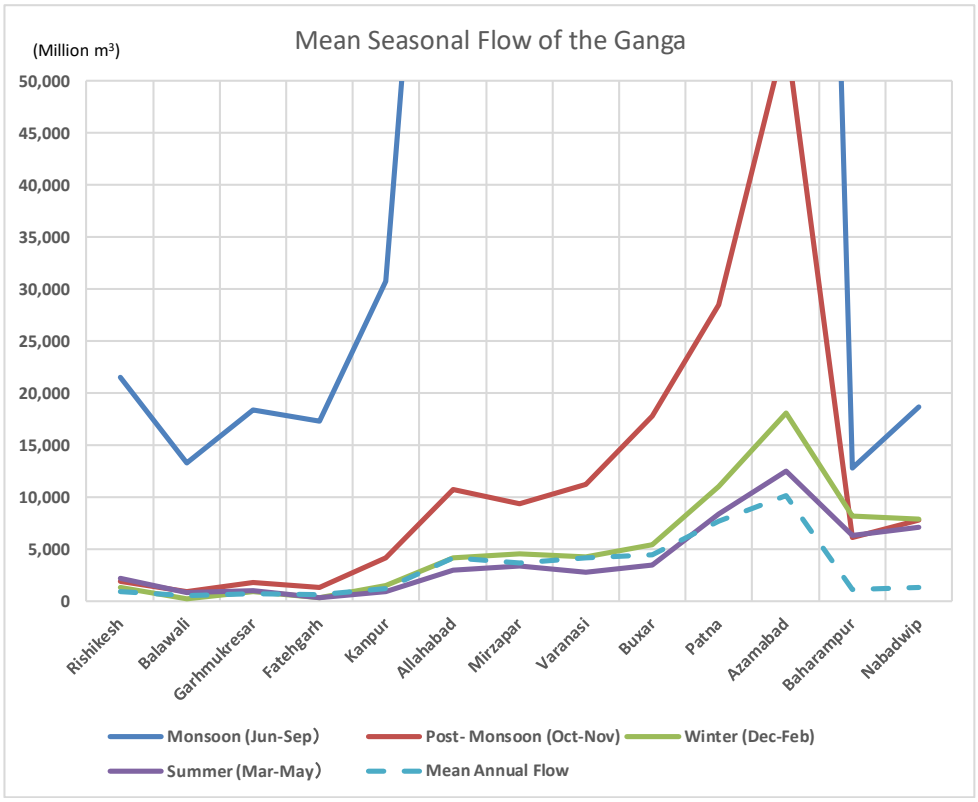


Figure 19.2.6 River Discharge of the River Ganga

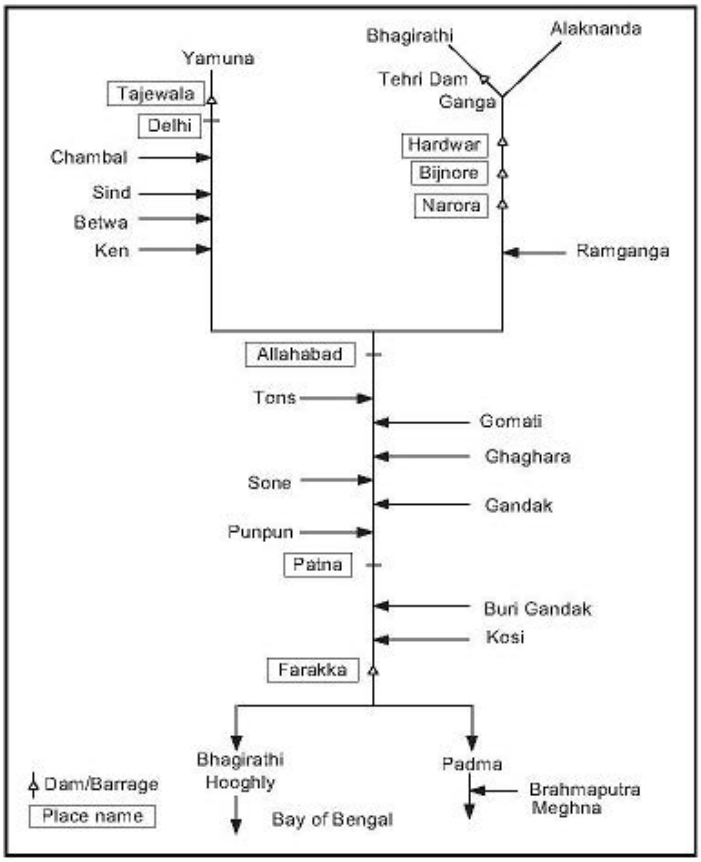


Figure 19.2.7 Line Diagram of Ganga with its Major Tributaries and Water Management Structures

19.2.6 Hydrogeology[6]

The Indian sub continent is occupied by major geological rock types such as metamorphics of pre Cambrian period, Igneous rocks represented by basaltic rocks of Cretaceous-Eocene period, Gondwana & Vindhyan rocks which are overlain by quaternary to recent sedimentary deposits .The distribution of these rock types are given in geological map (**Figure 19.2.8**).

[6] Source: B.M.Jha, Chairman & S.K.Sinha, Scientist D, CCWB, " Towards Better Management of Ground Water Resources in India", Source: B.M.Jha, Chairman & S.K.Sinha, Scientist D, CCWB, " Towards Better Management of Ground Water Resources in India",

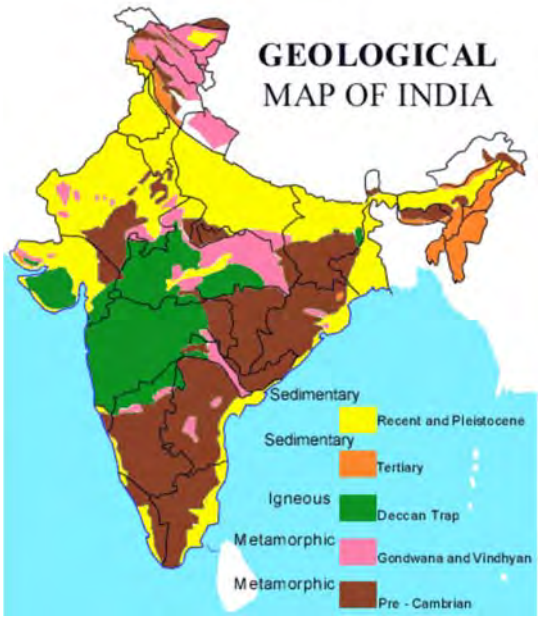


Figure 19.2.8 Geological Map of India (Source: GSI)[6]

Based on the formation characteristics and hydraulic properties to store and transmit ground water hydrogeologically all the litho units can be placed under two broad groups of water bearing formations Viz. ***Porous Formations*** which can be further classified into unconsolidated and semi consolidated formations having the primary porosity and ***Fissured Formation*** **or Consolidated** formations which has mostly the secondary or derived porosity. The Hydrogeological map showing the broad group of consolidated and unconsolidated water bearing formations along with their yield prospects are shown in **Figure 19.2.9**.

Physiographic and geomorphologic settings are among the important factors that control the occurrence and distribution of ground water. Based on these factors, the country has been broadly divided into five distinct regions.

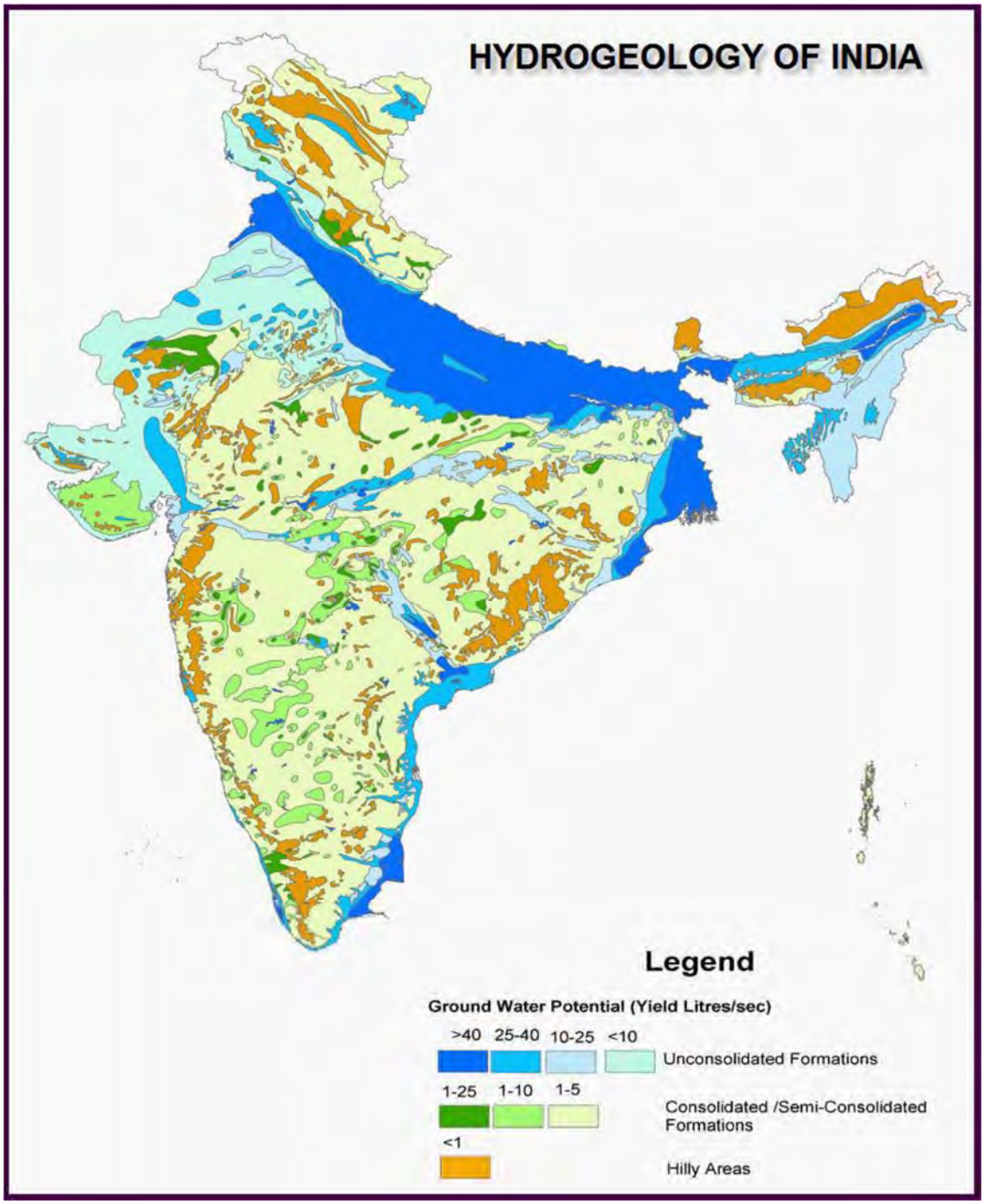


Figure 19.2.9 Hydrogeological Map of India[6]

Among others, the region of **Indo-Gangetic-Brahmaputra Alluvial Plains** encompasses an area of about 850,000 km^2 covering states of Punjab, Haryana, Uttar Pradesh, Bihar, Assam and West Bengal, accounting for more than one fourth of country's land area, comprises the vast plains of *Ganges* and *Brahmaputra* rivers and are underlain by thick piles of sediments of Tertiary and Quaternary age. This vast and thick alluvial fill, exceeding 1000 m at places, constitute the most potential and productive ground water reservoir in the country. These are characterized by regionally extensive and highly

productive multi-aquifer systems. The ground water development in this region is still sub-optimal, except in the states of Haryana and Punjab. The deeper aquifers available in these areas offer good scope for further exploitation of ground water with suitable measures. In Indo-Gangetic- Brahmaputra plain, the deeper wells have yield ranging from 25-50 lps.

19.3 Socio-economic Conditions

19.3.1 Population

In India, the census has been carried out every ten years like 1981, 1991, 2011 and 2011. The latest one is the Census 2011 and according to it, the total population of India was 1,210,854,977 persons, increasing by 182,117,541 persons from 1,028,737,436 persons of the Census 2001, which is the secondary biggest country in the world following China. The annual average population growth rate for 2001-2011 was 1.64%.

The total population of 118 River Front Towns identified by NMCG was 26,170,235 persons with an increase of 2,602,986 persons from 23,567,249 persons in 2001. The annual average population growth rate for this period was 1.05% which was 0.59% lower than the above national average.

For the state-wise annual average population growth rate of 118 towns, the biggest one is 2.44% of Bihar, followed by 1.90% of Uttarakhand, 1.41% of Uttar Pradesh, 1.22% of Jhakhand and 0.29% of West Bengal. Among others, the growth rate of West Bengal is extremely low.

Table 19.3.1 State-wise Annual Average Population Growth Rate of 118Towns

State	No. of towns	Census 2001	Census 2011	Annual Avg. Growth Rate (%)	No. of Towns	
					P.> 1 mil.	P> 1 lakh
Uttarakhand	15	423,747	511,403	1.90	0	1
Uttar Pradesh	31	7,354,925	8,457,577	1.41	3	8
Bihar	26	3,859,693	4,913,428	2.44	1	11
Jhakhand	2	98,131	110,728	1.22	0	0
West Bengal	44	11,830,753	12,177,099	0.29	1	31
118 owns	**118**	**23,567,249**	**26,170,235**	**1.05**	**5**	**51**

Source: Prepared by JICA Survey Team Based on Census 2011 data

For the town-wise annual average population growth rate of 118 towns, the biggest one is 17.84% of Barauni in Bihar, followed by 15.26% of Rudraprayag in Uttarakhand, 10.39% of Begusarai in Bihar, 4.69% of Bihar Sharif in Bihar and 4.34% of phulwari Sharif in Bihar.

19.3.2 Slum Population

According to the Census 2011, the total slum population in India was 65,494,604 persons equivalent to 5.41% of the total population.

The total slum population of 118 River Front Towns identified by NMCG was 5,367,885 persons equivalent to 20.5% of the total population, which was approximately four times bigger than the above national percentage. The percentage of slum population in 118 towns is substantially high.

According to the state-wise percentage of the slum population to the total population, the biggest one is 30.7% in West Bengal, followed by 14.3% in Uttar Pradesh, 9.2% in jhakhand, 8.6% of Uttarakhand and 7.5% in Bihar.

Table 19.3.2 State-wise Percentage of Slum Population in 118 Towns

State	Total Population	Slum Population	Percentage (%)
Uttarakhand	511,403	44,090	8.6
Uttar Pradesh	8,457,577	1,210,574	14.3
Bihar	4,913,428	368,037	7.5
Jhakhand	110,728	10,150	9.2
West Bengal	12,177,099	3,735,034	30.7
118 owns	**26,170,235**	**5,367,885**	**20.5**

Source: Prepared by JICA Survey Team Based on Census 2011 data

For the town-wise percentage of the slum population to the total population in 118 towns, the biggest one is 96.6% of Titagarh in West Bengal, followed by 79.1%% of both Dhulian and Champdani in West Bengal, 70.5% of Rishra in West Bengal and 70.4% of Devprayag in Uttarakhand.

Rudraprayag in Uttarakhand, 10.39% of Begusarai in Bihar, 4.69% of Bihar Sharif in Bihar and 4.34% of phulwari Sharif in Bihar.

19.3.3 Livestock

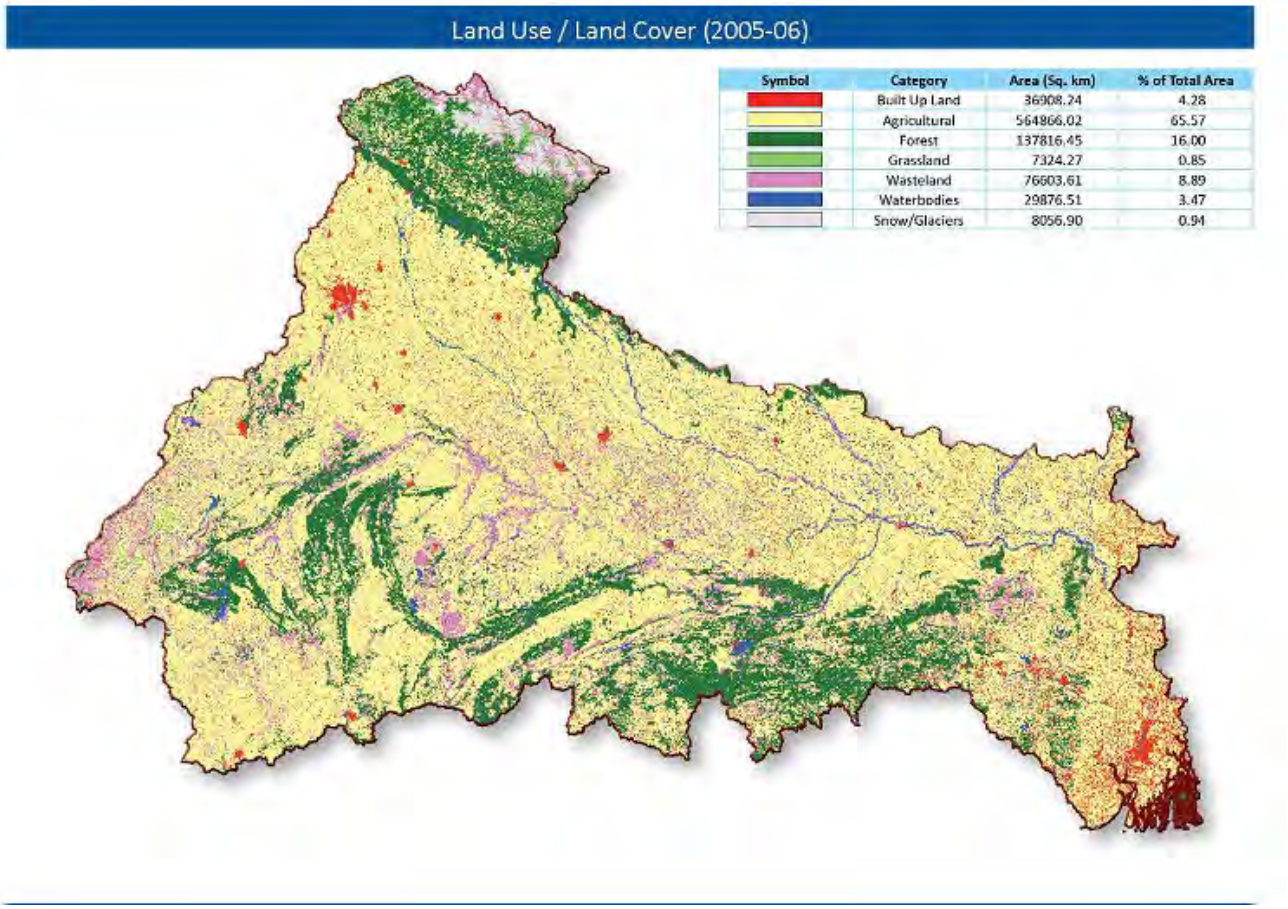
(1) Livestock Census 2012

The Livestock Census 2012 Report gives the district-wise number of livestock, but not town-wise one. For only bovine, the classification of “rural” and “urban” is given. Since the most livestock is farmed in the rural area, the district-wise data does not reflect the exact situation of each town.

Source: Department of Husbandry, Dairying and Fisheries, “19th Livestock Census District Wise Report 2012”
Note: The website PDF file covering the States of Uttarakhand, Uttar Pradesh and West Bengal (Volume III) is not available due to “Broken” as of March 1, 2016.

19.3.4 Land Use

The major part of basin in Indian territory is covered with agricultural land accounting to 65.57% (564,866 km^2) of the total area and 16.00% (137,816 km^2) of the basin is covered by forests, followed by 8.89% (76,604 km^2) by wasteland, 4.28% (36,908 kn^2) by built-up land and 3.47% (29.877 km^2) by water bodies.



Source: Ministry of Water Resources, "Watershed Atlas of India (Version 2.0)", April 2014

Figure 19.3.1 Land Use in the Ganga River Basin

19.3.5 State-wise Gross Domestic Product (GDP)

The percentage of the Gross Domestic Product (GDP) by five states related to the Ganga River Basin to the national GDP has been in the relatively stable range of 20.2% to 21.8% for these seven years (2007-2014) as shown in **Table 19.3.3.** Taking into account the fact that the population percentage of five states to the national population was XX% in the Census 2011, the five states within the Ganga river basin are rather contributed to the nation GDP.

Watching state-wisely them, the GDP percentage of Uttar Pradesh to all India was biggest as 8.2% (ranked at the 2nd), followed by 6.6% of west Bengal (6th), 3.3% of Bihar (13th), 1.8% of Jhakhand (16th) and 1.2% of Uttarakhand (19th).

19.3.6 Below Poverty Line (BPL)

The percentage of the poverty population to the total population was 21.92% in 2011-12, while that of five states related to the Ganga River Basin was 47.3%, which was almost double higher than the national average. It is hard to say the people within the Ganga River Basin is rich.

Watching the state-wisely them, the Jhakhand was highest as 37.8% among five states, followed by 33.7% in Bihar, 29.4% in Uttar Pradesh, 20.0% in west Bengal and 11.3% in Uttarakhand as shown in **Table 19.3.4**. Even the lowest Uttarakhand is ranked at the 14th out of thirty states in India.

Table 19.3.3 Gross State Domestic Product (GSDP) at Current Prices (as on 31-05-2014) Gross

Sl. No.	States/UTs	(Rupee in Crores) - (Data from 2004-05 at 2004-05 Prices)							(% Growth over previous year)							2012-2013 Rank	2012-2013 (%)
		2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-14	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
1	Andhra Pr.	364,813	426,765	476,835	583,762	662,592	754,409	857,364	21.19	16.98	11.73	22.42	13.50	13.86	13.65	3	8.0
2	Arunachal Pr.	4,810	5,687	7,474	9,013	10,619	12,091	13,382	17.09	18.23	31.42	20.59	17.82	13.86	10.68	28	0.1
3	Assam	71,076	81,074	95,975	112,688	125,820	141,621	162,652	9.87	14.07	18.38	17.41	11.65	12.56	14.85	18	1.5
4	Bihar	113,680	142,279	162,923	204,289	247,318	313,995	368,337	12.85	25.16	14.51	25.39	21.06	26.96	17.31	13	3.3
5	Chattisgarh	80,255	96,972	99,364	119,420	132,872	153,621	175,961	20.01	20.83	2.47	20.18	11.26	15.62	14.54	17	1.6
6	Goa	19,565	25,414	29,126	33,605	36,025	34,965	NA	18.41	29.90	14.61	15.38	7.20	2.94	NA	22	0.4
7	Gujarat	329,285	367,912	431,262	521,519	594,563	670,016	NA	16.07	11.73	17.22	20.93	14.01	12.69	NA	5	7.1
8	Haryana	151,596	182,522	223,600	260,621	301,959	345,238	392,894	17.76	20.40	22.51	16.56	15.86	14.33	13.80	12	3.7
9	Himachal Pr.	33,963	41,483	48,189	57,452	64,957	73,710	82,585	12.19	22.14	16.17	19.22	13.06	13.48	12.04	21	0.8
10	J & K	37,099	42,315	48,385	58,073	65,759	75,574	87,319	11.64	14.06	14.34	20.02	13.24	14.93	15.54	20	0.8
11	Jharkhand	83,950	87,794	100,621	127,281	143,891	164,876	189,208	25.42	4.58	14.61	26.50	13.05	14.58	14.76	16	1.8
12	Karnataka	270,629	310,312	337,559	410,703	458,894	524,502	593,811	19.10	14.66	8.78	21.67	11.73	14.30	13.21	7	5.6
13	Kerala	175,141	202,783	231,999	263,773	307,906	349,338	NA	13.89	15.78	14.41	13.70	16.73	13.46	NA	10	3.7
14	Madhya Pr.	161,479	197,276	227,984	263,396	311,670	372,171	450,900	11.69	22.17	15.57	15.53	18.33	19.41	21.15	9	4.0
15	Maharashtra	684,817	753,969	855,751	1,035,086	1,199,548	1,372,644	NA	17.16	10.10	13.50	20.96	15.89	14.43	NA	1	14.6
16	Manipur	6,783	7,399	8,254	9,137	10,504	11,983	NA	10.53	9.08	11.56	10.70	14.96	14.08	NA	29	0.1
17	Meghalaya	9,735	11,617	12,709	14,583	16,412	18,135	20,808	12.87	19.33	9.40	14.75	12.54	10.50	14.74	25	0.2
18	Mizoram	3,816	4,577	5,260	6,388	7,198	8,053	NA	15.99	19.94	14.92	21.44	12.68	11.88	NA	31	0.1
19	Nagaland	8,075	9,436	10,527	11,759	13,203	14,832	NA	11.27	16.85	11.56	11.70	12.28	12.34	NA	27	0.2
20	Odisha	129,274	148,491	162,946	197,530	214,583	255,459	288,414	26.94	14.87	9.73	21.22	8.63	19.05	12.90	15	2.7
21	Punjab	152,245	174,039	197,500	226,204	256,430	286,809	319,117	19.76	14.32	13.48	14.53	13.36	11.85	11.26	14	3.1
22	Rajasthan	194,822	230,949	265,825	338,348	403,422	459,215	513,688	13.90	18.54	15.10	27.28	19.23	13.83	11.86	8	4.9
23	Sikkim	2,506	3,229	6,133	7,412	8,616	9,957	NA	15.96	28.85	89.93	20.85	16.24	15.56	NA	30	0.1
24	Tamil Nadu	350,819	401,336	479,733	584,896	665,312	744,474	850,319	12.98	14.40	19.53	21.92	13.75	11.90	14.22	4	7.9
25	Tripura	11,797	13,573	15,403	17,868	20,982	23,855	NA	8.09	15.05	13.48	16.00	17.43	13.69	NA	24	0.3
26	Uttar Pradesh	383,026	444,685	523,394	600,164	679,007	768,930	886,410	13.89	16.10	17.70	14.67	13.14	13.24	15.28	2	8.2
27	Uttarakhand	45,856	56,025	70,730	83,969	97,696	113,958	132,969	24.63	22.18	26.25	18.72	16.35	16.65	16.68	19	1.2
28	West Bengal	299,483	341,942	398,880	460,959	538,209	620,160	707,848	14.45	14.18	16.65	15.56	16.76	15.23	14.14	6	6.6
29	A & N islands	2,990	3,480	4,120	4,345	4,746	5,067	5,351	17.81	16.39	18.39	5.46	9.23	6.76	5.60	32	0.1
30	Chandigarh	13,669	15,334	17,717	20,017	23,211	26,162	NA	11.35	12.18	15.54	12.98	15.96	12.71	NA	23	0.3
31	Delhi	157,947	189,533	219,396	252,753	296,957	348,221	404,576	16.49	20.00	15.76	15.20	17.49	17.26	16.18	11	3.7
32	Puducherry	9,251	10,050	12,304	13,092	14,630	17,192	21,500	10.99	8.64	22.43	6.40	11.75	17.51	25.06	26	0.2
All-India GDP 04-05 base)		**4,582,086**	**5,303,567**	**6,108,903**	**7,248,860**	**8,391,691**	**9,388,876**	**10,472,807**	**15.91**	**15.75**	**15.18**	**18.66**	**15.77**	**11.88**	11.54		96.9
Five States		**925,995**	**1,072,725**	**1,256,548**	**1,476,662**	**1,706,121**	**1,981,919**	**2,284,772**									
Five States / All India		**20.2%**	**20.2%**	**20.6%**	**20.4%**	**20.3%**	**21.1%**	**21.8%**									

Source: For Sl. No. 1-32 -- Directorate of Economics Statistics of respective State Governments, and for All-India — Central Statistical Organisation; Released on 1st March, 2014; Estimates from 2004-05 to 2010-11 have been discussed with States DES

Table 19.3.4 Number of Persons Below Poverty Line in 2011-12

S. No.	States	Number of Persons in 2011-12			Percentage of Persons 2011-12			Rank
		Rural (lakh)	Urban (lakh)	Total (lakh)	Rural (%)	Urban (%)	Total (%)	
1	Andhra Pradesh	61.80	16.98	78.78	10.96	5.81	9.20	8
2	Arunachal Pradesh	4.25	0.66	4.91	38.93	20.33	34.67	31
3	Assam	92.06	9.21	101.27	33.89	20.49	31.98	28
4	Bihar	320.40	37.75	358.15	34.06	31.23	33.74	30
5	Chhattisgarh	88.90	15.22	104.11	44.61	24.75	39.93	35
6	Delhi	0.50	16.46	16.96	12.92	9.84	9.91	11
7	Goa	0.37	0.38	0.75	6.81	4.09	5.09	3
8	Gujarat	75.35	26.88	102.23	21.54	10.14	16.63	19
9	Haryana	19.42	9.41	28.83	11.64	10.28	11.16	13
10	Himachal Pradesh	5.29	0.30	5.59	8.48	4.33	8.06	5
11	Jammu & Kashmir	10.73	2.53	13.27	11.54	7.20	10.35	12
12	Jharkhand	104.09	20.24	124.33	40.84	24.83	36.96	33
13	Karnataka	92.80	36.96	129.76	24.53	15.25	20.91	24
14	Kerala	15.48	8.46	23.95	9.14	4.97	7.05	4
15	Madhya Pradesh	190.95	43.10	234.06	35.74	21.00	31.65	27
16	Maharashtra	150.56	47.36	197.92	24.22	9.12	17.35	20
17	Manipur	7.45	2.78	10.22	38.80	32.59	36.89	32
18	Meghalaya	3.04	0.57	3.61	12.53	9.26	11.87	16
19	Mizoram	1.91	0.37	2.27	35.43	6.36	20.40	23
20	Nagaland	2.76	1.00	3.76	19.93	16.48	18.88	21
21	Orissa	126.14	12.39	138.53	35.69	17.29	32.59	29
22	Punjab	13.35	9.82	23.18	7.66	9.24	8.26	7
23	Rajasthan	84.19	18.73	102.92	16.05	10.69	14.71	18
24	Sikkim	0.45	0.06	0.51	9.85	3.66	8.19	6
25	Tamil Nadu	59.23	23.40	82.63	15.83	6.54	11.28	15
26	Tripura	4.49	0.75	5.24	16.53	7.42	14.05	17
27	Uttarakhand	8.25	3.35	11.60	11.62	10.48	11.26	14
28	Uttar Pradesh	479.35	118.84	598.19	30.40	26.06	29.43	26
29	West Bengal	141.14	43.83	184.98	22.52	14.66	19.98	22
30	Puducherry	0.69	0.55	1.24	17.06	6.30	9.69	9
31	Andaman & Nicobar Islands	0.04	0.00	0.04	1.57	0.00	1.00	1
32	Chandigarh	0.00	2.34	2.35	1.64	22.31	21.81	25
33	Dadra & Nagar Haveli	1.15	0.28	1.43	62.59	15.38	39.31	34
34	Daman & Diu	0.00	0.26	0.26	0.00	12.62	9.86	10
35	Lakshadweep	0.00	0.02	0.02	0.00	3.44	2.77	2
	All India	**2,166.58**	**531.25**	**2,697.83**	**25.70**	**13.70**	**21.92**	
	Five States	**1,053.23**	**224.02**	**1,277.25**				
	Five States / All India	48.6%	42.2%	47.3%				

Source: Open Government Data (OGD) Platform India (https://data.gov.in/catalog/below-poverty-line-india)

19.3.7 Status of Public Hygiene

The houselisting and housing census 2011 was carried out on the sources of drinking water, holding status and type of latrine, use of electricity, and so on. Since the survey area was the same as that for population census, the houselisting and housing census data is directly expressed the situation of 118 towns.

(1) Holding Status of Latrines by Houses

The percentage of households having a latrine within its premises is highest as 88.7% in UK, followed by 74.1% in UP, 71.6% in BH and 46.5% in JK. The average of 118 towns except for those in WB due to no data availability is 77.6%. (It should be noted that this figure will be changing depending on that of WB, since its population share is as high as 46.5% in 118 towns.)

The households not having a latrine within premises will borrow the neighbour's latrine for use, use a public toilet or make a defecation outdoors within or out of premises. Depending on its form, it may cause the deterioration of surrounding public hygiene. Even 4.9% of households within 118 towns make a defecation outdoors within premises and threaten their own living environment.

Table 19.3.5 Availability of Latrine by Households

State	Latrine Location	Households (HH)			Percentage (%)		
		No. of HHs	Latrine		No. of HHs	Latrine	
			Available	Not Available		Available	Not Available
Uttarakhand	Total number of households	105,465	97,988	7,477	100.0	92.9	7.1
	Within premises	96,017	93,501	2,516	91.0	88.7	2.4
	Near premises	6,244	3,361	2,883	5.9	3.2	2.7
	Away	3,204	1,126	2,078	3.0	1.1	2.0
Uttar Pradesh	Total number of households	1,379,752	1,210,217	169,535	100.0	87.7	12.3
	Within premises	1,072,619	1,022,607	50,012	77.7	74.1	3.6
	Near premises	241,967	155,235	86,732	17.5	11.3	6.3
	Away	65,166	32,375	32,791	4.7	2.3	2.4
Bihar	Total number of households	806,978	645,942	161,036	100.0	80.0	20.0
	Within premises	636,104	577,549	58,555	78.8	71.6	7.3
	Near premises	119,140	53,091	66,049	14.8	6.6	8.2
	Away	51,734	15,302	36,432	6.4	1.9	4.5
Jhakhand	Total number of households	21,541	13,194	8,347	100.0	61.3	38.7
	Within premises	11,812	10,025	1,787	54.8	46.5	8.3
	Near premises	5,209	1,997	3,212	24.2	9.3	14.9
	Away	4,520	1,172	3,348	21.0	5.4	15.5
West Bengal	Total number of households	0	0	0	0.0	0.0	0.0
	Within premises	0	0	0	0.0	0.0	0.0
	Near premises	0	0	0	0.0	0.0	0.0
	Away	0	0	0	0.0	0.0	0.0
Total	Total number of households	2,313,736	1,967,341	346,395	100.0	85.0	15.0
	Within premises	1,816,552	1,703,682	112,870	78.5	73.6	[illegible]
	Near premises	372,560	213,684	158,876	16.1	9.2	6.9
	Away	124,624	49,975	74,649	5.4	2.2	3.2

Note: Data for West Bengal is not available due to the broken file on the website。
Source: Prepared by JICA Survey Team based on Houselisting and Housing Census Data 2011 (http://censusindia.gov.in/2011census/hlo/HLO_Tables.html)

(2) Type of Latrine Facility

Table 19.3.6 shows the type of latrine facility within premises. According to this, the connection rates to a piped sewer system are 64.6% in UK, 47.1% in UP, 28.5% in WB,

11.3% in BH, and 1.8% in JK with a big difference among states concerned. The coverage by a septic tank is highest as 59.5% in BH, followed by 48.5% in WB, 48.3% in JK, 35.0% in UP and 22.5% in UK. The pour flush latrine is generally used for a septic tank which have a water seal unit to avoid the smell emission. The four states except for JK, more than 70% of households use the sanitary latrine with a water seal unit including the flush latrine. In addition, the ventilation-improved pit latrine with a slab is relatively much used at 13.0% households in WB

Out of the households not having latrine facility within premises, 37.8% use the public toilets and remaining 62.2% make a defecation at the vacancy. The open defecation rates to the total households are relatively high as 37.5% in JK and 17.2% in JK. Especially, the Jhakhand State has a big problem in public hygiene

Table 19.3.6 Type of Latrine Facility Used Households in 118 Towns

Number of Households (HHs)

S. No.				Uttarakhand	Uttar Pradesh	Bihal	Jhakhand	West Bengal	Total
(1)	Total number of households			105,465	1,380,980	817,752	21,541	2,569,541	4,895,279
(2)	Number of households having latrine facility within the premises			97,988	1,210,085	656,874	13,194	2,360,374	4,338,515
(3)	Type of latrine facility within the premises	Flush/pour flush latrine connected to	Piped sewer system	68,138	650,681	92,656	379	584,455	1,396,309
(4)			Septic tank	23,721	482,974	486,213	10,394	1,369,749	2,373,051
(5)			Other system	374	23,564	29,235	978	44,142	98,293
(6)		Pit latrine	With slab/ ventilated improved pit	5,168	22,901	30,298	828	334,460	393,655
(7)			Without slab/ open pit	88	5,762	8,465	198	10,021	24,534
(8)		Night soil disposed into open drain		347	13,685	6,050	399	6,813	27,294
(9)		Service Latrine	Night soil removed by human	62	6,539	1,968	11	2,171	10,751
(10)			Night soil serviced by animal	90	3,979	1,989	7	8,563	14,628
(11)	Number of households not having latrine facility within the premises			7,477	170,895	160,878	8,347	209,167	556,764
(12)	No latrine within premises	Alternative source	Public latrine	2,485	50,470	20,445	268	136,663	210,331
(13)			Open	4,992	120,425	140,433	8,079	72,504	346,433

Percentage (%)

S. No.				Uttarakhand	Uttar Pradesh	Bihal	Jhakhand	West Bengal	Total
(2)	Total number of households			100.0	100.0	100.0	100.0	100.0	100.0
(3)	Number of households having latrine facility within the premises			92.9	87.6	80.3	61.3	91.9	88.6
(4)	Type of latrine facility within the premises	Flush/pour flush latrine connected to	Piped sewer system	64.6	47.1	11.3	1.8	22.7	28.5
(5)			Septic tank	22.5	35.0	59.5	48.3	53.3	48.5
(6)			Other system	0.4	1.7	3.6	4.5	1.7	2.0
(7)		Pit latrine	With slab/ ventilated improved pit	4.9	1.7	3.7	3.8	13.0	8.0
(8)			Without slab/ open pit	0.1	0.4	1.0	0.9	0.4	0.5
(9)		Night soil disposed into open drain		0.3	1.0	0.7	1.9	0.3	0.6
(10)		Service Latrine	Night soil removed by human	0.1	0.5	0.2	0.1	0.1	0.2
(11)			Night soil serviced by animal	0.1	0.3	0.2	0.0	0.3	0.3
(12)	Number of households not having latrine facility within the premises			7.1	12.4	19.7	38.7	8.1	11.4
(13)	No latrine within premises	Alternative source	Public latrine	2.4	3.7	2.5	1.2	5.3	4.3
(14)			Open	4.7	8.7	17.2	37.5	2.8	7.1

Source: “Houselisting and Housing Census 2011”

19.3.8 Status of Ghats, Crematoria, etc.

Table 19.3.7 Status of Ghats and Crematoria

Towns	State	No. of Ghats	No. of Crematoria	Source
Haridwar	Uttarakhand	12		Website
Kanpur	Uttar Pradesh	29	N/A	CDP (2006)
Allahabad	Uttar Pradesh			
Varanasi	Uttar Pradesh	84	(2)	CDP (2015)
Patna	Bihar	20	3	DPR, CDP (2010-30)
Kolkata	West Bengal		7	Website
Kamarhati	West Bengal	13		DPR
Kanchrapara	West Bengal	16		DPR
Panihati	West Bengal	16		DPR
Howrah	West Bengal	7	1	DPR
Bally	West Bengal	7		DPR
Bansberia	West Bengal	?		DPR
Titagarth	West Bengal	4		DPR

CDP: City Development Plan DPR: Detailed Project Report

19.4 Irrigation, Water Supply and Other Water Use

19.4.1 Irrigation

The Ganga Basin happens to be one of the most widely and heavily irrigated agricultural lands in the world. The net area irrigated through all available sources is roughly 3,61,100 km^2 (2008) which constitutes about 57% of the total net irrigated area across the country. The farmers of this region practice multiple cropping in large parts of the basin, hence the fields get irrigated more than once a year. The sum of these multiple irrigated areas can be estimated to be about 4,84,240 km^2 which is the gross irrigated area. Precipitation through the atmosphere is the sole source of water which falls as rain, snow, sleet, or hail and acts as a water resource to the flowing river as well as the recharging of the Gangotri glacier. Much of the water runs off the land surface and also seeps through the subsoil layer eventually recharging the groundwater. A portion of the water amounting to about 30% is lost to the atmosphere through transpiration and evaporation. During its movement either on the surface or at the subsurface level, it absorbs large number of chemical constituents, some of which are the residues of pesticides and fertilizers which are used to supplement the growth of crops.

Table 19.4.1 State / Source-wise net area irrigated (2000-2001) in the Ganga Basin

S. No.	Name of the State/UT	Canals (Km^2)	Tank (Km^2)	Wells (Km^2)	Other Sources (Km^2)	Total Area (All Sources) (Km^2)
1	**Bihar**	**11360**	**1550**	**20390**	**2410**	**36250**
2	Haryana	14760	10	14670	140	29580
3	Himachal Pradesh	30	(a)	140	1070	1240
4	Madhya Pradesh	8080	850	26510	5910	41350
5	Rajasthan	13540	380	34730	420	49070
6	**Uttar Pradesh**	**30910**	**820**	**93840**	**2590**	**128160**
7	**West Bengal**	**2610**	**1730**	**13970**	**5230**	**23540**
8	Delhi	20	-	300	20	340
	Ganga Basin States	81310	5340	205090	17790	309530
	India as a Whole	159890	25240	332770	28920	546820

Source: Water Data- Complete Book, Central Water Commission, GoI, 2005
Note: (a): Below 5000 km^2 Total may not tally due to rounding off.

The net irrigated area in the Ganga Basin constitutes nearly 56.6 percent of India's 546, 820 km^2 of net irrigated area. About 41.4 per cent of the basin's irrigated area lies in Uttar Pradesh alone. In fact, the three Gangetic States - Uttar Pradesh, Bihar and West Bengal - have between them 60.7 per cent of the basin's total area irrigated.[7]

Table 19.4.2 shows the breakdown of water sources for irrigation in Uttar Pradesh in 2012-13. The use of irrigation canals is stayed at 16.7%, compared with 67.0% from private tubewells, 4.0% from governmental tubewells and 12.3% from others.

Similarly, in Bihar in 2009-10, the water sources for irrigation are 68.8% from private tubewells, 23.0% from irrigation canals, 1.9% from tanks, 0.2% from other wells and 5.4% from other sources.

[7] http://agropedia.iitk.ac.in/content/agricultural-characteristics-ganga-basin

Table 19.4.2 Breakdown of Water Sources for Irrigation in Uttar Pradesh (2012-13)

S. No.	District	Net Irrigated Area	Canal	Govt. Tubewell	Private Tubewell	Other Sources
1	Saharanpur	256,216	41,200	9,569	205,447	0
2	Muzaffarnagar	219,617	54,098	2,674	139,489	20,356
3	Shamli	**	**	**	**	**
4	Bijnor	307,157	16,642	6,114	186,249	98,152
5	Moradabad	182,286	12,391	8,590	64,643	96,662
6	Sambhal	**	**	**	**	**
7	Rampur	189,062	644	183	88,524	99,711
8	Amroha	170,595	0	213	113,939	56,443
9	Meerut	196,462	33,299	2,459	160,512	192
10	Baghpat	107,927	3,554	15,491	88,597	285
11	Ghaziabad	52,655	8,903	4,313	38,045	1,394
12	Hapur	**	**	**	**	**
13	Gautam Buddha Nagar	57,909	13,210	1,774	27,305	15,620
14	Bulandshahar	298,076	25,755	2,956	260,982	8,383
15	Aligarh	303,127	26,860	5,225	270,689	353
16	Hathras	149,515	12,680	1,439	135,371	25
17	Mathura	266,472	84,417	161,234	20,821	0
18	Agra	257,401	22,175	4,503	230,438	285
19	Firozabad	175,871	17,404	625	156,390	1,452
20	Etah	180,643	21,792	7,516	151,335	0
21	Kasganj	140,981	12,532	3,407	73,890	51,152
22	Mainpuri	183,294	54,679	9,182	116,817	2,616
23	Budaun	336,392	4	7,319	177,669	151,400
24	Bareilly	314,776	18,472	1,670	181,403	113,231
25	Pilibhit	230,142	35,130	433	194,574	5
26	Shahjahanpur	322,827	11,488	385	288,717	22,237
27	Kheri	412,165	16,743	2,467	392,955	0
28	Sitapur	394,610	18,640	6,192	369,591	187
29	Hardoi	391,993	54,956	4,197	332,818	22
30	Unnao	295,777	71,736	628	222,809	604
31	Lucknow	128,743	23,020	4,786	100,856	81
32	Rae Bareli	161,048	61,655	1,941	97,319	133
33	Amethi	173,978	84,926	6,176	70,473	12,403
34	Farrukhabad	138,195	2,982	5,322	129,891	0
35	Kannauj	139,896	11,253	4,466	121,036	3,141
36	Etawah	130,000	63,274	5,164	61,488	74
37	Auraiya	121,537	48,781	2,151	70,313	292
38	Kanpur Dehat	155,705	55,255	7,879	92,501	70
39	Kanpur Nagar	120,760	25,409	6,798	87,489	1,064
40	Jalaun	235,700	149,784	19,069	40,780	26,067
41	Jhansi	247,182	100,657	2,121	16,772	127,632
42	Lalitpur	282,099	93,832	530	65,478	122,259
	Total	**8,425,791**	**1,410,232**	**337,161**	**5,644,415**	**1,033,983**
	Percentage (%)	**100.0**	**16.7**	**4.0**	**67.0**	**12.3**

Source: Economics and Statistics Division, State Planning Institute, Planning Department、UP, "Statistical Diary – Uttar Pradesh 2014"

19.4.2 Water Supply

The data herein handled is based on the results of Houselisting and Housing Census 2011. Accordingly, the total population and the served population by water supply are not necessary follow the actual service area exactly defined in a water supply scheme, but reflect the rough figure of service coverage in the urban area.

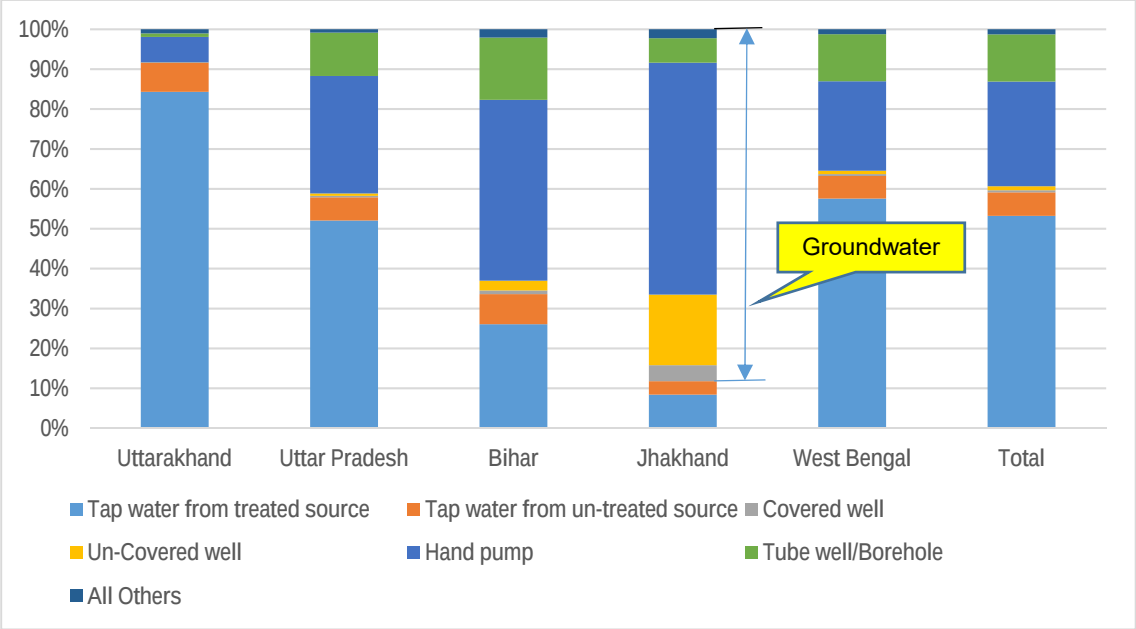
Table 19.4.3 Main Source of Drinking Water in 118 River Front Towns

(Unit: HHs)

Main source of drinking water	Uttarakhand	Uttar Pradesh	Bihar	Jhakhand	West Bengal	Total
All sources	105,465	1,379,752	806,978	21,541	4,881,805	7,195,541
Tap water from treated source	88,923	717,949	210,319	1,809	2,808,705	3,827,705
Tap water from un-treated source	7,709	80,595	60,744	730	277,028	426,806
Covered well	51	5,137	7,538	858	22,759	36,343
Un-covered well	22	7,882	19,629	3,816	41,760	73,109
Hand pump	6,705	406,493	365,881	12,522	1,095,393	1,886,994
Tube well/borehole	944	149,902	126,055	1,324	574,721	852,946
All others	1,111	11,794	16,812	482	61,439	91,638

Source: JICA Survey Team based on Houselisting and Housing Census 2011

The percentage of tap water from treated source is highest as 84.3% in UK, which is declined towards the downstream of the River Ganga such as 52.0% in UP, 26.1% in Bihar, only 8.4% in JK and then restored to 63.2% in WB with an average of 53.2% in the Ganga Basin. Adversely, the use of hand pumps is high as 58.1% in JK, 45.3% in Bihar, 29.5% in UP and 22.4% in WB and the use of tubewells is high as 15.6% in BH, 11.8% in WB and 10.9% in UP. Especially in JK and BH, the dependence on groundwater is very high as 86.0% and 64.3%, respectively. This supports that the Gangetic Plain is blessed with groundwater as stated in "**19.2.5 Hydrogeology**".



Source: Prepared by JICA Survey Team based on the results of "Houselisting and Housing Census – 2011"

Figure 19.4.1 State-wise Main Source of Drinking Water in 118 River Front Towns

19.5 Existing and Proposed Sewerage Facilities

19.5.1 Existing Sewerage Facilities

Tables 19.5.1 and **19.5.2** shows the status of sewerage project implementation in the River Ganga basin and their details, respectively.

Table 19.5.1 Status of Sewerage Project Implementation in the River Ganga Basin

State	Class							Total Capacity (MLD)
	I	II	III	IV	V	VI	Total	
Uttarakhand	1	1	3	3	3	4	15	
	1	1	2	2	2	2	10	94.30
Uttar Pradesh	11	10	8	2			31	
	6	2	3	1			12	1197.86
Bihar	12	9	5				26	
	5						5	282.00
Jhakhand		1	1				2	
		1					1	12.00
West Bengal	32	10	2				44	
	20	6	2				28	557.13
Total	56	31	19	5	3	4	118	
	32	10	7	3	2	2	56	2143.29
STP-Existing/Sanctioned Town								
Uttarakhand	Haridwar	Rishikesh	Tehri, Srinagar	Uttarkashi, Muni ki Reti-Dhaluwara	Kamaprayag, Rudraprayag	Badrinath, Devprayag		
Uttar Pradesh	Allahabad, Kanpur, Mirzapur, Varanasi, Moradabad, Ballia	Bijnor, Kannauj	Anupshahar, Garhmukteshwar, Narara	Bithoor				
Bihar	Buxar, Hajipur, Munger, Patna, Begusarai							
Jhakhand		Sahebganj						
West Bengal	Kolkata, Nabadwip, Barackpore, Baidyahati, Champdani, Bhadreshwar, Baranaagar, Naihati, Serampore, Maheshtala, Panihati, Bally, Khardah, Howrah, Bansberia, Chandannagar, Titagarh, Halishahar, Kalyani, Bhatpara	Jiaganj-Azimganj, Katwa, Konnagar, Budge Budge, Gayespur, Gaulia	Murshidabad, Diamond Harbour					

Table 19.5.2 Details of Sewerage Facilities in the River Ganga

S. No.	State	Class of Town	District	Town	Type	Date of Sanction	Name/ Nature of Works	EAP	STP Capacity			Sewer Network		Total Expenditure	Overall Physical Progress (%)	
									To be created (MLD)	To be created through rehab. (MLD)	Created (MLD)	To be laid (km)	Laid (km)			
1			Haridwar	Haridwar	NPP + OG + ITS	23/03/2011	SN		-			13.49	11.81	16.72	100	
		I				23/03/2011	STP (Sarai)		18.00		18.00			18.94	100	
						28/09/2015	STP (Jagjeetpur)		40.00							
2		II	Dehradun	Rishikesh (including Tapovan)	NPP	23/03/2011	SN		-			1.02	1.02	3.53	100	
3		III	Chamoli	Gopeshwar	NPP	18/03/2010	I&D		-			35.63	20.31	8.72	61	
4			Tehri Garhwal	Tehri	NPP	23/03/2011	SN, STP		3.50			11.04	10.00	12.34	92	
6		IV	Chamoli	Joshimath	NPP	17/03/2010	I&D		-			27.66	4.67	4.32	40	
			Uttarkashi	Uttarkashi (Budkot)	NPP	23/03/2011	SN, STP									
7						25/06/2015	SN *1									
8	Uttarakhand		Tehri Garhwal	Muniki Reti - Dhaluwala	NP + CT	26/12/2013	SN, STP	World Bank	7.50			29.52		0.26		
10		V	Chamoli	Karnaprayag	NP	24/12/2008	STP		1.40					0.00	0	
						20/07/2009	I&D		-			1.50	1.35	0.96	12	
11			Rudraprayag	Rudraprayag	NPP	22/09/2009	I&D		-			6.69	1.62	0.68	12	
						22/09/2009	STP		3.00					0.00	0	
14		Vi	Chamoli	Badrinath(puri)	NP	16/10/2008	I&D									
						22/08/2008	STP		3.00							
15			Tehri Garhwal	Devprayag	NP	08/07/2009	I&D		-			7.61	4.50	2.99	58	
						22/07/2009	STP		1.40					2.91	95	
						20/06/2015	SN *1									
									77.80		18.00	134.16	55.28	72.37		
17			Allahabad	Allahabad	M Corp. + OG + CB	06/05/2010			85.00		85.00	10.88	10.77	161.66	93	
						06/05/2010	SN, STP, RFD, LCS	World Bank	20.00		20.00	9.24	8.31	82.30	93	
						22/02/2011	SN ("E")	World Bank				109.20	108.00	117.99	93	
						27/11/2013	STP (Salori)	World Bank	14.00					6.33	25	
						27/11/2013	SN ("C" & Allahpur)	World Bank				134.19		12.60	7	
		I				20/02/2014	SN ("A")	World Bank				241.63		24.22		
						30/12/2014	SN ("B")	World Bank				214.88				
21			Varanasi	Varanasi	M Corp.	29/03/2011	RFD							0.72	12	
						29/08/2011										
						14/07/2010	SN, STP, RFD, LCS	JICA	140.00			28.00	12.00	144.84	27	
23			Moradabad	Moradabad (Ramganga)	M Corp	24/02/2011	SN, STP		58.00		52.00	264.25	213.53	124.01	73	
28		III	Kannauj	Kannauj	NPP	24/02/2011	SN, STP		1.00			62.50	46.25	19.77	48	

Table 19.5.2 Details of Sewerage Facilities in the River Ganga (Cont'd)

S. No.	State	Class of Town	District	Town	Type	Date of Sanction	Name/ Nature of Works	EAP	STP Capacity			Sewer Network		Total Expenditure	Overall Physical Progress (%)	
									To be created (MLD)	To be created through rehab. (MLD)	Created (MLD)	To be laid (km)	Laid (km)			
37			Bulandshahr	Anupshahar	NPP	19/05/2014	STP (Shahar)	World Bank	2.50			58.88				
40		III	Ghaziabad	Garhmukhteshwar	NPP	22/02/2011	SN, STP		9.00			69.00	55.20	25.78	74	
42			Bulandshahar	Narora	NP	04/04/2014	SN, STP	World Bank	4.00			21.03				
45		IV	Kanpur Nagar	Bithoor	NP	26/12/2013	SN, STP	World Bank	2.40			32.00				
									335.90		157.00	1255.68	454.06	720.22		
49			Buxar	Buxar	NP	08/03/2010	SN, STP	World Bank (Retroactive)	16.00			95.21	38.00	13.45	36	
51			Vaishali	Hajipur	NP	08/03/2010	SN, STP		22.00			198.00	61.50	32.48	47	
52			Munger	Munger	M Corp.	20/05/2010	SN, STP	World Bank (Retroactive)	27.00			143.00	14.50	3.24	21	
53			Patna	Patna	M Corp. + OG	19/06/2013	RFD	World Bank						50.14	53	
						26/12/2013	STP (Pahari)	World Bank	35.00	25.00				0.00		
						26/12/2013	SN (Zone IVA)	World Bank				87.69		0.00		
		I				20/02/2014	SN (Zone V)	World Bank				110.65		0.00		
						15/07/2014	STP (Beur)	World Bank	8.00	35.00						
						15/07/2014	STP (Kamalichak)	World Bank	33.00	4.00						
						30/12/2014	SN (Beur)	World Bank				179.74				
						30/12/2014	SN (Kamalichak)	World Bank				96.54				
						01/04/2015	SN, STP (Saidpur)	World Bank	60.00			55.10				
						01/04/2015	SN (Saidpur)	World Bank				172.50				
55			Begusarai	Begusarai	M Corp	08/03/2010	SN, STP	World Bank (Retroactive)	17.00			105.00	26.00	13.93	32	
									218.00	64.00		1243.43	140.00	113.24		
73	Jhakhand	II	Sahebganj	Sahebganj	NP	26/12/2013	SN, STP (Sahibganj)	World Bank	12.00			55.00		0.75	0	
									12.00			55.00		0.75		
75			Kolkata	Kolkata	M Corp.	10/01/2010	I&D, Afforestation							8.65	100	
						10/01/2010	RFD							13.00	100	
						29/01/2010	RFD, CRE							14.00	100	
	Westb Bengal	I				29/01/2010	RFD *2							8.30	100	
83			North 24 Parganas	Barrackpore	M	22/02/2011	RFD							6.23	100	
						30/12/2014	SN, STP	World Bank	24.00			247.14				
84			8.77	Uttarpara Kotrung	M	22/02/2011	RFD							8.77	100	

Table 19.5.2 Details of Sewerage Facilities in the River Ganga (Cont'd)

S. No.	State	Class of Town	District	Town	Type	Date of Sanction	Name/ Nature of Works	EAP	STP Capacity			Sewer Network		Total Expenditure	Overall Physical Progress (%)	
									To be created (MLD)	To be created through rehab. (MLD)	Created (MLD)	To be laid (km)	Laid (km)			
85			Hugli	Rishra	M	03/02/2010	RFD							2.33	100	
86			Hugli	Baidyabati	M	02/02/2010	RFD							4.72	100	
89			North 24 Parganas	Kamarhati	M	24/06/2010	RFD							11.33	100	
91			North 24 Parganas	Naihati	M	01/02/2010	RFD							10.57	100	
93			Hugli	Serampore	M	29/01/2010	RFD							3.62	100	
94			Hugli	Hugli-Chinsurah	M + OG	22/02/2011	RFD, CRE							9.99	100	
95			South 24 Parganas	Maheshtala	M	16/11/2010	RFD, CRE							7.82	100	
96			North 24 Parganas	Panihati	M	24/06/2010	RFD							11.70	100	
97			Haora	Bally	M	29/06/2010	RFD							4.55	100	
99			Haora	Howrah	M Corp	27/01/2010	CRE							2.40	100	
						02/02/2010	RFD							9.00	100	
100			North 24 Parganas	Khardah	M	01/02/2010	RFD							3.53	100	
101			Hugli	Bansberia	M	27/01/2010	RFD							11.75	100	
102			Hugli	Chandannagar	M Corp	01/02/2010	RFD							4.30	100	
103			North 24 Parganas	Titagarh	M	29/06/2010	RFD									
104			North 24 Parganas	Halishahar	M	22/02/2011	RFD, CRE							11.81	100	
						28/02/2014	SN, STP	World Bank	16.00			226.99		0.16		
105			Nadia	Kalyani	M	01/03/2011	SN, STP		5.00			51.00	4.30	58.77	59	
106			North 24 Parganas	Bhatpara	M + OG	01/03/2011	SN, STP		31.00			125.00	34.00	116.96	57	
113		II	Hugli	Konnagar	M	22/02/2011	RFD							5.32	100	
114			South 24 Parganas	BudgeBudge	M	22/02/2011	RFD							4.63	100	
						11/07/2014	SN, STP	World Bank	9.30			131.59		0.12		
115			Nadia	Gayespur	M	22/02/2011	SN, STP		8.23			61.00	20.00	77.24	100	
									93.53			842.72	58.30	431.57		

I&D: Interception and Divergence
SN: Sewer Network
CRE: Electric Crematoria
RFD: River Front development
DR: Disaster Restoration
LCS: Low Cost Sanitation
*1 Restoration and Reconstruction of SN due to Disaster
*2 Resuscitation of Chelta Boat Canal joining Ganga
Source: *https://nmcg.nic.in/Uttrakhand_Project.aspx*
https://nmcg.nic.in/writereaddata/fileupload/8_MPR%20NGRBA_Projects__statusUP_September-2015%20A4%20pg.pdf
Note: The sanction date is based on "Project Sanctioned" data of NMCG official website.

19.6 Status of Industrial Wastewater

19.6.1 Grossly Polluting Industries

The National River Conservation Authority (NRCA) in its meeting held on July 12, 1997 under the Chairmanship of the Prime Minister, decided that the polluting industries which are directly discharging their effluents into rivers and lakes, without requisite treatment, should be asked to install the requisite effluent treatment systems within three months, failing which closure notices should be issued.

The criteria defined for the National River Conservation Plan (NRCP) was to include those industries which (I) discharge their effluents into a water course including rivers and lakes, and (ii) are either involved in manufacture & use of hazardous substances or discharge effluents with a BOD load of 100kg/day or more, or both. These industries are called as Grossly Polluting Industries.

As on September 2009, a total of 478 GPIs were identified in Ganga Basin, out of which 348 industries have installed ETPs and operating satisfactorily, 56 industries are not operating satisfactorily and 74 industries have been closed down.

Table 19.6.1 Grossly Polluting Industries in the Ganga Basin

No.	Rivers	OPRS	OPRNS	UCL	Total
1	Betwa	0	1	0	1
2	Chambal	0	0	0	0
3	Damodar	3	0	0	3
4	Gandak	0	0	0	0
5	Ganga	95	22	38	155
6	Ghaghra	2	0	1	3
7	Gomti	21	5	4	30
8	Hindon	26	0	4	30
9	Kali	45	0	10	55
10	Khan	0	0	0	0
11	Kosi	1	3	0	4
12	Kshipra	0	0	0	0
13	Ramganga	30	17	4	51
14	Yamuna	125	8	13	146
	Total	**348**	**56**	**74**	**478**

http://www.moef.nic.in/sites/default/files/ngrba/Ganga%20Basin.pdf

OPRS- ETP operating satisfactorily
OPRNS- ETP not operating satisfactorily
UCL- Unit closed

CPCB has designated the following 17 categories as grossly polluting Industries:

Table 19.6.2 Categories Designated as Grossly Polluting Industries

1	Aluminium Smelter	10	Pesticides
2	Caustic Soda	11	Petrochemicals
3	Cement	12	Drugs & Pharmaceuticals
4	Copper Smelter	13	Pulp & Paper
5	Distilleries	14	Oil Refineries
6	Dyes & Dye Intermediates	15	Sugar
7	Fertiliser	16	Thermal Power Plants
8	Integrated Iron & Steel	17	Zinc Smelter
9	Tanneries		

The information on grossly polluting industries is collected through a questionnaire. The format of the questionnaire is duly filled by the regional offices of the concerned state Boards. The filled questionnaire after judicious scrutiny by in-house experts has been summarized below**.** It is pertinent to mention that this database is primarily on the information of grossly polluting industries. Grossly Polluting Industries (GPI) are defined as the industry which is discharging wastewater more than 100KLD and/or hazardous chemicals used by the industry as specified under the Schedule-I, Part-II of "The Manufacture, Storage and Import of Hazardous Chemical Rules of 1989" under "Environment (Protection) Act, 1986".

Industrial units are classified in following sectors.

- Chemicals: which mainly include fertilizer, petro-chemical, pesticides and pharmaceuticals.
- Distillery
- Dairy, Food & Beverage
- Pulp and Paper
- Sugar
- Tannery
- Textile, Bleaching & Dyeing
- Other (Cement, Slaughter house, Ordinance, Packaging & printing, Paint, Electronics& Electrical, Thermal, Kattha –kachh, Electroplating, Metallurgical, automobile etc.

Table 19.6.3 State-wise Status

S. No.	Action/State	Uttar Pradesh	Uttar-akhand	Bihar	West Bengal	Total
1	Direction under section 5 of Environment (Protection) Act, 1986	142	3	0	1	**146**
2	Direction under section 18(1)(b) of Water Act, 1974	12	0	0	1	**13**
3	Letter issued for ensuring compliance	25	2	1	6	**34**
4	No action required	23	0	0	0	**23**
5	Found closed	11	1	0	0	**12**
6	Action under process	158	4	0	15	**177**
7	Inspection report under preparation	33	2	0	1	**36**
	TOTAL	**404**	**12**	**1**	**24**	**441**

Source: CPCB, "Pollution Assessment: River Ganga", July 2013

Table 19.6.4 Industrial Sector-wise Status

S. No.	Action/ State	Distillery & Fermentation	Sugar	Pulp & Paper	Tannery	Chemical	Food, Dairy & Beverage	Dyeing & Textile	Other	Total
1	Direction under section 5 of Environment (Protection) Act, 1986	23	3	10	106	1	1	2	0	**146**
2	Direction under section 18(1)(b) of Water Act,1974	0	1	0	11	0	0	0	1	**13**
3	Letter issued for ensuring compliance	3	10	5	3	2	0	3	8	**34**
4	No action required	1	0	1	20	1	0	0	0	**23**
5	Found closed	1	1	3	6	0	0	1	0	**12**
6	Action under progress	14	3	7	110	10	11	10	12	**177**
7	Inspection report under preparation	1	0	6	3	9	4	3	10	**36**
	TOTAL	**43**	**18**	**32**	**259**	**23**	**16**	**19**	**31**	**441**

Source: CPCB, "Pollution Assessment: River Ganga", July 2013

19.6.2 Problem Areas Identified by CPCB

CPCB has identified 24 problem areas in the country where industrial and anthropogenic activities are concentrating and cause rigorous environmental degradation. These problem areas are presented in **Table 19.6.5**. In the Ganga Basin, Singrauli in Uttar Pradesh and Durgapur and Howrah (or Haora) in West Bengal are designated as the problem area.

Table 19.6.5 Problem Areas Identified by CPCB

Sl. No.	Problem Area Identified by CPCB	State
1.	**Durgapur**	**West Bengal**
2.	**Howrah**	**West Bengal**
3.	Dhanbad	Jharkhand
4.	Angul Talcher	Orissa
5.	**Singrauli**	**Uttar Pradesh (U.P.)**
6.	Vishakapatnam	Andhra Pradesh (A.P.)
7.	Bolaram-Patancheru	Andhra Pradesh (A.P.)
8.	Bhadravathi	Karnataka
9.	Greater Cochin	Kerala
10.	Manali	Tamilnadu (T.N.)
11.	North Arcot	Tamilnadu (T.N.)
12.	Ankleshwar	Gujarat
13.	Vapi	Gujarat
14.	Chembur	Maharashtra
15.	Tarapur	Maharashtra
16.	Digboi	Assam
17.	Parwanoo	Himachal Pradesh (H.P.)
18.	Kala-Amb	Himachal Pradesh (H.P.)
19.	Mandi Gobindgarh	Punjab
20.	Nagda-Ratlam	Madhya Pradesh (M.P.)
21.	Korba	Chattisgarh
22.	Chembur	Maharashtra
23.	Pali-Jodhpur	Rajasthan
24.	Drain Basin Area, Najafgarh	Delhi

19.6.3 Notice to Industries

CPCB declared the following Notice to Highly Polluting Industries issued on February 11, 2016.

The Central Pollution Control Board had issued "show cause notice" (dated: July 2015 and August 2015) under the provision of section 5 of Environment (Protection) Act, 1986 to 3387 highly polluting Industries of 17 categories. The following 815 industrial units have not responded to the show cause notice issued to them wherein 256 directions were returned undelivered and 559 have

not responded. This has been viewed seriously on the part of the industry for noncompliance of directions.

Notice is hereby, issued to the listed industries that should respond immediately but not later than within a weeks' time from the publication of this notice failing which the industry shall be liable for closure for noncompliance for the direction under section 5 of Environment (Protection) Act, 1986.

As an Example, the Notice to one sugar industry was as follows:

WHEREAS, the Unit was inspected under National Ganga River Basin Authority (NGRBA) programme by the officials of Central Pollution Control Board (CPCB} on 29.12.2015, and observed the following:

1. ETP outlet effluent sample analysis showed BOD 130 mg/l and COD 257 mg/l as against the prescribed limits of BOD 100 mg/l and COD 250 mg/l.

It is evident from the above observations that the Unit is violating the notified general effluent standards under the Environment (Protection) Act, 1986 and the Unit without complying with the prescribed effluent discharge standards is discharging its partially treated effluent for irrigation purpose or in drain thereby posing serious threat to the surface and groundwater quality.,

NOW, THEREFORE, in view of the above observations and the exercise of powers delegated to the Chairman, Central Water Pollution Board under Section 5 of the Environment (Protection) Act, 1986, notice is hereby served to the Unit to Show Cause why the Unit should not be closed down for not complying with the prescribed effluent discharge standards notified under the Environment (Protection) Rules, 1986 and amendment thereof.

The reply to the Show Cause Notice shall be submitted to this office within 20 days from the date of receipt of this notice.

While, for another sugar industry

WHEREAS, the Unit was inspected under National Ganga River Basin Authority (NGRBA) programme by the officials if Central Pollution Control Board (CPCB) 0n 02.01.2016, and observed the following:

1. *ETP outlet effluent sample analysis showed BOD 808 mg/l and COD 1234 mg/l as against the prescribed limits of BOD 100 mg/l and COD 250 mg/l.*

2. *During inspection, ETP was found not operational.*
3. *Unit has not constructed separate lagoon for storage of treated effluent and was found discharging partially treated effluent via tankers to local drain/fields.*

For the factory not complied with the effluent standards, CPCB has responded strictly regardless of their extents exceeding the standards

19.6.4 Pollution Load on the River Ganga Discharged through Drains

Drains are the channels which are either man made or available in the system naturally to carry storm water to its disposal point which can be either a river or a lake/pond or sea. However, in absence of sewerage systems, drains are turned into open sewers to carry storm water and sewage.

CPCB has identified 138 drains and discharging 6087 MLD of wastewater. In Uttrakhand 14 nos. of drains are discharging 440 MLD of industrial and domestic wastewater directly/indirectly to river Ganga. Uttar Pradesh discharges 3,289 MLD of industrial and domestic wastewater through 45 drains. 25 no. of drains identified in state of Bihar discharging 579 MLD of wastewater to river Ganga. 1,779 MLD of wastewater discharges to river Ganga through 54 drains in West Bengal. Details are mentioned below:

The BOD load discharged from the drains into the Ganga is biggest as 558 t/day (or 55.9% of the total) in the Kanpur Region followed by 77 t/day (7.7%) in the Jajmau Region.. These adjoining two regions discharge almost two-third BOD load of the total into the Ganga.

Table 19.6.6 State-wise Flow and BOD Load Discharged into Drains/Nallas

State	No. Of Drains	Flow (MLD)	BOD Load (Tonnes / Day)
Uttarakhand	14	440	42
Uttar Pradesh	45	3,289	761
Bihar	25	579	99
West Bengal	54	1,779	97
Total	138	6,087	999

Source: CPCB, "Pollution Assessment: River Ganga", July 203

The BOD load of each drain/*nalla* is attributed to a variety of wastewater such as domestic/ commercial wastewater not connected to a public sewer system, effluent discharged from septic tanks, washed-out human and livestock excreta on the ground, industrial wastewater with/without treatment, agricultural drain and so on collected in respective basins. Accordingly, although those are tentatively allocated to the towns immediately upstream of a confluence with drain/*nalla*, such BOD load does not mean the load that was generated within the said town.

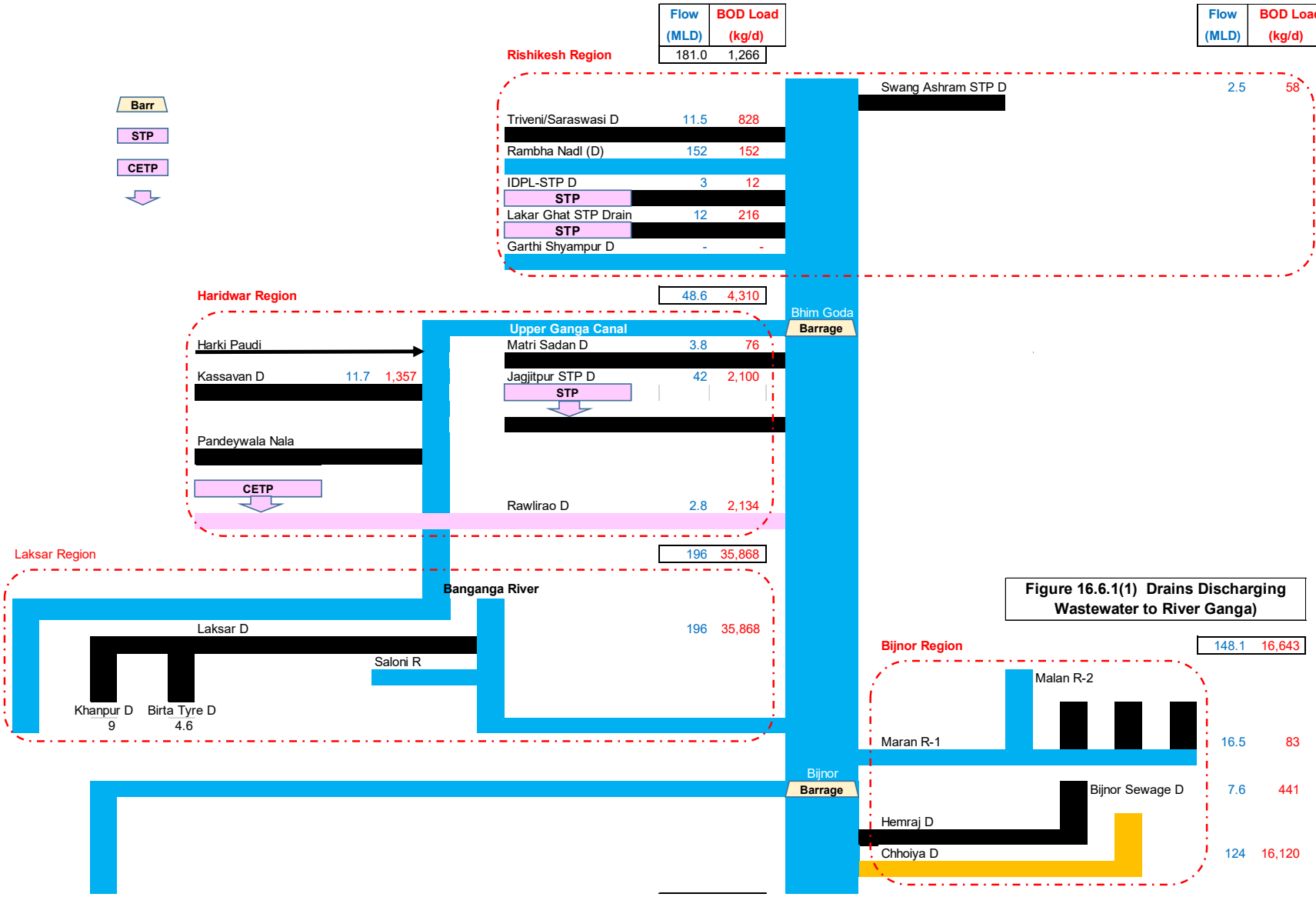


Figure 16.6.1(1) Drains Discharging Wastewater to River Ganga)

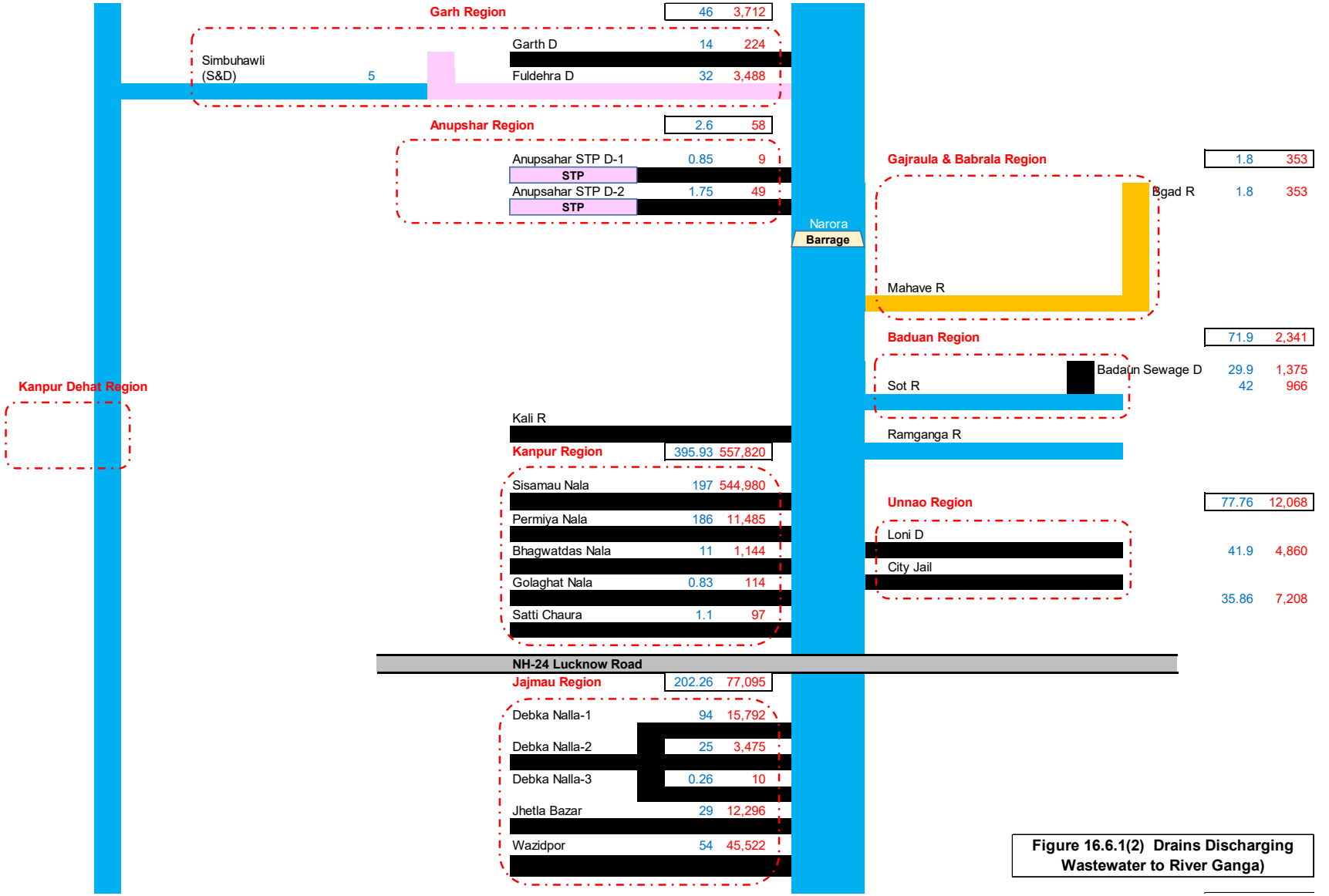


Figure 16.6.1(2) Drains Discharging Wastewater to River Ganga)

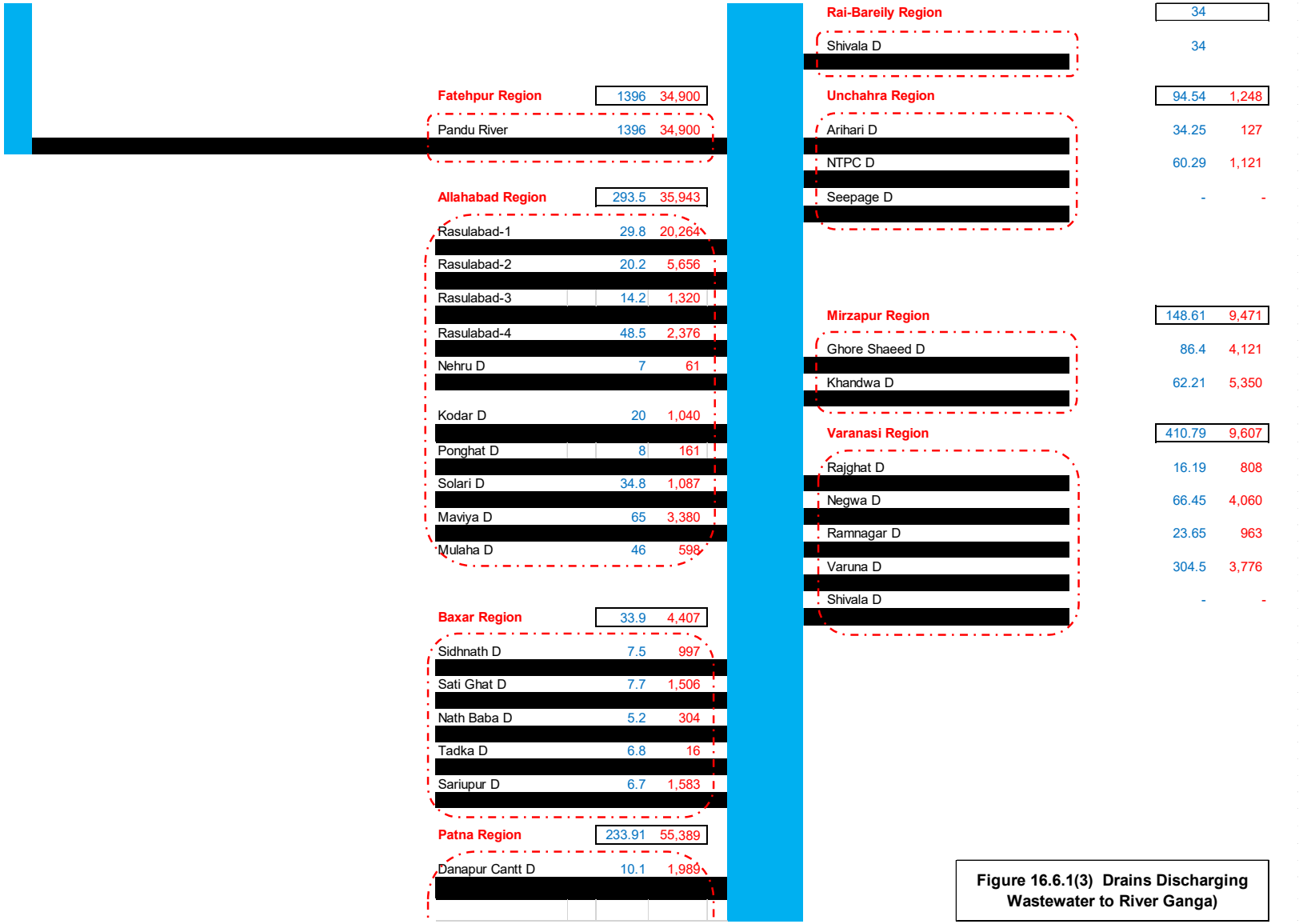


Figure 16.6.1(3) Drains Discharging Wastewater to River Ganga)

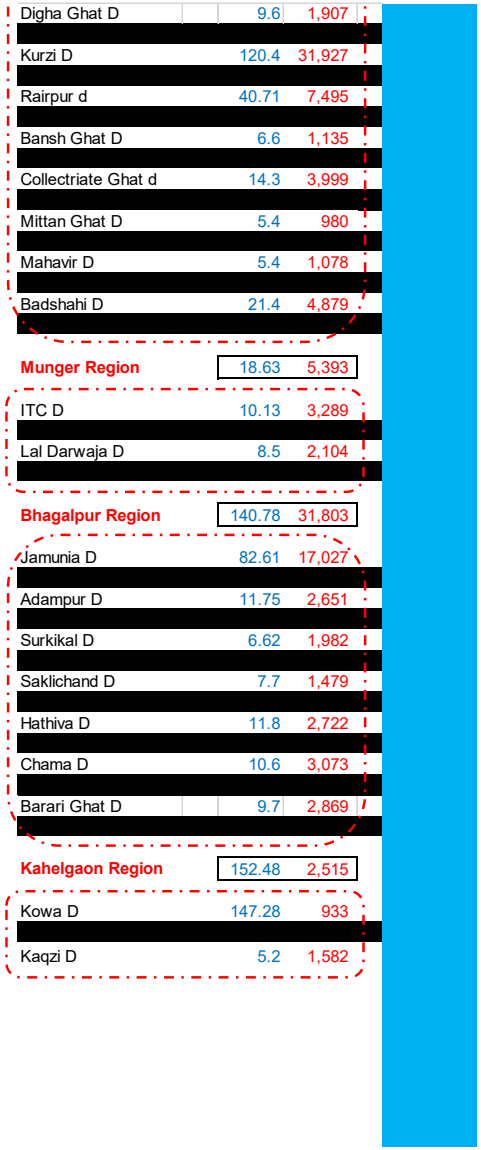
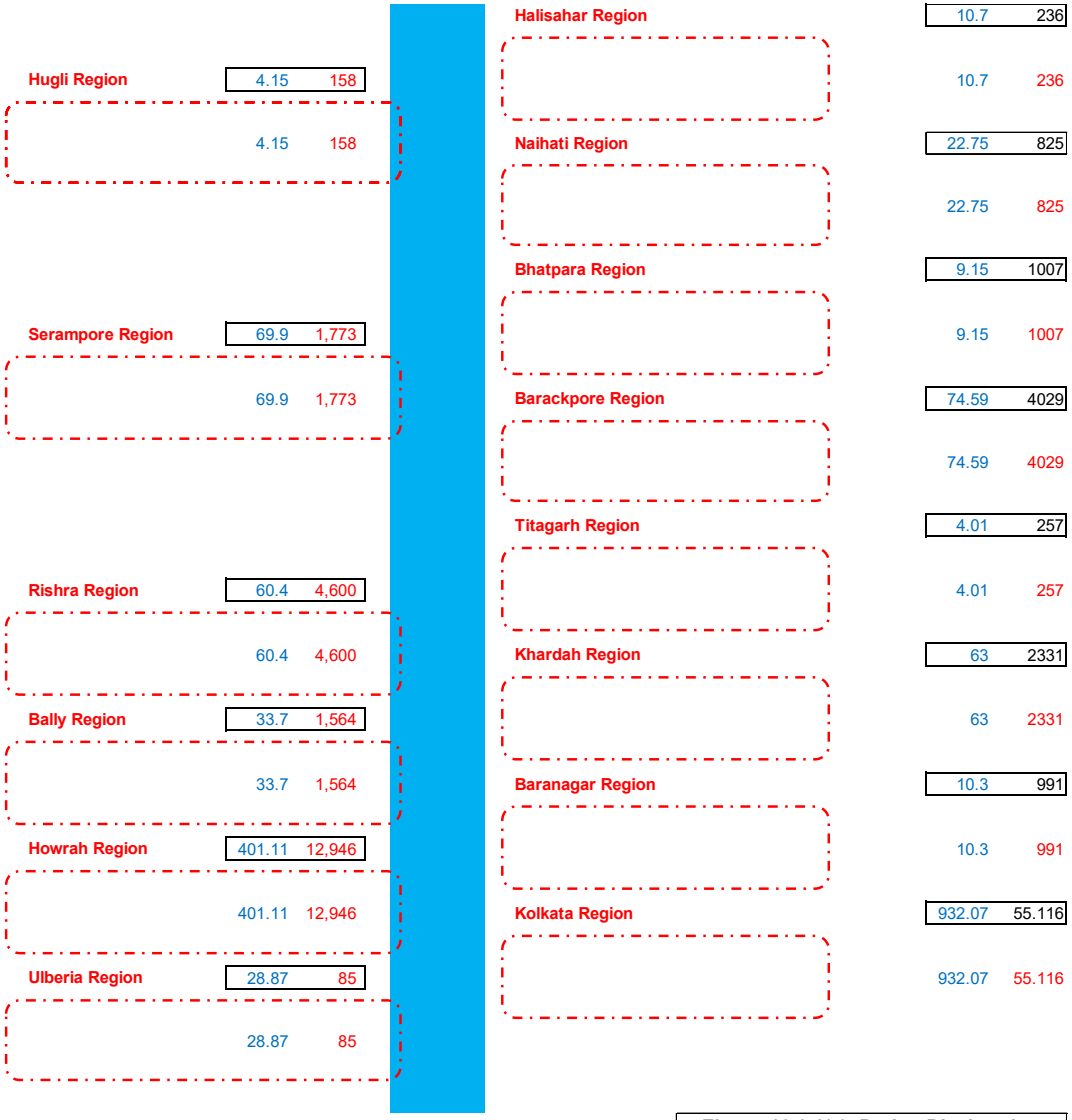


Figure 16.6.1(4) Drains Discharging Wastewater to River Ganga)



Source: *Central Pollution Control Board, "Pollution Assessment : River Ganga", July 2013*

Note: Prepared by JICA Survey Team referring the above reference with corrections of discreancies in figures between Table and Figure therein.

Figure 16.6.1(5) Drains Discharging Wastewater to River Ganga)

19.7 Situation of Solid Waste Management

According to the Progress Report (October 2015) for "**Data Collection and Clarification Study on Improvement of Environment in Varanasi City**" prepared by Kokusai Kogyo Co., Ltd. under the assistance of JICA, the situation of solid waste management in Varanasi is described as follows:

"As of August 2015, the Varanasi Municipal Corporation (VMC) directly provides waste collection and disposal services to its citizens. Until 15th May, 2014, all waste management had been outsourced to a private company called A2Z Infrastructure Private Limited, based on the concession agreement. However, due to financial disagreements between the VMC and A2Z, A2Z withdrew from the entire business of solid waste management in Varanasi city.

In the VMC area, in general, the general public and business entities discharge their waste onto the road side nearby, and 2,600 municipal sanitary workers manually collect these heaps of waste on the roads and bring them to the municipal storage depots by tricycle. Then the bulk of waste is loaded onto the dumper trucks and tractors at the municipal storage depots, and then transferred to the final disposal site."

The Ministry of Urban Development (MoUD), India has prescribed the benchmarks of administrative services such as water supply, sewerage, solid waste management and storm water drain, monitored their town-wise achievements and declared as"Benchmarking Urban Services in India - Targeting Improved Performance – Status Report 2011-12" on the website. For solid waste management, the following benchmarks are given.

Table 19.7.1 Benchmarks of Solid Waste Management in India

	Indicator	Benchmark
1	Household level coverage of solid waste management services	100%
2	Efficiency of collection of municipal solid waste	100%
3	Extent of segregation of municipal solid waste	100%
4	Extent of municipal solid waste recovered	80%
5	Extent of scientific disposal of municipal solid waste	100%
6	Efficiency in redressal of customer complaints	80%
7	Extent of cost recovery in SWM services	100%
8	Efficiency in collection of SWM charges	90%

Source: Ministry of Urban Development, "Handbook of Service Level Benchmarking"

Each indicator is defined as shown in **Table 19.7.2**.

Table 19.7.2 Definition of Indicators for Solid Waste Management

S. No.	Indicator	Unit	Definition
1	Household level coverage of solid waste management services	%	Percentage of households and establishments that are covered by a daily doorstep collection system.
2	Efficiency of collection of municipal solid waste	%	The total waste collected by the ULB and authorized service providers versus the total waste generated within the ULB, excluding recycling or processing at the generation point. (Typically, some amount of waste generated is either recycled or reused by the citizens themselves. This quantity is excluded from the total quantity generated, as reliable estimates will not be available for these.)
3	Extent of segregation of municipal solid waste	%	Percentage of waste from households and establishments that is segregated. Segregation should at least be at the level of separation of wet and dry waste at the source, that is, at the household or establishment level. Ideally, the separation should be in the following categories: bio-degradable waste, waste that is non-biodegradable, and hazardous domestic waste such as batteries, etc. In line with this description, the ULB may further refine the criteria for classifying waste as being 'segregated'. It is important that waste segregated at the source is not again mixed, but transported through the entire chain in a segregated manner. It is therefore important that this indicator is based on measurement of waste arriving in a segregated manner at the treatment/disposal site, rather than being measured at the collection point.
4	Extent of municipal solid waste recovered	%	This is an indication of the quantum of waste collected, which is either recycled or processed. This is expressed in terms of percentage of waste collected.
5	Extent of scientific disposal of municipal solid waste	%	The amount of waste that is disposed in landfills that have been designed, built, operated and maintained as per standards laid down by Central agencies. This extent of compliance should be expressed as a percentage of the total quantum of waste disposed at landfill sites, including open dump sites.
6	Efficiency in redressal of customer complaints	%	The total number of SWM-related complaints redressed within 24 hours of receipt of the complaint, as a percentage of the total number of SWM-related complaints received in the given time period.
7	Extent of cost recovery in SWM services	%	This indicator denotes the extent to which the ULB is able to recover all operating expenses relating to SWM services from operating revenues of sources related exclusively to SWM. This indicator is defined as the total annual operating revenues from SWM as a percentage of the total annual operating expenses on SWM.
8	Efficiency in collection of SWM charges	%	Efficiency in collection is defined as current year revenues collected, expressed as a percentage of the total operating revenues, for the corresponding time period.

Source: Ministry of Urban Development, "Handbook of Service Level Benchmarking"

According to ”Benchmarking Urban Services in India - Targeting Improved Performance – Status Report 2011-12”, which is the latest version of this survey, The report covers the towns in 13 states out of thirty (32) states/UTs of India such as Andhra Pradesh, **Bihar**, Chhattisgarh, Gujarat, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Rajasthan, Tripura and **Uttar Pradesh**. There is no change in the number of states from 2010-11 version.

Table 19.7.3 Service Coverage by Solid Waste Management

Uttar Pradesh

NMCG: Important 118 River Front Towns Identified						Solid waste Management															
S. No.	Class of Town	District	Town	Type	Census 2011 Population	Household Level Coverage		Efficiency of Collection of MSW		Extent of Segregation		Extent of MSW recovered		Extent of scientific disposal		Efficiency in redressal of customer complaints		Cost recovery		Efficiency in collection of charges	
						100%		100%		100%		80%		100%		80%		100%		90%	
						Status 2010-11	Target 2011-12	Status 2010-11	Target 2011-12	Status 2010-11	Target 2011-12	Status 2010-11	Target 2011-12	Status 2010-11	Target 2011-12	Status 2010-11	Target 2011-12	Status 2010-11	Target 2011-12	Status 2010-11	Target 2011-12
16		Farrukhabad	Farrukkabad	NPP	276,581		0.0	89.0	98.0		0.0		0.0		0.0		0.0		0.0		0.0
17		Allahabad	Allahabad	M Corp. + OG + CB	1,195,329	20.0	30.0	71.0	81.0	0.0	5.0		5.0	0.0	0.0	73.0	80.0	0.0	5.0		5.0
18		Ghazipur	Ghazipur	NPP + OG	121,020			100.0	100.0		0.0		0.0		0.0		0.0		0.0		0.0
19		Kanpur Nagar	Kanpur	M Corp. + OG + CB	2,876,591	40.0	50.0	72.0	80.0	43.0	48.0		80.0	0.0	50.0	85.0	85.0	0.0	10.0		5.0
20	I	Mirzapur	Mirzapur	NPP	234,871			95.0	105.0		0.0		0.0		0.0		0.0		0.0		0.0
21		Varanasi	Varanasi	M Corp.	1,198,491	27.3	37.3	85.8	100.0	0.0	5.0		0.0	0.0	0.0	66.0	76.0	0.3	5.0		45.0
22		Chandauli	Mughal Sarai	NPP	109,650			100.0	100.0		0.0		0.0		0.0		0.0		0.0		0.0
23		Moradabad	Moradabad (Ramganga)	M Corp	887,871	35.4	40.4	63.7	68.7	46.0	51.0		8.3	0.0	0.0	83.3	83.3	0.0	5.0		5.0
24		Ballia	Ballia	NPP	104,424			100.0	100.0		0.0		0.0		0.0		0.0		0.0		0.0
25		Unnao	Unnao	NPP	177,658			80.0	88.0		0.0		0.0		0.0		0.0		0.0		0.0
26		Fatehpur	Fatehpur	NPP	193,193			94.0	103.0												
27		Bijnor	Bijnor	NPP	93,297			100.0	100.0												
28		Kannauj	Kannauj	NPP	84,862			100.0	100.0												
29		Unnao	Gangaghat	NPP	84,072																
30		Bijnor	Najibabad	NPP	88,535			100.0	100.0												
31	II	Jyotiba Phule Nagar	Gajraula	NP	55,048																
32		Bijnor	Nagina	NPP	95,246			100.0	100.0												
33		Bijnor	Chandpur	NPP	83,441			100.0	100.0												
34		Bijnor	Dhampur	NPP	50,997			100.0	100.0												
35		Bulandshahar	Jahangirabad	NPP	59,858			79.0	87.0												
36		Sant Ravidas Nagar	Bhadohi	NPP	94,620			80.0	88.0												
37		Bulandshahr	Anupshahar	NPP	29,087																
38		Mirzapur	Chunar	NPP	37,185			56.0	62.0												
39		Ghazipur	Saidpur	NP	24,338																
40	III	Ghaziabad	Garhmukhteshwar	NPP	46,077			100.0	100.0												
41		Varanasi	Ramnagar	NPP	49,132			100.0	100.0												
42		Bulandshahar	Narora	NP	22,775																
43		Kanshiram Nagar	Soron	NPP	27,468			100.0	100.0												
44		Meerut	Hastinapur	NP	26,452		10.0	100.0	100.0		5.0		5.0			93.3	93.3		5.0		5.0
45	IV	Kanpur Nagar	Bithoor	NP	11,300																
46		Budaun	Babrala	NP	18,108																
					8,457,577																

Table19.7.3 Service Coverage by Solid Waste Management (Cont'd)

Bihar

NMCG: Important 118 River Front Towns Identified						Solid waste Management															
S. No.	Class of Town	District	Town	Type	Census 2011 Population	Household Level Coverage		Efficiency of Collection of MSW		Extent of Segregation		Extent of MSW recovered		Extent of scientific disposal		Efficiency in redressal of customer complaints		Cost recovery		Efficiency in collection of charges	
						100%		100%		100%		80%		100%		80%		100%		90%	
						Status 2010-11	Target 2011-12	Status 2010-11	Target 2011-12	Status 2010-11	Target 2011-12	Status 2010-11	Target 2011-12	Status 2010-11	Target 2011-12	Status 2010-11	Target 2011-12	Status 2010-11	Target 2011-12	Status 2010-11	Target 2011-12
47		Bhojpur	Arrah	M Corp.	261,430		20.0	50.0	65.0		20.0					50.0	65.0		25.0		30.0
48		Bhagalpur	Bhagalpur	M Corp.	252,008	30.0	50.0	80.0	90.0	20.0	35.0					90.0	95.0		40.0	10.0	50.0
49		Buxar	Buxar	NP	102,861		20.0	50.0	65.0		20.0					50.0	65.0		35.0		35.0
50		Saran	Chapra	NP	202,352		20.0	50.0	60.0		20.0					50.0	65.0		30.0		35.0
51		Vaishali	Hajipur	NP	147,688		20.0	50.0	65.0		20.0					50.0	65.0		30.0		35.0
52		Munger	Munger	M Corp.	213,303		25.0	50.0	65.0		25.0					50.0	65.0		40.0		40.0
53	I	Patna	Patna	M Corp. + OG	1,684,297	20.0	40.0	80.0	90.0	30.0	40.0					70.0	85.0		30.0	20.0	40.0
54		Patna	Danapur (Dinapur Nizamat)	NP + CB	211,152		20.0	50.0	65.0		15.0					50.0	65.0		30.0		30.0
55		Begusarai	Begusarai	M Corp	252,008		25.0	40.0	60.0		25.0					50.0	65.0		30.0		30.0
56		Katihar	Katihar	M. Corp + OG	240,838		25.0	50.0	65.0		20.0					50.0	65.0		35.0		35.0
57		Munger	Jamalpur	NP	105,434		20.0	50.0	65.0		20.0					50.0	65.0		35.0		35.0
58		Nalanda	Bihar Sharif	M. Corp	297,268		25.0	50.0	65.0		20.0					50.0	65.0		35.0		40.0
59		Patna	Mokameh	NP	60,678		20.0	40.0	60.0		15.0					50.0	65.0		30.0		35.0
60		Patna	Fatuah	NP	50,961																
61		Patna	Barh	NP	61,470		20.0	40.0	55.0		20.0					50.0	65.0		25.0		30.0
62		Begusarai	Barauni	NP	71,660																
63	II	Bhagalpur	Sultanganj	NP	52,892		20.0	30.0	45.0		15.0					50.0	65.0		30.0		35.0
64		Buxar	Dumraon	NP	53,618		20.0	30.0	45.0		20.0					50.0	65.0		30.0		30.0
65		Kaimur (Bhabua)	Bhabua	NP	50,179		20.0	30.0	45.0		15.0					50.0	65.0		25.0		30.0
66		Lakhisarai	Lakhisarai	NP	99,979		20.0	50.0	65.0		15.0					50.0	65.0		30.0		35.0
67		Patna	Phulwari Sharif	NP	81,740		20.0	30.0	45.0		15.0					50.0	65.0		30.0		35.0
68		Lakhisarai	Barahiya	NP	43,032																
69		Bhagalpur	Kahelgaon (Colgong)	NP + CT	33,700																
70	III	Patna	Bakhtiyarpur	NP	47,897																
71		Bhagalpur	Naugachhia	NP	49,069																
72		Saran	Sonepur	NP	37,776																
					4,765,290																

19.8 Status of Assistance by Other Donors

The external assistance to India by various donors are summarized in **Table 19.13.1** with their focusing field.

Table 19.8.1 External Assistance to India

Country	Focusing Field	Project	2014-15	
			Loan (crore)	Grant (crore)
Bilateral				
France (AFD)	• Sustainable management of global public goods • Preservation of bio-diversity		214	
Germany (KfW, GIZ)	• Energy • Environmental policy • Protection and sustainable use of natural resources • Sustainable economic development	(See **Sub-Section 16.15.3**)	378	12
Japan (JICA)		(See **Sub-Section 16.15.2**)	4774	
Russian Federation	• Nuclear Power Plant	• Kudankulam Nucleat Power Project•		
Unted Kingdom (IK)	• Millenium Development Goal (MDG) in the area of health, education, slum development, etc.		557	
USA (USAID)	• To strengthen health systems • To develop replicable models to extend food security • To accelerate transition to a low emmissions and energy secure economy • To reduce greenhouse gas emmissions through carbon sequestration by forests • To assist individuals and communities to adapt to climate change, and • To improve the quality of basic education through teachers training and development			
Multi Lateral				
ADB	• Many assistance to water supply and sewerage through a sector loan especially for Karnataka, Rajasthan and Madhya Pradesh	• North Karnataka Urban Sector Investment Program • Rajasthan Urban Sector Development Investment Program • Kolkata Environmental Improvement Investment Plan • Uttarakhand Urban Sector Development Investment Program • Urban Water Supply and Environmental in Madhya Pradesh	5537	0.62
European Union (EU)	• Environment, public health and education	• Sarva Shiksha Abhiyan (SSA) • National Rural Health Mission (NRHM) • Reproductive Child Health (RCH) • Sector Policy Support Programme for Elementary and Secondary Education		
Global Fund Organization	• To prevent and treat HIV and AIDS, tuberculosis and malaria		331	
IBRD	• To reduce poverty in middle-income countries and creditworthy poorer countries • Infrastructure projects (Power Sector and Roads)	(See **Sub-Section 16.15.1**)	2907	69
IDA	• Poverty reduction		6239	6
IFAD	• Agriculture, rural development, tribal development, womenn's empowerment, natural resources management and rural fnance sector		168	
UNDP	• Capacity developmentb in sustainable human development (SHD)			

Source: "Receipt Budget, 2015-2016, External Assistance"

19.8.1 World Bank

The World Bank has committed US$ 1 billion assistance to the Government of India for the Ganga Rejuvenation Project on November 2011 and conducted the survey for the following towns up to now. Some of them have already entered into the project implementation stage.

Table 19.8.2 Towns Studied by the World Bank for National Ganga River Basin Project

State	Towns Studied
Uttarakhand	Muni Ki Reti-Dhalwala
Uttar Pradesh	Allahabad (District "A", "B", "C" & "E"), Anupsahar, Narora, Kanpur, Bithoor
Bihar	Begusarai, Buxar, Munger, Patna (Saidpur, Beur & Karmalichak)
Jharkhand	Sahibganj
West Bengal	Halisahar, Barackpore, Budge Budge

The World Bank has released nineteen (19) environment assessment reports, two (2) resettlement plans and three (3) indigenous people plans for the project implementation in 14 towns from July 2014 to February 2016 and clarified the problems and solutions therein.

19.8.2 ADB

Original Loan:	US$162.71 million	16 April 2002 – 20 November 2012
Supplemental Loan:	US$ 79.06 million	01 June 2007 – 13 November 2013

Table 19.8.3 ADB-assisted Project

City	Output
Kolkata	Kolkata Environmental Improvement Project Sewerage and Drainage Assessment of targets versus project achieved under S&D reveals the following: (a) 378 km of S&D network was constructed covering the entire project area (100% of the revised target set in 2008); (b) 218 km of existing S&D conduits were renovated and desilted as per the actual requirement, against the estimated target of 364 km; (c) the target of augmentation of 3 existing sewage treatment facilities was fully achieved; (d) 20 new pumping stations were constructed and 22 existing pumping stations rehabilitated with increased efficiencies and capacities (100% achievement of the revised target set in 2008); (e) 14 water bodies were rehabilitated; and (f) 46,145 sewerage connections were provided, achieving full coverage in project areas. (ii) Canal improvement

Source: ADB, "India: Kolkata Environmental Improvement Project – Completion Report", September 2015

19.8.3 JICA

The assistance by JICA for sewerage and sanitation sectors are summarized in **Table 19.13.4** for technical assistance and **Table 19.13.5** for loan

The assistance of JICA to the National Ganga Rejuvenation Project has been focused on Varanasi only so far including non-sewerage component such as the construction of public toilets in the ghat area.

Table 19.8.4 JICA's Technical Assistance for Sewerage and Sanitation Sector

Project Name	Survey Area	Prepared in
Data collection survey on improvement of environment in Varanasi city	Varanasi	2016.2
Data collection and clarification study on sanitation facilities (latrines) in India	States of Rajasthan, Uttar Pradesh and Tamil Nadu	2015.3
Study for formulation and revision of manuals on sewerage and sewage treatment phase-2	-	2013.3
Study for formulation and revision of manuals on sewerage and sewage treatment phase-1	-	2011.3
Study on augmentation of water supply and sanitation for the Goa State	Goa State	2006.11

Source: JICA, "Data Collection Survey on Improvement of Environment in Varanasi City", February 2016

Table 19.8.5 JICA's Assistance for Sewerage Sector (Loan)

Project Name	L/A	Loan Amount (JY million)
Project for Pollution Abatement of River Mula-Mutha in Pune	2016/1/13	19,064
Guwahati Sewerage Project	2015/2/27	15,620
Yamuna Action Plan Project (III)	2011/2/17	32,571
Tamil Nadu Urban Infrastructure Project	2008/3/10	8,551
Goa Water Supply and Sewerage Project	2007/9/14	22,806
Amritsar Sewerage Project	2007/3/30	6,961
Orissa Integrated Sanitation Improvement Project	2007/3/30	19,061
Bangalore Water Supply and Sewerage Project (II-2)	2006/3/31	28,358
Hussain Sagar Lake and Catchment Area Improvement Project	2006/3/31	7,729
Ganga Action Plan Project (Varanasi)	2005/3/31	11,184
Bangalore Water Supply and Sewerage Project (II-1)	2005/3/31	41,997
Yamuna Action Plan Project (II)	2003/3/31	13,333

Source: JICA

19.8.4 GIZ

So far, GIZ or the German Technical Cooperation has no direct assistance for the National Ganga River Basin Project but focus on the area of energy, sustainable economic development, environmental policy, conservation and sustainable use of natural resources. There are many supports in the field of renewable energy such as solar power generation and climate change. GIZ has been involved in the preparation of several state action plans on climate change, including Uttar Pradesh and West Bengal. Besides the above, GIZ has supported to the preparation of City Sanitation Plans (CSPs) as shown in **Table 19.13.6.**

Table 19.8.6 Assistance by GIZ for the Preparation of CSPs

Project Name	Period	Executing Agency	Target Area	Expected Achievements
Support to National Urban Sanitation Policy (SNUSP) (II)	2014-2017	MoUD	Plural cities will be selected	To enhance the capacities at state and city level towards adopting participatory processes for formulating and implementing city-wide sanitation plans
Support to National Urban Sanitation Policy (SNUSP) (I)	2011-2014	MoUD	Six cities	Support the preparation of City Sanitation Plan (CSP) for six cities

Source: JICA, "Data Collection Survey on Improvement of Environment in Varanasi City", February 201

19.9 Status of DPR Preparation and Structure of Project Implementation

The status of DPR preparation by 118 river front towns are shown in **Table 19.8.1**.

Table 19.9.1 Status of DPR Preparation (As of February 29, 2016)

S. No.	State	Class of Town	District	Town	Type	Status of DFR
1	Uttar-akhand	I	Haridwar	Haridwar	NPP + OG + ITS	
2		II	Dehradun	Rishikesh (including Tapovan)	NPP	
3		III	Chamoli	Gopeshwar	NPP	I&D
4			Tehri Garhwal	Tehri	NPP	
5			Garhwal	Srinagar	NPP	
6		IV	Chamoli	Joshimath	NPP	I&D+STP
7			Uttarkashi	Uttarkashi (Budkot)	NPP	
8			Tehri Garhwal	Muniki Reti - Dhaluwala	NP + CT	
9		V	Chamoli	Gaucher	NP	
10			Chamoli	Karnaprayag	NP	I&D

S. No.	State	Class of Town	District	Town	Type	Status of DFR
11			Rudraprayag	Rudraprayag	NPP	I&D
12		VI	Garhwal	Kirtinagar	NP	
13			Chamoli	Nandprayag	NP	
14			Chamoli	Badrinath(puri)	NP	STP (3 MLD)
15			Tehri Garhwal	Devprayag	NP	STP (1.4 MLD)
16	Uttar Pradesh	I	Farrukhabad	Farrukkabad	NPP	
17			Allahabad	Allahabad	M Corp. + OG + CB	
18			Ghazipur	Ghazipur	NPP + OG	
19			Kanpur Nagar	Kanpur	M Corp. + OG + CB	
20			Mirzapur	Mirzapur	NPP	
21			Varanasi	Varanasi	M Corp.	
22			Chandauli	Mughal Sarai	NPP	
23			Moradabad	Moradabad (Ramganga)	M Corp	
24			Ballia	Ballia	NPP	
25			Unnao	Unnao	NPP	
26			Fatehpur	Fatehpur	NPP	
27		II	Bijnor	Bijnor	NPP	
28			Kannauj	Kannauj	NPP	
29			Unnao	Gangaghat	NPP	
30			Bijnor	Najibabad	NPP	
31			Jyotiba Phule Nagar	Gajraula	NP	
32			Bijnor	Nagina	NPP	
33			Bijnor	Chandpur	NPP	
34			Bijnor	Dhampur	NPP	
35	Uttar Pradesh	II	Bulandshahar	Jahangirabad	NPP	
36			Sant Ravidas Nagar	Bhadohi	NPP	
37		III	Bulandshahr	Anupshahar	NPP	
38			Mirzapur	Chunar	NPP	
39			Ghazipur	Saidpur	NP	
40			Ghaziabad	Garhmukhteshwar	NPP	
41			Varanasi	Ramnagar	NPP	
42			Bulandshahar	Narora	NP	
43			Kanshiram Nagar	Soron	NPP	
44			Meerut	Hastinapur	NP	
45		IV	Kanpur Nagar	Bithoor	NP	
46			Budaun	Babrala	NP	
47	Bihar	I	Bhojpur	Arrah	M Corp.	
48			Bhagalpur	Bhagalpur	M Corp.	
49			Buxar	Buxar	NP	SN & STP (16 MLD)
50			Saran	Chapra	NP	
51			Vaishali	Hajipur	NP	SN & STP (22 MLD)
52			Munger	Munger	M Corp.	SN & STP (27 MLD)
53			Patna	Patna	M Corp. + OG	
54			Patna	Danapur (Dinapur Nizamat)	NP + CB	

S. No.	State	Class of Town	District	Town	Type	Status of DFR
55			Begusarai	Begusarai	M Corp	SN & STP (17 MLD)
56			Katihar	Katihar	M. Corp + OG	
57			Munger	Jamalpur	NP	
58			Nalanda	Bihar Sharif	M. Corp	
59		II	Patna	Mokameh	NP	
60			Patna	Fatuah	NP	
61			Patna	Barh	NP	
62			Begusarai	Barauni	NP	
63			Bhagalpur	Sultanganj	NP	
64			Buxar	Dumraon	NP	
65			Kaimur (Bhabua)	Bhabua	NP	
66			Lakhisarai	Lakhisarai	NP	
67			Patna	Phulwari Sharif	NP	
68		III	Lakhisarai	Barahiya	NP	
69			Bhagalpur	Kahelgaon (Colgong)	NP + CT	
70			Patna	Bakhtiyarpur	NP	
71			Bhagalpur	Naugachhia	NP	
72			Saran	Sonepur	NP	
73	Jhakhand	II	Sahebganj	Sahebganj	NP	
74		III	Sahebganj	Rajmahal	NP	
75	West Bengal	I	Kolkata	Kolkata	M Corp.	I&D*
76			Maldah	English Bazaar	M	
77			Murshidabad	Bahrampur	M	
78			Nadia	Santipur	M	
79			Purba Medinipur	Haldia	M	
80	West Bengal	I	Uttar Dinajpur	Raiganj	M	
81			Nadia	Krishnanagar	M	
82			Nadia	Nabadwip	M	
83			North 24 Parganas	Barrackpore	M	
84			Hugli	Uttarpara Kotrung	M	
85			Hugli	Rishra	M	RFD
86			Hugli	Baidyabati	M	RFD
87			Hugli	Champdani	M	
88			Hugli	Bhadreshwar	M	
89			North 24 Parganas	Kamarhati	M	RFD (13 Ghats)
90			North 24 Parganas	Baranagar	M	
91			North 24 Parganas	Naihati	M	RFD
92			North 24 Parganas	Kanchrapara	M + OG	RFD (16 Ghats)
93			Hugli	Serampore	M	RFD
94			Hugli	Hugli-Chinsurah	M + OG	RFD
95			South 24 Parganas	Maheshtala	M	RFD
96			North 24 Parganas	Panihati	M	RFD (16 Ghats)

S. No.	State	Class of Town	District	Town	Type	Status of DFR
97			Haora	Bally	M	RFD (7 Ghats)
98			Haora	Ulluberia	M + OG	
99			Haora	Howrah	M Corp	RFD & EC
100			North 24 Parganas	Khardah	M	RFD
101			Hugli	Bansberia	M	RFD (? Ghats)
102			Hugli	Chandannagar	M Corp	RFD
103			North 24 Parganas	Titagarh	M	RFD (4 Ghats)
104			North 24 Parganas	Halishahar	M	
105			Nadia	Kalyani	M	
106		II	North 24 Parganas	Bhatpara	M + OG	
107			Murshidabad	Dhulian	M	
108			Murshidabad	Jangipur	M	
109			Nadia	Ranaghat	M	
110			Murshidabad	Jiaganj-Azimganj	M	
111			Barddhaman	Katwa	M	
112			Nadia	Chakdah	M	
113			Hugli	Konnagar	M	
114			South 24 Parganas	BudgeBudge	M	RFD
115			Nadia	Gayespur	M	
116			North 24 Parganas	Garulia	M	
117	West Bengal	III	Murshidabad	Murshidabad	M	
118			South 24 Parganas	Diamond Harbour	M	

Source: http://www.moef.nic.in/sites/default/files/ngrba/index.html
Kolkata: (1) ID & Afforestation, (2) Resuscitation of Chelta Boat Canal Jointing Ganga
Note: Uttar Pradesh & Jhakhand: No Response on the Website
RFD: River Front Development, I&D: Interception & Diversion, SN: Sewer Network, EC: Electric Cramatoria

As shown in **Table 19.9.1**, most DPRs especially of West Bengal are focused on the RFD (RFD) which are composed of the following items in case of the Patna RFD as an example;

- Development of ghats (change room, life guard etc.) on 20 Ghats
- Promenades – 2.3 km
- Community Cum Cultural Centres – 4 Nos
- Landscape Works on 21 Ghats
- City Level Parks – 2 Nos
- Improvement of approach roads
- Crematorium (Gulvi Ghat) – **1** No
- Interceptor Drain
- Sulabh Toilet Complex – 3 Nos

In relation to a sewerage sub-sector, the interceptor drain and the sulabh toilet complex is important.

19.10 Situation of Flow and Water Quality of the Ganga and its Tributaries

19.10.1 River Flow

The data pertaining to dependable flow of the River Ganga at Kanpur (1959–2008), Allahabad (1970–2008) and Varanasi (1959–2008), is depicted in **Figure 19.9.1**. The data indicates that the average flow is below 1,000 m^3/s in Kanpur and Allahabad and 1,200 m3/s in Varanasi, respectively, and during lean period of November to May and 10%, 50%, 90%, and average dependable flow tends to be the same. However, during July to October, a higher value due to monsoon discharge is observed, along with a sharp variation on 10%, 50%, 90%, and average dependable value. This also indicates a higher degree of flow during certain periods of monsoon, while the flow during rest of the times is very small.

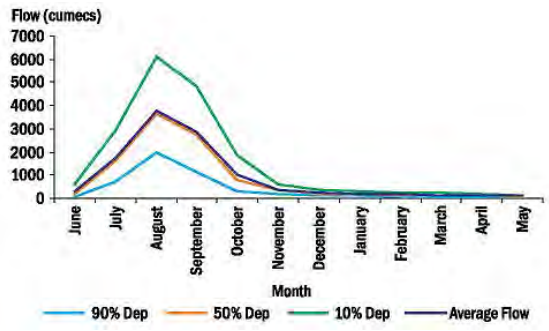
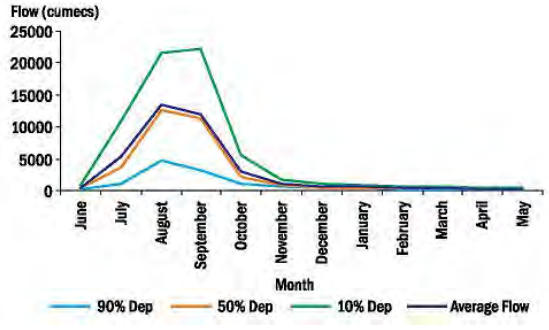
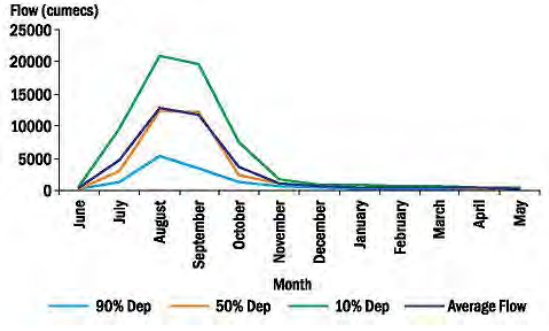
(1) Kanpur During lean period of November to May: 90–386 m^3/s	
(2) Allahabad During lean period of November to May: 279-997 m^3/s	
(3) Varanasi During lean period of November to May: 278-1,160 m^3/s	

Figure 19.10.1 Dependable Flow of the River Ganga

A comparison of the flow data in Kanpur, Allahabad, and Varanasi reveals a similar trend in the flow. However, the flow in Kanpur during the lean period is almost half of that in Allahabad andVaranasi, thus conferring a critical status on Kanpur with respect to water quality management.[8]

Table 19.9.1 shows the Seasonal Variation of the River Ganga Flow.

Table 19.10.1 Seasonal Variation of the River Ganga Flow

Station	Distance from Source (km)	Elevation above Sea Level (m)	Mean Seasonal Flow					Mean Annual Flow
			Monsoon (Jun-Sep)	Post-Monsoon (Oct-Nov)	Winter (Dec-Feb) Dry Season		Summer (Mar-May)	
			(mil.m^3)	(mil.m^3)	(mil.m^3)	(m^3/sec)	(mil.m^3)	(m^3/sec)
Rishikesh	250	350	21,531	1,912	1,305	41	2,150	856
Balawali	330	280	13,306	947	167	5	760	481
Garhmukresar	440	200	18,392	1,756	908	29	982	699
Fatehgarh	670	145	17,300	1,266	264	8	281	606
Kanpur	800	138	30,763	4,139	1,518	48	910	1,184
Allahabad	1,050	95	112,278	10,703	4,148	132	2,987	4,126
Mirzapar	1,170	90	97,142	9,362	4,529	144	3,362	3,627
Varanasi	1,295	80	112,206	11,244	4,213	134	2,793	4,105
Buxar	1,430	60	113,247	17,741	5,463	173	3,438	4,436
Patna	1,600	50	192,625	28,488	11,044	350	8,341	7,626
Azamabad	2,000	35	235,357	54,494	18,055	573	12,474	10,159

Source: Central Water Commission
JICA, "Integrated Pollution Abatement and River Basin Management Project for Ganga Basin – Preparatory and Pre-Feasibility Study Report", November 2002

At the upstream of Kannauj and Kanpur, the significant quantity of water is abstracted through three barrages, namely Bheem Gaura Barrage at Haridwar, Ch. Chransingh Barrage at Bijnor and Narora Barrage at Narora, which is equivalent to about 80% of average flow of the River Ganga at Haridwar as shown in **Figure 19.10.2**. In addition, Madhya Ganga Canal (Phase-II) is under construction to abstract further water from Ch. Chransingh Barrage. That is to say, it is required to reduce the pollutant loads certainly at Kannauj and Kanpur for water quality improvement in the River Ganga.

[8] NRCD. "Status Paper on River Ganga – State of Environment and Water Quality", August 2009

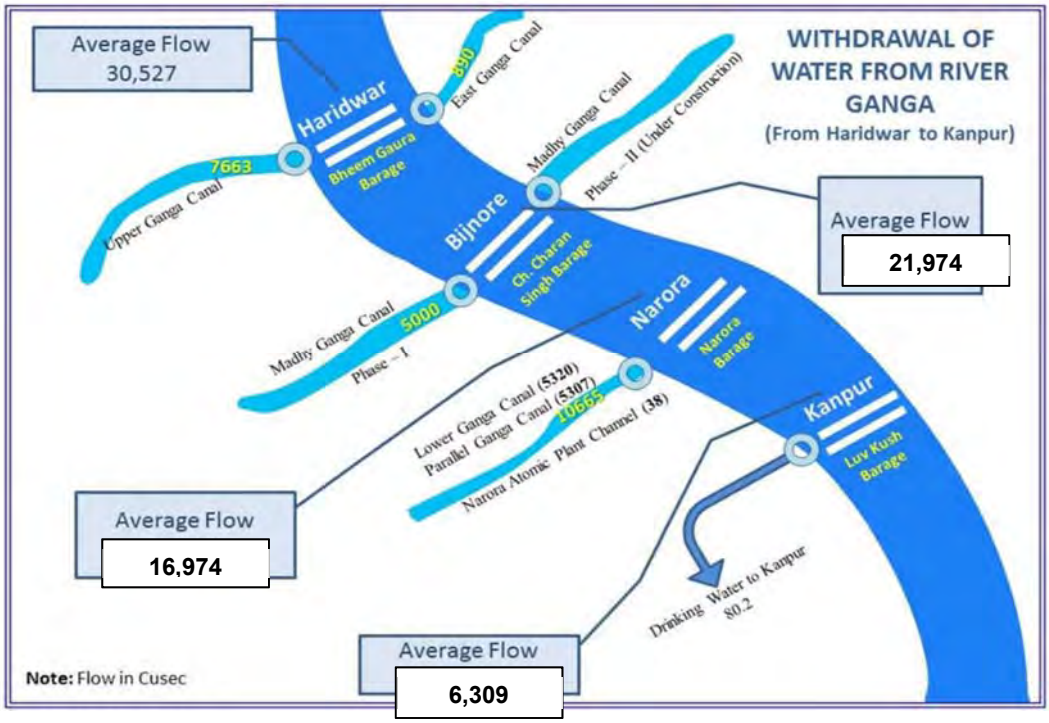


Figure 19.10.2 Withdrawal of Water from the River Ganga between Haridwar and Kanpur

Source: CPCB, "A Plan on Conservation of Water Quality of River Ganga", December 2015
Note: Figures in "Average flow" are corrected by the JICA Survey Team.

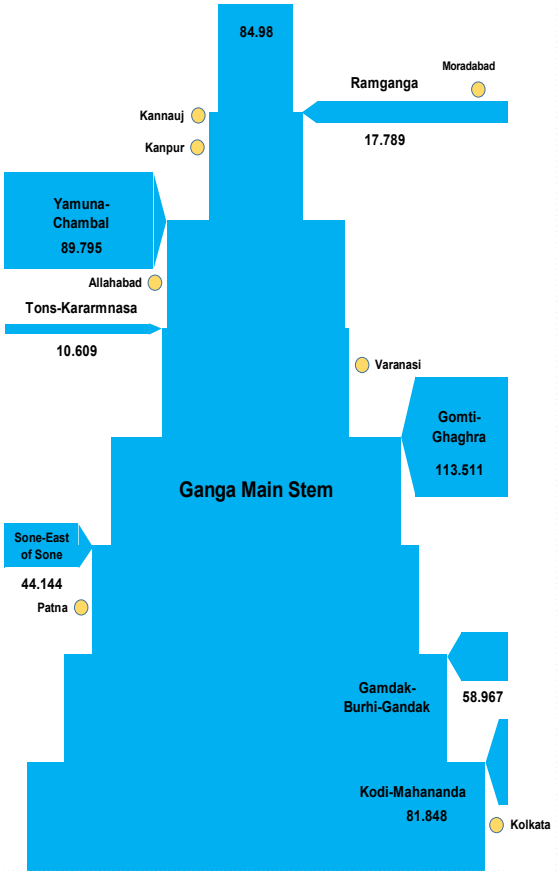


Figure 19.10.3 shows the scale of the annual average river discharge of the River Ganga System and the location of major cities in the basin.

Figure 19.10.3
Annual Average Discharge of the River Ganga and Location of Major Cities

19.10.2 Water Quality Standards

Table 19.10.2 Primarily Water Criteria Based on the Designated Best Use

Designated-Best-Use	Class of Water	Criteria
Drinking water source without conventional treatment but after dsinfection	A	1. Total Coliforms Organism MPN/100ml shall be 50 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 6 mg/l or more 4. Biochemical Oxygen Demand 5 days 20°C 2 mg/l or less
Outdoor bathing* (organised)	B	1. Total Coliforms Organism MPN/100ml shall be 500 or less 2. pH between 6.5 and 8.5 3. Dissolved Oxygen 5 mg/l or more 5. Biochemical Oxygen Demand 5 days 20°C 3 mg/l or less
Drinking water source after conventional treatment and disinfection	C	1. Total Coliforms Organism MPN/100ml shall be 5000 or less 2. pH between 6 to 9 3. Dissolved Oxygen 4 mg/l or more 4. Biochemical Oxygen Demand 5 days 20°C 3 mg/l or less
Propagation of wild life and Fisheries	D	1. pH between 6.5 to 8.5 2. Dissolved Oxygen 4 mg/l or more 3. Free Ammonia (as N) 1.2 mg/l or less
Irrigation, industrial cooling, controlled waste disposal	E	1. pH between 6.0 to 8.5 2. Electrical Conductivity at 25°C µmhos/cm Max.2250 3. Sodium absorption Ratio Max. 26 4. Boron Max. 2 mg/l

* The draft notification of new Primary Water Quality for Bathing Water was gazetted on November 30, 2015.

Table 19.10.3 Primary Water Quality Criteria for Bathing Reaches in Rivers by MoEFCC

Criteria		Rationale
1. Faecal Coliform	500 (Desirable) MPN/100ml 2500 (Maximum Permissible)	To ensure low sewage contamination. Faecal coliform and faecal streptococci are considered as they reflect the bacterial pathogenicity.
2. Faecal Streptococci	100 (Desirable) MPN/100ml 500 (Maximum Permissible)	The desirable and permissible limits are suggested to allow for fluctuation in environmental conditions such as seasonal changes, changes in flow conditions etc.
3. pH	Between 6.5-8.5	The range provides protection of the skin and delicate organs like eyes, nose, ears etc. which are directly exposed during outdoor bathing.
4. Dissolved Oxygen	5 mg/l or more	The minimum dissolved oxygen concentration of 5 mg/l ensures reasonable freedom from oxygen consuming organic pollution immediately U/S which is necessary for preventing production of anaerobic gases (obnoxious gases) from sediments
5. Biochemical Oxygen Demand, 3 day, 27°C	3 mg/l or less	The Biochemical Oxygen Demand of 3 mg/l or less of the water ensures reasonable freedom from oxygen demanding pollutants and prevent production of obnoxious gases.

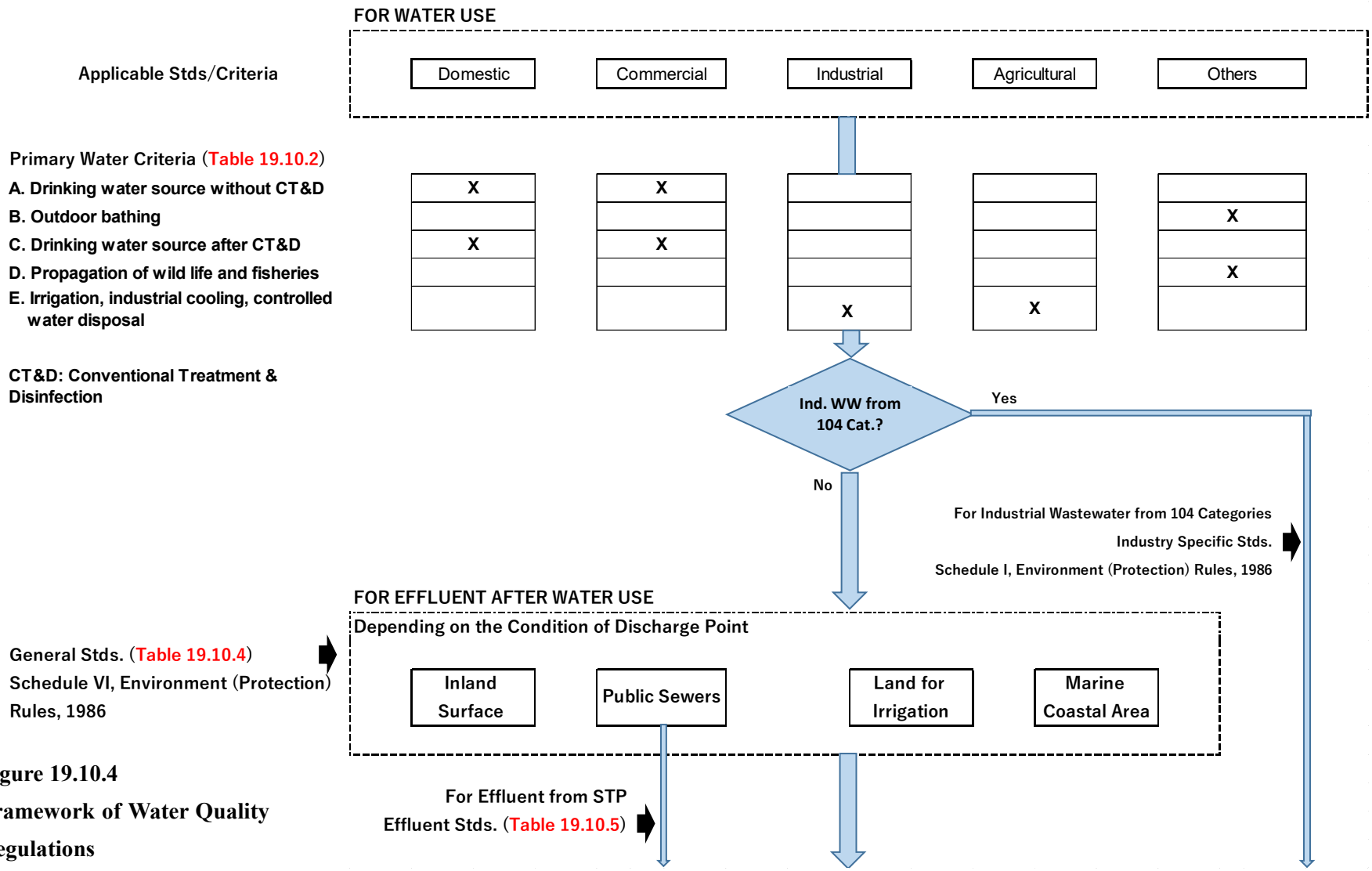


Figure 19.10.4
Framework of Water Quality Regulations

19.10.3 Effluent Standards

In India, the effluent quality is regulated by the General Standards in Schedule VI (see **Table 19.9.4**) of "Rule 3. Standards for Emission or Discharge of Environmental Pollutions" of the Environment (Protection) Rules, 1986 in accordance with the condition of discharge points**.**

Table 19.10.4 General Standards for Discharge of Environmental Pollutants

S. No.	Parameters	Standards			
		Inland surface water	Public sewers	Land for irrigation	Marine coastal areas
1	2	3			
		(a)	(b)	(c)	(d)
1.	Colour and odour	See 6 of Annexure-I	--	See 6 of Annexure-I	See 6 of Annexure-I
2.	Suspended solids mg/l, Max.	100	600	200	(a) For process waste water-100
					(b) For cooling water effluent 10 percent above total suspended matter of influent.
3.	Particulate size of suspended solids	Shall pass 850 micron IS Sieve	--	--	(a) Floatable solids, max. 3 mm.
					(b) Settleable solids, max. 850 microns.
[2]4	***	*	--	***	--
5.	pH Value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
6.	Temperature	shall not exceed 5oC above the receiving water temperature	--	--	shall not exceed 5oC above the receiving water temperature
7.	Oil and grease mg/l, Max.	10	20	10	20
8.	Total residual chlorin mg/l, Max.	1.0	--	--	1.0
9.	Ammonical nitrogen (as N) mg/l, Max.	50	50	--	50
10.	Total Kjeldahl Nitrogen (as NH3) mg/l, Max.	100	--	--	100
11.	Free ammonia (as NH3) mg/l, Max	5.0	--	--	5.0
12.	Biochemical Oxygen demand [3][3 days at 27ºC] mg/l, Max.	30	350	100	100
13.	Chemical Oxygen Demand, mg/l,	250	--	--	250

S. No.	Parameters	Standards			
		Inland surface water	**Public sewers**	**Land for irrigation**	**Marine coastal areas**
1	**2**	**3**			
		(a)	(b)	(c)	(d)
	Max.				
14.	Arsenic (as As), mg/l, Max.	0.2	0.2	0.2	0.2
15.	Mercury (as Hg), mg/l, Max.	0.01	0.01	--	0.01
16.	Lead (as Pb) mg/l, Max.	0.1	1.0	--	2.0
17.	Cadmium (as Cd) mg/l, Max.	2.0	1.0	--	2.0
18.	Hexavalent Chromium (as Cr+6), mg/l max.	0.1	2.0	--	1.0
19.	Total chromium (as Cr) mg/l, Max.		2.0	--	2.0
20.	Copper (as Cu) mg/l, Max.	3.0	3.0	--	3.0
21.	Zinc (As Zn) mg/l, Max.	5.0	15	--	15
22.	Selenium (as Se) mg/l, Max.	0.05	0.05	--	0.05
23.	Nickel (as Ni) mg/l, Max.	3.0	3.0	--	5.0
[4]24.	* * *	*	*	*	*
[4]25.	* * *	*	*	*	*
[4]26.	* * *	*	*	*	*
27.	Cyanide (as CN) mg/l, Max.	0.2	2.0	0.2	0.2
128.	* * *	*	*	*	*
29.	Fluoride (as F) mg/l, Max.	2.0	15	--	15
30.	Dissolved Phosphates (as P) mg/l, Max.	5.0	--	--	--
231.	* * *	*	*	*	*
32.	Sulphide (as S) mg/l, Max.	2.0	--	--	5.0
33.	Phenoile compounds (as C_6H_5OH) mg/l, Max.	1.0	5.0	--	5.0
34	Radioactive Materials:				
	(a) Alpha emitter, micro curie/ml.	10^{-7}	10^{-7}	10^{-8}	10^{-7}
	(b) Beta emitter, micro curie/ml.	10^{-6}	10^{-6}	10^{-7}	10^{-6}

S. No.	Parameters	Standards			
		Inland surface water	Public sewers	Land for irrigation	Marine coastal areas
1	2	3			
		(a)	(b)	(c)	(d)
35.	Bio-assay test	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent	90% survival of fish after 96 hours in 100% effluent
36.	Manganese (as Mn)	2 mg/l	2 mg/l	--	2 mg/l
37.	Iron (as Fe)	3 mg/l	3 mg/l	--	3 mg/l
38.	Vanadium (as V)	0.2 mg/l	0.2 mg/l	--	0.2 mg/l
39.	Nitrate Nitrogen	10 mg/l	--	--	20 mg/l
[4]40.	* * *	*	*	*	*

1 Schedule VI inserted by Rule 2(d) of the Environment (Protection) Second Amendment Rules, 1993 notified vide G.S.R. 422(E) dated 19.05.1993, published in the Gazette No. 174 dated 19.05.1993

2 Omitted by Rule 2(d)(i) of the Environment (Protection) Third Amendment Rules, 1993 vide Notification No.G.S.R.801(E), dated 31.12.1993.

3 Substituted by Rule2 of the Environment (Protection) Amendment Rules, 1996 notified by G.S.R.176, dated 2.4.1996 may be read as BOD (3 days at 27ºC) wherever BOD 5 days 20ºC occurred.

4 Omitted by Rule 2(d)(i) of the Environment (Protection) Third Amendment Rules, 1993 vide Notification No.G.S.R.801(E), dated 31.12.1993.

For industrial wastewater, the Industry Specific Standards in Schedule I of "Rule 3. Standards for Emission or Discharge of Environmental Pollutions" of the Environment (Protection) Rules, 1986 are applied to wastewater discharged from 104 categories: while the General Standards in Schedule VI (see **Table 19.9.4**) are applied to wastewater from other industries than 104 categories.

For effluent from a sewage treatment plant, **Table 19.9.5** is applied to.

Table 19.10.5 Effluent Standards for Sewage Treatment Plant

Parameter	Existing Standards	Proposed Standards (Draft Notification 24/11/2015)
pH	6.0-9.0	6.5-9.0
BOD	30 mg/l	10 mg/l
COD	50 mg/l	50 mg/l
TSS	20 mg/l	20 mg/l
NH_4-N	-	5 mg/l
N-total	-	10 mg/l
Fecal Coliform	-	<100 MPN/100ml

(i) All values in mg/l except for pH and Coliform.

(ii) These standards will be applicable for discharge in water resources s well as for land disposal. The standards for Fecal Coliform may not be applied for use. of treated sewage in industrial purposes.

* Achievements of Standards for existing STPs within 05 years from date of notification.

19.10.4 BOD5 Variation along the River Ganga

(1) Water Quality Monitoring Station

To assess the water quality of the River Ganga, the Central Pollution Control Board (CPCB） has set fifty-seven (57) water quality monitoring stations in the main stem of the River Ganga in cooperation with the State Pollution Control Board (SPCB) of five states concerned. These monitoring stations are listed in **Table 19.9.6** with the location map in **Figure 19.11.1**.

Table 19.10.6 State-wise Water Quality Monitoring Stations on Main Stem of River Ganga

State	No. of Monitoring Locations	Frequency	Monitoring Agency
Uttarakhand	11	Yearly/Monthly	UEPPCB/CPCB
Uttar Pradesh	20	Monthly	UPPCB
Bihar	15	Monthly	BPCB
Jharkhand	1	Monthly	JPCB
West Bengal	10	Monthly	WBPCB

(2) Water Quality Assessment of River Ganga

The monitoring results obtained during 2011 under National Water Quality Monitoring Programme reflect that organic matter and bacterial population of faecal origin continue to dominate the pollution problem in River Ganga. The major water quality concerns as revealed from the monitoring results are pathogenic pollution as reflected through indicators i.e. Total Coliforms (TC) & Faecal Coliform (FC), organic matter as reflected through Biochemical Oxygen Demand (BOD) and salinity as reflected through conductivity.

(3) River Water Quality

Figure 19.10.5 shows the BOD_5 yearly variation along the River Ganga based on the yearly average data at each monitoring station. Haridwar, Kaunanj, Kanpur, Allahabad and Varanasi are clearly identified as five big polluting points. The monitoring station-wise BOD_5 yearly variation is presented in **Figure 19.10.6** for selected monitoring stations. Most stations show the slight ascending trend, except for Varanasi which shows the big improvement in BOD_5 concentrations.

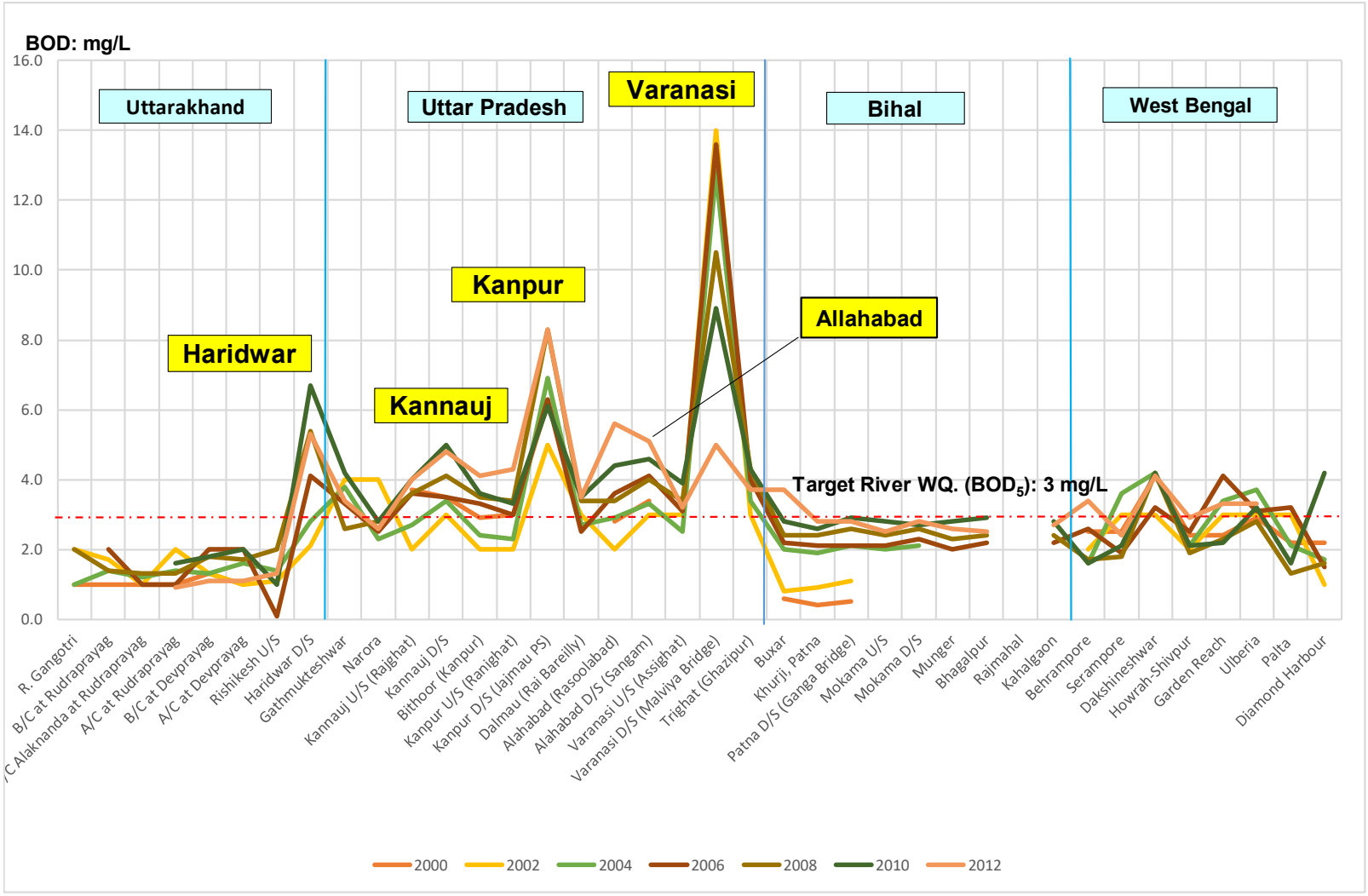


Figure 19.10.5 BOD_5 Yearly Variation along the River Ganga (2000-2012)

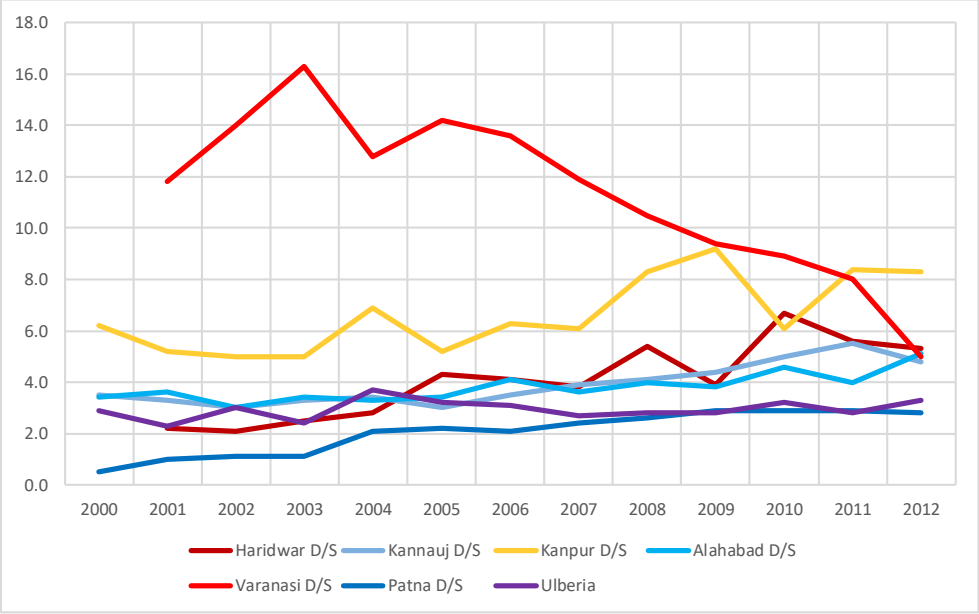


Figure 19.10.6 BOD_5 Yearly Variation at Major Monitoring Stations Based on Yearly Average

While, **Figure 19.10.7** shows the BOD_5 yearly variation along the River Ganga based on the summer average data covering four months of March to June average data at each monitoring station as shown in **Table 19.10.7**. Almost monitoring stations show that BOD_5 concentrations are moving sideways and have not yet been improved.

Table. 19.10.7 Yearly Variation of BOD5 at Major Monitoring Stations along the Ganga

Station Name	1994	1996	1998	1999	2002	2004	2006	2008	2010
Hardwar D/S	2.1	1.1	1.6	1.2	1.7	1.5	1.3	1.4	1.90
Kannauj D/S	3.0	3.2	3.5	4.8	4.2	3.18	4.2	3.1	4.58
Kanpur D/S	8.5	4.1	6.4	6.5	4.8	5.70	6.8	4.1	4.16
Allahabad D/S	3.6	3.3	2.6	3.2	3.8	3.58	3.2	3.2	4.41
Varanasi D/S	2.9	2.3	4.3	3.7	2.5	2.65	2.25	3.0	3.78
Patna D/S	1.6	1.6	1.6	2.4	1.9	1.65	2.3	2.4	2.20
Uluberia	3.2	2.0	2.2	NA	1.9	2.43	2.64	3.6	2.69

Note: The 2000 data is not available

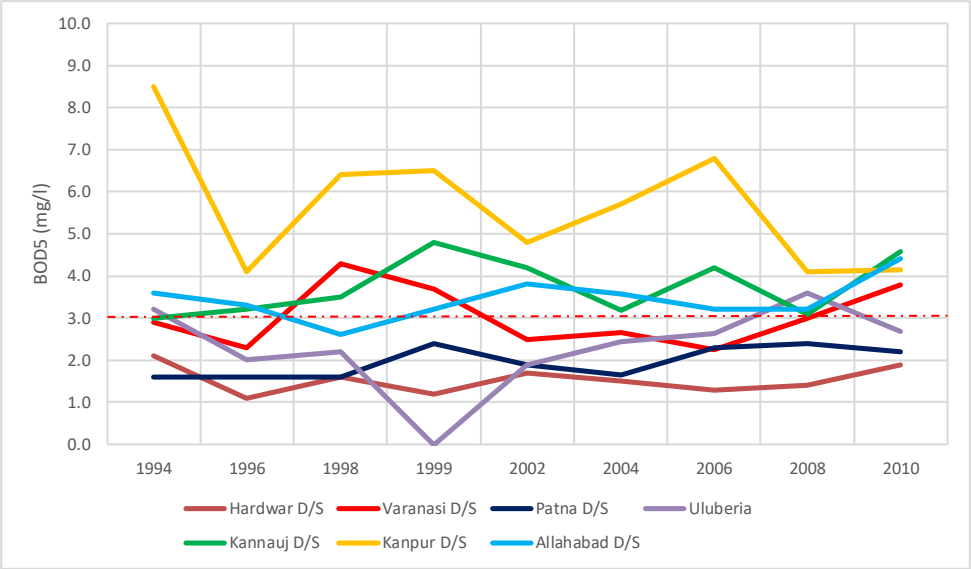


Figure 19.10.7 Yearly Variation of BOD5 at Major Monitoring Stations along the Ganga (Average during Summer of March to June)

Figure 19.10.8 is prepared to check the trends between the yearly average (dot lines) and the summer average (solid lines) for four major polluting points, or Kanauj, Kanpur, Allabad and Varanasi, which shows a big difference in both Kanpur and Varanasi, but a slight difference in both Kannauj and Allahabad. As far as seeing these data, their trends are not even. The water quality is largely variable by the river flows and incoming pollution loads to the River Ganga during the monsoon season, therefore, in the comparison of water quality among monitoring stations, it is better to use the four-month average in the summer when the river flows are low. Watching the 2012 values of four major polluting points, they are gathering at around 4 mg/l in BOD_5. It can be said that there is still no outstanding improvement in water quality of the River Ganga.

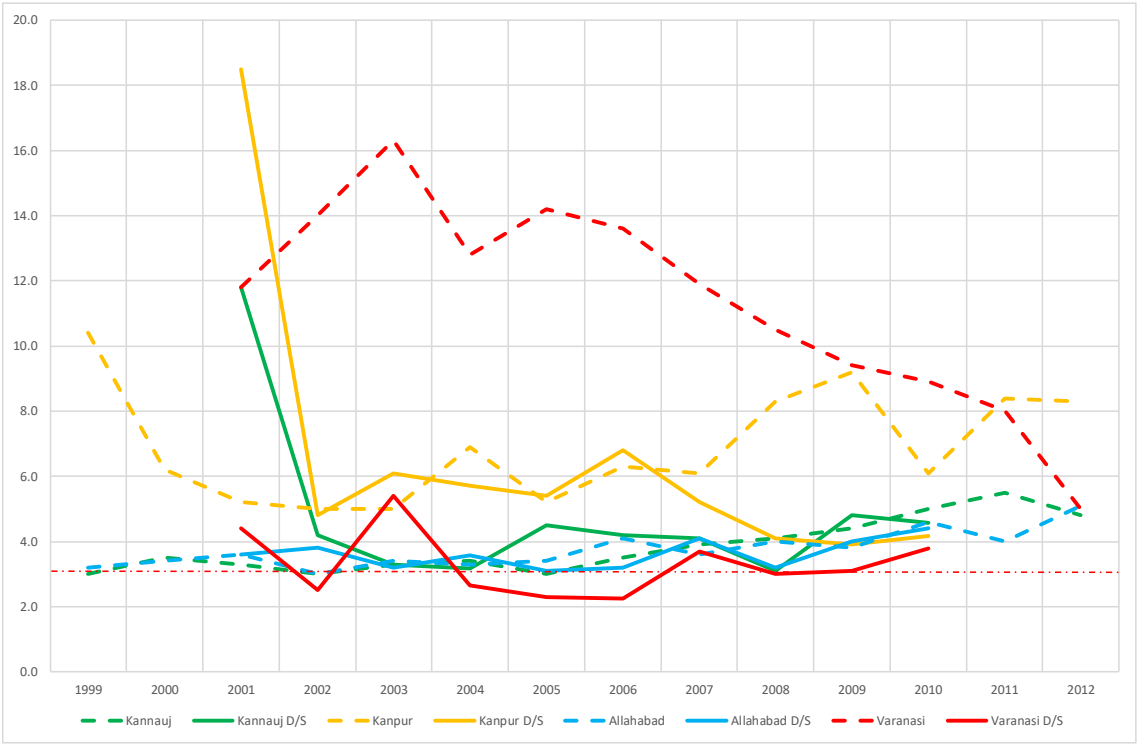


Figure 19.10.8 Comparison of BOD5 between Yearly Average and Summer Average at Four Major Polluting Points, Say, Kannauj, Kanpur, Allahabad and Varanasi

19.11 Water Quality Monitoring on the Ganga and its Tributaries

19.11.1 Outline

The Central Pollution Control Board (CPCB) has established a network of monitoring stations on rivers across the country. The present network is comprising of 870 stations in 26 States and 5 Union Territories spread over the country. The monitoring is done on monthly or quarterly basis in surface waters and on half yearly basis in case of ground water. The monitoring network covers 189 Rivers, 53 Lakes, 4 Tanks, 2 Ponds, 3 Creeks, 3 Canals, 9 Drains and 218 Wells. Among the 870 stations, 567 are on rivers, 55 on lakes, 9 on drains,12 on canals, 4 on tank, 3 on and creeks,2 on pond and 218 are groundwater stations. The monitoring of water quality at 257 stations is being done on monthly basis, 393 stations on quarterly basis, 216 on half yearly basis and 4 stations on yearly basis. Presently the inland water quality-monitoring network is operated under a three-tier programme i.e. GEMS, Monitoring of Indian National Aquatic Resources System and Yamuna Action Plan.

Water samples are being analysed for 28 parameters (see **Table 19.10.1**) consisting of physico-chemical and bacteriological parameters for ambient water samples apart from the field observations. Besides this, 9 trace metals and 15 pesticides (see **Table 19.10.1**) are analysed in selected samples. Biomonitoring is also carried out on specific locations. In view of limited resources, limited numbers of organic pollution related parameters are chosen for frequent monitoring i.e.

monthly or quarterly and major cations, anions, other inorganic ions and micro pollutants (toxic metals & POP's) are analysed once in a year to keep a track of water quality over large period of time. The water quality data are reported in Water Quality Statistics yearbooks.[9]

Generally, SPCBs assist in sampling and analysis of water quality data, while the CPCB undertakes scrutiny, processing, and storage of data, along with the analysis of data for interpretation and preparation of action plans. The monitoring is undertaken either on monthly or yearly basis.[10]

Table 19.11.1 List of Parameters Monitored under National Water Quality Monitoring Programme

Field Observations (7)	Core Parameters (9)	General Parameters (19)	Bio-monitoring (3)	Trace Metals (9)	Pesticides (15)
• Weather • Depth of main stream/depth of water table	• PH • Temperature	• Turbidity, NTU • Phenolphthalein Alkalinity, as $CaCO_3$	• Saprobity Index • Diversity Index	• Arsenic, µg/L • Cadmium, µg/L	• Alpha BHC, µg/L • Beta BHC, µg/L
• Colour and intensity	• Conductivity, µ mhos/cm	• Total Alkalinity, as $CaCO_3$	• P/R Ratio	• Copper, µg/L	• Gama BHC (Lindane) , µg/L
• Odour	• Dissolved Oxygen, mg/L	• Chlorides, mg/L		• Lead, µg/L	• O P DDT, µg/L
• Visible effluent discharge	• BOD, mg/L	• COD, mg/L		• Chromium (Total), µ g/L	• P P DDT, µg/L
• Human activities around station	• Nitrate – N , mg/L	• Total Kjeldahl - N, as N mg/L		• Nickel, µg/L	• Alpha Endosulphan, µ g/L
• Station detail	• Nitrite – N, mg/L	• Ammonia - N, as N mg/L		• Zinc, µg/L	• Beta Endosulphan, µ g/L
	• Faecal Coliform, MPN/100 ml	• Hardness, as $CaCO_3$		• Mercury, µg/L	• Aldrin, µg/L
	• Total Coliform, MPN/100 ml	• Calcium, as $CaCO_3$		• Iron (Total) , µg/L	• Dieldrin, µg/L
		• Sulphate, mg/L			• Carboryl(Carbamate), µg/L
		• Sodium, mg/L			• 2-4 D, µg/L
		• Total Dissolved Solids, mg/L			• Malathian, µg/L
		• Total Fixed Dissolved Solids, mg/L			• Methyl Parathian,
		• Total suspended Solid, mg/L			• Anilophos, µg/L
		• Phosphate, mg/L			• Chloropyriphos, µg/L
		• Boron, mg/L			
		• Magnesium, as $CaCO_3$			
		• Potassium, mg/L			
		• Fluoride, mg/L			

19.11.2 Water Quality Monitoring Network

Central Pollution Control Board started national water quality monitoring in 1978 under Global Environmental Monitoring System (GEMS), Water Programme. Monitoring Programme was started with 24 surface water and 11 groundwater stations. Parallel to GEMS, a National Programme of

[9] *Source: R.M. Bhardwaj, CPCB, "Water Quality Monitoring in India – Achievement and Constraints"*

[10] *Source: CPCB, "Pollution Assessment: River Ganga", July 2013*

Monitoring of Indian National Aquatic Resources (MINARS), was started in 1984, with a total of 113 stations spread over 10 river basins. The present network comprises of 870 stations on rivers, lentic water bodies and subsurface waters is elaborated in **Table 19.10.2**. The number of locations on mainstream of the major river and their tributaries, medium and minor rivers, lakes, ponds, tanks and other water bodies is given in parenthesis.

Table 19.11.2 Monitoring Stations in the Ganga River Basin

River	Distribution of Monitoring Stations	Total Station
Main Stream	Ganga	39
Tributaries	Barakar (1), Betwa (3), Chambal (7), Damodar (5), Gandak (1), Saryu-Ghaghra (3), Gomti (5), Hindon (3), Kali (West) (2), Kali Nadi (2), Khan (1), Kshipra (2), Mandakini (Madhya Pradesh) (1), Parvati (3), Ramganga (1), Rapti (1), Rihand (2), Rupanarayan (1), Sai (1), Sone (5), Tons (Madhya Pradesh) (2), Yamuna (23), Sind (1), Johila (1), Sankh(1), Gohad (1), Kolar (1), Sai(1), Churni (1), Tons (Himachal Pradesh) (1), Sikrana (1), Daha (1), Sirsa (1), Dhous (1), Farmer (1)	88

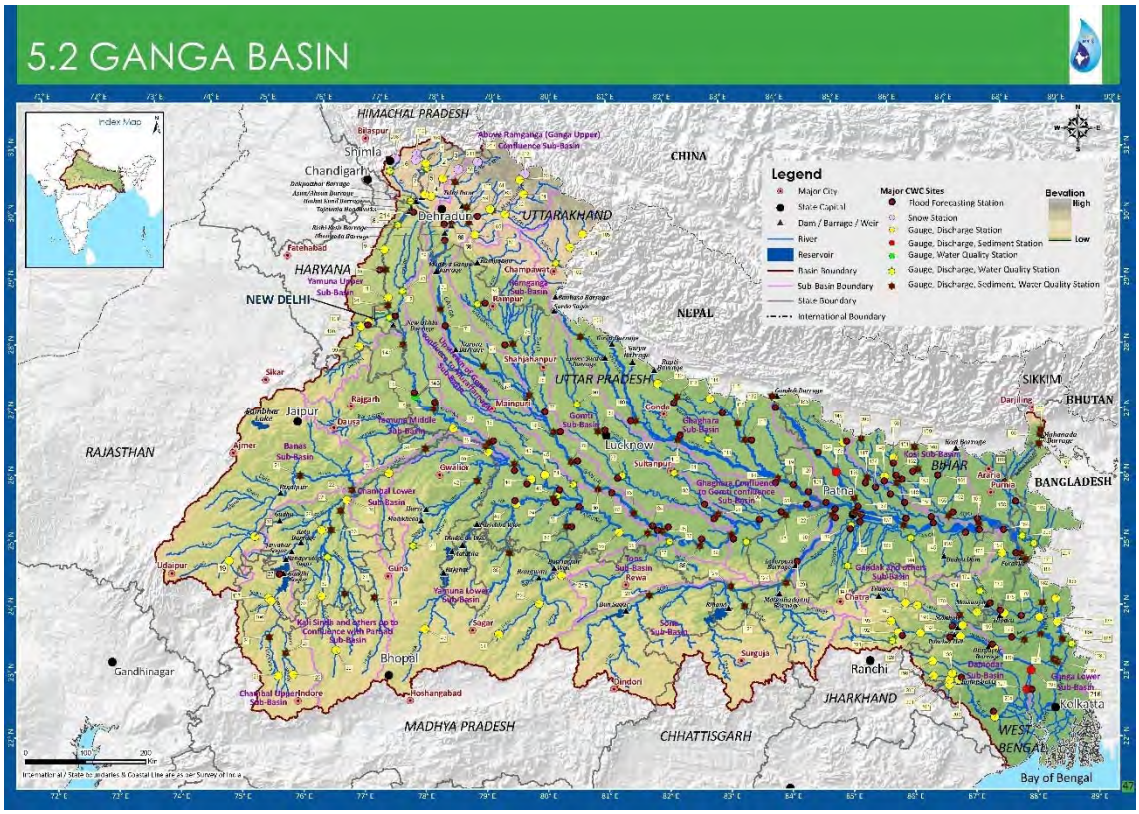


Figure 19.11.1 Location of Water Quality Monitoring Stations on the River Ganga (Shown with Mainly Yellow Marks)

The results of water quality monitoring on the River Ganga are available at the website of ENVIS Centre on Control of Pollution Water, Air and Noise (*see below*) for parameters of temperature, dissolved oxygen, pH, electric conductivity, BOD_5, faecal coliform and total coliform. The data is available by backdating to 2002. For 2012 data, the results of water quality monitoring at 57 stations on the main stem and 57 stations at its tributaries are open

http://cpcbenvis.nic.in/water_quality_data.html

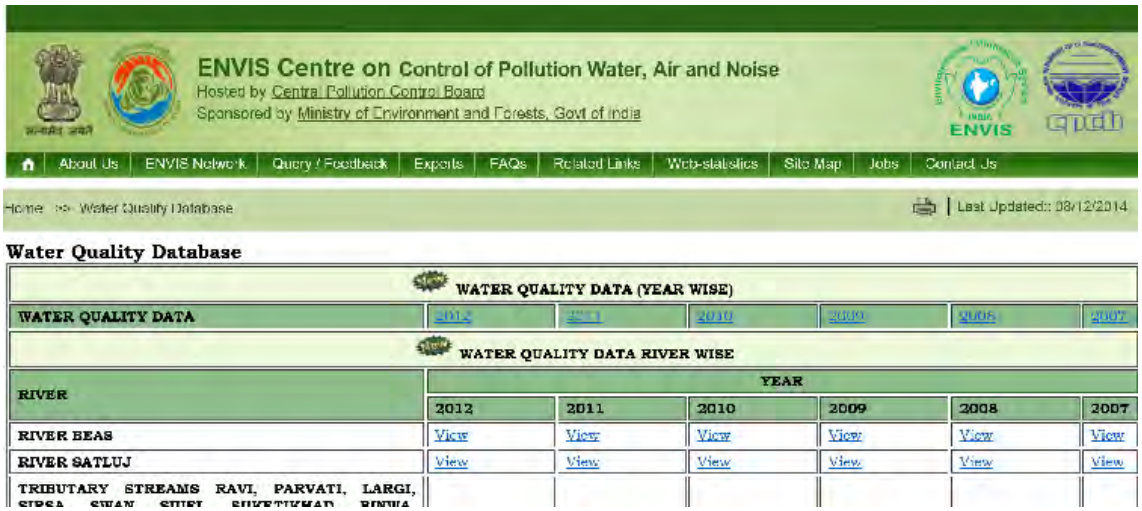


Figure 19.11.2 Website of ENVIS Centre on Control of Pollution Water, Air and Noise

CWC is maintaining a three tier laboratory system for analysis of the parameters. The level-I laboratories are located at 258 field water quality monitoring stations on various rivers of India where physical parameters such as temperature, colour, odour, specific conductivity, total dissolved solids, pH and dissolved oxygen of river water are observed. There are 23 level–II laboratories located at selected division offices to analyze 25 nos. physico-chemical characteristics and bacteriological parameters of river water.4 level-III/II+ laboratories are functioning at Varanasi, Delhi, Hyderabad and Coimbatore where 41 parameters including heavy metals/toxic parameters and pesticides are analysed.

The following procedure is followed in CWC for classification of stations, sampling frequency, identification of parameters and their analysis, which is based on Water Quality Assessment Authority's Gazette Notification dated June 18, 2005.

(A) Classification

Stations are classified as Base, Trend and Flux Stations. CWC has 164 Base stations, 179 Trend stations and 28 Flux stations.

(B) Frequency of Monitoring

- **Base Station**: One sample is collected every two months and totals six samples in a year.
- **Trend Stations**: Sample is collected once in every month.
- **Flux Stations**: Samples are collected thrice in a month, however toxic and trace metal are analyzed once in a month.

19.11.3 Automatic Water Quality Monitoring on the River Ganga[11]

Under the World Bank aided project Automatic Water Quality Monitoring has been setup under the NGRBA Project for the river Ganga at an estimated cost of Rs. 94.45 Cr. approx. The network will consist of 113 stations at critical locations along the main stem of the river. These stations will be located at:

- Upstream and downstream of major urban areas
- On major tributaries upstream of the confluence with the Ganga
- Downstream of Sewerage Treatment Plants (STPs)
- In major *nallahs*
- Downstream of industrial areas
- At intakes of drinking water treatment plants
- At important bathing ghats

This Project focuses on the main stem of the Ganga River in the states of Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal with the following objectives;

- To assess nature and extent of pollution.
- To understand the environmental fate of different pollutants.
- To evaluate effectiveness of pollution control measures in place.
- To evaluate water quality trend.
- To assess the fitness of water for different uses.

This project is expected to provide a state-of-the-art, real-time picture of water quality of river Ganga through the real time data on predefined 20 parameters and acquire the data from all the 113 stations for the all predefined parameters such as Ammonia, BOD, COD, BTX Chloride, DO, DOC, EC, Fluoride, Nitrate, Hydrogen Sulfide, pH, Potassium, TOC, TSS Turbidity, Colour, Temperature

[11] Source: https://nmcg.nic.in/pdf/NMCGdocketonWQM.pdf

Nitrites and water level. The Executing Agency of this project is the NGRBA Cell of CPCB for implementing the Automatic Water Quality Monitoring System.

Real time data, collected at an interval of fifteen minutes will be transferred to the Central Repository / Data Server / RDBMS though the GSM / GPRS telemetry link. The Data Server will be supported with the mechanism to feed real data and processed data. The filtered and calibrated data will be analyzed and process in the desired form to feed in the NGRBA Ganga Knowledge Centre Portal and also other Websites/Portals/Mobile Applications.

All the data that is delivered will be validated by an audit contractor in order to qualify for purchase. The audit contractor will perform continuous field inspections of the equipment and sensors in each station.

In addition to the automatic 113 station, NGRBP proposes to monitor water quality manually in 134 stations along the main stem of river Ganga. Bio-monitoring to evaluate the impact of pollutants on the wholesomeness of the aquatic ecosystem is also proposed to involve community monitoring and also to identify additional sources of pollution through citizens group, like schools, cultural and religious organizations and NGOs, with an interest in conservation of local water resources.

19.12 Organisation for Water Quality Control of the River Ganga

19.12.1 Central Pollution Control Board (CPCB）

The Central Pollution Control Board (CPCB), a statutory organization, was constituted in September, 1974 under the Water (Prevention and Control of Pollution) Act, 1974. Further, CPCB was entrusted with the powers and functions under the Air (Prevention and Control of Pollution) Act, 1981.

It serves as a field formation and also provides technical services to the Ministry of Environment, Forests and Climate Change of the provisions of the Environment (Protection) Act, 1986. Principal Functions of the CPCB, as spelt out in the Water (Prevention and Control of Pollution) Act, 1974, and the Air (Prevention and Control of Pollution) Act, 1981, (i) to promote cleanliness of streams and wells in different areas of the States by prevention, control and abatement of water pollution, and (ii) to improve the quality of air and to prevent, control or abate air pollution in the country.

Functions of the CPCB at the National Level are given below:

- Advise the Central Government on any matter concerning prevention and control of water and air pollution and improvement of the quality of air.
- Plan and cause to be executed a nation-wide program for the prevention, control or abatement of water and air pollution;
- Co-ordinate the activities of the State Board and resolve disputes among them;

- Provide technical assistance and guidance to the State Boards, carry out and sponsor investigation and research relating to problems of water and air pollution, and for their prevention, control or abatement;
- Plan and organize training of persons engaged in program on the prevention, control or abatement of water and air pollution;
- Organize through mass media, a comprehensive mass awareness program on the prevention, control or abatement of water and air pollution;
- Collect, compile and publish technical and statistical data relating to water and air pollution and the measures devised for their effective prevention, control or abatement;
- Prepare manuals, codes and guidelines relating to treatment and disposal of sewage and trade effluents as well as for stack gas cleaning devices, stacks and ducts;
- Disseminate information in respect of matters relating to water and air pollution and their prevention and control;
- Lay down, modify or annul, in consultation with the State Governments concerned, the standards for stream or well, and lay down standards for the quality of air; and
- Perform such other function as may be prescribed by the Government of India

As per the policy decision of the Government of India, the CPCB has delegated its powers and functions under

- Water (Prevention & Control of Pollution) Cess Act, 1977.
- Air (Prevention & Control of Pollution) Act, 1981
- Environment (Protection) Act, 1986 and Rules made thereunder
- Hazardous Waste (Management & Handling) Rules1989.
- Manufacture, storage and Import of Hazardous Chemicals Rules, 1989
- Bio-medical Waste (Management & Handling) Rules, 1998
- Municipal Solid Waste (Management & Handling) Rules, 2000.
- Plastics wastes Rules, 1999 o Coastal Regulation Zone Rules, 1991
- Public Liability Insurance Act, 1991

CPCB along with its counterparts State Pollution Control Boards (SPCBs)/Pollution Control Committees (PCC) are responsible for implementation of legislations relating to prevention and control of environmental pollution.

19.12.2 Relationship between CPCB and SPCB

The Central Pollution Control Board is fully funded by the Central Ministry of Environment & Forests. The State Pollution Control Boards receive funds from the concerned State Governments and from the Central Ministry of Environment & Forests through reimbursement of Water Cess (upto

80%) collected by the respective State Boards. In addition, the State Boards receive fees for processing for applications from the industries for issuing consent in regard to discharge of effluent and emissions.

SPCBs are getting only marginal/ nominal financial assistance from State Governments. In some of the State Pollution Control Boards, State Governments are not providing budgetary grants. State Pollution Control Boards are dependent on consent and authorization fee and cess reimbursements which they get out of cess collections.

Ministry of Environment, Forests and Climate Change (MoEF&CC) provides financial assistance to State Pollution Control Boards on specific projects relating to prevention and control of pollution. Ministry provides financial assistance on following programmes:

- Specific projects for abatement of pollution
- Hazardous waste management
- Management of municipal solid waste
- Strengthening of Pollution Control Boards (for laboratory upgrdation)

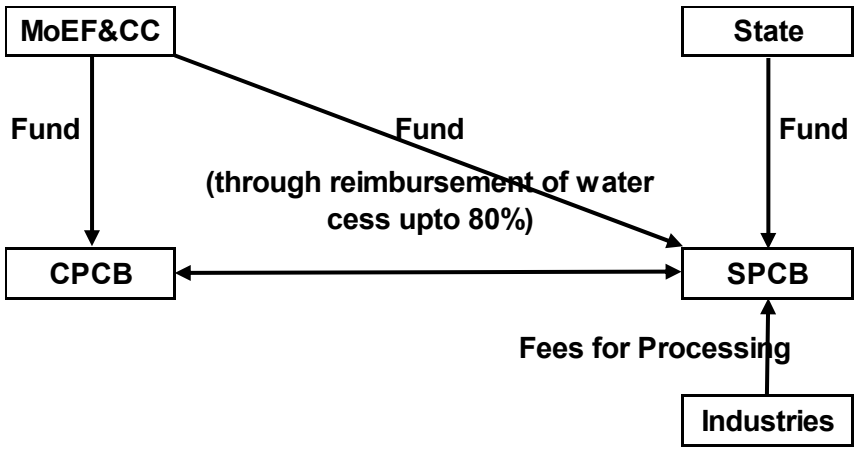


Figure 19.12.1 Fund Flow

The functions of SPCB are as follows:

- Pollution control in 17 categories of highly polluting industries
- Pollution control from industries discharging waste water into rivers and lakes
- Inventorization of pollution industries in the State and ensuring their compliance to the pollution control norms
- Restoration of environmental quality in critically polluted areas

- Monitoring of water and ambient air quality in the States
- Hazardous waste

19.13 Smart Ganga City Programme

On August 13, 2016, the NMCG selected the 10 cities in the first phase for infrastructure development for sewage treatment, on hybrid annuity mode with the following contents:.

- Union Minister for Water Resources, River Development and Ganga Rejuvenation and Union Urban Development Minister launched Smart Ganga City Scheme in ten important cities through video conference.
- These cities are – *Haridwar, Rishikesh, Mathura-Vrindavan, Varanasi, Kanpur, Allahabad, Lucknow, Patna, Sahibgunj and Barrackpore*.
- National Mission for Clean Ganga (NMCG) has chosen these cities in the first phase for infrastructure development for sewage treatment.
- This will be on hybrid annuity mode based on PPP model.

Source: MoWRRD&GR, "NAMAMI Ganga Programme" presented at INDIA@COP22 on November 10, 2016

19.14 Estimation of Sewage Flow for the Year of 2030

(1) Available data source

The additional capacity requirement for STP for the certain year is considered as one of the important indices to select the town(s) for the Phase-II Project out of 118 towns identified by NMCG, which is given by the following equation.

Additional capacity requirement for STP by 2030
= Estimated sewage flow in the year of 2030 – Existing/sanctioned STP capacity

The sanctioned STP capacity doesn't show the present STP capacity but it is committed to enter into operation within about five years, since the STP construction has been sanctioned, and handled equivalent to the existing STP capacity

As the clues to estimate the sewage flow for the year of 2030, the following reports and data are helpful:

1) The design population and sewage flow proposed in the existing DPRs for sewerage facility construction
2) The World Bank has prepared the Environmental and Social Assessment and Management Plan for some towns out of 118 towns identified for the Ganga Action Plan. The report analyzes the impacts of proposed project, and suggests the management plans to handle any negative impacts on the basis of the DPR that has been prepared by U.P. Jal Nigam. Therefore, the

results on the projection of design population and sewage flow are referred in the report without detailed description but they are useful in case of no availability of DPRs.

3) The City Development Plan (CDP） shows the development plans for various urban infrastructures including sewerage facilities with the population projection and required STP capacity
4) Since most towns out of 118 towns have not yet any DPRs and CDPs, it is still necessary for the population projection based on the past census populations and the estimation of sewage flows as per the manual.

Among the reports mentioned above, the first priority to population projection and sewage flow estimation is given to those in DPRs as well as WB reports which are discussing sewerage facility development directly, followed by CDPs. For the towns with no DPR and CDP, the population shall be projected using the past five census populations (1971-2011) and the sewage flow shall be estimated as per the manual.

(2) Problems in DPRs and CDPs

There are the following problems in DPRs and CDPs:

- The target years in the DPR and/or CDP are different depending on the towns
  In the selection of towns for Phase-II Project, it is necessary to calculate the additionally required STP capacities in the certain year for comparison. For this purpose, the target year was set at the year of 2030, and all the figures on projected population and estimated sewage flow available in the existing reports as mentioned-above were converted to those for the year of 2030 using the proportional interpolation method.
- Some DPRs and CDPs do not reflect the 2011 census population (refer to **Appendix 19.14.1**)
- Some reports were prepared before 2010 (refer to **Appendix 19.14.1**)
  The figures on projected population and estimated sewage flow proposed in the existing reports shall be accepted as they are without any review.

(3) Estimation of Sewage Flow Based on Population Projection

In case of using the census population, the sewage flow for the year 2030 shall be estimated applying the figures in **Table 19.14.1**. to the following equation:

Sewage flow = (Projected population) x (Rate of water supply) x (Conversion factor to sewage)
x (1＋Infiltration rate）

Table 19.14.1 Criteria for Estimation of Sewage Flow (2030)

Population size	P≥5 lac	5 lac>P≥1 lac	P<1 lac	Remark
Rate of water supply	150 lpcd	135 lpcd	135 lpcd	
Conversion factor to sewage	80%	80%	80%	
Infiltration rate	20%	10%	10%	

The results of estimated sewage flow for the year of 2030 is summarized in **Table 19.14.2** for 118 river front tows based on DPRs, WB reports, CDRs or census populations and the additional STP capacity requirements are shown in **Figure 19.14.1**

The additional STP capacity requirement is biggest as 413.6 MLD in Kolkata, followed by Kanpur (203.5 MLD), Patna (135.4 MLD), Howrah (133.3 MLD) and Moradabad (83.0 MLD), respectively.

Table 19.14.2 Estimated Sewage Flow for the Year of 2030

S. No.	Year	Census Population						DPR (Detailed Design Report) / WB (World Bank)						CDP				Estimated Sewage Flow (2030) (MLD)				
		1971	1981	1991	2001	2011	2030 (Proj'd)	Projected Population			Estimated Sewage Flow (MLD)			Projected Population		Estimated Sewage Flow (MLD)		JICA Survey Team	NMCG	DPR / WB	CDP	Adopted
1	Haridwar	91,371	75,946	187,392	220,767	278,286	400,565							2,021 516,859		2021 50.3		47.6	135.0		71.2	71.2
2	Rishikesh	17,646	29,145	44,487	66,189	70,499	95,604											11.4	18.0			11.4
3	Gopeshwar	6,354	9,709	15,378	19,833	21,447	27,018	2011 28,000	2026 46,000	2041 74,000	2011 3.0	2026 5.0	2041 6.0					3.2	4.0	5.3		5.3
4	Tehri	5,480	12,249	20,226	25,423	24,014	32,819											3.9	3.4			3.9
5	Srinagar	5,566	9,171	18,791	19,658	20,115	24,135											2.9	6.4			2.9
6	Joshimath	5,852	8,610	11,488	13,204	16,709	22,552	2011 36,130	2026 46,730	2041 64,430	2011 3.8	2026 5	2041 7					2.7	6.8	5.5		5.5
7	Uttarkashi	6,020	10,043	13,919	16,218	17,475	20,376											2.4	3.1			2.4
8	Muni ki Reti - Dhaluwala *1	1,126	2,264	4,519	19,636	28,636	48,925	2013 38,553		2045 70,672	2013 3.8		2045 7.0					5.8	7.3	5.5		5.5
9	Gaucher		3,284	4,422	7,303	8,864	13,793											1.6	1.4			1.6
10	Kanaprayag		3,772	5,169	6,977	8,297	11,894	2011 11,384	2026 18,056	2041 28,638	2011 1.23	2026 1.95	2041 3.09					1.4	1.4	2.3		2.3
11	Rudraprayag		1,331	1,542	2,250	9,313	20,415	2011 18,433	2026 28,452	2041 43,922	2011 1.99	2026 3.07	2041 4.74					2.4	3.1	3.5		3.5
12	Kirtinagar	--	736	1,058	1,040	1,517	1,783											0.2	0.3			0.2
13	Nandprayag		1,103	1,262	1,704	1,641	1,645											0.2	0.3			0.2
14	Badrinath		2,576	978	1,682	2,438	2,801	2011 18,370	2026 27,480	2041 36,640	2011 1.98	2026 2.97	2041 3.96					0.3	2.8	3.2		3.2
15	Devprayag	1,527	1,701	2,164	2,769	2,152	2,448	2011 12,146	2026 12,886	2041 13,771	2011 1.31	2026 1.39	2041 1.49					0.3	1.4	1.4		1.4
16	Allahabad *1	513,036	650,070	844,546	1,042,229	1,195,329	1,534,171	2010 1,496,955	2026 1,908,697	2040 2,549,444	2010 197.8	2026 251.95	2040 336.63					220.9	296.0	276.1		276.1
17	Farukhabad	102,768	145,793	194,567	228,333	276,581	363,938							N/A				43.2	40.2			43.2
18	Ghazipur	45,635	60,725	76,547	103,298	121,020	159,244	2015 130,000	2030 165,000	2045 205,000	2015 15.4	2030 19.6	2045 24.4					18.9	17.6	19.6		19.6
19	Kanpur	1,158,321	1,576,833	1,974,441	2,656,607	2,876,591	4,235,871	2020 3,668,232	2035 5,295,697	2050 7,645,209	2020 528.2	2035 762.6	2050 1,100.9	2,025 5,599,999	2,040 8,632,000	2025 673	2040 1035	610.0	673.0	684.5	793.7	684.5
20	Mirzapur	105,939	127,787	169,336	205,053	234,871	303,434	2030 322,533	2035 346,686	2050 423,624	2030 38	2035* 41	2050 50	N/A				36.0	34.1	38.0		38.0

Table 19.14.2 Estimated Sewage Flow for the Year of 2030 (Cont'd)

S. No.	Year	Census Population						DPR (Detailed Design Report) / WB (World Bank)						CDP				Estimated Sewage Flow (2030) (MLD)				
		1971	1981	1991	2001	2011	2030 (Proj'd)	Projected Population			Estimated Sewage Flow (MLD)			Projected Population		Estimated Sewage Flow (MLD)		JICA Survey Team	NMCG	DPR / WB	CDP	Adopted
21	Varanasi	588,608	735,175	947,481	1,091,918	1,198,491	1,451,459	2020 1,831,523	2035 2,654,338	2050 3,800,478	2020 302	2035 425	2050 540					209.0	348.0	384.0		384.0
22	Mugalsarai	13,583	48,063	66,529	88,387	109,650	245,138											29.1	15.9			29.1
23	Moradabad *4	258,590	330,051	429,214	641,583	887,871	1,347,329	2020 989,390	2030 1,305,892	2050 2,216,400	2020 106.9	2030 141.0	2050 239.4					194.0	143.4	141.0		141.0
24	Ballia	47,101	61,704	84,063	101,465	104,424	138,692											16.5	17.0			16.5
25	Unnao	38,195	75,983	107,425	144,662	177,658	347,832											41.3	25.8			41.3
26	Fatehpur	54,665	84,831	117,675	152,078	193,193	269,050											32.0	28.1			32.0
27	Bijor	43,290	56,713	66,486	79,346	93,297	122,609											14.6	24.0			14.6
28	Kannauj	28,187	41,016	58,932	71,727	84,862	111,783											13.3	12.3			13.3
29	Gangaghat	--	26,050	50,260	70,803	84,072	105,742											12.6	13.4			12.6
30	Najibabad	42,586	55,109	66,860	79,025	88,535	113,873											13.5	12.9			13.5
31	Gairaula	--	--	21,096	39,790	55,048	87,302											10.4	8.0			10.4
32	Nagina	37,066	50,405	58,513	71,350	95,246	132,576											15.8	13.8			15.8
33	Chandpur	28,179	41,552	55,825	68,287	83,441	111,328											13.2	12.1			13.2
34	Dhampur	22,639	29,070	39,179	46,869	50,997	62,352											7.4	7.4			7.4
35	Jahangirabad	21,578	29,301	37,981	51,394	59,858	78,721											9.4	8.7			9.4
36	Bhadohi	23,250	32,192	64,010	74,522	94,620	138,768											16.5	13.8			16.5
37	Anupshahar *1	12,253	15,193	19,684	23,795	29,087	39,244	2028 45,887	2033 49,878	2048 63,635	2028 4.94	2033 5.39	2048 6.9					4.7	5.0			4.7
38	Chunar	10,240	21,307	27,778	33,933	37,185	42,807	2030 55,000	2035 63,000	2050 80,000	2030 6.5	2035* 7.5	2050 9.5					5.1	5.4	6.5		6.5
39	Saidpur	10,045	12,937	18,217	21,568	24,338	31,127											3.7	3.5			3.7
40	Garhmukteshwa	10,937	17,914	25,241	33,847	46,077	67,593											8.0	9.0			8.0

Table 19.14.2 Estimated Sewage Flow for the Year of 2030 (Cont'd)

S. No.	Year	Census Population						DPR (Detailed Design Report) / WB (World Bank)						CDP				Estimated Sewage Flow (2030) (MLD)				
		1971	1981	1991	2001	2011	2030 (Proj'd)	Projected Population			Estimated Sewage Flow (MLD)			Projected Population		Estimated Sewage Flow (MLD)		JICA Survey Team	NMCG	DPR / WB	CDP	Adopted
41	Ramnagar	17,241	23,297	30,116	40,619	49,132	66,537		2035 87,122	2050 118,503		2035 10.36	2050 14.06					7.9	7.1	9.1		9.1
42	Naraura *1	--	9,573	15,652	20,407	22,775	26,024	2018 31,400	2033 40,060	2048 49,620			2048 4					3.1	4.0	3.1		3.1
43	Soron	17,153	19,443	21,966	26,678	27,468	32,368											3.8	4.0			3.8
44	Hastinapur	8,889	11,637	15,081	21,249	26,452	37,048											4.4	3.8			4.4
45	Bithoor *1	--	5,318	7,444	9,652	11,300	15,797	2020 17,900	2035 24,000	2050 32,300	2020 2	2035 2.6	2050 3.6					1.9	2.1	2.4		2.4
46	Babrala	--	6,151	9,786	14,451	18,108	28,799											3.4	2.6			3.4
47	Arrah	92,919	125,111	157,082	203,380	261,430	365,219							2,035 490,828		2030 70		43.4	42.0		70.0	70.0
48	Bhagalpur	172,202	225,062	253,225	340,767	400,146	535,316							2,030 536,000		2030 63		77.1	65.0		63.0	63.0
49	Buxar	31,691	42,952	55,753	83,168	102,861	177,670	2011 106,759	2026 153,995	2041 *2 218,514		2026 17.28	2041 24.25					21.1	17.0	19.1		19.1
50	Chapra	83,101	111,564	136,877	179,190	202,352	258,997							2,035 384,739		2030 46.6		30.8	32.0		46.6	46.6
51	Hajipur	41,890	62,520	87,687	119,412	147,688	204,965	2011 152,979	2026 217,992	2041 305,494		2026 23.54	2041 32.99	2,035 357,581		2030 45		24.3	23.4	26.1	45.0	26.1
52	Munger *1	102,474	129,260	150,112	188,050	213,303	264,538			2041 370,439		2026 30		2,030 310,000		Not incl'd		31.4	33.7	35.0		35.0
53	Patna *1	517,994	872,647	1,041,033	1,591,619	1,895,449	2,549,741	2028 2,770,400	2032 3,085,217	2047 4,568,410	2028 332.5	2032 370.2	2047 548.2					367.2	340.3	351.4		351.4
54	Danapur	59,993	82,228	108,107	159,410	211,152	310,051							2,030 348,185		2030 37.5		36.8	33.4		37.5	37.5
55	Begusarai	35,736	56,633	71,424	93,741	252,008	480,889	2011 117,516	2026 162,410	2041 *2 221,740		2026 18.26	2041 24.66	2,035 250,000		2030 35		57.1	39.9	20.0	35.0	20.0
56	Katihar	80,121	122,005	154,367	190,873	240,838	346,917							2,030 405,698		2030 43.81		41.2	38.1		43.8	43.8
57	Jamalpur	61,731	78,356	86,112	96,983	105,434	133,150							2,030 152,000		2030 18		15.8	16.7		18.0	18.0
58	Bihar Sharif	100,046	151,343	201,323	232,071	297,268	403,713							2,035 485,873		2030 59		48.0	47.0		59.0	59.0
59	Mokameh	38,164	51,047	59,528	56,615	60,678	67,323											8.0	10.0			8.0
60	Fatuah	15,309	21,252	30,668	38,672	50,961	73,723											8.8	8.1			8.8

Table 19.14.2 Estimated Sewage Flow for the Year of 2030 (Cont'd)

S. No.	Year	Census Population						DPR (Detailed Design Report) / WB (World Bank)						CDP				Estimated Sewage Flow (2030) (MLD)				
		1971	1981	1991	2001	2011	2030 (Proj'd)	Projected Population			Estimated Sewage Flow (MLD)			Projected Population		Estimated Sewage Flow (MLD)		JICA Survey Team	NMCG	DPR / WB	CDP	Adopted
61	Barh	23,599	31,869	45,285	48,442	61,470	83,829											10.0	10.0			10.0
62	Barauni	8,348	11,672	12,594	13,882	71,660	126,139											15.0	11.3			15.0
63	Sultanganj	14,654	22,578	34,181	41,958	52,892	73,819											8.8	9.0			8.8
64	Dumraon	22,969	29,560	35,068	45,806	53,618	69,297											8.2	8.5			8.2
65	Bhabua	13,420	19,896	27,041	41,775	50,179	69,411											8.2	7.9			8.2
66	Lakhisarai	26,782	39,818	53,360	77,875	99,979	143,075											17.0	15.8			17.0
67	Phulwari Sharif	15,917	22,712	35,123	53,451	81,740	132,746											15.8	12.9			15.8
68	Barahiya	24,665	27,180	31,980	39,865	43,032	53,011											6.3	7.0			6.3
69	Kahelgaon	10,543	14,030	17,899	22,049	33,700	57,539											6.8	5.3			6.8
70	Bakhtiyarpur	5,764	11,358	26,867	32,293	47,897	77,103											9.2	8.0			9.2
71	Naugachhia	9,544	23,235	31,250	38,287	49,069	67,843											8.1	8.0			8.1
72	Sonepur	--	20,363	27,124	33,490	37,776	49,638											5.9	6.0			5.9
73	Sahibganj *1	35,640	45,154	49,257	80,154	88,214	124,358	2025	2027	2042	2025	2027	2042					14.8	12.0	18.2		18.2
								103,796	105,988	124,908	11.2	17.6	20.7									
74	Rajmahal	8,189	12,426	13,958	17,977	22,514	31,290											3.7	3.4			3.7
75	Kolkata *3	3,716,377	4,126,846	4,399,819	4,572,876	4,496,694	4,643,890	2032	2037	2042	2032	2037	2042					668.7	744.5	567.6		567.6
								4,812,815	5,019,525	5,292,815	577.53	602.34	635.14									
76	English Bazaar	61,335	84,665	139,204	161,456	205,521	293,053											34.8	27.8			34.8
77	Baharampur	72,605	94,896	117,647	160,143	195,223	265,212											31.5	26.5			31.5
78	Santipur	61,166	82,980	109,956	138,235	151,777	187,222											22.2	20.6			22.2
79	Haldia	9,968	21,122	100,347	170,673	200,827	308,933											36.7	27.2			36.7
80	Raiganj	43,191	60,343	151,045	165,212	183,612	293,887											34.9	24.9			34.9

Table 19.14.2 Estimated Sewage Flow for the Year of 2030 (Cont'd)

S. No.	Year	Census Population						DPR (Detailed Design Report) / WB (World Bank)						CDP				Estimated Sewage Flow (2030) (MLD)				
		1971	1981	1991	2001	2011	2030 (Proj'd)	Projected Population			Estimated Sewage Flow (MLD)			Projected Population		Estimated Sewage Flow (MLD)		JICA Survey Team	NMCG	DPR / WB	CDP	Adopted
81	Krishnanagar	85,923	98,141	121,110	139,110	153,062	186,546											22.2	20.7			22.2
82	Nabadwip	94,204	109,108	125,037	115,016	125,543	138,420											16.4	17.0			16.4
83	Barrackpore *1	96,889	115,516	142,557	144,391	152,783	175,691	2024 189,602	2029 199,688	2044 215,535			2044 24.0					20.9	21.1	21.3		21.3
84	Uttarpara Kotlun	67,568	79,598	101,268	150,363	159,147	199,667											23.7	21.6			23.7
85	Rishra	63,486	81,001	102,815	113,305	124,577	147,863											17.6	16.9			17.6
86	Baidyabati	54,130	70,573	90,081	108,229	121,110	152,926											18.2	16.4			18.2
87	Champdani	58,596	76,138	101,067	103,246	111,251	133,433											15.9	15.1			15.9
88	Bhadreshwar	45,586	58,858	72,474	106,071	101,477	119,823											14.2	13.8			14.2
89	Kamarhati	169,404	234,951	266,889	314,507	330,211	360,823											42.9	44.7			42.9
90	Baranagar	136,842	170,343	224,821	250,768	245,213	278,756											33.1	86.6			33.1
91	Naihati	82,080	114,607	132,701	215,303	217,900	254,928											30.3	29.5			30.3
92	Kanchrapara	78,768	98,816	111,602	135,198	129,576	141,923											16.9	17.6			16.9
93	Serampore	102,023	127,304	137,028	197,857	181,842	200,796											23.9	24.6			23.9
94	Hugli Chinsurah	105,241	128,918	160,976	184,173	179,931	202,591											24.1	24.4			24.1
95	Maheshtala				385,266	448,317	578,165											83.3	60.7			83.3
96	Panihati	148,046	205,718	275,990	348,438	377,347	486,265											57.8	51.1			57.8
97	Bally		147,735	184,474	260,906	293,373	379,797											45.1	39.7			45.1
98	Ulluberia	62,573	81,352	155,172	204,771	235,345	328,244											39.0	31.9			39.0
99	Khardah	36,679	50,202	88,358	122,133	108,496	130,139											15.5	14.7			15.5
100	Howrah	737,877	744,429	950,435	1,007,532	1,077,075	1,238,195											178.3	162.1			178.3

Table 19.14.2 Estimated Sewage Flow for the Year of 2030 (Cont'd)

S. No.	Year	Census Population						DPR (Detailed Design Report) / WB (World Bank)						CDP				Estimated Sewage Flow (2030) (MLD)				
		1971	1981	1991	2001	2011	2030 (Proj'd)	Projected Population			Estimated Sewage Flow (MLD)			Projected Population		Estimated Sewage Flow (MLD)		JICA Survey Team	NMCG	DPR / WB	CDP	Adopted
101	Bansberia	61,748	77,967	94,698	107,081	103,920	115,053											13.7	11.2			13.7
102	Chandannagar	75,238	101,923	120,378	162,187	166,867	210,759											25.0	18.0			25.0
103	Titagarh	88,218	104,534	114,085	124,213	116,541	129,995											15.4	12.6			15.4
104	Halisahar *1	68,906	99,366	117,539	130,621	124,939	134,960		2025			2025						16.0	14.6	14.0		14.0
									147,000			12.5										
105	Kalyani	18,310	39,257	57,648	85,503	100,575	206,935											24.6	16.0			24.6
106	Bhatpara	204,750	265,419	315,976	444,655	386,019	472,121											56.1	56.3			56.1
107	Dhulian	22,068	25,466	33,191	72,850	95,706	130,685											15.5	19.3			15.5
108	Jangipur	29,872	43,795	55,981	74,458	88,165	115,854											13.8	9.5			13.8
109	Ranaghat	47,815	64,722	71,929	85,321	75,365	76,118											9.0	8.1			9.0
110	Jiaganj-Azimganj	26,535	32,725	42,104	47,212	51,790	63,787											7.6	5.6			7.6
111	Katwa	28,832	44,430	55,541	71,589	81,615	101,571											12.1	8.8			12.1
112	Chakdah	46,345	59,308	74,769	86,999	95,203	114,042											13.5	10.3			13.5
113	Konnagar	34,424	51,211	62,200	72,177	76,172	84,255											10.0	38.9			10.0
114	Budge Budge *1	51,039	70,404	77,575	81,554	76,837	78,035	2014	2029	2044	2014	2029	2044					9.3	10.0	11.6		11.6
								91,000	97,500	110,000	9.3	11.5	12.5									
115	Gayespur	21,291	41,667	52,158	55,048	58,998	72,997											8.7	7.4			8.7
116	Gaulia	44,271	57,061	80,918	79,926	85,336	101,453											12.1	9.2			12.1
117	Murushidabad	17,110	21,341	30,327	36,947	44,019	59,409											7.1	4.8			7.1
118	Diamond Harbou	13,072	20,259	30,266	37,234	41,802	53,045											6.3	5.7			6.3
																		4,502.6	4,746.3			4,692.7

*1 *Figures in DPR/WB coloums are based on WB reports*

*2 *Projected population is also confirmed in WB report*

*3 *ADB, "Technical Assistance Consultant's Report - India: Preparing for Kolkata Environmental Improvement Project Phase II", March 2012*

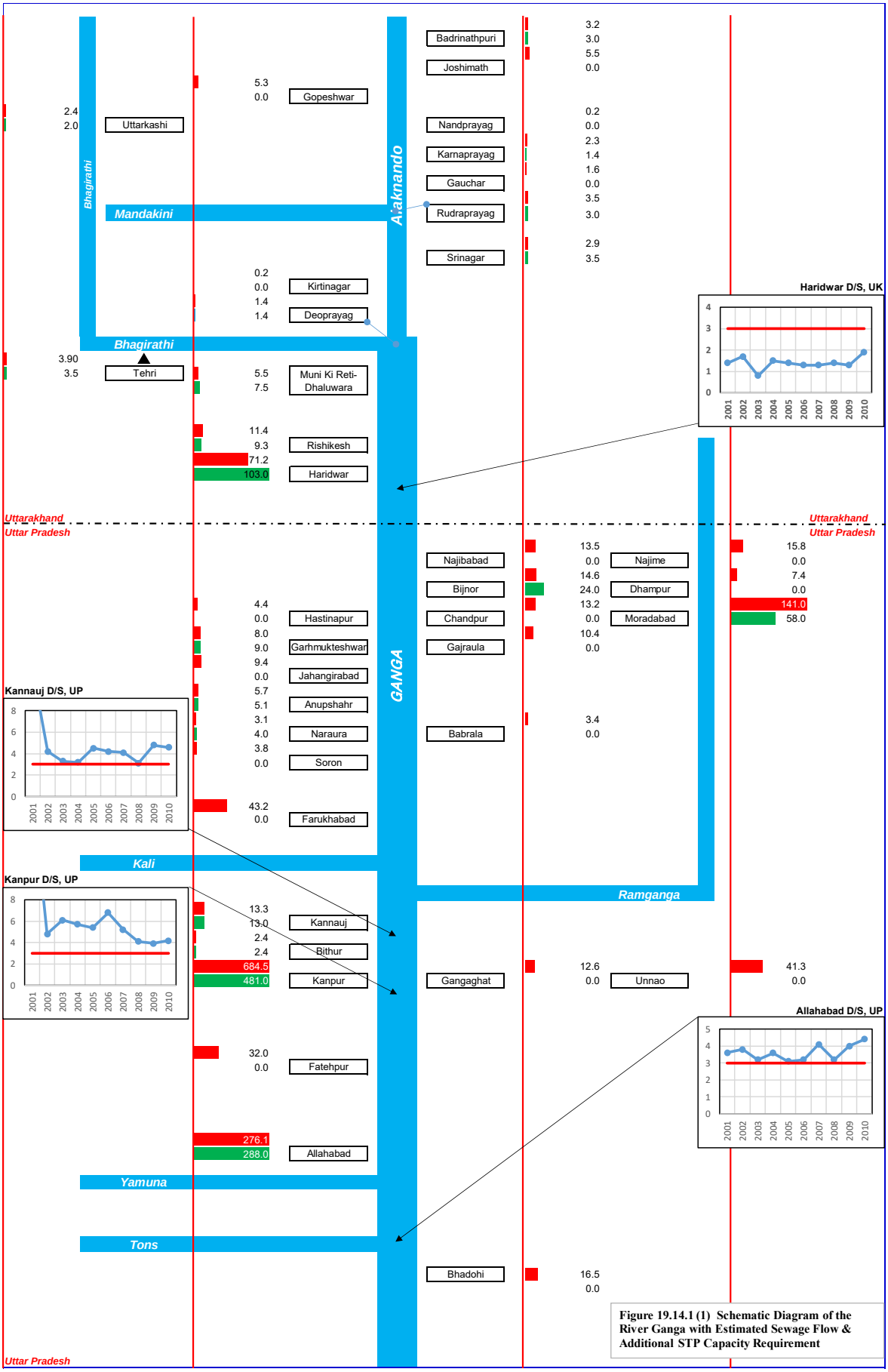


Figure 19.14.1 (1) Schematic Diagram of the River Ganga with Estimated Sewage Flow & Additional STP Capacity Requirement

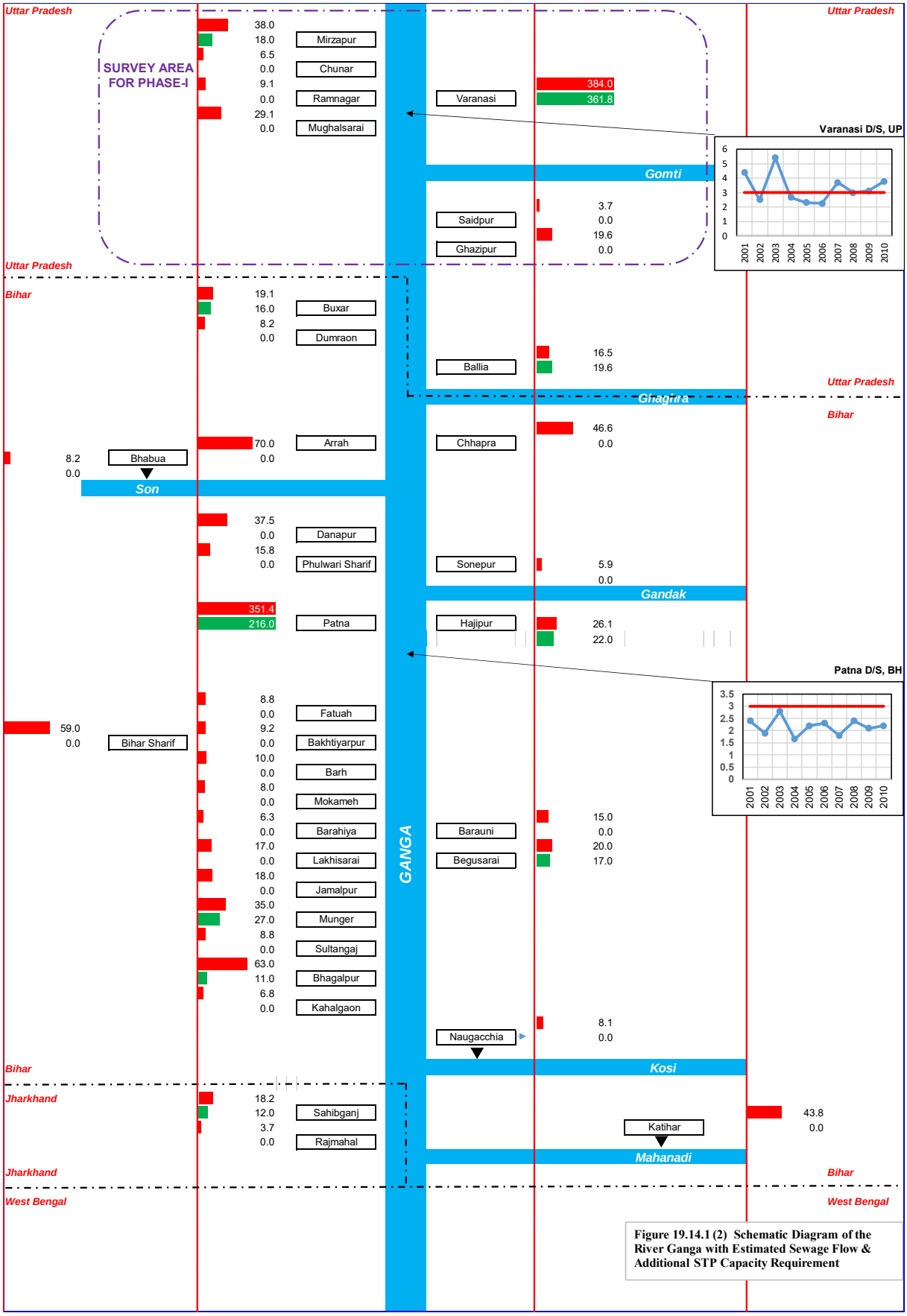
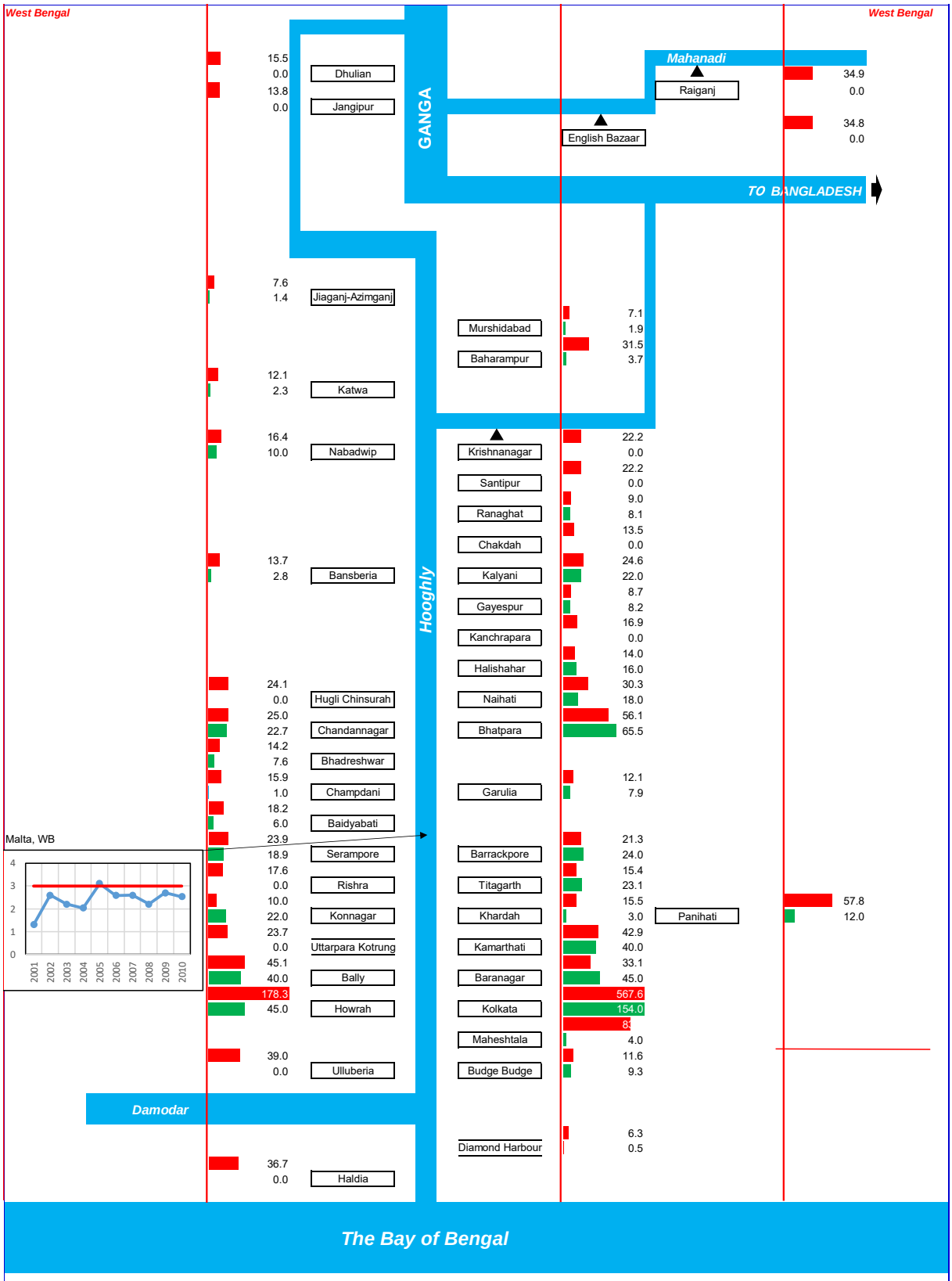


Figure 19.14.1 (2) Schematic Diagram of the River Ganga with Estimated Sewage Flow & Additional STP Capacity Requirement



Note: Since the bar char of the above is set so as to have the maximum of 100 MLD, the bar chart with a capacity of more than 100 MLD doesn't follow the scale.

Figure 19.14.1 (3) Schematic Diagram of the River Ganga with Estimated Sewage Flow & Additional STP Capacity Requirement

PART-II: SELECTION OF TARGET AREA FOR PHASE-II PROJECT

19.15 Composition of Database

19.15.1 Composition of Database

The composition of database is shown in **Table 19.15.1** with data source and availability (for more details, refer to **Appendix 19.15.1**).

Table 19.15.1 Composition of Database

Database-1

Source	NMCG	Census			MoUD: Service Level Benchmark			
Contents	118 RFTs	Census 2001	Census 2011	Census 2011 (Slum)	Water Supply	Sewerage	Solid Waste Management	Storm Water Drain
Colum Range	A~K	L~AC	AD~DS	DT~GZ	HA~HT	HU~IL	IM~JB	JC~JF
Uttarakhand	√	√	√	√	N/A	N/A	N/A	N/A
Uttar Pradesh	√	√	√	√	√	√	√	√
Bihal	√	√	√	√	√	√	√	√
Jharkhand	√	√	√	√	N/A	N/A	N/A	N/A
West Bengal	√	√	√	√	N/A	N/A	N/A	N/A

Database-2

Source	NMCG	State	DADF	Wikipedia	Census		NGRBA	
Contents	118 RFTs	Rainfall	Livestock Census 2012	Location (Coordinates)	Latrine Availability	Bathing Facility Availability	Status of DFR	
Colum Range	A~K	L~AL	AM~AW	AX~BJ	BK~CD	CE~CR	CS	
Uttarakhand	√	N/A	*1	√	√	√	√	
Uttar Pradesh	√	N/A	*1	√	√	√	√	
Bihal	√	√	√	√	√	√	√	
Jharkhand	√	N/A	√	√	√	√	√	
West Bengal	√	N/A	*1	√	√	√	√	

Database-3

Source	NMCG	Housinh Census 2011*2						
Contents	118 RFTs	Total	Within the Premises	Near the Premises	Away			
Colum Range	A~K	L~BH	BI~CV	CW~EJ	EK~FX			
Uttarakhand	√	√	√	√	√			
Uttar Pradesh	√	√	√	√	√			
Bihal	√	√	√	√	√			
Jharkhand	√	√	√	√	√			
West Bengal	√	*3	*3	*3	*3			

Collected

Website file (19th Livestock Census District Wise Report 2012 Volume III) is broken

Location, source of drinking water, electricity availability and latrine availability wise

Website file is broken

19.15.2 Limits of Database

There are some problems to prepare the database as described below, therefore it is necessary to check the data carefully one by one so as to minimize their effects.

- Even in census data, the town/village code is different between Census 2001 and Census 2011.
- One town data out of 118 towns may be sometime given dividing into a few areas in other data source.
- The extent of an urban area used in the various data sources may not be necessarily same.
- The data is arranged in accordance with the town name and the urban/rural division neglecting the separation/integration of towns, if any

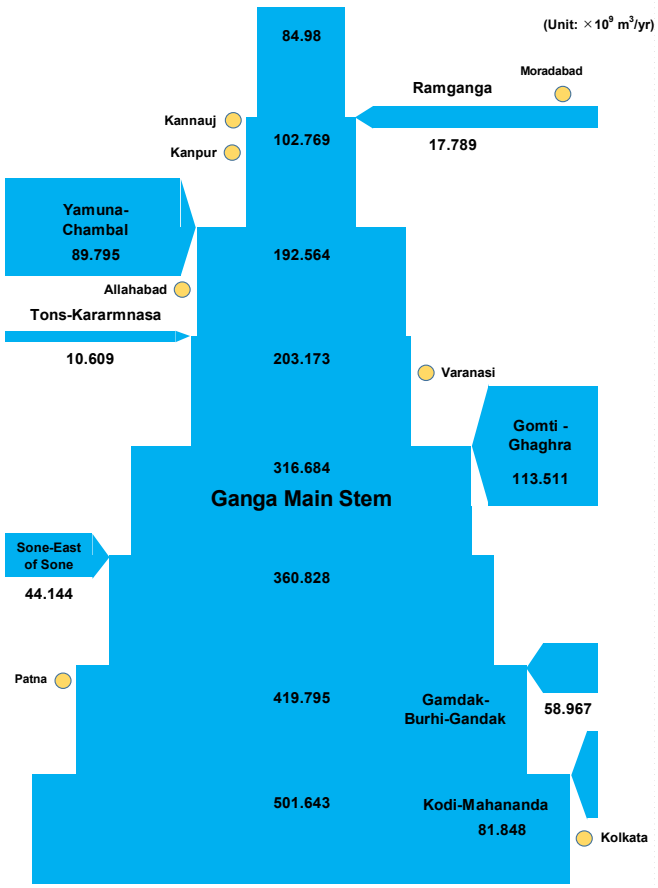
19.16 Selection of Target Area for Phase-II Project

The contents as described in **Sections 19.2** to **19.14** are summarized in **Table 19.16.1**.

Table 19.16.1 Summary of Present Situation of 118 Towns

Item	Situation
(1) Natural conditions	● The temperature is about 5°C lower in Dehradun (UK) and Ranchi (JK) among five state capitals in the River Ganga basin, but their annual fluctuation patters are almost same. ● The precipitation is biggest as 2,209 mm in Dehradun (UK) at the uppermost stream of the Ganga, but, entering into the plain, almost halves to 990 mm in Lucknow (UP), and then increase to 1,019 mm in Patna (BH), 1,398 mm in Ranchi (JK) and 1,800 mm in Kolkata (WB) westwards or toward the downstream of the Ganga. ● The River Ganga basin covers 26.2% of the country land, out of which the UP State shares 34.2% followed by BH (16.7%) and WB (8.3%). ● The States of UP, BH and WB located in the Indo-Gangetic Plain are blessed with affluent groundwater
(2) Socio-economic conditions	● The total population of five states (UK, UP, BH, JK and WB) in the Ganga Basin is 260 billion accounting for 26.3% of the total population in India ● The total population of 118 towns identified by NMCG as the river-front towns is 26.3 million, in which UP accounts for 32.3% followed by 18.8% by BH and 46.5% by WB. ● The state-wise percentages in the total Indian GDP are 8.2% in UP (2nd ranked in India), 3.3% in BH (13th) and 6.6% in WB (6th). ● The percentages holding a latrine within a premise to the total state households is 87.7% in UP and 71.6% in BH (WB: N/A).

(3) Irrigation, water Supply and water re-use	● The irrigation area in the Ganga Basin is biggest as 41.3% in UP followed by 11.7% by BH and 7.6% by WB. ● The UP State accounts for 38.0% of the total irrigation area by canals and 45.8% by groundwater ● The breakdown of water source for water supply is 53.2% in UP, 26.1% in BH and 63.2% in WB by treated tap water and 29.5% in UP, 45.3% in BH and 22.4% in WB by hand pumps (groundwater)
(4) Existing/on-going sewerage projects	● The sewerage projects have been implemented in 53 towns out of 118 towns with a total existing/sanctioned treatment capacity of 2317.4 MLD.
(5) Status of industrial wastewater	● The Grossly Polluting Industries (GPI) identified in the Ganga Basin amounts to 155 industries which is classified into ETP operating satisfactorily (95 industries), ETP not operating satisfactorily (22) and unit closed (38). ● According to CPCB, the 6,087 MLD wastewater is discharged into the Ganga with a BOD load of 999 t/day) through 138 drains, out of which 3,289 MLD (761 t/day) is derived from UP, 1,779 MLD (97 t/day) from WB and 579 MLD (99 t/day) from BH, respectively. The UP State accounts for 54.0% of wastewater and 76.2% of BOD load. ● The region-wise BOD load discharged from the drains into the Ganga is biggest as 558 t/day (or 55.9% of the total) in the Kanpur Region followed by 77 t/day (7.7%) in the Jajmau Region.. These adjoining two regions discharge almost two-third BOD load of the total into the Ganga.
(6) Status of solid waste management	● The Service Level Benchmarking (SLB) Survey for 2010-11by MoUD shows that the solid waste collection rates from individual households are 20.0% in Allahabad. 40.0% in Kanpur, 27.3% in Varanasi, and 35.4% in Moradabad in the UP State and 30.0% in Bhagalpur and 20.0% in Patna in the BH State (WB* N/A).
(7) Movement of other donors for 118 towns	● The World Bank has extensively provided the assistance to 15 towns in five states. For major cities, it concentrates the assistance to Allahabad (UP) and Patna (BH). ● ADB has provided the assistance to Kolkata (BWB) and JICA to Varanasi, while GIZ has no performance
(8) Status of DPR preparation	● *MoWRRD&GR reported the all the DPRs for 118 towns would be completed by December 2015 in "Ganga Rejuvenation Committee of Estimate (2016-17)" on 11/05/2016*

(9) River discharge and water quality	 ● The river discharge balance of the Ganga is shown in the above figure based on the annual river discharge. ● At the upstream of the confluence with the Ramganga River, or one of tributaries of the Ganga, the 80% of an annual river discharge of the Ganga is taken through tour irrigation canals. In addition, one more canal is under construction. ● According to the past water quality variation along the Ganga, Do has achieved the target quality of more than 5 mg/l at all monitoring stations except for Kanpur, while BOD has achieved the target water quality of less than 3 mg/l at all monitoring stations except for the stretch of the UP State. ● For BOD, there are obviously four pollution points, say, Kannauj, Kanpur, Allahabad and Varanas in the stretch of the UP Statei. ● The pollution at kannauj is not caused by Kannauj itself but the tributary of the Ganga, that is to say, the Ramganga River in which Moradabad is located in its upstream.
(10) Status of water quality surveillance	● The water quality in the Ganga is monitored at the network consisting of 39 stations in the Ganga main stem and 88 stations in its tributaries for 20 parameters. The results are open at the website of ENVIS Centre. ● Under the assistance of the World Bank, the formation of an automatic water

	quality monitoring system is in progress on a state-of-art, real time basis at 113 monitoring stations for 20 parameters.
(11) Organizational structures for water quality management	● CPCB (Central Pollution Control Board) is responsible for the enforcement of laws concerning the environmental protection and pollution control in collaboration with SPCB (State Pollution Control Board).
(12) Smart Ganga City	● NMCG has selected the following ten cities under the Smart Ganga Cities Programme for Phase-1 on 13 August, 2016. Haridwar, Rishkesh, Mathura-Vrindavan, Varanasi, Kanpur, Allahabad, Lucknow, Patna, Sahibganj and Barrackpore ● These sewerage projects will be implemented under the HAM-PPP Model
(13) Additional STP capacity requirement	● The additional STP capacity is biggest as 413.6 MLD in Kolkata, followed by Kanpur (203.5 MLD), Patna (135.4MLD), Howrah (133.3 MLD) and Moradabad (83.0 MLD).

Source: JICA Survey Team

The conditions of 118 Towns are as follows:

- The precipitation is biggest as 2,209 mm in Dehradun (UK) at the uppermost stream of the Ganga, almost double in the plain represented by Lucknow (UP) as 990 mm, however the river discharge of the Ganga is cut to 80% at Haridwarto use for irrigational purpose up to before the confluence with the Ramganga River.
- The state-wise percentages in the total Indian GDP is 8.2% in the UP State which is ranked at the 2nd showing the active economic activities in the area.
- The sewerage projects have been implemented in 53 towns out of 118 towns with a total existing/sanctioned treatment capacity of 2317.4 MLD.
- So far Allahabad has been mainly assisted by the World Bank, as well as Varanasi by JICA. When the currently proposed project for Varanasi will be implemented in addition to the existing/sanctioned project, the sewerage system will almost cover the service area with sewage treatment plants. The similar situation to Varanasi is expected in Allahabad, although the sewer network and sewage treatment plant plan has not yet been fixed in some service areas.
- According to CPCB, the 6,087 MLD wastewater is discharged into the Ganga with a BOD load of 999 t/day) through 138 drains. The UP State accounts for 54.0% of wastewater and 76.2% of BOD load.
- The region-wise BOD load discharged from the drains into the Ganga is biggest as 558 tonnes/day (or 55.9% of the total) in the Kanpur Region followed by 77 tonnes/day (7.7%) in the Jajmau Region.. These adjoining two regions discharge almost two-third BOD load of the total into the Ganga.

- According to the "Service Level Benchmarks (SLB) Survey for 2011-12", the collection rate of solid waste from households is still in the low level of 20 to 40% even in the major cities.
- The World Bank has extensively provided the assistance to 15 towns in five states. For major cities, it concentrates the assistance to Allahabad (UP) and Patna (BH) as well as ADB to Kolkata (BWB) and JICA to Varanasi. GIZ has no performance in the field of sewerage facility construction
- The DO variation along the Ganga main stem is shown in Table 19.14.4 as summer average (March – June) for the period of 2001-2010. The DO requirement for outdoor bathing was achieved at all monitoring stations except for Kanpur downstream (D/S) which showed a DO concentration of less than 5 mg/L in some years

Table 19.16.2 DO Variation along the Ganga Main Stem (2001-2010, Summer Average)

Monitoring Sta.	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Haridwar	8.8	7.8	9.0	8.1	8.1	8.1	8.1	7.9	7.8	7.38
Kannauj D/S	6.8	6.5	6.2	7.85	7.6	6.45	6.4	6.2	7.6	7.03
Kanpur D/S	4.8	7.2	4.4	5.28	4.7	3.9	4.6	6.0	7.5	6.18
Allahabad D/S	7.2	8.2	7.3	6.58	8.4	8.5	8.8	7.7	8.1	7.98
Varanasi D/S	7.2	7.5	8.1	5.55	8.3	8.65	8.4	7.3	7.7	7.85
Patna D/S	7.7	7.1	7.8	6.73	8.0	8.1	6.9	5.9	6.8	6.10
Palta	6.8	7.2	7.2	7.55	7.0	6.96	6.9	6.9	7.2	7.61

- For the BOD variation along the River Ganga, the requirement of less than 3 mg/l in BOD is almost achieved in the stretch of Uttarakhand, Bihar, Jhakhand and West Bengal, but not achieved in the almost stretch of Uttar Pradesh as shown in **Figure 19.16.1**.

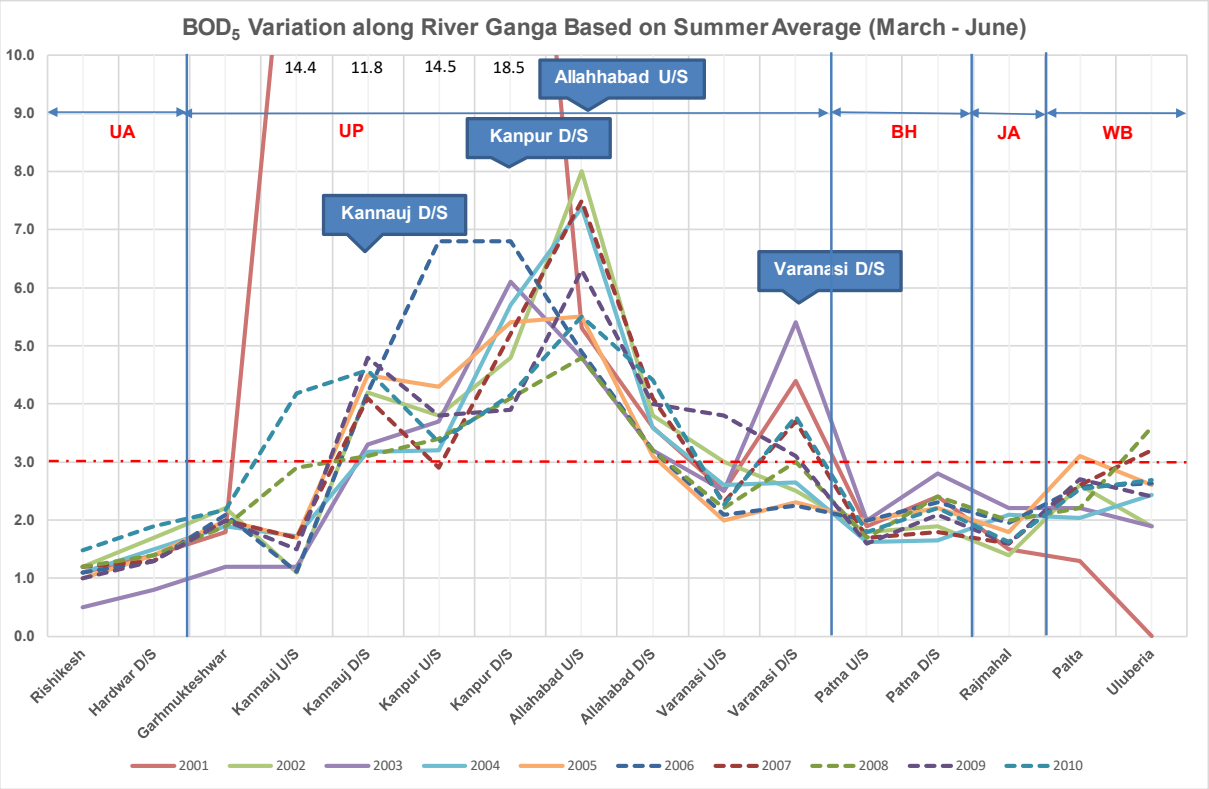


Figure19.16.1 BOD Variation along the River Ganga (Summer Average: March-June)

- In the stretch of Uttar Pradesh, there are obviously four major pollution sources, that is to say, Kannauj, Kanpur, Allahabad and Varanasi.
- Kannauj is not a so big town with an estimated population of about 139,000 persons for the year of 2030 in the Ganga basin as shown in Table 19.14.2 (S. No. 28). The pollution is caused by the Ganga tributary, or the River Ramganga. When ascending the River Ramganga, it reaches to Moradabad.
- **Figures 19.16.2** and **19.16.3** show the DO and BOD variations in the stretch of Uttar Pradesh for a period of October 2015 to July 2016, respectively. The DO concentrations are below 5 mg/l in only May and June, 2016, at Kanpur D/S, while the BOD concentrations are above 5 mg/l in almost months at almost monitoring stations. Especially in the summer season covering March to June, the BOD concentrations (dot line) is higher than those in non-summer season.

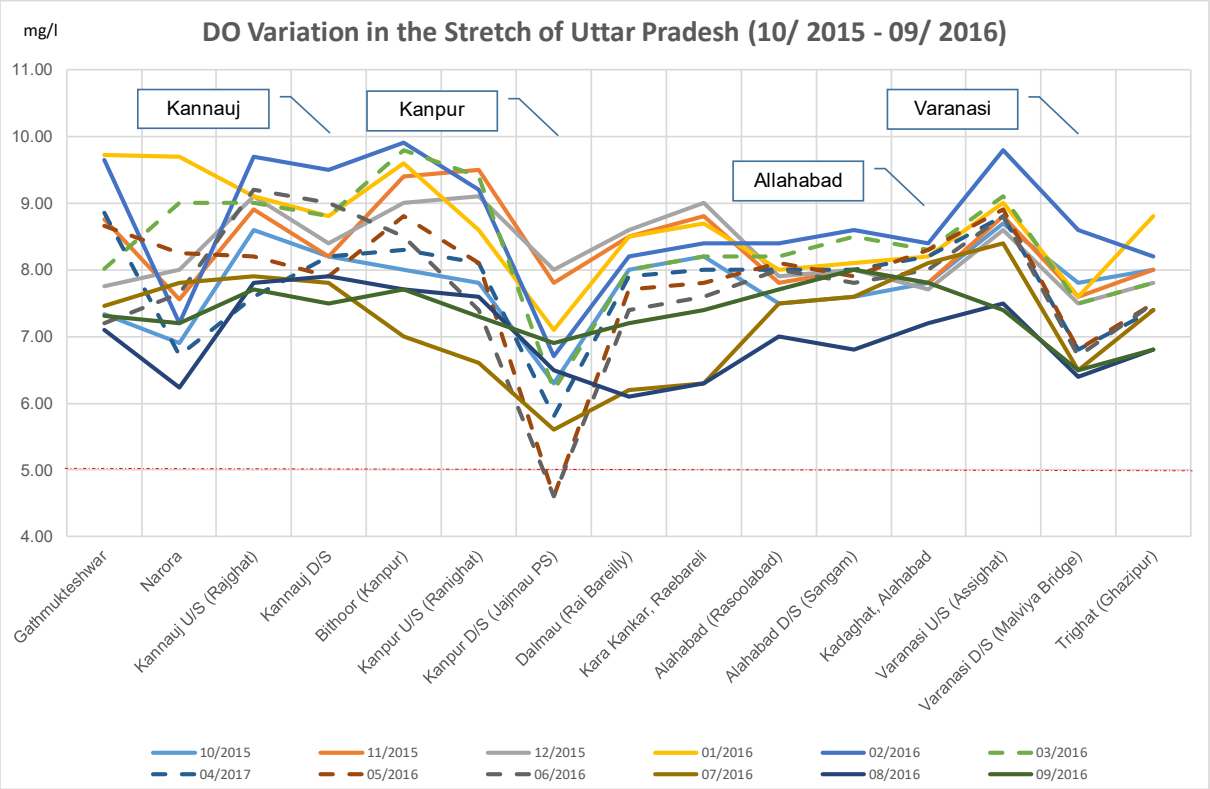


Figure 19.16.2 DO Variation along the Stretch of Uttar Pradesh (10/2015-09/2016)

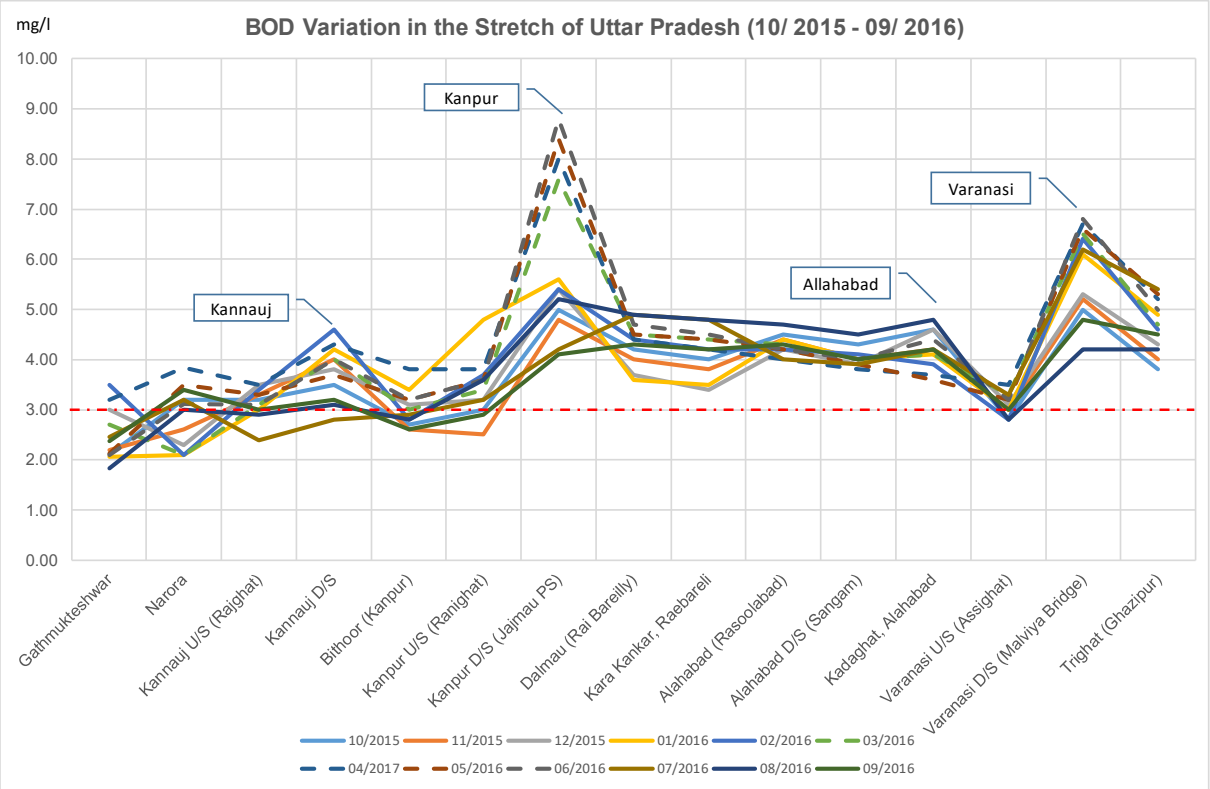


Figure 19.16.3 BOD Variation along the Stretch of Uttar Pradesh (10/2015-09/2016)

Table 19.16.2 shows the comparison of 14 towns ranked within the 14th regarding the addition STP capacity requirement and 6 towns except for Mathura-Vindavan and Lucknow in the different river basin from the Ganga and Kanpur and Patna already in cluded in the above 14 towns

From the situation mentioned below, Kanpur is recommended as the target area for the Phase-II Project together with Unnao (additional STP capacity requirement: 50.1 MLD) and Gangaghat (16.2 MLD). which are located on the opposite side of the River Ganga from Kanpur.

- The Ganga Action Plan aims to achieve a BOD concentration of less than 3 mg/l for bathing purpose in the holly Ganga in the earliest time. Therefore, the priority should be given to the compliance status of primary water quality criteria set for the Ganga in selecting the target area for the Phase-II Project.
  - ✓ Total Coliforms Organism: 500 MPN/100 ml or less
  - ✓ pH : 6.5 – 8.5
  - ✓ DO : 5 mg/l or more
  - ✓ BOD_5 at $20^{O}C$: 3 mg/l or less
- The primary water quality criteria of both DO and BOD is not achieved in Kanpur where the biggest BOD load is discharged into the Ganga through drains from the adjoining two regions, say Kanpur and Jajmau.
- The additional STP capacity requirement is in proportion to the untreated pollution load and the value dividing the additional STP capacity requirement by the annual average river discharge shows the magnitude of impact on water quality, that is to say, sewage treatment effect. The impact on water quality is biggest in Kanpur, followed by Kolkata, Moradabad, Farrukhabad and Unnao.
- Kanpur is selected as one of the Phase-I Smart Ganga Cities under the HAM-PPP Model, for infrastructure development of sewage treatment by NMCG on 13 August 2016
- There is no competition with other donor agencies/countries (The World Bank has provided the assistance to Kanpur 36 years ago in 1981.)
- Unnao is ranked as the 5th position regarding the impact on water quality as mentioned above.

Moradabad is secondly proposed as the target area for Phase-II Project. Since Modarabad is ranked at the 3rd position and the synergy effect is expected on Kannauj and Kanpur n the ganga main stem.

Table 19.16.3 Comparison of Major Towns with Big Additional STP Capacity Requirements and Smart Ganga Cities

	Item	(2)		(4)	(13)	(1), (9)		(12)	(7)	(5)
Add. STP Cap. Rank	City/Town	Census 2011 Population	2030 Estimated Sewage (MLD)	Existing /Sanctioned STP Capacity (MLD)	Additional STP Capacity Requirement (MLD)	River Discharge (10^6 m^3/yr)	Sewage Flow / River Discharge	Smart Ganga City Programme	Externally Assisted Project	BOD Load from Drains (kg/day)
1	Kolkata	4,496,694	567.60	154.00	**413.60**	501,643	**0.0301**		ADB	55,116
2	Kanpur	2,876,591	684.50	481.00	**203.50**	102,769	**0.0723**	×	World Bank*1	634,915*1
3	Patna	1,684,297	351.40	216.00	**135.40**	419,795	0.0118	×	World Bank	55,389
4	Howrah	1,077,075	178.30	45.00	**133.30**	501,643	0.0097			12,946
5	Moradabad	887,871	141.00	58.00	**83.00**	102,769	**0.0295**			
6	Maheshtala	448,317	83.30	4.00	79.30	501,643	0.0058			
7	Arrah	261,430	70.00	0.00	70.00	360,828	0.0071			
8	Bihar Sharif	297,268	59.00	0.00	59.00	419,795	0.0051			
9	Bhagalpur	252,008	63.00	11.00	52.00	419,795	0.0045			31,803
10	Chapra	202,352	46.60	0.00	46.60	360,828	0.0047			
11	Panihati	377,347	57.80	12.00	45.80	501,643	0.0033			
12	Katihar	240,838	43.80	0.00	43.80	360,828	0.0044			
13	Farrukkabad	276,581	43.20	0.00	43.20	84,980	**0.0186**			
14	Unnao	177,658	41.30	0.00	41.30	102,769	**0.0147**			12,068
	Rishkesh	73,726	11.40	9.30	2.10	84,980		×		1,266
	Haridwar	278,286	71.20	103.00	-31.80	84,980		×		4,310
	Varanasi	1,198,491	384.00	361.80	22.20	203,173		×	JICA	9,607
	Allahabad	1,195,329	276.10	288.00	-11.90	192,564		×	World Bank	35,943
	Sahibganj	88,214	18.20	12.00	6.20	419,795		×	World Bank	
	Barracjpore	152,783	21.30	24.00	-2.70	501,843		×	World Bank	4,029

*1 ADB assistance to Kanpur is 36 years ago (1981).. *2 The figure is the summation o adjoining two regions or Kanpur and Jajmau.

19.17 Situation of Sewerage Works in Kanpur and Moradabad

(1) Kanpur

Kanpur City with a population of 2,942,910 in Census 2011 is situated on the most important national highways no. 2 and 25 and state highway, and on the main Delhi-Howrah railway trunk line. It is situated on bank of holy River Ganga and is about 126 meters above the sea level.

1) Population

According to the DPR for Sewerage Works for Zone 1, district-III, Kanpur", the district-wise population is projected as shown in **Table 19.17.1**.

Table 19.17.1 District-wise Population Projection of Kanpur

	Census Population	Projected Population		
	2011	2020	2035	2050
District-I	795,444	914,761	1,272,710	1551,116
Kanpur Cantonment	108,035	113,428	122,512	130,313
Total District-I	903,479	1,028,189	1,395,222	1,681,429
District-II	1,418,727	1,773,409	2,482,772	3,546,818
District-III	424,875	573,581	849,750	1,397,839
District-IV	135,456	230,275	501,187	948,192
Total of all District	**2,882,537**	**3,605,454**	**5,228,932**	**7,574,277**
Northern Railway colony	29,708	31,203	33,645	36,109
Chakeri (Air Force)	9,868	10,164	10,628	11,206
Armapur Estate (Arms Factory Residential Area)	20,797	21,421	22,492	23,617
Total Population of Other Areas	**60,373**	**62,778**	**66,765**	**70,932**
TOTAL	**2,942,910**	**3,668,232**	**5,295,697**	**7,645,209**

2) Water Supply

Table 19.17.2 Present Status of Water Supply in Kanpur

Areas	Production Capacity	Water Supplied
WTP at Bhenajbhar	280 MLD	230 MLD
WTP at Gujaini	28.5 MLD	15 MLD
WTP at Barraj	200 MLD	35 MLD
Tube wells	169 nos. 133 MLD	133 MLD
Private wells and Hand Pumps	14342 Hps-192.75 MLD	166 MLD
Total	**834.25 MLD**	**579 MLD**

3) Sewerage

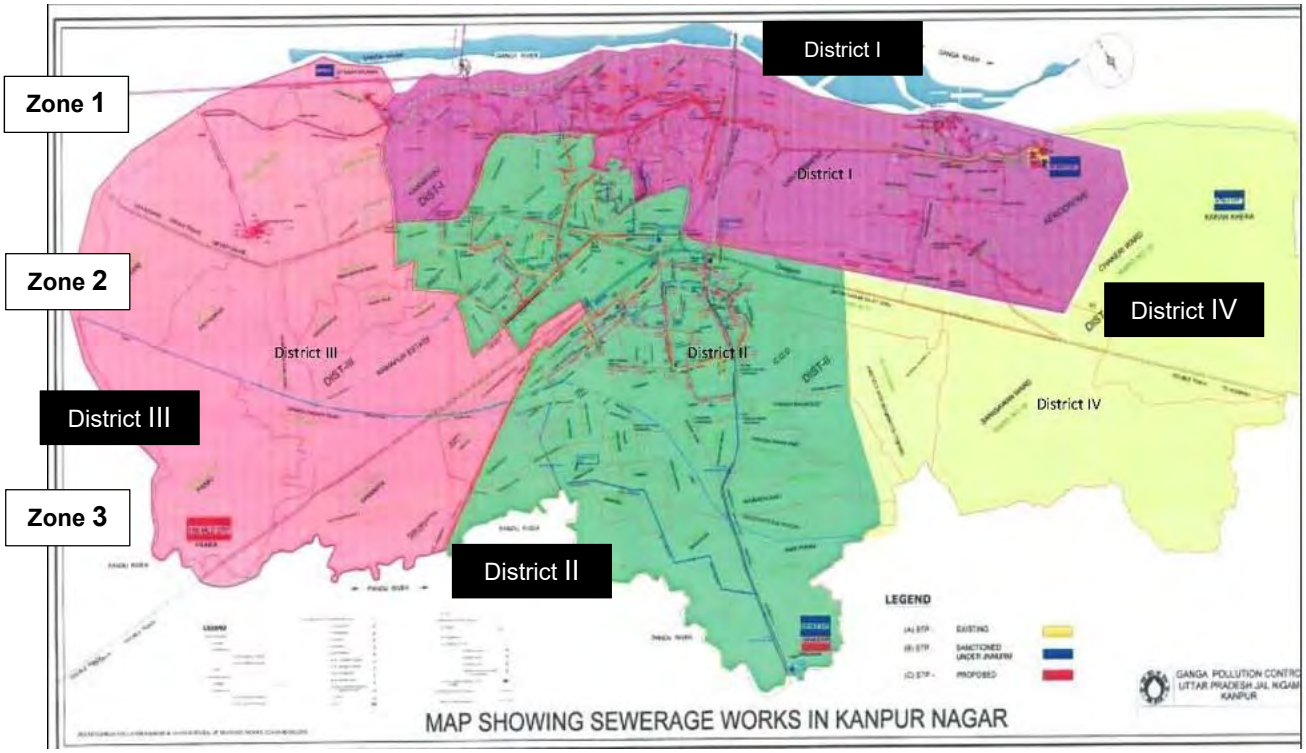


Figure 19.17.1 Sewerage Plan for Kanpur

The present status of sewerage works is summaraised as shown in **Table 19.17.3.**

Table 19.17.3 Present Status of Sewerage Works in Kanpur

Sewerage District	Sub-district	STP	Capacity (MLD)	Treatment Process	Fund	Status
District I		Jajmau	5	UASB	GAP-I	Existing (1989)
			36	CETP* UASB+ASP	GAP-1	Existing (1994)
			130	ASP	GAP-1	Existing (1999)
			43	ASP	JNNURM (P-I)	Under execution
District II		Bingawan	210	??	JNNURM (P-II)	Under execution
			105	??		Under preparation
District III	Zone-1	Baniyapura	15	??	JNNURM (P-I)	Under execution
	Zone-2		109	??		Under preparation
	Zone-3					
District-IV		Sajari	42	??	JNNURM (P-III)	Under execution

CESP: Common Effluent Treatment Plant for Industrial Wastewater

Source: Prepared by the JICA Survey Team based on the description in "Environmental and Social Assessment with Management Plan for Laying of Branch Sewers and Allied Works in Sewerage District-I of Kanpur City, Uttar Pradesh", 2014, et al.

"The Detailed Design Report for Sewerage Works Zone I, District-III, Kanpur" was prepared with an estimated cost of Rs.147.00 Crores in July 2016.

(2) Modarabad

Moradabad with a population of 894,337 in Census 2011 is situated 167 km from Delhi, connected to it by the National Highway 24. And on the main railway line between Howrah and Amritsar. Ramganga river flows in the north east and Gagan river in south west of the city.

1) Population

City Area: 85 km^2
DPR Area: 50 m^2

Table 19.17.4 Year-wise Population Projection of Moradabad

Sl. No.	Zone	2011	2020	2030	2035	2050
1	Zone-I	506,184	519,168	555,613	577,935	660,321
2	Zone-II	107,044	126,436	189,450	227,354	370,486
3	Zone-III	119,302	158,170	292,668	373,749	680,299
4	Zone-IV	161,807	185,616	268,161	317,500	505,294
Total		894,337	989,390	1,305,892	1,496,538	2,216,400

2) Water Supply

Rate of water Supply: 135 lpcd

Table 19.17.5 Present Water Supply of Moradabad

Sr. No.	Description	Water Production, MLD
1	Surface Water	0
2	Ground Water (92 Tube wells & hand pumps)	166
Total, mld		166

3) Sewerage

Interception Factor: 0.8 as per "Manual of Sewerage & Sewage Treatment (Dec. 1993)"

Table 19.17.6 Year-wise Sewage Generation of Moradabad

Sl. No.	Zone	Year-wise Sewage Generation (MLD)				
		2011	2020	2030	2035	2050
1	Zone-I	54.67	56.07	60.01	62.42	71.32
2	Zone-II	11.56	13.66	20.46	24.55	40.01
3	Zone-III	12.88	17.08	31.61	40.36	73.47
4	Zone-IV	17.48	20.05	28.96	34.29	54.57
Total		96.59	106.85	141.04	161.63	239.37

Zone-1 comprises of the old city area from Katghar to PAC Tiraha. Sewerage and sewage treatment work, entitled "Prevention of Pollution of River Ram Ganga at Moradabad (Phase-I)" for Zone-1 of Moradabad have been sanctioned from NGRBA, on 24/02/2011, under Non-EAP Project for Rs. 279.91 Crores. Works proposed under this estimate are under implementation, these works are tentatively scheduled for completion by the year 2015-16. In this project sewer network of length 264 Km, 11 numbers of sewage pumping stations and one sewage treatment plant of capacity 58 MLD based on SBR technology have been proposed.

The Detailed Design Report of Sewerage Works in Moderabad City for Abatement of Pollution of River Ramganga, Phase-II (Zone-II – Sewerage Network) has been recently prepared with an estimated cost of Rs.232.34 Crores for the developed area of Zone-II, leaving undeveloped area between Moradabad-Bijnaur and Moradabad-Delhi railway line for which a separate project will be framed after development of this area. Total length of proposed sewer in Zone-II of Moradabad town is 140 km. The diameter of proposed sewer varies between 200 mm and 600mm.

For Zone-III and Zone-IV, the DPR has not yet been prepared

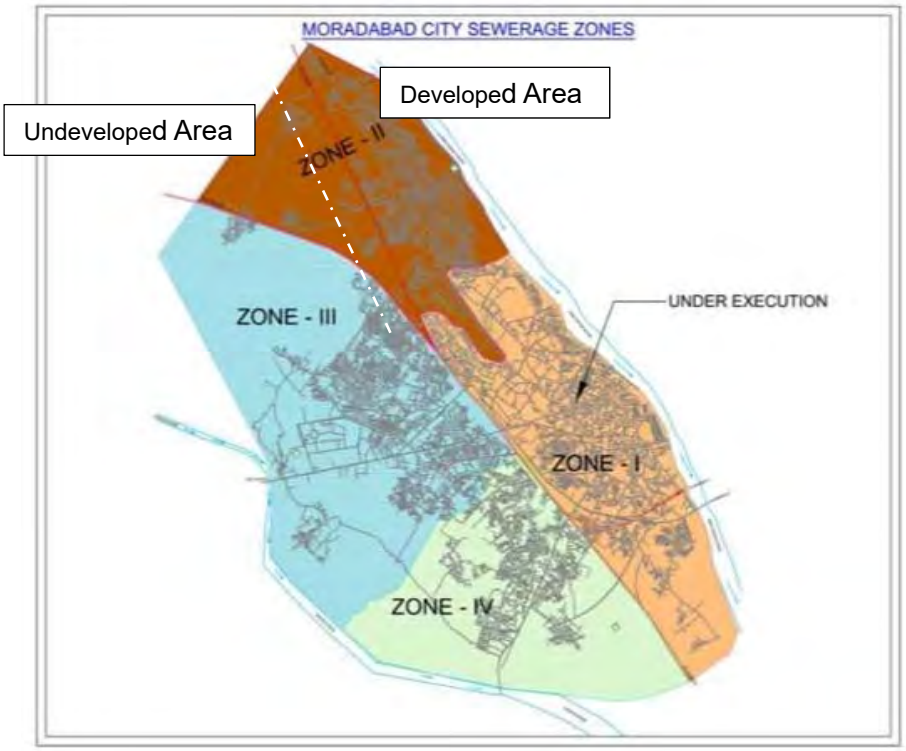


Figure 19.17.2 Moradabad City Sewerage Zones

Source: "Detailed Project Report for Sewerage Works in Moradabad for Abatement of Pollution on River Ramganga Phase-II (Zone-II - Sewerage Network)", UP Jal Nigam

Sewage Treatment for the developed area of Zone-II is not included in the proposed project. However, the treated sewage is set as shown in **Table 19.17.7** according to the General Standards for Discharge of Environment Pollutants notified by Ministry of Environment & Forest (MoEF), GoI in April 2015.

Table 19.17.7 General Standards for Discharge from Sewage Treatment Plant

S. No.	Parameters	Raw Sewage	Treated Sewage	
			For discharge on land	For discharge into water
1	Total BOD_5 at 20oC	250 mg/l	<10 mg/l	<10 mf/l
2	COD	600 mg/l		
3	Total Suspended Solids	450 mg/l	<20 mg/l	<10 mg/l
4	pH	7.2-8.5		
5	Fecal Coliform	10^6 MPN/100 ml	<100 MPN/100 ml	<100 MPN/100 ml

4) Storm Water Drainage

Present Situation: Moradabad city has very limited and inefficient Drainage system, due to which, open drains also carry the sewage which ultimately discharge into the river Ram Ganga and Ganga.

Chapter 20 Risk Control

<Objective of the Study>

Following five project risks were evaluated for project implementation:

1) Increase of STP effluent discharge not conforming to the new effluent standard, 2) Timing gap of construction completion under the different project implementation structure for sewer network and SPS/STP, 3) Ramana STP contract negotiation may affect on subsequent HAM-PPP projects, 4) Land acquisition for the Ramnagar STP and 5) Sewerage development by the comprehensive or ID&T system

<Result of Study>

Probability, Impact, Mitigation Measure, Action and Contingency plan was studied. Land acquisition was raised to have large impact on the project risk. The role of UPJN who will be involved in both EPC and HAM-PPP projects is very important to adjust two project implementation schedule for sewer networks and STP/SPS. UPJN is also concerned with land acquisition and the decision on sewerage development method for the comprehensive or ID&T system.

The following five project risks is supposed to be involved during the project implementation

1) Increase of STP effluent discharge not conforming to the new effluent standard
2) Timing gap of construction completion under the different project implementation structure for sewer network and SPS/STP
3) Whether tendering for Ramana STP is completed successfully or not may affect on subsequent HAM-PPP projects
4) Land acquisition for the Ramnagar STP
5) Sewerage development by the comprehensive or ID&T system

These risks are evaluated from the viewpoint of probability, impact, analysis of probability and impact, mitigation measures, action during the implementation and contingency plan, if applicable,

Table 20.1 Possible Risks Involved in the Project Implementation.

Potential Project Risks	Assessment
Project Risk	
Increase of STP effluent discharge not conforming to the new effluent standards The wastewater generated in District-I and District-II of Varanasi will flow into the existing 80 MLD Dinapur STP and the 140 MLD Dinapur STP under construction, respectively. A part of wastewater generated in District-I is diverted to District-II. The DPR for upgrading and rehabilitation of the Dinapur and Bhagwanpur STPs was once revised so as to meet the new	**Probability: High** **Impact: Small** **Analysis of Probability and Impact:** Since the continuation of present operation at Dinapur and Bhagwpur STPs is the matter decided by NMCG/UPJN who is the implementation/execution agency, it is unavoidable to discharge the treated sewage not conforming to the new effluent standards. The continuation period is unknown at this moment

effluent standards in accordance with the instruction of NMCG, but NMCG/UPJN has decided to maintain the operation of the 80 MLD Dinapur STP as it is with no modification. Therefore, the development of District-I sewer network will increase the discharge of STP effluent in no conformity with the new effluent standards. When the existing 80 MLD Dinapur STP will be reconstructed to meet the new effluent standards is unknown at this moment. While the 140 MLD Dinapur STP is under construction as JICA-assisted GAP-II Project, which adopts the activated sludge process as the treatment process in conformity with the old effluent standards, or BOD/TSS: 20/30. Accordingly likewise District-1, the development of District-II sewer network will increase the discharge of STP effluent in no conformity with the new effluent standards.	**Mitigation Measures:** Adoption of treatment process proposed by the JICA survey team, if the reason for the continuation of present operation at Dinapur STP is attributed to its high construction cost proposed by UPJN. The continuation of present operation with no modification at Dinapur STP is decided by NMCG/UPJN but its reason is unknown. The revised DPR by UPJN to meet the new effluent standards is based on the idea to demolish the existing STPs fully and re-construct them in the present premises due to the constraint of land availability. If the decision is based on the such construction cost, the proposal of the JICA survey team will be worthy to be considered, Its proposal is based on the idea to make use of existing treatment facilities as long as possible, since they were constructed 23 years ago in 1994 and has not yet reached to their service life and are still usable.
	Action during the Implementation: None
	Contingency Plan (If Applicable): None
Executing Agency Risk	
Timing gap of construction completion under the different project implementation structure for sewer network and SPS/STP The wastewater of District-III will flow into the 50 MLD Ramna STP to be implemented under the HAM-PPP Model but the District-III sewer network development will be done under the conventional EPC model. The construction schedule for the Ramna STP is already open in its bidding documents and, if the schedule will be in progress as expected, the Ramna STP will be completed by June 30, 2019 including 63 days for contractual processing and two-year construction period starting from the bid opening on April 29, 2017. On the other hand, since the schedule of the loan agreement for District-III has been not yet fixed, the Ramna STP will be completed preceding the commissioning of the District-III sewer network, which will lead to the idle time of the Ramna STP.	**Probability: High**
	Impact: Small
	Analysis of Probability and impact
	Mitigation Measures: According to the JICA-assisted Master Plan, when the Ramna STP will be completed, the existing Bhagwanpur STP will be de-commissioned and the wastewater that flows into the Bhagwanpur STP will be led to the Ramna STP. Therefore, if the trunk sewer to convey the wastewater from the Bhagwanpur STP to the Ramna STP will be installed in the early time during the District-III sewer network development work, the idle time of the Ramna STP will be avoided and the period that the Bhagwanpur STP discharge the effluent not conforming to the new effluent standards will be shortened.
	Action during the Implementation: Keep close communication between both EPC and HAM-PPP projects so as to adjust the construction schedules
	Contingency Plan (If Applicable): None
Executing Agency Risk	
Whether tendering for Ramana STP is completed successfully or not may affect on subsequent HAM-PPP	**Probability: Middle**
	Impact: Small

projects The Ramana STP is the first project that the HAM-PPP Model is applied to the Ganga Projects. Whether the procedure up to the contract signing will be in progress as scheduled in the bid documents is unknown and there is even the risk of delay. When the bidder will attend the contract negotiation with any alternatives or requests on the application conditions of the HAM-PPP model shown in the bid documents, since such results will become the previous instance for other projects, NMCG/UPJN will carefully correspond to thrush out the conditions that the concessionaire will be acceptable which will result in taking a time. The sewerage projects in Mirzapur, Chunar and Ghazipur that the HAM-PPP Model will be expectedly applied to will be affected by the movement of contract negotiation on the Ramana STP project.	**Analysis of Probability and impact:** If the Ramana STP project under HAM-PPP will not be successfully negotiated, other projects that HAM-PPP will be applied to subsequently will be affected **Mitigation measures: None** **Action during the Implementation:** Watch the bid for the Ramna STP under the HAM-PPP Model closed on April 29, 2017 and the subsequent contract negotiation **Contingency Plan (If Applicable):** Dialogue to develop the model at policy level.
Executing Agency Risk	
Land acquisition for the Ramnagar STP According to the letter (draft) from Executive Office, Municipal Council Office, Ramnagar addressed to General Manager, Ganga Pollution Prevention Unit, UPJN, the landowner for the Ramnagar STP site mentioned The JICA survey team also submitted the letter to the State Government of Uttar Pradesh to get the budgetary allocation and proceed the land acquisition of the particular site as early as possible but could not get the information that the land acquisition had been completed during the field survey in Varanasi. Therefore, it is necessary to confirm the situation of STP site land acquisition in the course of project formation。	**Probability: Low** **Impact: Big** **Analysis of Probability and impact:** On the delay in land acquisition, "Ganga Rejuvenation Committee of Estimate (2016-17)" on May 11, 2016" under MoWRRD&GR describes below. "In written reply to a query as to why only 25 out of 80 projects and 600 kms out of 3315 Kms network of sewer lines were built, the M/oWR,RD&GR stated that "The delay in the construction of STPs is mainly due to delay in land Acquisition and dispute over land. Laying of sewer network in densely populated towns is delayed, mainly due to narrow streets and issues in road cutting. Despite such constraints, 25 out of 80 projects and 600 kms out of 3315 Kms network of sewer lines were built". Therefore, the land acquisition issue is common in India. If the land acquisition for the STP site will not be completed by the conclusion of L/A, the impact will be big. **Mitigation measures: None** **Action during the Implementation:** Monitor the status of land acquisition for the Ramnagar STP site **Contingency Plan (If Applicable): None**

	Confirm the completion of land acquisition for the Ramnagar STP site before the agreement on the scope (design site) for the project. .
Stakeholder Risk	
Sewerage development by the comprehensive or ID&T system MoUD promotes the comprehensive (or comprehensive) sewerage system for the cities with a population of more than 100,000 (1 lark), while NMCG adopts the Interception, Diversion and Treatment sewerage system (ID&T system) with the priority to solve the water pollution issues. Mirzapur has submitted both DPRs for the comprehensive and ID&T systems, but Ghazipur has submitted only the DPR for the comprehensive system and not submitted the DPR for the ID&T system in spite of the request of the JICA survey team during the field survey. Both cities have once shown the movement to submit the application to AMRUT which provides the fund for the development of a comprehensive system. This issue will smolder in the future and may cause the delay of project implementation. In case that the project will be implemented under the HAM-PPP model, since the sewer cost is very small in the ID&T system, it will be included in the HAM-PPP cost, but it will be too big in the comprehensive system resulting in an increase of the concessionaire's burden. For example, in Mirzapur, the net construction cost is sewer : SPS/STP=21,455:5,762 (unit: Rs. Lacs) for the comprehensive system and 1,478:5,651 for the ID&T system. The total cost of the comprehensive system is 3.8 folds of that of the ID/T system. There is a big gap in the rate of the sewer cost to the STP cost, or 372% for the comprehensive system and 26% in the ID/T system.	**Probability: Middle** **Impact: Small** **Analysis of Probability and impact:** Since Ghazipur could not submit the ID&T DPR to the JICA survey team, it has somewhat high possibility that the comprehensive plan sewerage system will be adopted. The project cost of a sewer network for Ghazipur is not so big. **Mitigation measures:** **Action during the Implementation:** Watch the scope of work for Mirzapur and Ghazipur HAM-PPP projects. **Contingency Plan (If Applicable): None**
Overall Risk Rating	**Probability: Middle** **Impact: Low**
The role of UPJN who will be involved in both EPC and HAM-PPP projects is very important to adjust two project implementation schedule for sewer networks and STP/SPS. UPJN is also concerned with land acquisition and the decision on sewerage development method for the comprehensive or ID&T system.	

Chapter 21 Operation and Effect Indicators

<Objective of the Study>
Herein, the served population by sewage treatment, amount of sewage treatment are proposed for operation indicators and the coverage ratio by sewerage for an effect indictor, respectively.
<Result of the study>
Even though the BOD concentration of sewage will be improved from 20 mg/l to 10 mg/L by sewage treatment, the effect on the BOD concentration in the River Ganga will be only less than 0.1 mg/L so that it may be difficult to identify the water quality improvement effect in the Ganga, that is to say, the discharge of the River Ganga is too big in Varanasi in comparison to the sewage flow Due to the reason, Effect of the sewage treatment will be measured by BOD removal rate in STPs

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The construction period for sewer network development in District-I, District-II and District-III in Varanasi is estimated three years, respectively. According, it will be completed in 2020 including one-year preparatory period in 2017. The operation and effect indicators are set for the year of 2022 two years later after its completion.

It is assumed that the Yen Loan will be applied to the sewer network development of District-I, District-II and District-III in Varanasi and the construction of Ramnagar ID/T system under the EPC model. The sewerage project in other cities like Mirzapur, Ghazipur, Chunar and the Ramna STP project in Varanasi will be implemented under the HAM-PPP model.

For Varanasi, the wastewater generated in District-I, District-II and District-III will flow into the 80 MLD Dinapur STP (existing), 140 MLD Dinapur STP (new) and 50 MLD Ramna STP (new), respectively. The existing 80 MLD Dinapur STP and new 140 MLD Dinapur STP under the GAP-II Project have responded to the old effluent standards (say BOD/TSS=20/30), while the new 50 MLD Ramna STP will respond to the new effluent standards (BOD/TSS/T-N=10/10/10)

21.1 Operation Indicators

The operation indicators show to what extent the facilities have been operated efficiently to achieve the target.

(1) Served population by Sewage Treatment

As of November 2015, the number of connections for water supply and sewerage in Varanasi is reported as 99,876 units (**Table 12.1.2**) and 109,392 units (**Table 12.1.3**), respectively against the total

number of 150,236 connections. While in the Census 2011, the number of connections for sewerage counts 141,184 units for the total number of 180,865 connections. Since the per household population is 6.2 persons in the Census 2011, then the served population by sewerage is calculated as 889,000 persons. Although there is no actual data on the increase rate of a number of connections, referring to the actual data in Kyoto, Japan of which the population size is almost same, the increase rate is set at 4.0% per annum, the served population is estimated as 962,000 persons in the year of 2022.

(2) Amount of Sewage Treatment

Assuming the per capita water supply at 150 lpcd, the conversion factor to sewage at 0.80 and the groundwater infiltration rate as 25% for a mega city like Varanasi, the amount of sewage treatment in 2022 is calculated as 144.3 MLD as shown below.

2020 889,000 x (150 lpcd / 1,000) x 0.8 x (1 + 0.25) = 133.5 MLD
2022 962,000 x (150 lpcd / 1,000) x 0.8 x (1 + 0.25) = 144.3 MLD

21.2 Effect Indicators

The effect indicators show the extent of amenities in the people's life and the conservation of water environment

(1) Coverage Ratio by Sewerage

According to the results of the Census 2011, the number of connection was 141,184 units for the total households of 180,805 units, the coverage ratio by sewerage is then calculated as 78.1%. While "City Development Plan for Varanasi, 2041" prepared in March 2015 says that the coverage of sewerage service network is 78%. The people are seeing the progress of pipe-laying works with their own eyes extended throughout the city with much expectation for comfortable life in addition to the awareness campaign to promote the household connection to a sewerage system. It is the usual pattern that the growth rate of household connections to a sewerage system is high for some years after the project completion and then gradually declining to less than one percent. Similarly to the served population by sewage treatment, the growth rate of household connections is assumed at 4% per annum for the first two years and the coverage ratio by sewerage is calculated at 84.5% In the year of 2022.

(2) Water Quality Improvement Effect in the Receiving Water Bodies

The river discharge of the Ganga fluctuates drastically by season or the monsoon (Jun.-Sep.), post-monsoon (Oct.-Nov.), winter (Dec.–Feb.) and summer (Mar. – May) as shown in **Figure 19.2.6** and even in the winter or the dry season, the river discharge (30,358.7 MLD, see below) is too big in comparison with the sewage flow (144,3 MLD). The sewage flow is only 0.5% of the river discharge,

therefore it is difficult to show the improvement effect in terms of river water quality numerically.

Therefore, effect of improvement for the receiving water body shall be measured by effluent BOD level and sewage treatment efficiency.

Since the BOD of raw sewage is 250mg/l and that of effluent is expected to be 10 mg/l after the completion of the construction, BOD removal rate will be 96 %.

Table 21.1 Operation Indicators and Effect Indicators

Indicators	Present	Target Year	Remarks
Served population by Sewage Treatment	889,000	962,000	Population
Amount of Sewage Treatment	133.5MLD	144.3MLD	
Coverage ratio by Sewerage	78.1%	84.5%	
Sewage Water Quality Improvement Effect	Inflow BOD:250mg/l	Effluent BOD:10mg/l	Removal rate 96%

Source: JICA Survey Team

Note:
The river discharge is 2,793 million m^3 as the total amount during the summer from March to May or 92 days as shown in **Table 19.10.1**, which is converted to 30.358.7 MLD.

Chapter 22 SAFETY MEASURES

<Objective of the Study>

This chapter introduces the most important two acts regarding the safety control in the construction works in India, especially focusing on submission of documents concerning safety and health to the administrative office, obligation compensation, safety control structure for offices/ establishment and administrative measures, social sanctions, etc., when worker's accidents occurs using the latest data.

<Result of the Study>

Based on the JICA's safety management policy, Safety measure of construction work in India such as, Laws and Regulations concerning Safety and Health,Worker's accidents, Compensation and Safety Control , Expenses, Administrative measures and Factories Act were studied and summarized.

22.1 Basic Policies for Safety Management in Japan's Official Development Assistance

Japan's Official Development Assistance Charter was formulated to assure fairness by giving consideration to the condition of the socially vulnerable, and the gap between the rich and the poor as well as the gap among various regions in developing countries whilst paying great attention with respect to factors such as the environmental and social impact on developing countries arising from the implementation of ODA. In particular, emphasis is put on "ensuring human safety" by focusing on individuals when implementing safety management on ODA construction works.

"Ensuring human safety" and "respect for basic human rights" have the top priority in ODA construction works. The stakeholders are therefore obliged to comply with the relevant laws and regulations of the recipient country in order to establish a safe and health-conscious working environment. They also need to establish a "culture of safety", whereby all organizations and individuals involved in the works prioritize safety, is clearly understood, establish a mechanism that automatically promotes active implementation of occupational safety measures in the relevant organizations, and enhances people's awareness of safety.

JICA provides the following eight basic principles for safety management.

(1) Safety is a top priority
All Project Stakeholders shall put top priority on safety and use their best endeavours to eliminate the occurrence of accidents.

(2) Elimination of causes
The Contractor shall identify every possible danger in each process of construction work, and examine, analyze and eliminate the causes of such danger and take appropriate action to ensure the safe execution of the work.

(3) Thorough precautions
The Contractor shall give consideration to in advance the inherent risk of accidents at each stage of construction work, review appropriate measures to cope with such risks, and commence work once these preventive measures have been implemented

(4) Thorough compliance with relevant laws and regulations.
Compliance with Relevant Laws and Regulations shall be complied with.

(5) Thorough prevention of public accidents
All Project Stakeholders shall implement safety management measures taking the interests of third parties duly into consideration in order to prevent public accidents

(6) Thorough implementation of PDCA cycle for safety management
PDCA for Safety Management shall be complied with.

(7) Thorough sharing of information
All Project Stakeholders shall share all safety-related information they possess in a manner and at times as appropriate in the circumstances.

(8) Thorough participation of all Project Stakeholders
All Project Stakeholders shall actively participate in activities related to safety management at construction sites.

Source: JICA, "The Guidance for the Management of Safety for Construction Works in Japanese ODA Projects", September 2014

22.2 Safety Measures in India

The safety control in the construction works is mainly regulated by the following two acts:

- The Factories Act, 1948
- The Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996

(1) Laws, Regulations, etc. Concerning Safety and Health

In India, both the central and state governments can enact the Labour-related legislations

- "The Factories Act, 1948" provides conditions of service for workers in the manufacturing factories and basic requirements for safety, health and welfare.
- "The Building and Other Construction Workers Act 1996" is the comprehensive Central Legislation for regulating their safety, health, welfare and other conditions of service which is applied to the establishments for construction works with more than fifty workers. The regulations enacted by the state government is applied to other establishments that the Central legislation is not applied.

(2) Submission of Documents Concerning Safety and Health to the Administrative Office

- "The Building and Other Construction Workers Act 1996" regulates the scaffolds, plan on dangerous process, etc. but their notification is not the contractor's obligation.
- In India, it is usual that the sub-contractor's agreement covers the temporary works in addition to the body works and the clients may require the submission of temporary plans and construction statements of steel frameworks.
- In case of road occupation and detour, the submission of documents is required to get an approval from the police station.

(3) Obligation When Worker's Accidents or Accidents Occurs

1) Obligation of Notice on the occurrence of worker's accidents or accidents to the administrative office

- "The Building and Other Construction Workers Act 1996" defines the obligation of "Notification of Accidents and Dangerous Occurrences" as Form-24
- "The Factories Act, 1948" also defines "Notice of Certain Accident (Section 88), "Notice of Certain Dangerous Occurrences (Section 88A)" and "Notice of Certain Diseases (Section 89)".

  "Notice of Certain Accident (Section 88)"

  "(1) Where in any factory an accident occurs which causes death, or which causes any bodily injury by reason of which the person injured is prevented from working for a period of forty-eight hours or more immediately following the accident, or which is of such nature as may be prescribed in this behalf, the manager of the factory shall send notice thereof to such authorities, in such form and within such time, as may be prescribed."

  (2) Where a notice given under sub-section (1) relates to an accident causing death, the authority to whom the notice is sent shall make an inquiry into the occurrence within one month of the receipt of the notice or if there is no such authority, the Chief Inspector cause the Inspector to make an inquiry within the said period.

  (3) The State Government may make rules for regulating the procedure inquires under this section.

2) Survey by the Authority when worker's accidents or accidents occurs

a) Target of survey

- "The Building and Other Construction Workers Act 1996" defines "Procedure for enquiry into causes of accident or dangerous occurrence (Clause 211)".
- "The Factories Act, 1948" also defines "Safety and Occupational Health Surveys (Section

91A), "Notice of Certain Dangerous Occurrences (Section 88A)" and "Notice of Certain Diseases (Section 89)". The authority to whom the notice is sent shall make an inquiry into the occurrence within one month of the receipt of the notice

b) Enquiry Officer, etc.

- "The Building and Other Construction Workers Act 1996" defines "Notification of Accidents and Dangerous Occurrences" in Form-24. The enquiry is commenced by the the authority or enquiry officer as early as it may be, and in any case, within fifteen days of the receipt of notice of accident or dangerous occurrence under rule 210.

(4) Compensation, etc. to Sufferers when Worker's Accident or Accident Occurs

Employees' State Insurance (ESI) is a self-financing social security and health insurance scheme for Indian workers. This fund is managed by the Employees' State Insurance Corporation (ESIC) according to rules and regulations stipulated there in the ESI Act 1948. ESIC is an autonomous corporation by a statutory creation under the Ministry of Labour and Employment, the Government of India. The ESI Act applies to any premises/precincts, where 10 or more persons are employed.

1) Outline of the Insurance

Employees covered under the scheme are entitled to medical facilities for self and dependants. They are also entitled to cash benefits in the event of specified contingencies resulting in loss of wages or earning capacity. The injured women are entitled to maternity benefit for confinement. Where death of injured employee occurs due to employment injury or occupational disease, the dependants are entitled to family pension payment as the dependants benefit. Various benefits that the insured employees and their dependants are entitled to, the duration of such benefits and contributory conditions thereof

2) Contribution

For all employees earning Rs. 21,000/- (US$330/-) or less per month as wages, the employer contributes 4.75 percent and employee contributes 1.75 percent, total share 6.5% percent. State government's share is 1/8th and that by central government is 7/8th. which oversees the provision of medical and cash benefits to the employees and their family. ESI scheme is a type of social security scheme for employees in the organized sector.

3) Compensation for permanent total disablement and for the death

- In case of permanent total disablement from the injury, the amount of compensation shall be 60% of the monthly wages of the injured workman multiplied by the relevant factor or an amount Rs. 140,000//- whichever is more.
- In case of death resulting from the injury, the amount of compensation shall be equal 50% of the monthly wages of the decreased workman multiplied by the relevant factor, or an amount

of Rs. 120,000//- thousand whichever is more.

(5) Safety Control Structure for Offices/Establishments

1) Safety and Health Control Structure for Establishments

- "The Building and Other Construction Workers Act 1996" defines "208. Safety Committees" and "209. Safety Officer" as follows:

208 Safety Committees

(1) Every establishment wherein five hundred or more building workers are ordinarily employed, there shall be a Safety Committee constituted by the employer which shall be represented by equal number of representatives of employer and building workers employed in such establishment. In no case the number of representatives of the employer shall exceed the representatives of building workers. The Committee shall be represented by representatives of the recognised unions wherever such unions exist.

(2) The main functions of the Safety Committee shall be—

(a) to identify probable causes of accident and unsafe practices in building or other construction work and to suggest remedial measures;

(b) to stimulate interest of employer and building workers in safety by organising safety weeks, safety competition, talks and film shows on safety, preparing posters or taking similar other measures as and when required or as necessary;

(c) to go round the construction site with a view to check unsafe practices and detect unsafe conditions and to recommend remedial measures for their rectification including First Aid Medical and Welfare Facilities;

(d) to look into the health hazards associated with handling different types of explosives, chemicals and other construction material and to suggest remedial measures including use of proper personal protective equipment;

(e) to suggest measures for improving welfare amenities in the construction site and other miscellaneous aspects of safety, health and welfare in building or other construction work;

(f) to bring to the notice of the employer the hazards associated with use, handling and maintenance of the equipment used during the course of building and other construction work.

(3) The Safety Committee shall meet at regular intervals at least once in a month and it shall be chaired by the senior person having overall control over the affairs of the construction site.
(4) The agenda and minutes of the meeting shall be circulated to all concerned and it shall be in the language understood by majority of the building workers and shall be produced to the Inspector on demand for inspection.
(5) The decisions and recommendations of the Safety Committee shall be complied with by the employer within reasonable time limits.

209. Safety Officer

(1) In every establishment wherein five hundred or more building workers are ordinarily employed, the employer shall appoint Safety Officers as per the scale laid down in Schedule VIII annexed to these rules. Such Safety Officers may be assisted by suitable and adequate staff.
(2) Duties, qualifications and the conditions of service of Safety Officers appointed under sub-rule (1) shall be as provided in Schedule VIII annexed to these rules.
(3) Wherever number of workers employed by single employer is less than five hundred, such employers may form a group and appoint a common Safety Officer for group of employers with prior permission of Director General.

(6) Expenses for Safety

- The expenses for safety in public works is estimated at 5-8% of the total construction cost, of which the contents are specified in the tender documents.
- The expenses for safety in private works is estimated at 3-5% of the total construction cost which is usually included in the contract amount.

(7) Administrative Measures, Social Sanction, etc. by Worker's Accident or Accident Occurrence

1) Administrative measures to Contractors
As the result of trial, the particular project manager may have a possibility to be arrested, but the administrative measures to cancel the contractor's qualification for bidding has not been confirmed.
2) Administrative measures to Subcontractors
As the result of trial, the persons concerned (for example, crane operator) may have a possibility to be arrested,
3) Social Sanction

Nothing in particular.

(8) The Factories Act, 1948 (Act No. 63 of 1948) as amended by the Factories (Amendment) Act, 1987 (Act No. 20 of 1987)

The Factories Act, 1948 (Act No. 63 of 1948) as amended by the Factories (Amendment) Act, 1987 (Act No. 20 of 1987) regulates the following issues which may be faced at the construction sites,

Chapter I describes the preliminary issues such as interpretation, etc. which defines the "factory" as follows:

Section 2. Interpretation.-
(m) "factory" means any premises including the precincts thereof-
(i) whereon ten or more workers are working, or were working on any day of the preceding twelve months, and in any part of which a manufacturing process is being carried on with the aid of power, or is ordinarily so carried on, or
(ii) whereon twenty or more workers are working, or were working on any day of the preceding twelve months, and in any part of which a manufacturing process is being carried on without the aid of power, or is ordinarily so carried on,- but does not include a mine subject to the operation of the Mines Act, 1952 (XXXV of 1952) or a mobile unit belonging to the armed forces of the Union, a railway running shed or a hotel, restaurant or eating place;

Chapter II presents the matters on the inspecting staff.

Chapter III regulates the matters on health such as cleanliness (Section 11), disposal of wastes and effluents (S-12), dust and fume (S-14), lighting (S-17), drinking water (S-18), latrines and urinals (S-19), etc.

Chapter IV mentions the matters on safety on fencing of machinery (S-21), working on or near machinery in motion (S-22), employment of young person on dangerous machineries (S-23)

Chapter V provides the matters on welfare such as first-aid0-applianes (S-45), etc.

Chapter VI ordains the matters on working hours of adults on weekly hours (S-51), weekly holidays (S-52), compensatory holidays (S-53), daily hours (S-54), intervals for rest (S-55), extra wages for overtime (S-59), etc.

Chapter VII specifies the matters on employment of young persons such as prohibition of employment of young children (S-67), certificate of fitness (S-69), working hours for children (S-71), notice of period of work for children (S-71), register of child workers (S-73), etc.

Chapter VIII states the matters on annual leave with wages such as annual leave with wages (S-79), wages during leave periods (S-80), etc.

Chapter IX prescribes the special provisions such as notice on certain accident (S-86), notice on certain dangerous occurrences (S-88A), notice of certain diseases (S-89), etc.